A biodiversity assessment of the Monte Mitra forest, Monte Alen National Park, Equatorial Guinea

Smithsonian Institution

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Finally, particular thanks to CARPE, notably Dr John Flynn, for funding Smithsonian Institutions' activities in the Congo Basin and having faith in our technical and "cross-cutting capacity".

EXECUTIVE SUMMARY

During a three-week period in September and October 2005, a multi-institutional and multi-disciplinary team undertook a rapid biodiversity assessment of the Monte Mitra forest within the Monte Alen National Park. The field surveys focussed on assessments of the vegetation, using both standardised plot and transect methods, large mammals, birds and reptiles and amphibians. Human signs within the National Park were also recorded by the field teams enabling an assessment of the management issues pertaining to the conservation of the area to be made.

The information presented in this report suggest that the Monte Mitra forest is one of the most important reservoirs for biodiversity in the Congo Basin. In addition, the theory that the wider Monte Alen and Monts de Cristal Inselberg Forest Landscape is a Pleistocene refuge of global importance is further supported by our findings, particularly when our results are compared with other sites in the region.

In terms of vegetation, the Monte Mitra assessment site exhibited the highest tree diversity recorded on our permanent 1 ha Biodiversity Plots (BDPs) as yet in the Congo Basin, aside from the contiguous Monts de Cristal region in Gabon. In addition, the standardised transect methodology utilised by researchers of the Missouri Botanical Garden found that not only that levels of plant diversity are correspondingly high but levels of endemism within the Landscape are exceptional. The finding of a new species of *Scaphopetalum*, and of a new record of *Korupodendron songweanum* to Equatorial Guinea, confirm this floristic importance.

The large mammal fauna is also of interest with one of the highest encounter rates of forest elephant for Africa recorded on the slopes of Monte Mitra. Primate diversity and endemism are also high and many large mammals, notably extirpated in many comparable sites in the Congo Basin, such as the leopard (*Panthera pardus*) are confirmed extant in the Monte Alen National Park.

As expected, the avian fauna is also high and a number of new records were encountered both for the site and the country. The high bird diversity fully supports the Birdlife classifications for the region and both Important and Endemic Bird Areas. Although the reptile and amphibian fauna also exhibits a certain level of diversity and endemism, the field work took place at the height of the rainy season, a period notoriously difficult for herpetological surveys and further sampling in the dry season will undoubtedly increase the species list considerably.

During the basic field assessments for each biological group, the field teams also compiled information relating to management which has led to the preparation of a separate chapter regarding management issues within this report. Of particular concern is the high level of uncontrolled and indiscriminate hunting, including of protected species, within the boundaries of the Monte Alen National Park to supply, primarily, the thriving bushmeat market of Bata (see also Fa and Yuste, 2001). A study of the provenance of the shotgun cartridges found within the area also suggests that, with cartridges originating from as far away as Italy, well organised commercial hunting is clearly taking place in the area. Crop raiding by elephants, and the recent culling of two large males, suggests that mitigation measures are needed to deter

elephants from entering farmland, rather than resorting to randomly killing lone individuals after the event.

One of the main emphases of the Smithsonian Institutions' project in Central Africa is capacity building for local technicians. In this regard, training takes place both in formal workshops and during the implementation of field work. Working closely with INDEFOR during the Monte Mitra assessment we were able to provide close mentoring and supervision to their technicians in field survey methods, particularly those most concerned with the direct management of the National Park itself. The contribution of INDEFOR staff is genuinely reflected in the authorship of a number of the papers in this report.

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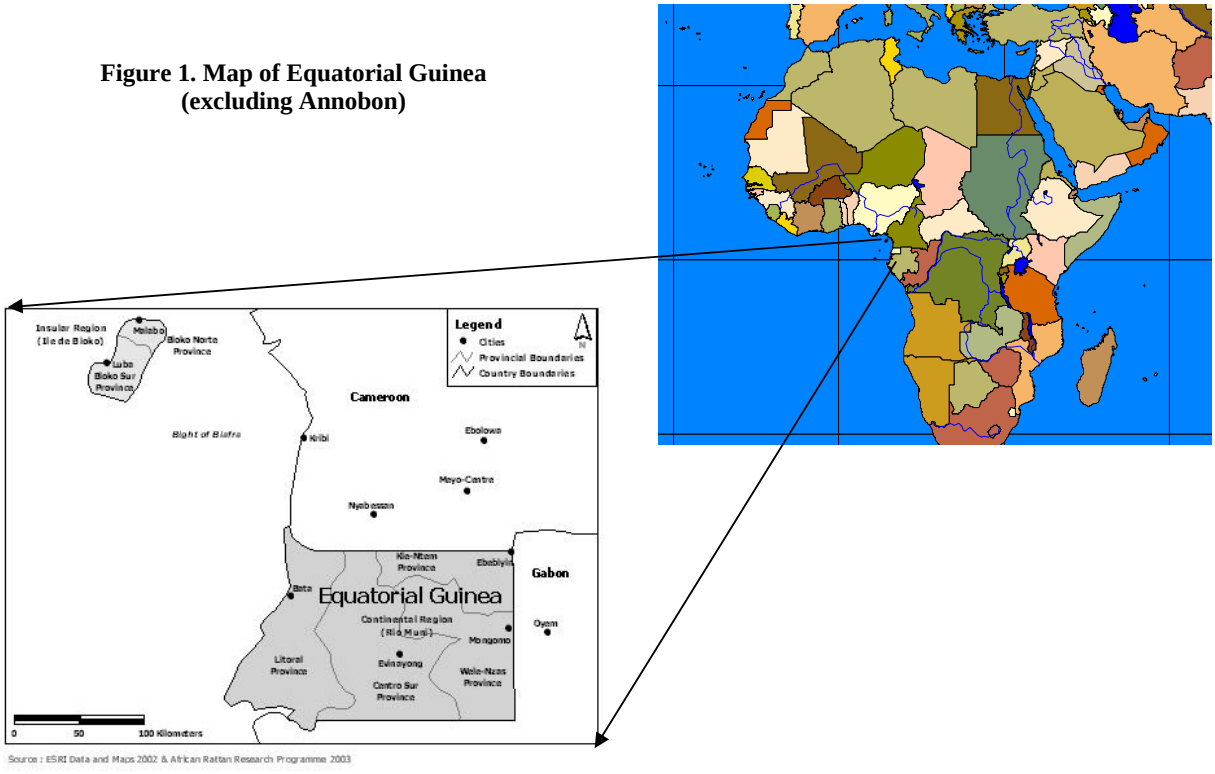
1. INTRODUCTION: EQUATORIAL GUINEA AND THE MONTE MITRA ASSESSMENT SITE

Terry C.H. Sunderland, Miguel Leal & Anthony C. Nchanji

1.1. Introduction

The Republic of Equatorial Guinea consists of three diverse and disparate territories: the mainland territory of Rio Muni (26,017 km^2) and the islands of Bioko (2,017 km^2) and Annobon (17 km^2). The former Spanish colony gained independence in 1969, but the results of a tumultuous postcolonial era led to the country being classified as one of the poorest in Africa (Liniger-Gomez 1988). The discovery of large oil deposits (Goldman 1998), and the opening of the country to foreign timber exploiters (Stenmanns pers. comm.) has recently changed the fortunes of this relatively unknown African enclave and Equatorial Guinea is forecast to become one of the most prosperous countries in sub-Saharan Africa. Oil extraction began in 1992 and has now reached 0.3 million barrels a year (NGS, 2005). The income from oil now greatly exceeds that of timber and this has resulted in a dramatic increase in the country's GNP. Despite this, 70% of the country's population continue to rely on subsistence agriculture supplemented by fishing and hunting as a means of providing the main sources of protein (Del Val, 2001).

Figure 1. Map of Equatorial Guinea (excluding Annobon)



Equatorial Guinea's population of around 400,000 is composed of a number of ethnic groups, which were formerly distributed along geographical lines. The Fang and the Ndowe originate from the Rio Muni region and the Bubis from the island of Bioko

(Liniger-Gomez 1988). However, much migration by the Fang from the mainland has seen the Bubi become a minority on Bioko (Collel *et al*., 1994). Other African migrants are also present in significant numbers in Equatorial Guinea, including Cameroonians (notably Hausa traders), Nigerians, and Ghanaians as well as small numbers of people from Chad and Mali. The majority of these people are engaged in small-scale trading and business (Sunderland and Obama, 1999).

1.2. The Rio Muni territory

The continental territory of Equatorial Guinea is a rectangular-shaped piece of land bordered on the west by the Atlantic Ocean, on the east and south by Gabon and on the north by Cameroon. It lies between 1°01' and 2°21'N with its eastern border following the meridian of 11°20'E. The territory has 222 km of coastline between the estuaries of Rio Muni at the southern end and Rio Campo (or Ntem) at the northern end. It is from the former that the territory derives its name.

The forested zone of Rio Muni was recently estimated to cover a total of 17,226 km^2 (van Breugel and Parren, 1997) and is dominated by lowland forest (below 1,000 m). These forests are part of the Guineo-Congolian phytochorian and recent floristic investigations have shown them to be extremely diverse (Lisowski, 1997; Collin, 1998). The interior of the mainland consists of a peneplain with an average altitude of 650 m, and is dominated by a number of protruding inselbergs, the highest of which, Monte Mitra (see below) rises to 1,200 m (Guinea-Lopez, 1946).

At the time of independence in 1969, the economy of the country, particularly in Rio Muni, was based on coffee and cocoa but these have been in decline ever since. Until recently, forestry activities were the main source of foreign exchange (Del Val, 2001) and the lowland forest zone has been much affected in recent time by extensive logging represented by an increase in exploitation of 250,000m^3 in 1993 to 760,000m^3 in 1997 (CUREF, 1998). Timber exploitation was first undertaken in the coastal regions and, as techniques improved, the practice spread further into the interior (van Breugel and Parren 1997). Today, much of the mainland territory has been logged or is currently under concession (Stenmanns pers. comm.) despite a proposed network of protected areas[1] (Garcia and Eneme 1997).

Agricultural plantations of oil palm and rubber are maintained on the coastal plain and some cocoa plantations have long been established along the border with Cameroon. Small-scale agriculture is also widely encountered in the coastal region, but the relatively small population militates against this land use being a major factor in forest conversion (Serrano, 1997).

1.3. Biological significance

Comparatively, mainland Equatorial Guinea (Rio Muni) is botanically poorly known (Davis *et al.*, 1986). The two countries in which between it is wedged, Cameroon and Gabon, are much better known and both are rich in plant species. Equatorial Guinea is

[1] Proposed protected areas represent a total of 18% of the national territory; one of the highest networs of protected areas in Africa (Del Val, 2001).

probably therefore equally diverse and perhaps more so, because of its rugged topography in combination with a high rainfall and the absence of a distinct and severe dry season. This rugged topography creates a diversity in habitats, which contributes to a high plant diversity. Each type of habitat has its unique environmental characteristics which will only fit the requirements of certain species; the more habitats the greater the species diversity.

The relatively high year-round humidity favors the presence of many small understorey plant species. These smaller plant species make up the bulk of central African's biodiversity and are often absent in areas with less rainfall, because they are sensitive to moisture deficiencies.

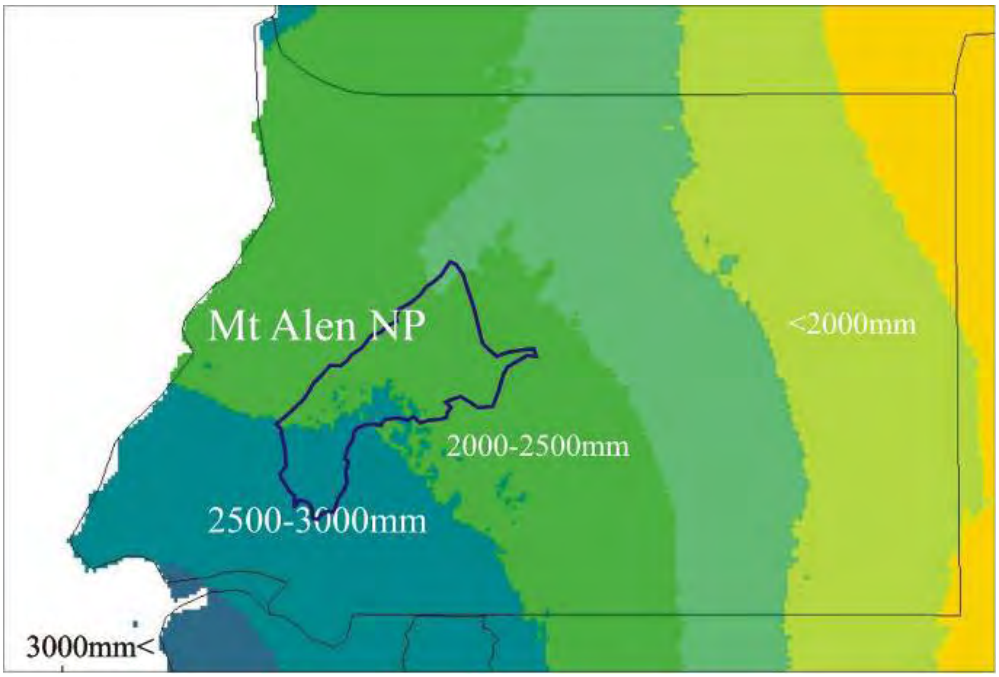


Figure 2. Rainfall patterns over Equatorial Guinea

1.4. Monte Mitra

Monte Mitra falls within the Monte Alen National Park (01º30'N:10º15'E) an area of 200,000 ha and encompassing and altitudinal range of between 300-1,250m. The National Park was created by Presidential Decree in 2000 along with thirteen other protected areas. Monte Mitra itself is the highest part of the Niefang Mountain Range which is orientated more or less parallel to the coast. West of the range stretches the coastal plain; at the other side, to the east, is the inland plateau. Both the plain and the plateau have a gentler topography than the range itself.

The Niefang Mountain range obtained its higher altitude and rougher topography, due to the uplifting of this part of the pre-Cambrian shield as the African continent drifted northward and collided with the European plate. As it uplifted it became exposed to erosion. In time only the most resistant geological formations persisted. The summits of the range now consist of large rocky blocks sometimes creating cliffs of 50m and more. Within Rio Muni, Monte Mitra is particularly interesting, since it is the only

area with montane forest. These montane forests usually also contain species unique only to these highland areas (endemics).

Monte Mitra area is source of several permanent streams that drain the region and flow either north into Rio Wele or Rio Madjobo, or south into Rio Mitong or Rio Congue. The climate of the region is typically hot humid equatorial in nature with average temperatures of about 25°C in the lowland area and ca. 20°C-23°C in the highlands (Fa & Yuste, 2001). There are two typical seasons; a short dry season from January to February and the rainy season from March to December. Much of the rainfall occurs from March to May and September to December with less falling in June to August. The mean annual rainfall is between 3000-3500mm.

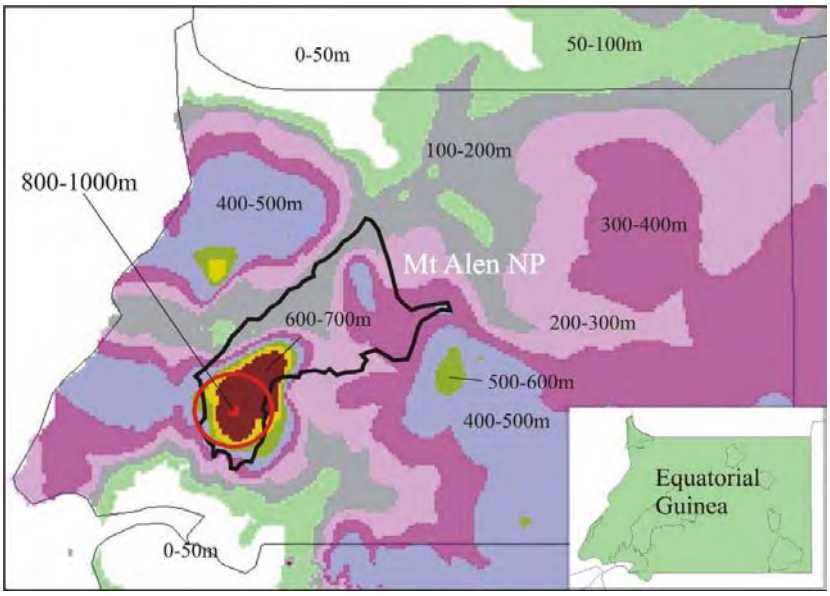


Figure 3: The geographical position of the Mt Mitra area (red encircled), clearly distinguishable within the regional by its higher altitude

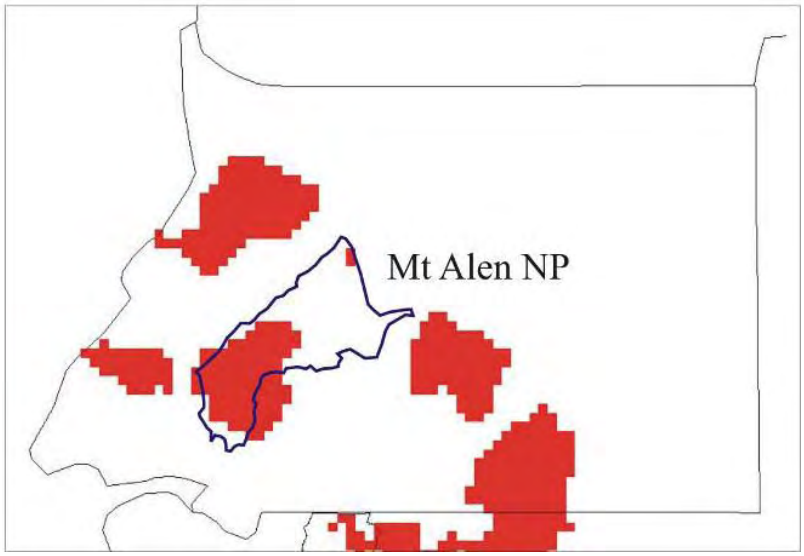


Figure 4. Postulated Pleistocene refuges area (red)

The study area is especially rich in endemics as it is also a postulated Pleistocene forest refuge. These are areas where the rain forest persisted during the last glacial maximum when climate was much drier. At Monte Mitra there may be many species which were locally extirpated elsewhere.

The Fang are the dominant ethnic group in the Monte Mitra region. The human population is described as sparse (Fa and Yuste, 2001) and is concentrated mostly in the villages along the Sendje to Cogo road about 10-15 km to the west and southern boundary of the park. The economy of area is dominated by subsistence agriculture heavily supplemented by hunting. Perennial cash crops such as cocoa and coffee that previously dominated the local economy have been mostly abandoned due to the decline in the market price of these commodities.

1.5. Management issues

Until recently, Monte Alen NP was the only protected area in the country to be actively managed but the recent withdrawal of this support by ECOFAC (*Conservation et Utilisation Rationelle des Ecosystèmes Forestieres en Afrique Centrale*) means that very little active management or protection is currently taking place. The area was subject to some level of commercial logging during pre-independence time, and old logging roads and skid trails can still be clearly seen throughout the NP. However, there are today few signs of logging activity or agricultural expansion and commercial hunting is the currently the major conservation threat within the Monte Alen region (Fa and Yuste, 2001).

A discussion of the wider biodiversity issues relating to the region, including the importance of biodiversity sanctuaries, is also included in the chapter on management issues later in this report.

2. AN ORNITHOLOGICAL SURVEY OF MONTE MITRA

Francis Motombe Njie

2.1. Introduction

The avifauna of Equatorial Guinea is one of the poorest known in Africa (Del Val, 2001). Although up to 340 species are recorded from the Rio Muni region (Dowsett, cited in Del Val, 2001), this figure will probably be revised to include more species as further field work is completed. The entire Rio Muni region falls within the Cameroon and Gabon lowlands Endemic Bird Area (EBA 085) as well as within the Guinea-Congo Forest biome (A05). The Monte Alen National Park itself is an Important Bird Area (IBA GQ004) with A1 criteria[1]. This brief chapter presents the findings of a rapid ornithological survey of the Monte Mitra region of the Monte Alen National Park which recorded a total of 235 bird species, including four species of conservation importance. Del Val (2001) records that a total of 265 species have been recorded from the Monte Alen National Park, including all four species of the Cameroon and Gabon WBA, recorded from Equatorial Guinea and 164 of the 176 species of the Guinea-Congo Forest biome recorded from the country. Despite the fact this survey took place during the height of the rainy season, our initial results show that the Monte Mitra area warrants its Important Bird Area status.

2.2. Survey methods

The methods used in this survey was the "recce transect method" (White and Edwards, 2000). Using paths and old timber tracks as transects in the four directions of our base camp, for example East, West, South and North a 2-man survey team moved slowly along the transect for a total distance of 2km, recording both birds calls and direct sighting in each perpendicular direction from the transect. It was intended to combine the transect method with mist netting, but due to the fact that many species were recorded as breeding, we decided this would pose too great a threat to the fecund avi-fauna.

2.3. Results

2.3.1. Species richness

For the 14 days spent in Monte Mitra, 235 birds were recorded. Of these, the following important species were encountered (see also Appendix 2);

- Three A1 globally threatened species;
  Grey necked Picathartes (*Picathartes oreas*), VULNERABLE
  Yellow-casqued hornbill (*Ceratogymna elate*), NEAR THREATENED
  White crowned tiger heron (*Tigrionis leucophus*) DATA DEFICIENT
  Fernando Po swift (*Apus sladeniae*) DATA DEFICIENT

[1] Which means "this site holds significant numbers of a globally threatened species, or other species of global concern" (Fishpool and Evans, 2001).

- Four A2 restricted range species;
  Rachel's Malimbe (*Malimbus racheliae*)
  Grey necked Picathartes (*Picathartes oreas*)
  White tailed warbler (*Poliolais lopezi*)
  Waller's chestnut winged starling (*Onychognathus walleri*)

- Two A07 Afromontane species;
  White tailed warbler (*Poliolais lopezi*)
  Waller's chestnut winged starling (*Onychognathus walleri*)

- Two EBA085 species;
  Rachel's Malimbe (*Malimbus racheliae*)
  Grey necked Picathartes (*Picathartes oreas*)

- 132 A05 restricted biome species (see Appendix 1).

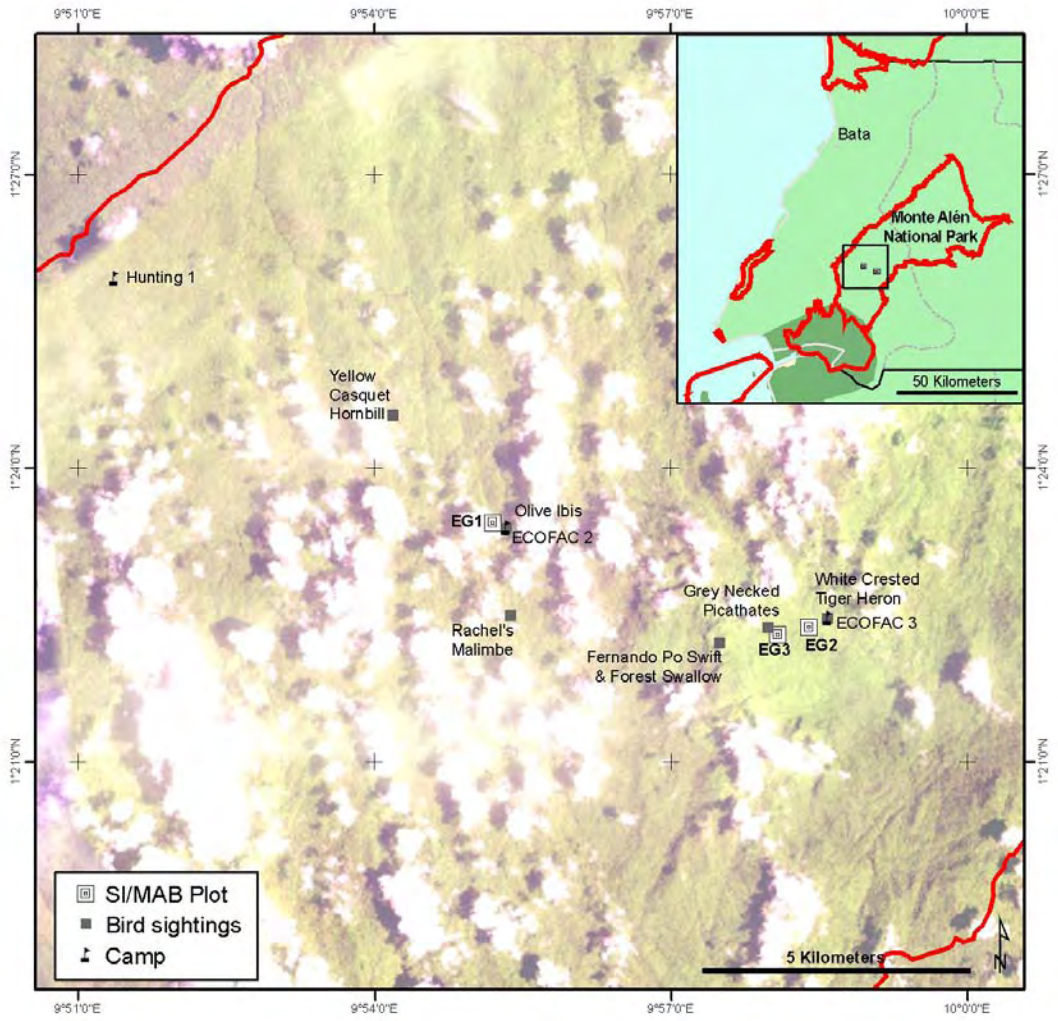


Figure 5. Locations of important bird sightings in Monte Mitra (map prepared by Dan Slayback)

2.3. Discussion

Prior to this survey, which was confined to Monte Mitra only, 265 species had previously been recorded from the entire Monte Alen National Park (Del Val, 2001). Given the rapid nature of this survey and at a bad time of year climatically (i.e. at the height of the rainy season), our results provide an excellent representation of the high diversity of the avi-fauna of Monte Mitra. A number of new records were confirmed, including the Fernando Po swift (*Apus sladeniae*) and the Olive ibis (*Bostry chia olivacea*).

Because of the timing of the survey, we did not encounter certain species that have previously been recorded from Monte Mitra. These included, the little grey greenbul (*Andropadus gracilus*), the tambourine dove (*Tutur tympanistria*), klaas's cuckoo (*Chrysococyx cupreus*). In addition, migratory species such as the paleo-arctic migrants are still on their way back from Europe and hence were also not recorded during this survey. In addition, the lack of record for a number of species of warblers was undoubtedly due to the heavy rains that occurred each day.

Despite the fact that hunting pressures in Monte Mitra are exceptionally high, the impact on the avifauna is minimal. However, hunters are known to target both hornbills and turacos and greater enforcement is indeed required to ensure the protection of these species, particularly those of conservation concern.

If we were to survey during the dry season and employ the use of mist nets, we would undoubtedly capture many more records than we did during this rapid survey. It is recommended that further surveys could be undertaken in February/March.

2.4. Conclusion

This survey confirms that Monte Mitra contains a diverse avifauna which fully justifies its IBA classification. The occurrence endangered, restricted range and biome restricted species makes the conservation of the National Park in its entirety a management priority.

Plate 1. Great Blue Turaco (*Corythaeola cristata*) (© T.C.H. Sunderland)

Plate 2. Francis Njie with black sparrowhawk (*Accipiter melanoleucus*) (© T.C.H. Sunderland)

Plate 3. Blue breasted kingfisher (*Halcyon malimbica*) (© T.C.H. Sunderland)

Plate 4, African goshawk (*Accipiter tachiro*) (© Carlton Ward Jnr.)

Plate 5, Grey-necked Picathartes (*Picathartes oreas*) (© T.C.H. Sunderland)

Plate 6. White bellied kingfisher (*Alcedo leucogater*) (© Carlton Ward Jnr.)

Plate 7. Blue billed malimbe (*Malimbus nitens*) (© Carlton Ward Jnr.)

Appendix 1: Checklist of the birds Of Monte Mitra, Equatorial Guinea
IUCN categories: EN: Endangered; VU: Vulnerable; NT: Near-threatened;
RR: Restricted Range species (total world range less than 50,000 km²)

IUCN	RR	ENGLISH NAMES	SCIENTIFIC NAMES	STATUS
		Dwarf bittern	*Ixobrychus sturmii*	
DD		White-crested tiger heron	*Tigriornis leucolophus*	RARE
		Cattle egret	*Bublcus ibis*	FREQUENT
		Little egret	*Egretta garzetta*	//
		Hadada ibis	*Bostrychia hagedash*	//
		Olive ibis	*Bostrychia olivacea*	UNCOM
		Spot-breasted Ibis	*Bostrychia rara*	UNCOM
		Honey buzzard	*Pemis apivorus*	
		Bat hawk	*Macheiramphus alcinus*	
		Black kite	*Milvus migrans*	COM
		Palm-nut vulture	*Gypohierax angolensis*	COM
		African harrier hawk	*Polyboroides typus*	COM
		African goshawk	*Accipiter tachiro*	FREQUENT
		Black sparrowhawk	*Accipiter melanoleucus*	RARE
		Long-tailed hawk	*Urotriorchis macrourus*	//
		Ayre's hawk eagle	*Hieraaetus ayresii*	
		Cassin's hawk eagle	*Spizaetus africanus*	
		Crowned eagle	*Stephanoaetus coronatus*	RARE
		Black Guineafowl	*Agelastes niger*	UNCOM
		Plumed Guineafowl	*Guttera plumifera*	
		Latham's forest francolin	*Francolinus lathami*	UNCOM
		Scaly francolin	*Francolinus squamatus*	//
		Nkulengu rail	*Himantomis haematopus*	//
		White-spotted flufftail	*Sarothrura pulchra*	COM
		Buff-spotted fluffail	*Sarothrura elegans*	
		African finfoot	*Podica senegalensis*	UNCOM
		African green pigeon	*Treron calva*	COM
		Blue-headed wood dove	*Turtur brehmeri*	UNCOM
		Tambourine dove	*Turtur tympanistria*	//
		Blue-spotted wood dove	*Turtur afer*	//

		Western bronze-naped pigeon	*Columba iriditorques*	
		Afep pigeon	*Columba guinea*	//
		Red-eyed dove	*Streptopelia semtorquata*	//
		Grey parrot	*Psittacus erithacus*	COM
		Red-fronted parrot	*Poicepgalus gulielmi*	FREQUENT
		Red-headed lovebird	*Agapomis pullarius*	RARE
		Great blue turaco	*Corythaeola critata*	COM
		Green turaco	*Tauraco persa*	UNCOM
		Yellow-billed turaco	*Tauraco macrorthnchus*	COM
		Red-chested cuckoo	*Cuculus solitarius*	//
		Black cuckoo	*Cuculu clamosus*	FREQUENT
		Dusky long-tailed cuckoo	*Cercococyx mechowi*	//
		Olive long-tailed cuckoo	*Cercococcyx olivinus*	UNCOM
		African emerald cuckoo	*Chrysococcyx cupreus*	REQUENT
		Yellow-throated Cuckoo	*Chrysococcyx flavigularis*	UNCOM
		Klaas's cuckoo	*Chrysococcyx klaas*	COM
		Didric cuckoo	*Chrysococcyx caprius*	UNCOM
		Yellowbill	*Ceuthmochares aereus*	FREQUENT
		Black-throated coucal	*Centropus leucogaster*	UNCOM
		Gabon coucal	*Centropus anselli*	UNCOM
		Fraser's eagle owl	*Bubo poensis*	RARE
		Sjostedt's barred owlet	*Glaucidium sjostedti*	//
		African wood owl	*Strix woodfordii*	FREQUENT
		Sabine's spinetail	*Rhaphidura sabini*	//
		Cassin's spinetail	*Neafrapus cassini*	//
		African palm swift	*Cypsiurus parvus*	//
		African black swift	*Apus barbatus*	UNCOM
		European swift	*Apus apus*	
		Bates's swift	*Apus batesi*	
		White-rumped swift	*Apus caffer*	
DD		Fenardo Po swift	*Apus sladeniae*	UNCOM
		Little swift	*Apus affinis*	
		Narina trogon	*Apaloderma narina*	RARE

		Bare-cheeked trogon	*Apaloderma aequatoriale*	//
		Chocolate-backed kingfisher	*Halcyon badia*	COM
		Blue-breasted kingfisher	*Halcyon malimbica*	//
		Woodland kingfisher	*Halcyon senegalensis*	REQUENT
		African dwarf kingfisher	*Ceyx lecontei*	
		African pygmy kingfisher	*Ceyx picta*	UNCOM
		White-bellied kingfisher	*Alcedo leucogater*	UNCOM
		Shining-blue kingfisher	*Alcedo quadribrachys*	REQUENT
		Giant kingfisher	*Megaceryle maxima*	
		Black Bee-eater	*Merops gularis*	UNCOM
		Blue-throated roller	*Eurystomus gularis*	//
		Broad-billed roller	*Eurystomus glaucurus*	//
		Red-billed dwarf hornbill	*Tockus camurus*	UNCOM
		African pied hornbill	*Tockus fasciatus*	COM
		Piping hornbill	*Ceratogymna fistulator*	//
		Black-and-white-casqued hornbill	*Ceratogymna subcylindricus*	
		White-thighed hornbill	*Ceratogymna albotibialis*	UNCOM
		Black-casqued wattled hornbill	*Ceratogymna atrata*	FREQUENT
NT		Yellow-casquedwattled hornbill	*Ceratogymna elata*	UNCOM
		Grey-throated barbet	*Gymnobucco bonapartei*	
		Naked-faced barbet	*Gymnobucco calvus*	FREQUENT
		Speckled tinkerbird	*Pogoniulus scolopaceus*	COM
		Red-rumped tinkerbird	*Pogoniulus atroflavus*	//
		Yellow-throated tinkerbird	*Pogoniulus subsulphureus*	//
		Yellow-rumped tinkerbird	*Pogoniulus bilineatus*	FREQUENT
		Yellow-spotted barbet	*Buccanodon duchaillui*	COM
		Hairy-breasted barbet	*Tricholaema hirsuta*	FREQUENT
		Double-toothed barbet	*Lybius bidentatus*	
		Yellow-billed barbet	*Trachyphonus purpuratus*	FREQUENT
		Spotted honeyguide	*Indicator maculatus*	
		Lesser honeyguide	*Indicator minor*	
		Thick-billed honeyguide	*Indicator conirostris*	FREQUENT
		Least honeyguide	*Indicator exilis*	//

		Willcocks's honeyguide	*Indicator willcocksi*	
		Green-backed woodpecker	*Campethera cailliautii*	UNCOM
		Buff-spotted woodpecker	*Campethera nivosa*	FREQUENT
		Brown-eared woodpecker	*Campethera caroli*	UNCOM
		Gabon woodpecker	*Dendropicos gabonensis*	
		Elliot's woodpecker	*Dendropicos elliotii*	UNCOM
		Grey-headed broadbill	*Smithomis sharpei*	//
		Rufous-sided broadbill	*Smithornis rufolateralis*	
		Square-tailed saw-wing	*Psalidoprocne nitens*	COM
		Black saw-wing	*Psalidoprocne pristoptera*	UNCOM
		White-throated blue swallow	*Hirundo nigrita*	
		Grey wagtail	*Motacilla cinerea*	
		Mountain wagtail	*Motacilla clara*	UNCOM
		Blue cuckoo-shrike	*Coracina azurea*	//
		Little greenbul	*Andropadus virens*	COM
		Little grey greenbul	*Andropadus gracilis*	
		Yellow-whiskered greenbul	*Andropadus latirostris*	COM
		Golden greenbul	*Calyptocichla serina*	//
		Honeyguide greenbul	*Baeopogon indicator*	UNCOM
		Spotted greenbul	*Ixonotus guttatus*	COM
		Yellow-necked Greenbul	*Chlorocichla falkensteini*	
		Simple greenbul	*Chlorocichla simplex*	UNCOM
		Swamp palm bulbul	*Thescelocichla leucopleura*	FREQUENT
		Icterine greenbul	*Phyllastrephus icterinus*	//
		Xavier's greenbul	*Phyllastrephus xavieri*	UNCOM
		White-throated greenbul	*Phyllastrephus albigularis*	//
		Red-tailed bristlebill	*Bleda syndactyla*	FREQUENT
		Comon bristlebill	*Bleda notata*	COM
		Eastern beared greenbul	*Criniger chloronotus*	FREQUENT
		Red-tailed greenbul	*Criniger calurus*	//
		Common bulbul	*Pycnonotus barbatus*	//
		Forest robin	*Stiphromis erythrothorax*	UNCOM
		Lowland akalat	*Sheppardia cyomithopsis*	

		Fire-crested alethe	*Althediademata*	FREQUENT
		Brown-chested aethe	*Altethe poliocephala*	//
		White-tailed at trush	*Neocossyphus poensis*	UNCOM
		Rufous flycatcher-thrush	*Neocossyphus fraseri*	COM
		Black-eared gound Thrush	*Zoothera cameronensis*	RARE
		Grey ground thrush	*Zoothera princei*	
		Black-faced rufous warbler	*Bathmocercus rufus*	UNCOM
		Banded prinia	*Prinia bairdii*	//
		Masked apalis	*Apalis binotata*	RARE
		Black-capped apalis	*Apalis nigriceps*	COM
		Buff-throated apalis	*Apalis rufogularis*	FREQUENT
	RR	White-tailed warbler	*Poliolais lopezi*	UNCOM
		Grey-backed camaroptera	*Camaroptera brachyura*	COM
		Yellow-browed camaroptera	*Camaroptera superciliaris*	FREQUENT
		Olive-green camaroptea	*Cameroptea chloronota*	//
		Yellow longbill	*Macrosphenus flavicans*	UNCOM
		Grey longbill	*Macrophenus concolor*	//
		Rufous-crowned ermomela	*Eremomela badiceps*	FREQUENT
		Green crombec	*Sylvietta virens*	//
		Lemon-bellied crombec	*Sylvietta denti*	UNCOM
		Fraser's forest flycatcher	*Fraseria ocreata*	UNCOM
		White-brown forest flycatcher	*Fraseria cinerascens*	//
		Cassin's flycatcher	*Musciapa cassini*	//
		Yellow-footed flycatcher	*Muscicapa sethsnithi*	FREQUENT
		Sooty flycatcher	*Muscicapa infuscata*	//
		Grey tit-flycatcher	*Myioparus plumbeus*	UNCOM
		Chestnut-capped flycatcher	*Erythrocercus mccallii*	//
		Dusky crested flycatcher	*Elminia nigromitrata*	
		Blue-headed crested flycatcher	*Trochocercus nitens*	//
		African paradise flycatcher	*Terpsiphone viridis*	FREQUENT
		Rufous-vented paradise flycatcher	*Terpsiphone rufocinerea*	UNCOM

		Red-bellied paradise flycatcher	*Terpsiphone rufiventer*	COM
		Shrike-flycatcher	*Megabyas flammulatus*	UNCOM
		Black-and white flycatercher	*Bias musicus*	//
		Chestnut wattle-eye	*Dyaphorophyia castanea*	FREQUENT
		White-spotted wattle-eye	*Dyaphorophyia tonsa*	UNCOM
		Yellow-bellied wattle-eye	*Dyaphorophyia concreta*	//
		Verreaux's batis	*Batis minima*	
		Bioko batis	*Batis poensis*	UNCOM
		Brown illadopsis	*Llladopsis flulvescens*	COM
		Pale-breasted llladopsis	*Llladopsis rufipennis*	//
		Blackcap llladopsis	*Llldopsis cleaveri*	UNCOM
VU	RR	Grey-necked Picathartes	*Picathartes oreas*	RARE
		Tit-hylia	*Pholidomis rushiae*	
		Green sunbird	*Anthreptes rectirostris*	UNCOM
		Collared sunbird	*Anthreptes recirostris*	FREQUENT
		Little green sunbird	*Nectarinia seimundi*	FREQUENT
		Bate's sunbird	*Nectarinia batesi*	UNCOM
		Olive sunbird	*Nectarinia olivacea*	COM
		Green-headed sunbird	*Nectarinia verticalis*	FREQUENT
		Blue-throated brown sunbird	*Nectarinia cyanolaema*	COM
		Green throated sunbird	*Nectarinia rubescens*	FREQUENT
		Olive-bellied sunbird	*Nectarinia chloropygia*	UNCOM
		Tiny sunbird	*Nectarinia minulla*	
		Superb sunbird	*Nectarinia superba*	UNCOM
		Western black-headed oriole	*Oriolus brachyrthnchus*	FREQUENT
		Black-winged oriole	*Oriolus nigripennis*	UNCOM
		Sooty boubou	*Laniarius leucorthynchus*	UNCOM
		Many-coloured bush shrike	*Malaconotus multicolor*	
X		Flery-breasted bush shrike	*Malaconotus cruentus*	
		Western nicator	*Nicator chloris*	UNCOM
		Yellow-throated nicator	*Nicator vireo*	RARE
		Square-tailed drongo	*Dicrurus ludwigii*	UNCOM

		Shining drongo	*Dicrurus atripenins*	COM
		Velvet-mantled drongo	*Dicrurus modestus*	FREQUENT
		Pied crow	*Corvus albus*	COM
		Narrow-tailed starling	*Poeoptea lugubris*	UNCOM
	Rr	Waller's chestnut-winged starling	*Onychognathus walleri*	//
		Forest chestnut-winged starling	*Onychognathus fulgidus*	FREQUENT
		Purple-headed glossy starling	*Lamprotomis purpureiceps*	//
		Splendid glossy starling	*Lamprotomis splendidus*	UNCOM
		Grey-headed sparrow	*Passer griseus*	
		Black-necked weaver	*Ploceus nigricollis*	
		Village weaver	*Ploceus cucullatus*	UNCOM
		Yellow-mantled weaver	*Ploceus tricolor*	
		Maxwell's black weaver	*Ploceus albinucha*	UNCOM
		Preuss's golden-backed weaver	*Ploceus preussi*	UNCOM
		Blue-billed malimbe	*Malimbus nitens*	COM
		Crested malimbe	*Malimbus malimbicus*	FREQUENT
		Cassin's malimbe	*Malimbus cassini*	UNCOM
	Rr	Rachel's malimbe	*Malimbus racheliae*	FREQUENT
		Red-headed malimbe	*Malimbus rubricollis*	UNCOM
		Red-bellied malimbe	*Malimbe erythrogaster*	
		Red-headed antpecker	*Parmoptila woodhouse*	UNCOM
		Grey-crowned negrofinch	*Nigrita canicapilla*	FREQUENT
		Pale-fronted negrofinch	*Nigrita luteifrons*	UNCOM
		Chestnut-breasted negrofinch	*Nigrita bicolor*	//
		White-breasted negrofinch	*Nigrita fusconota*	COM
		Black-bellied seedcracker	*Pyrenestes ostrinus*	UNCOM
		Western bluebill	*Spemophaga haematina*	//
		Orange-cheeked waxbill	*Estrilda melpoda*	
		Red-bellied helmet shrike	*Prionops caniceps*	

Appendix 2: Further notes on interesting bird records from Monte Mitra

1) Yellow-casqued hornbill (*Ceratogymna elata*)
This is rare forest species and is recorded West-ward from Cameroon, Nigeria to Togo (Borrow and Demey 2001). It is a NEAR THREATENED species and is a NEW RECORD for Equatorial Guinea.

2) Grey necked Picathartes (*Picathartes oreas*)
This specie is a rare individual of the sub Montane forest. It is classified as VULNERABLE.

3) White-crested tigerheron (*Tigriornis leucolophus*).
This is a rare forest bird. Its status is DATA DEFICIENT.

4) Olive Ibis (*Bostry chia olivacea*)
This species was recorded along a river near the first ECOFAC Camp site. This bird is NEW RECORD for the site.

5) Longtailed hawk (*Urotriorchis macrourus*)
Two individuals were recorded in the forest at the foot of Monte Mitra. This is a RARE forest bird.

6) Fernando Po swift (*Apus sladeniae*)
Two breeding pairs were recorded at the summit of Monte Mitra. This is only the fourth record of this species and a NEW RECORD for Rio Muni. It is classified as DATA DEFICIENT.

7) Preuss's golden-backed weaver (*Ploceus preussi*).
A breeding pair was recorded at the foot of Monte Mitra, in a mixed flock of birds. It is a RARE forest resident.

8) Rachel's Malimbe (*Malimbus racheliae*).
Two breeding pairs were recorded at ECOFAC Camp2 and 6 individuals were recorded at 500m altitude on Monte Mitra. This species is one of the representatives of the ENDEMIC BIRD AREA (EBA085) that occurs on Monte Mitra.

3. AN ASSESSMENT OF THE LARGE MAMMALS OF THE MONTE MITRA FOREST, MONTE ALEN NATIONAL PARK

Anthony Chifu Nchanji, Gabriel Ngua Ayecaba & Pablo Esono Esono

3.1. Introduction

A survey of large mammals of the Monte Mitra region within the Monte Alen National park took place recently as part of a wider biodiversity assessment undertaken as part of the Smithsonian Institution's "Capacity building for science-based conservation in the Congo Basin". This was funded by the Central African Regional Programme for the Environment (CARPE) of the US Government. In addition to the collation of baseline biological information, data relating to management issue regarding the conservation of the Monte Alen National Park was also collected. These are further elaborated in Chapter 7.

3.2. Objectives of the survey

The objectives of the large mammal survey of the Monte Mitra region were to:

- Provide a comprehensive checklist of the large mammals of the region;
- Assess the relative abundance of the major large mammals species;
- Identify current human activities and conservation threats in the region[1];
- Make suitable recommendations for conservation of large mammals of the region;
- Undertake *in situ* training in large mammal survey techniques for INDEFOR staff.

3.3. Materials and methods

3.3.1. Introduction

Prior to the commencement of field work the survey team spent two full days at both the Bata and Sendje markets identifying and noting fresh animal carcasses arriving from Monte Mitra the region with the intermediate traders/hunters. In addition to these direct observations, we worked with two post-graduate students, Sophie Allebone-Webb and Janna Rist of the Zoological Society of London's Institute of Zoology who are studying the commercial bushmeat trade in the area. They visit the Bata market daily and make periodic visits to hunting camps in the Mitra forests and have taken many photographs of fresh animal carcasses, representing a wide range of species. We spent time examining their photographs, noting their localities, to identify and record the species being hunted from the forests of Monte Mitra in particular. Finally we undertook a 12-day field expedition into the Monte Mitra forest where we visited hunting camps to identify species killed from fresh carcasses and trophies found. Using the recce transect method, we observed and recorded the presence of large mammal species through direct or indirect observations. In addition, we used informal interview and interpersonal

[1] The conservation threats and recommendations for conservation action are made in Chapter 7 of this report.

discussions with 12 local hunters opportunistically encountered during out expedition to further complement our checklist.

3.3.2. Conservation status of mammal species of Monte Mitra region

We used the perceptions of 12 local hunters informally interviewed to determine local status of the mammal species listed for Monte Mitra region as:

- Abundant: if species are always captured or sighted during each hunting expedition;
- Common: if species are captured or sighted at least every other hunting expedition;
- Rare: if captured or sighted at least once every 6 – 12 months or heard captured in this time range in the area.

The above accepted status was the consensus perception of at least 66% of those interviewed. We further detailed the listing of each species by Equatorial Guinean current conservation legislation, CITES and IUCN as much as possible.

3.3.3. Species abundance

We used the recce-transect technique or rapid reconnaissance walks of Barnes *et al*. (1989) to determine species abundance through encounter rates (i.e. the number of animals or animal signs per kilometer) of large mammals in the Monte Mitra forest. Recce walks are faster, cheaper and reliable method for gathering information on large mammal abundance indices other than densities to aid management decisions. This method is recommended particularly for difficult terrain or large geographical areas (Barnes *et al*., 1989). Unlike strict line transect surveys, where observers walk a straight line from a point along a predetermined compass bearing and record objects with accompanying perpendicular distances to determine densities; observers in recce walks record objects along paths of least resistance through the forest without recording accompanying perpendicular distances to determine encounter rates. However, during the recce walk, observers remain within ±15° of the predetermined compass bearing from the predetermined point.

Between September 26 and October 6, 2005 we conducted reconnaissance walks along the Bisun – ECOFAC (Conservation et Utilisation Rationelle des Ecosystèmes Forestiers en Afrique Centrale) Camp II path (22.8 km) in five segments and along five other recce transects of approximately 2 km each. The recce transects were at least 5km from each other and almost perpendicular to the Bisun – ECOFAC Camp II path. We walked the segments on the path, or each transect, at a speed of 0.5 km/h and recorded animals sighted or signs seen (dung, nests, feeding remains, footprints and/or carcass/parts) or heard (calls). We compared primates calls heard with taped vocalizations of Gaultier-Hion *et al*., (1999) to confirm species in cases of doubts. It was difficult to distinguish chimpanzee nests from those of gorilla, so we classified all nests found as “ape nests”.

It was also difficult to distinguish species of duikers based on dung morphology; therefore we used dung size to group the duikers as small (Blue duiker, young of medium and Yellow-backed duikers), medium (Black-fronted, White-bellied, Peter's, Bay and Ogilby's duikers and young of Yellow-backed duiker) and large (Yellow-backed duiker).

Plate 8. Relatively fresh elephant dung (© A. Nchanji)

Plate 9. Dung pellets of medium-sized duikers (© A. Nchanji)

Plate 10. Old great ape nest (© A. Nchanji)

Plate 11. Signs of gorilla feeding on *Aframomum* sp. (© A. Nchanji)

3.3.4. Data analysis

The observations were classified by species, or taxonomic group as described above, and used to determine their encounter rates as the index of abundance. Indirect signs especially dung and nests, were aged following White & Edwards (2000).

3.4. Results

3.4.1. Checklist and conservation status of the large mammals

We confirmed the presence of 56 large mammal species, representing eight families, in the Monte Mitra forest (Appendix 1). About 46.2% of the species are locally perceived as common, 27.6% as abundant and 26.2% as rare. No species is perceived to have been locally extirpated in the region. The leopard (*Panthera pardus)*, listed as "Critically Endangered" and the black colobus (*Colobus satanus*), chimpanzee (*Pan troglodytes troglodytes*), forest elephant (*Loxodota cyclotis*), lowland gorilla (*Gorilla gorilla gorilla*), mandrill (*Mandrillus sphinx*) and red-eared monkey (*Cercopithecus erythrotis*) listed as "Endangered", the "Vulnerable" Pogonias monkey (*Cercopithecus pogonias*), the red-capped Mangabey (*Cercocebus torquatus*), giant pangolin (*Smutsia gigantea*) and hippopotamus (*Hippopotamus amphibus*) are all species of conservation importance still confirmed as present within the Monte Mitra forest.

3.4.2. Mammal species abundance

We walked a total of 32.8 km; 22.8 km along the Bisun to ECOFAC Camp II and 10km of 5 x 2 km long recce transects almost tangential to the path. We commonly observed or by indirect signs and heard calls of 23 of the 56 mammals species of Monte Mitra forest on our recce walks. The most abundant species were *Loxodota cyclotis*, encounter rate 8.29 and *Syncerus caffer nanus*, 0.95. For *L. cyclotis* about 30% (n = 272) of signs (dung) observed were either fresh or recent (1 to 4 days old). These were followed by the grouped taxa, small and medium-sized duikers. The diurnal primates were the next abundant species with encounter rates ranging from 0.18 in the grey-cheeked mangabey (*Lophocebus albigena*) to 0.48 in putty-nosed monkey *(C. nictitans)*.

Table 1. Abundance of key species in the Monte Mitra forest

Common English name	Scientific name	Total # signs	Observed distance (km)	Encounter rate
Forest Elephant	*Loxodota cyclotis*	272	32.8	8.29
Small Duikers*		68	32.8	2.07
Medium Duikers*		50	32.8	1.52
Forest buffalo	*Syncerus caffer nanus*	31	32.8	0.95
Putty-Nosed Monkey	*Cercopithecus nictitans*	21	32.8	0.64
Gorilla	*Gorilla gorilla gorilla*	16	32.8	0.48
Black Colobus	*Colobus satanus*	14	32.8	0.43
Mona Monkey	*Cercopithecus mona*	13	32.8	0.39
Giant Pangolin	*Smutsia gigantea*	13	32.8	0.39
Crowned Guenon	*Cercopithecus pogonais*	10	32.8	0.30
Grey-cheeked mangabey	*Lophocebus albigena*	6	32.8	0.18
Pygmy squirrel	*Myosciurus pumilio*	6	32.8	0.18
Red river hog	*Potamochoerus porcus*	6	32.8	0.18
Mandrill	*Mandrillus sphinx*	5	32.8	0.15
Palm squirrel	*Epixerus wilsoni*	4	32.8	0.12
Sitatunga	*Tragelaphus spekei*	4	32.8	0.12
Giant forest squirrel	*Protoexerus stangeri*	3	32.8	0.09
Great Apes*		3	32.8	0.09
Pangolins	*Phataginus/Uromanis Spp.*	3	32.8	0.09
Rock hyrax	*Procavia capensis*	3	32.8	0.09
African giant rat	*Cricetomys emini*	2	32.8	0.06
Brush-tailed porcupine	*Atherurus africanus*	2	32.8	0.06
Tree hyrax	*Dendrohyrax dorsalis*	1	32.8	0.03

* = group of species

3.5. Discussion

This study has provided a comprehensive checklist of the large mammals of Monte Mitra forest. It confirms most of the species listed by Fa and Yuste (2001) and hence supports the presupposition that bushmeat sales points in villages and cities are good for studying the faunal diversity of the surrounding areas. The species list developed by this study indicates that Monte Mitra forest is a biodiversity hotspot for rainforest large mammals although there is no endemism. Species such as the leopard, black colobus and giant pangolin that are reported as rare elsewhere in the sub region still possess high encounter rates. The encounter rate for the forest elephant is also extremely high, one of the highest

in the region, and probably accounts for the many incidents of crop raiding reported by local villagers.

Despite the high encounter rates for many species, especially those of conservation value and/or are protected by National and International legislation, we observed a high level of commercial hunting. These observations concur with Fa and Yuste (2001) and at current levels of exploitation; continued hunting threatens the conservation of many large mammal species in Monte Mitra. These issues are discussed further in Chapter 7.

Table 2 . Comparison of the encounter rates of some key mammal species of Monte Mitra forest with other areas in the region.

Species	This study	CR[1]	TFR[2]	CM[3]	MDNP[4]
Loxodota cyclotis	8.29		0.94	0.03	3.6
Small Duikers*	2.07		0.43	3.6	9.4
Medium Duikers*	1.52		1.54	0.1	8.0
Syncerus caffer nanus	0.95	0.3	0.09	0.3	3.4
*Cercopithecus nictitans**	0.64	2.5	0.35	0.43	2.0
*Gorilla gorilla gorilla**	0.48		0.64		-
*Colobus satanus**	0.43		-		1.7
*Cercopithecus mona**	0.39		0.110	1.2	0.4
Smutsia gigantea	0.39	-	-	0.25	0.4
*Cercopithecus pogonais**	0.30	1.2	-	1.2	0.6
*Lophocebus albigena**	0.18	0.35	-	0.01	5.6
Potamochoerus porcus	0.18	0.2	0.88	0.25	0.1
*Mandrillus sphinx**	0.15	0.3	-	0.03	-
Tragelaphus spekei	0.12	-	-	0.25	2.1
Great Apes*	0.09				0.6
*Phataginus/Uromanis Spp**	0.09				4.7

* = group of species

1= Campo region, Cameroon (Adele & Mathew 2000);
2 = Takamanda Forest Reserve, Cameroon (Sunderland-Groves & Maisels, 2003);
3 = Campo Ma'an area (Matthews & Matthews, 2000);
4 = Mbam-Djerem National Park, Cameroon (Nchanji & Bechem 2001).

3.6. Research and conservation recommendations

Until recently, aside from data on bushmeat markets, little was known about the large mammals of Monte Mitra forest aside from presence or absence. There should be further

detailed surveys of the large mammals within the whole Monte Alen National Park to determine faunal abundance and densities, particularly of species of conservation value and a long-term ecological monitoring programme designed and implemented. Further conservation-based recommendations are made in Chapter 7.

Clockwise from top left:

Plate 12. Blue duiker (*Cephalophus monticola*) on forest floor (© A. Nchanji)

Plate 13. Startled bay duiker (*Cephalophus dorsalis*) (© T.C.H Sunderland)

Plate 14. Hoof print of forest buffalo (*Syncerus caffer nanus*) in old elephant dung (© A. Nchanji)

Appendix 1. Checklist of large mammals in Monte Mitra region of Monte Alen National Park, Equatorial Guinea and current conservation status

Evidence of species presence: S = Sighted, Tk = Track/Trail, Ty = Trophy, D = Dung, Cas. = Carcass, Int. = Interview, RCP = Recent carcass picture,
Equatorial Guinea laws: A = totally protected, B = Partially protected, C = not protected, Ii = Insufficient information,
Local perception: Ab. = Abundant, Co. = Common, Ra. = Rare,

IUCN Categories: CR = Critically endangered; EN = Endangered; Vu = Vulnerable; CD = Conservation Dependent; LR : nt, cd or lc = Low Risk (nt = near threatened, cd = conservation dependent, lc = least conservation concerned); DD = Data Deficient, NE = Not Evaluated
* = Species not listed in the IUCN data list but most probable category is inferred from information in Kingdon (1997), NL = not listed.

Species name					**Evidence of species presence**	**Conservation status**			
English	French	Spanish	Fang	Scientific		Local perception	EG laws	IUCN Cat.	CITES Cat.
Proboscidea									
Forest Elephant	Eléphant	Elefante	Nzok	*Loxodota cyclotis*	D, RCP	Ab.		En: A1b	I
Artiodactyla									
Hippopotamus	Hippopotame	Hippotamo	Nzok-osuin	*Hippopotamus amphibus*	Int	Ra.		Vu: A1a	III
Red river hog	Potamochère	Jabali del rio	Nguin	*Potamochoerus porcus*	Tk, Ty, Cas.	Ab.		NL: LR – DD*	
Water chevrotain	Chevrotain aquatique	Dorcaterio	Viong	*Hyemoschus aquaticus*	Cas. RCP	Ra.		LR: nt	III
Forest buffalo	Buffle	Bufalo/Cebu	Nnat	*Syncerus caffer nanus*	D	Ab.		LR: cd	
Bushbuck	Guib harnaché	Antilope geroglifico	Nkwa	*Tragelaphus sriptus*	Ty	Ra		NL – LR: cd*	
Sitatunga	Sitatunga	Sitatunga	Mvuu	*Tragelaphus spekei*	D, Ty, RCP	Co.		LR: nt	III
Dwarf Antelope	Antilope de Bates	Antilope enano	Odjuin	*Neotragus batesi*	Int.	Ra		LR: cd	
Peter's duiker	Céphalophe Peters	Duikero Peters	Nvin	*Cephalophus callypigus*	Cas, RCP	Co.		LR: cd	
Yellow-backed duiker	Céphalophe à dos jaune	Duikero de Iomo amarillo	Nzip	*Cephalophus silvicultor*	Int.	Ra		LR: nt - DD	II
Ogilby's duiker	Céphalophe d'Ogilby	Duikero Ogilbi	Nvin	*Cephalophus ogilbyi*	S, Cas, RCP	Ab.		LR: nt	
Bay duiker	Céphalophe	Duikero bayo	Sóo	*Cephalophus dorsalis*	S, Cas, RCP	Ab.		LR: nt - DD	

	bai								
Blue Duiker	Céphalophe bleu	Duikero azul	Opong	*Cephalophus monticola*	S, Cas, RCP	Ab.		NE – LR: lc*	II
White-bellied duiker	Céphalophe à ventre blanc	Duikero de Gabon	Mie	*Cephalophus rufilatus*	Cas, RCP	Co.		LR: cd	
Black-fronted duiker	Céphalophe à front noir	Duikero de frente negra	Nzom	*Cephalophus nigrifrons*	Cas, RCP	Ab.		LR: nt - DD	
Pholidota									
Tree pangolin	Pangolin Commun	Pangolin arboricola	Ka	*Phataginus tricuspis*	Cas, RCP, Tk	Ab.		NE – DD*	
Long- tail pagolin	Pagolin à longue queue	Pangolin de cola larga	Ka	*Uromanis tetradactyla*	Cas, RCP, Tk	Ab.		NE – DD*	
Giant Pangolin	Pangolin géant	Pangolin gigante	Fima	*Smutsia gigantea*	Tk, Ty	Co.		NE – Vu: DD*	III
Carnivora									
Leopard	Panthère	Leopardo Panthera	Nze	*Panthera pardus*	Ty, RCP	Co.		CR: C2a	I
African civet	Civette d'Afrique	Civeta africana	Nsuein	*Civettictis civetta*	Cas, RCP	Ab.		NE – LR: lc*	
Blotched genet	Genetta à grandes taches	Jineta, Labo	Nsing	*Genetta tigrina*	Cas, RCP	Ra.		NE – LR: DD*	
African palm civet	Nandinia	Civeta de las palmeras	Nvein	*Nandinia binotata*	RCP	Co.		NE – LR: lc*	
Common genet	Genette vulgaire	Jineta comun	Nsing	*Genetta genetta*	Cas, RCP	Ra.		NE – LR: lc, DD*	
Servaline (Spotted) genet	Genette Servaline	Jineta servalina	Nsing	*Genetta servalina*	RCP	Ra.		NE – LR, DD*	
Central African Lisang	Poiane centrafricaine	Lisang africano	Oyan	*Poiana richardsoni*	RCP	Co		NE – nt DD*	
Cuisimase	Mangue brune	Mangosta oscura	Osurgum	*Crossarchus obscurus*	RCP	Co			
Golden cat	Chat doré	Gato dorado	Ebio	*Felis aurata*	Int.	Co			
Slender Mongoose	Mangouste rouge	Mangosta flaca	Nva	*Herpestes sanguinea*	Int.	Ra.			
Ratel (Honey badger)	Ratel		Nvak	*Mellivora capensis*	Int.	Ra.		NE – LR: nt, DD*	
Marsh Mongoose	Mangouste des marais	Mangosta patinegra	Ngue-nvá	*Atlax paludinosus*	RCP	Ra.		NE – LR: lc, DD*	
Black-legged	Mangouste à	Mangosta blanca	Mfum-mva	*Bdeogale nigripes*	Cas, RCP	Co.		LR: lc, DD	

Mongoose	pattes noir								
Long-snouted Mongoose	Mangouste à long museau	Mangosta de los pantanos	Mvá-mitan	*Herpestes naso*	Cas, RCP	Co.		NE – LR: DD*	
Swamp otter	Loutre de Congo	Nutria de cuello monteado	Nfum-abáng	*Aonyx congica*	S	Co.		LR: nt	I
Spot-necked otter	Loutre à cou tacheté			*Lutra maculicollis*	Int.	Ra			
Rodentia									
Marsh cane-rat	Aulcode	Aulacodo	Akukuein	*Thryonomys swinderianus*	Int., RCP	Co.		NE – LR: lc*	
African giant rat	Rat de gambie	Rata gigante	Kuin	*Cricetomys emini*	Cas. RCP	Ab.		NE – LR: lc*	
Brush-tailed porcupine	Atherure Africain	Puercoespin	Ngom	*Atherurus africanus*	Cas. RCP	Ab.		LR: nt	
Giant forest squirrel	Grand écureuil de stanger	Ardilla de cuatri bandas	Oseng	*Protoexerus stangeri*	S	Co.		NE – LR: lc*	
Palm squirrel	Écureuil d'Ebi	Ardilla de las palmeras	Sep-oseng	*Epixerus wilsoni*	Cas.	Ab.		NE – LR: DD*	
Fire-footed rope squirrel	Funisciure à pattes rousses	Ardilla sol de patas rojas	Edun	*Funisciurus pyrropus*	Cas	Co.		NE – LR: lc*	
Ribboned rope Squirrel	Funisciure rayé	Ardilla	Oseng	*Funisciurus lemiscatus*	S	Co.			
Pygmy squirrel	Écureuil nain			*Myosciurus pumilio*	S	Co.			
Red-legged Sun squirrel	Heliosciure à jambes rousses			*Heliosciurus rufabrachium*	Cas	Co.			
Chirptera									
Fruit bats		Murciolagos	Endem	*Rousettus aegyptiacus*	S	Ab.			
Insectivora									
Giant Otter Shrew	Potamogale			*Potamogale velox*	Int.	Ra.		En: B1 + 2c	
Hyracoides									
Rock hyrax	Daman de rouher	Osito tropical	Osun	*Procavia capensis*	Vo.	Co.		NE – LR: lc, DD*	
Tree hyrax	Daman d'arbre	Damán arboreo	Osun	*Dendrohyrax dorsalis*	S	Co			
Primates									
Bosman Potto	Potto de Bosman	Poto de bosmán	Agun	*Perodicticus potto*	Vo.	Ra.		NE – LR: nt*	II/C2
Golden Potto (Angwantibo)	Potto aurée	Poto dorado	Kak	*Arctocebus aureus*	Cas	Co.		LR: nt	II
Needle-claws	Galago élégant	Galago elegante	Nsen	*Euoticus elegantulus*	Vo.	Co.		LR: nt	

Galago									
Allen's Galago	Galago d'allen	Galago de Allen	Emam	*Galago alleni*	Vo.	Co.		LR: nt	
Galago bushbaby	Galago	Galago enano	Emam	*Galagoides* sp *(demidoff*?)	Cas	Co.		NE – LR, DD*	
Chimpanzee	Chimpanzé	Chimpancé	Engoro	*Pan troglodytes*	Ne, Int.	Ra.		En: A2cd	I
Grey-cheeked Mangabey	Mangabé à joues grises	Mangabey de mejillas	Fung	*Lophocebus albigena*	Vo.	Co.		LR: nt, DD	II
Gorilla	Gorille	Gorila	Ngi	*Gorilla gorilla gorilla*	Ne. RCP	Co		En: A2cd	
Black Colobus	Colobe noir	Colobo negro	Nvoan	*Colobus satanus*	S, Vo.	Ab.		En: A1c	II
Mona Monkey	Mone	Mono mona	Esuma	*Cercopithecus mona*	S, Vo.	Ab.		NE – LR: lc, DD*	
Putty-Nosed Monkey	Hocheur	Mono de nariz blanca	Avem	*Cercopithecus nictitans*	S, Vo., Cas, RCP	Ab.		NE – LR: lc, DD*	
Crowned Guenon	Cercopithèque pogonias	Mono mona	Esuma	*Cercopithecus pogonais*	Vo. RCP	Ab.		Vu: A2c	II
De Brazza's Monkey	Cercopithèque de Brazza	Mono obispo	Fung	*Cercopithecus neglectus*	RCP	Ra.		NE – LR: lc, DD*	
Moustached Monkey	Moustac	Mono de cola roja	Ngamechogo	*Cercopithecus cephus*	RCP, Vo	Co.		NE – LR: lc, DD*	
Mandrill	Mandrill	Mandril	Esaga	*Mandrillus sphinx*	RCP, Tk, Int.	Co.			I
Talapoin Monkey	Talapoin du nord	Talapoin	Onzem	*Miopithecus ogouensis*	Int.	Co.		NE – LR: lc*	
Red-capped Mangabey	Cercocèbe à collier blanc			*Cercocebus torquatus*	Cas, Vo.	Ra		Vu: A2c	II
Red-eared Monkey	Moustac à oreilles rousses			*Cercopithecus erythrotis*	Vo. RCP	Co.		En : A2cd	II

4. AN ASSESSMENT OF THE REPTILES AND AMPHIBIANS OF THE MONTE MITRA FORESTS OF THE MONTE ALEN NATIONAL PARK

Nono Legrand Gonwouo & Angeles Nsang

4.1. Introduction

An inventory of the reptiles and amphibians of the Monte Mitra forest within the Monte Mitra National Park, Equatorial Guinea was conducted between September and October, 2005. We used visual and encounter surveys, opportunistic trapping and drift fence pit fall buckets in our inventory. A total of 55 species representing 33 reptiles, including 16 snakes, and 22 amphibians. The area supports a number of key reptiles of conservation importance, including the dwarf crocodiles *Osteolaemus tetraspis,* heavily collected in the region for the bush meat market; the slender-snouted crocodile *Crocodylus cataphractus* that appears to be rare in the region and probably in the central African Sub region. The hinge back tortoises *Kinixys erosa* and *K. homeana* are present in the region with the former species being still relatively abundant. However, they are collected whenever encountered and eaten locally and this activity seems to be having a negative impact on the population of *K. homeana* which appears to be becoming increasingly rare. Threatened amphibians recorded include the largest African toad, *Bufo superciliaris*, the world's largest frog, *Conraua goliath,* and the hairy frog *Trichobatrachus robustus*. The latter is also collected and eaten locally. A forest dependent species of gecko *Hemidactylus intestinalis* was recorded in the area hereby indicating the pristine nature of the forest. Aside from the logging activities that have modified the forest structure along the old logging road, the study area still possesses extensive pristine forest that can support considerable populations of herpetofauna and other wildlife populations.

4.2. Materials and methods

Amphibians and reptiles were surveyed from 25th September to 9th of October, 2005. This period coincides with a the peak in rainfall in the region and is the wettest period of the year. Two principal surveys and collection methods were used to inventory species within the region. First, specimens where mainly located opportunistically during visual encounter surveys of all the ecological habitats in the region by three people. Additional opportunistic observations and collections where made by additional members of the multi taxa research team during their various periods of field work work. Random tracks were followed to locate amphibians and reptiles in every microhabitat type including along available streams. Search techniques included visual scanning of microhabitats such as lifting rocks and logs, peeling away backs, moving fallen debris and inspecting tree stems. A small hand held torch was used to look into cracks and holes in logs and rocks. Logs and rocks where restored to minimise habitat alteration. When encountered, reptiles were collected by hand and amphibians by the use of a hand held net (5 x 6 cm square and 40cm long). Captured specimens were identified in the field and the amphibians and lizards were placed in a plastic containers, and snakes in cloth bags. Well known species were immediately released at the point of capture and no more than four voucher specimens where collected for a single species.

To supplement opportunistic collecting, habitats were also sampled using pitfall traps placed along drift fences. Drift fences consist of 30m of aluminium flashing fence 0.8m high supported by wooden stakes along the trap line. The fence runs at right angle from a moving stream with pitfalls (in this instance, plastic buckets) being placed every 5m giving a total of seven buckets along the length of the fence. The base of the fence is hooked in the ground and covered with soil and leaf litter to direct specimen intercepted during their normal movements along the fence towards the bucket traps. The buckets are sunk into the ground with their rims flush to the ground level and positioned so that the drift fence runs centrally across the mouth of each trap. One trap was placed at each end of the drift fence. Traps were checked every morning and every evening. Captured specimens where removed and placed into plastic containers. Those not retained as voucher specimens where released in the vicinity of the trap about 20m away.

Plate 15. Drift fence and bucket pit fall traps in primary forest (© T.C.H. Sunderland)

Voucher specimens collected were tagged with their own unique reference code. They were killed by an injection of chlorbutanol solution direct to the heart and then and preserved in 70% alcohol. Voucher specimens were deposited in the INDEFOR office in Bata and at the Cameroon Biodiversity Conservation Society offices in Yaoundé, Cameroon. For specimen identification, we used the following references:

- Amphibians (Amiet, 1971, 1972, 1977; Rödel, 2000; Schiøtz, 1999)
- Geckos (Van den Audenaerde, 1967; Perret, 1963, 1973; Hoogmoed,1974);
- *Mabuya* (Chirio and Ineich (2000);
- Panaspis (Perret, 1973);
- Chameleons (Wild, 1993);
- Snakes (Chippaux, 2001).

4.3. Results

4.3.1. Introduction

A total of 55 species including 33 reptiles from 12 families and 24 genera and 22 amphibians from 7 families and 13 genera were documented in the park during the study. The complete

list of species observed and species whose presence was detected during the study are presented in Tables 3 & 4 (below).

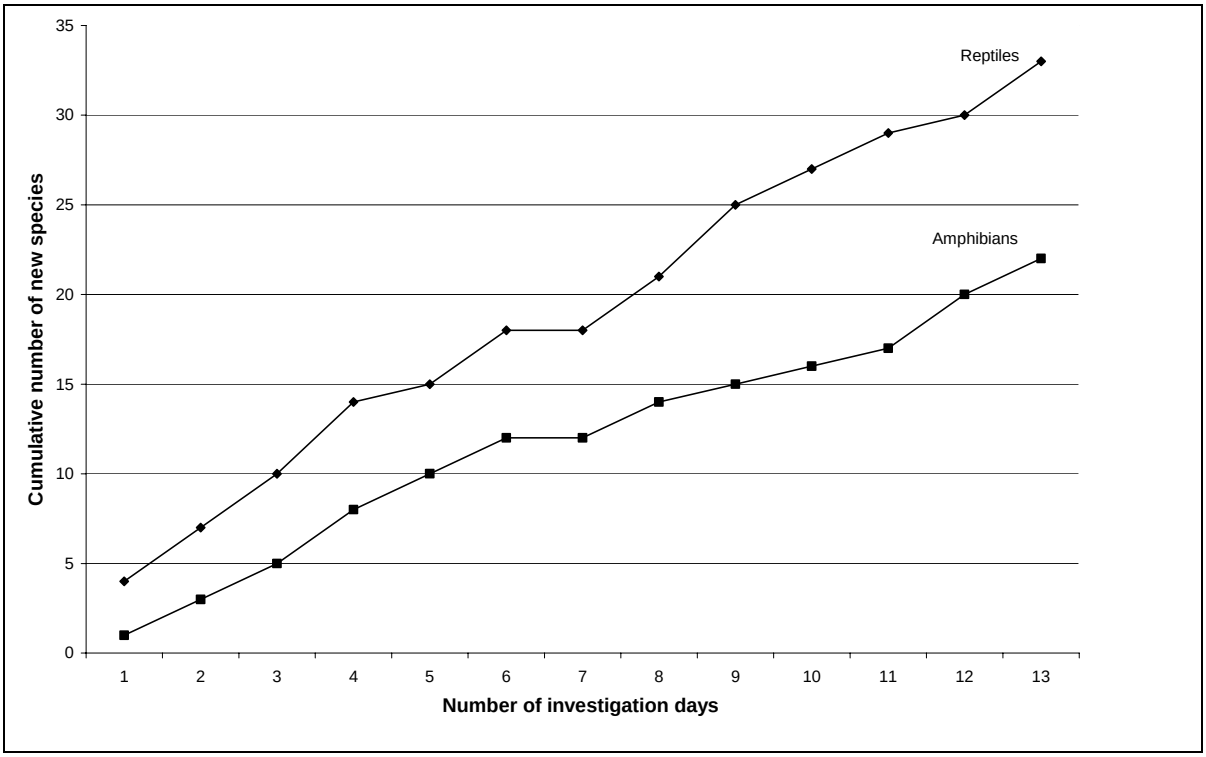


Figure 6. Plot of cumulative number of new species recorded each day during the survey

4.3.2. Random encounter survey

The random encounter surveys were very successful during this study as 125 specimens belonging to 51 species including 32 reptiles and 19 amphibians were recorded. Generally hand capture during random encounter survey and opportunistic observation is often the most effective method of accumulating the most species in the minimum amount of time (Scott, 1994; Rödel & Ernst, 2004). The majority of species recorded during this study were recorded from this mode of survey.

4.3.3. Drift fence and pit fall traps

Drift fence/pitfall traps were operated throughout the study period for a total of 13 trap-nights[1]. A total of 11 reptiles and 26 amphibians where captured in drift fence pitfall traps. As expected, amphibians accounted for 75% of all herpetofauna species collected in the pitfall traps. This method has been used successfully to determine species richness and to detect the presence of rare species (Corn, 1994). In our study, this method proved only marginally effective recording two reptiles (*Mabuya affinis, Panaspis breviceps*) and six amphibians (*Hymenocherus boettgeri camerunensis, Xenopus fraseri, Bufo supercilliaris, Cardioglossa elegans, Arthroleptis variabilis,* and *Phrynobatrachus auritus*). A limitation of this method is

[1] A trap-night is defined as a trap in active use for a 24-hour period.

that such traps tend to capture some species more readily than others and is less effective than stream searching for amphibians. In addition to reptiles and amphibians, 11 small mammals were captured in the drift fence/pitfall traps and were released when removed from the traps.

Table 3: Number of species and specimen of reptiles found during visual encounter survey/ opportunistic survey and drift fence pitfall traps

TAXA	Survey method		Number of specimens observed
	Visual encounter survey/ Opportunistic trapping	Drift fence-pitfall traps	
Crocodylia			**1**
Crocodylus cataphractus	*		
Osteolaemus tetraspis tetraspis	1		
Tesudinidae			**24**
Kinixys erosa	23		
Kinixys homeana	1		
Trionychidae			**1**
Trionyx triunguis	1		
Gekkonidae			**7**
Hemidactylus fasciatus fasciatus	1		
Hemidactylus intestinalis (= H. ansorgi)	2		
Hemidactylus mabouia mabouia	3		
Lygodactylus conraui	1		
Agamidae			**5**
Agama cf agama	5		
Chamaeleonidae			**3**
Chamaeleo cristatus	1		
Rhampholeon spectrum spectrum	2		
Scincidae			**36**
Mabuya affinis	13	2	
Mabuya maculilabris maculilabris	11		
Mabuya polytropis	1		
Panaspis breviceps		9	
Varanidae			**1**
Varanus ornatus	1		
Pythonidae			**1**
Python sebae sebae	1		
Colubridae			**10**
Bothrolycus ater	1		
Dipsadoboa viridis viridis	1		
Hapsidophrys lineatus	1		
Hapsidophrys smaragdina	1		
Hormonotus modestus	1		
Lamprophis olivaceus	1		
Hydraethiops melanogaster	1		
Mehelya stenophthalmus	1		
Philothamnus carinatus	2		
Elapidae			**2**
Dendroaspis jamesoni jamesoni	1		
Naja melanoleuca melanoleuca	1		
Viperidae			**5**
Atheris squamiger	2		
Bitis gabonica gabonica	1		
Bitis nasicornis	1		
Causus maculatus	1		
Total Species	**33**	**Total**	**96**

** = Species not directly observed whose presence was indicated through indirect signs*

Table 4: Number of species and specimen of amphibians found during Visual encounter survey/ Opportunistic survey and Drift fence pitfall traps

TAXA	Survey Method		Number of specimens observed
	Visual encounter survey/ Opportunistic trapping	Drift fence-pitfall traps	
Pipidae			**28**
Hymenocherus boettgeri camerunensis		7	
Xenopus fraseri	9	12	
Bufonidae			**5**
Bufo maculatus	1		
Bufo camerunensis	2		
Bufo superciliaris		1	
Bufo tuberosus	1		
Astylosternidae			**9**
Astylosternus diadematis	1		
Astylosternus batesi	1		
Arthroleptidae			**7**
Trichobatrachus robustus	1		
Cardioglossa elegans	1	1	
Arthroleptis variabilis	2	2	
Ranidae			**1**
Conraua goliath	*		
Amnirana amnicola	1		
Petropedetidae			**18**
Ptychadena mascaraniensis	6		
Phrynobatrachus auritus	2	3	
Phrynobatrachus batesi	3		
Phrynobatrachus cornatus	2		
Phrynobatrachus sp ??	2		
Hyperoliidae			**5**
Hyperrolius ocellatus	1		
Leptopelis calcaratus	1		
Leptopelis boulengeri	2		
Leptopelis brevirotris	1		
Total Species	**22**	**Total**	**66**

** = Species not directly observed whose presence was indicated through indirect signs*

4.4. Discussion

4.4.1. Reptile diversity

Reptiles from twelve families represented 60% of the herpetofauna found in the study area. The most diverse family was the Colubridae 28%, followed by the Gekkonidae, Scincidae and Viperidae 12% each. Snakes accounted for 49% of all reptiles. Although this proportion appears to be high, snakes in general are not well-represented by this study with only 16 species found. For example,. similar sites in the Guineo-Congolian region have some of the richest and most diverse snake faunas of Africa. For example, 54 snakes were recorded from Korup National Park, Cameroon (Lawson, 1993), 47 from Takamanda Forest Reserve, Cameroon (LeBreton *et al*., 2003), 45 species in Dinamika, Congo Republic (Trape, 1985), 40 from Tai National Park, Ivory Coast (Ernst & Rödel, 2002) and 32 from Kibale National Park, Uganda (Vonesh, 2001). The low record of snakes in Monte Mitra compared to other region in Africa is justified by the fact that the region was under sampled given only a two-week sampling period.

Lizards were represented by five families (Scincidae, Gekkonidae, Chamaeleonidae, Agamidae and Varanidae) with the most diverse being the skinks (12%) and geckos (12%) with four species each. In all, 12 species of lizards accounting for 36% of all reptiles were recorded. Lizard fauna recorded in other African sites: Korup National Park Cameroon, Lawson, (1993) revealed 20 species. Kibale National Park Uganda Vonesh (2001), 15 species and the Central African Republic represented by 10 species of skinks. The number recorded during this study relatively reflects the lizard fauna of the area but may slightly under represent it. The species recorded are more forest dependent as compared to records from Cameroon and Uganda that includes more species of disturbed forest and farm bush. Species from modified habitats probably occur in the southern part of the park that we did not visit.

Other reptiles recorded included two land tortoises *Kinixys erosa* and *K. homeana* (Testudinidae 6%) and the soft shell tortoise *Trionyx triunguis* (Trionychidae 3%). Species of *kinixys* are heavily collected in the region for food. *K. erosa* appears to still be somewhat common but *K. homaena* populations may already be suffering from high levels of uncontrolled collection. Lawson (2001) discussed the unsustainable exploitation of these species in the Korup National Park, Cameroon and the Monte Mitra forest is likely to suffer the same fate if conservation measures are not implemented.

Two crocodiles species were recorded (6%) including the very commonly harvested dwarf crocodile *Osteolaemus tetraspis* and *Crocodylus cataphractus*, which was rarely encountered. Like the two land tortoises of the genus *Kinixys*, *Osteolaemus tetraspis* is heavily hunted for the bush meat marketing in Bata and this appears to be unsustainable for the species. It is likely to be threatened by overexploitation in a near future as is the case in West Africa (Akani and Luiselli, 2001). It is certain that additional reptile surveys in the region extended over a longer period of time and covering both rainy and dry seasons will give a better idea of the fauna and specific threats to their conservation.

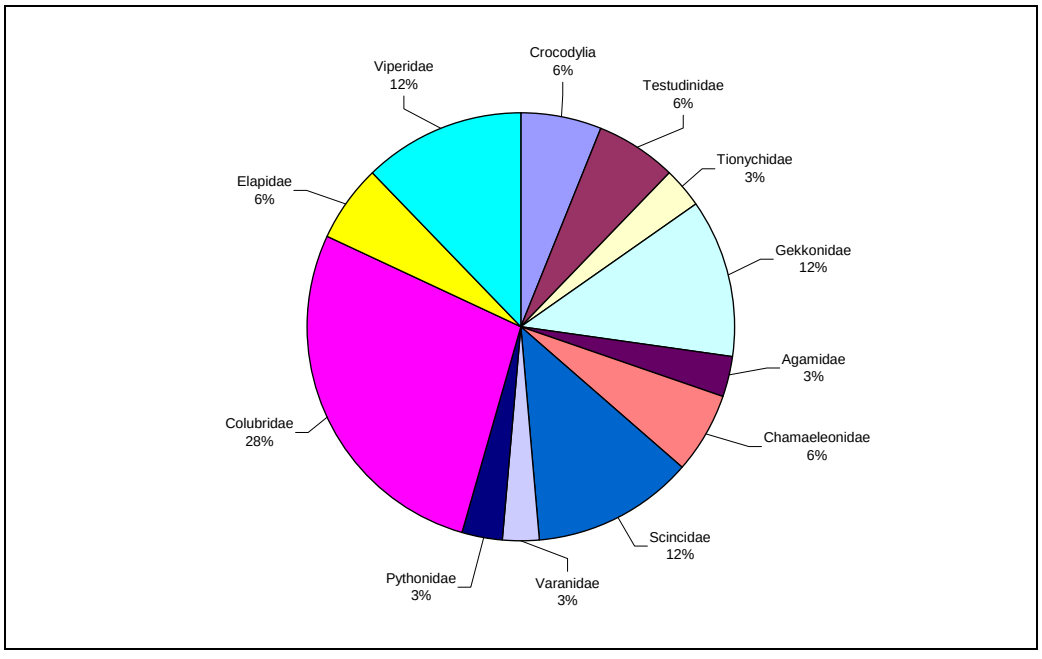


Figure 7. Reptile diversity of Monte Mitra by family

4.4.2. Amphibian diversity

We found 22 amphibians from 7 families representing 40% of all known herpetological species found in the survey. The most diverse group were the Petropedetidae 23%, followed by the Bufonidae, Hyperolidae 18% each, Arthroleptidae 14% and Pipidae, Astyloternidae and Ranidae 9% each. The low number of amphibians recorded during this study is probably due to the fact that the field work period was short, as previously mentioned.

We note the presence of *Bufo superciliaris* the largest African toad in the Monte Mitra forest. This species ranges from Guinea in West Africa to the northern Democratic Republic of Congo and Gabon (Rödel, *et al*., 2004). It is regarded as very rare in West Africa and hard to find as Guibe & Lamotte (1958a) collected only two specimens in primary forest during 20 months of field work on Mount Nimba. Rödel (unpublished data) recorded only two specimens in the primary forest of Tai National Park Ivory Coast. In central Africa, the species appears to be more common as Lawson (1993) reported to regularly collect this species in pitfall traps in the Korup National Park Cameroon. He attributes the scarcity of the species to its excellent cryptic camouflage and sedentary nocturnal nature. We found one specimen in two weeks of field work and this can be an indication that there is an important population of the species in the wider Monte Alen National Park. No records of the world's largest frog (*Conraua goliath*), which is known to occur only in Cameroon and Equatorial Guinea, were obtained in the field but local sources reveal the presence of this species in the region. They are known to inhabit the tributaries of larger streams and fast flowing waters and rapids. The loss of habitat and the degradation of rivers by forestry and urban development are the major threats to this species (LeBreton, 1998). However no night surveys were conducted along rivers to confirm its presence. The hairy frog (*Trichobatrachus robustus*) is known to be confined to the western rainforest of central Africa. The record of one specimen during the study confirms its presence.

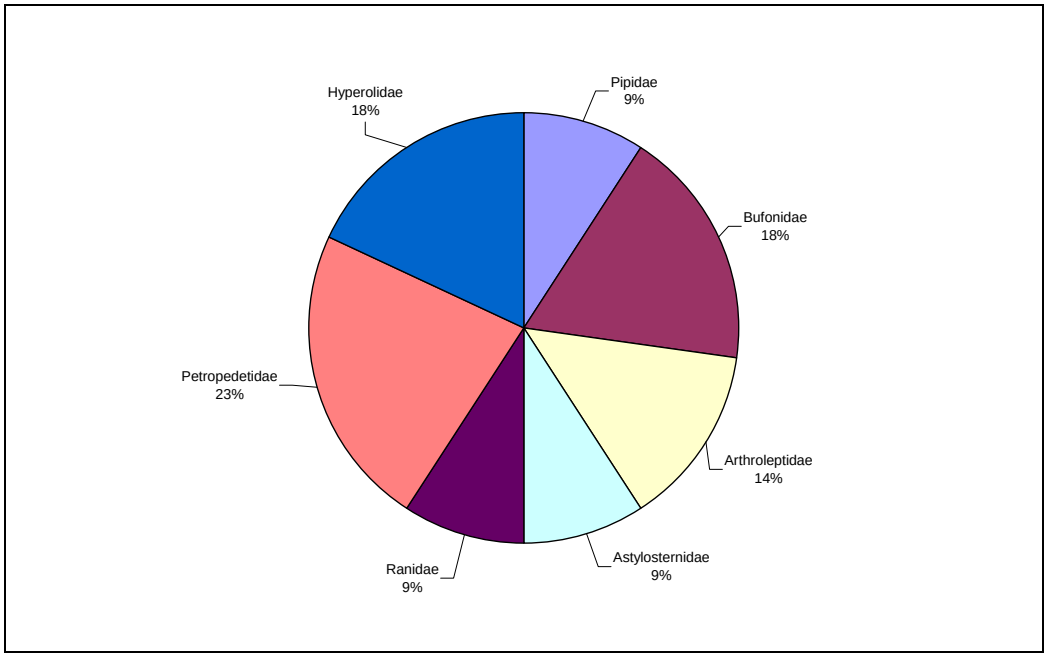


Figure 8. Amphibians diversity recorded arranged in families

4.4.3. Species of conservation importance

Herpetofauna species of conservation interest recorded in the area that need special attention when developing conservation action plan include:

1- *Crocodylus cataphractus*: This species appears to be rare in the area but may still be present in the park where there are limited human activities. More information on its distribution and density should be collected to determine which parts of the park are important for this species.
2- *Osteolaemus tetraspis*: This commonly collected crocodile in the region greatly contributes to the protein intake of residents of the area and many are sold in the neighbouring market of Bata. Although still common in the region, the present collection for the bush meat trade is unsustainable. Regulation of hunting could reduce the pressure on this species in the park.
3- *Kinixys erosa* and *K. homeana*: The former appears to have an important population in the area (average of two individuals collected per day by hunters = 23 observed) but the latter may already be threatened by high scale collection (only one individual seen all through the study). They are listed as Data Deficient on the IUCN red list.
4- *Python sebae*: This species is commonly eaten in the region and often collected on snare traps. Their skin is used for decoration.
5- *Conraua goliath*: The world's largest frog occurs in the general area of the park. More research on distribution and sites of importance in the park should be undertaken. Larger streams and waterfalls are the preferred habitat of this species.
6- *Trichobatrachus robustus*: The hairy frog is very well known by locals. They are collected whenever encountered and eaten locally. Information on its distribution and relative abundance will help develop sound conservation measures
7- *Bufo superciliaris*: This is a species threatened with extinction. Studies of distribution and relative abundance will help develop sound conservation measures.

4.5. Conclusion

Although this survey was conducted for a relatively short time, the indications are that the Monte Alen National Park still harbours important populations of reptiles and amphibians of the central African rainforest range and the preliminary reptile (33) and amphibian (22) species recorded in this study indicates the Monte Mitra fauna are similar in richness and diversity to other sites in central Africa. Despite the relatively high number of herpetofauna species recorded during this study (55 species), this list is far from complete for the areaand the completion of a more comprehensive list will require additional extensive field work spaced over both wet and dry seasons and using various inventory methods.

Aside from the old logging road constructed about 35 years ago that has modified the vegetation along its length, human impact in the forest is low. However, due to the indiscriminate use of wire snares, it is likely that some reptiles, including the monitor lizard (*Varnus ornatus*), the forest tortoises (*Kinixys* spp) and possibly the African rock python (*Python sebae*) become snared and rot before being removed. Hunting and trapping may be significantly impacting on some species and if reducing this impact is a management priority, then regulation of detrimental human activities in the park may be necessary.

A number of threatened species where recorded during the study and include *Bufo superciliaris* CITES appendix I, *Crocodylus cataphractus* and *Osteolaemus tetraspis* all

CITES appendix I species and currently listed as Vulnerable in the IUCN Red list 2001. *Kinixys erosa* and *Kinixys homeana* listed as Appendix II of the CITES convention and data deficient on the IUCN red list. Other species of note recorded include: *Varanus ornatus, Python sebae* CITES Appendix II. A forest dependent species of gecko *Hemidactylus intestinalis* was recorded in the area. Its presence in the Monte Alen National Park indicates the pristine nature of the forest and this species appears to be a reliable a bio-indicator.

Appendix 1. Species accounts

Below are notes on some reptiles and amphibians observed or detected during the study. Short descriptions of habitats are provided and collection numbers of specimens deposited at INDEFOR Equatorial Guinea and CBCS Cameroon. Notes on range distribution for some species are also given.

Reptiles

Crocodylus cataphractus (Cuvier, 1825)
The slender-snouted crocodile is well distinguished by the form of its head and is well-known by hunters of the region. They regard the species as scarce as it is rarely encountered during night hunting adding that they last met one more than a year ago along a river south of the first ECOFAC research station. No individuals were observed during the study but photos of this species taken south of the Park were seen from a reliable source studying bush meat trade in this region. *C. cataphractus* seems to be on a regional decline over its range in Central Africa. In Nigeria, it is thought to be near extinct and is regarded as Critically Endangered (Luiselli *et al.,* 2000). Lawson (1993) revealed that this species was common in moderate sized streams of the Korup National Park. Gonwouo *et al.* (2004) recorded 1 individual from the Ejagham Forest Reserve north of the Korup, Cameroon. It is possible that degradation of forest around streams may have an effect on this species. The Monte Mitra forest still possesses good pristine forest suitable for this species however, no information exists on its status and distribution. It is listed on Appendix I of the CITES convention and as Data Deficient on the IUCN red list of species and as such particular attention should be paid to its distribution and management.

Osteolaemus tetraspis tetraspis (Cope, 1861)
Dwarf crocodiles seem to be abundant in this region and are often collected alive and sold in the bush meat market in Bata. Hunters of the region revealed that the animals are sometimes encountered in the multiple water pools found along the old logging road where hunting is sometimes conducted for this species. No night survey was carried out at these ponds to assess the populations but reliable information source from a study of bush meat around the area revealed that up to 15 individuals can be observed in the market in Bata on a single day. A live individual was observed being loaded in a taxi in Bata. *Osteolaemus tetraspis* seems to be relatively abundant in the Monte Mitra area. This species is listed as *Vulnerable* on the IUCN Red List and is in Appendix I of the CITES convention. It is known to have a large distribution range on the African continent but unsustainable collection is already having a negative effect on populations elsewhere (Barknett *et al.,* 2001). Given the present collection pressure on the species for the bush meat trade, it is at high risk of extirpation regionally and as such special attention must be paid to ensure its continued existence.

Plate 16. A live individual of *Osteolaemus t. tetraspis* in Bata (© N.L. Gonwouo)

Kinixys erosa (Schweigger, 1812).
The forest hinge back tortoise seems to be abundant in the region (23 live individuals observed during the study) and contributes to the protein source of people in the region. They have a wide distribution on the African continent (Spawls et al., 2002) and seem to be still common in Monte Mitra as they are often collected during random hunting movements in the park by locals. Hunters reveal that one can easily collect up to 10 individuals at a point where there is mushroom growing.

Plate 17. *Kinixys erosa* (© N.L. Gonwouo)

Kinixys homeana (Bell, 1827).
This species is rarer in the region than the previous. Only one live individual was seen with hunters and it is always collected whenever encountered. The small number recorded seems to be as a result of a reduction in population. Recent studies conducted in Cameroon revealed that *K. erosa* was more common than *K. homeana* (Gonwouo and LeBreton, 2003). Present

collection in the region appears to be unsustainable and special attention should be paid to this species when developing conservation measures.

Hemidactylus fasciatus fasciatus (Gray, 1842), Voucher specimen: 0005.
Three individuals where found in the night on tree trunks along the logging road near the first ECOFAC Camp. This species is often encountered in clearings and degraded patches in primary and secondary forest and also ranges into the savannah region through gallery forests (Rödel *et al*., 1997).

Hemidactylus intestinalis (= *ansorgei*) (Werner, 1897)
An individual of this species was observed on a tree trunk about 2.5m high in primary forest around the area where pitfall traps where set. It sometimes frequents farm bushes and plantations but its presence in an area indicates the intact nature of the forest.

Hemidactylus mabouia mabouia (Moreau de Jonnes, 1818)
This forest distributed gecko frequents houses and human settlements. Three individuals were sighted feeding on insects around a bulb at night in the village of Sendje.

Mabuya affinis (Gray, 1838), Voucher specimen: 0002, 0006
The brown-flanked skink was the most commonly encountered lizard in the region. It was mostly encountered in secondary forest notably along the old logging road basking on tree trunks and leaf litter. It was also found in primary forest with 2 individuals collected in the pit fall traps. Studies conducted elsewhere in Africa have mentioned trapping this species in funnel traps in secondary forest at stream sites (eg. Rödel et al., 1997, Akani and Luiselli, (2001).

Plate 18. ***Mabuya affinis*** **(© N.L. Gonwouo)**

Panaspis breviceps (Peters, 1873) Voucher specimens : 0013, 0017, 0018, 0019
Nine individuals of this species were collected in the pit fall traps. This species is common in primary forest on leaf litter but can also be observed in secondary forest.

Plate 19. *Panaspis breviceps* (© N.L. Gonwouo)

Agama agama (Linnaeus, 1758)
This lizard is wide spread in Africa and often commonly encountered where ever there are any forest disturbances. Five individuals where observed in the abandoned village of Bisun. Their absence from the majority in the park explains the pristine nature of the forest as their presence often displaces native species and indicates human disturbance.

Chamaeleo cristatus (Stutchbury, 1837) Voucher specimen: 0033
This species is well known by local hunters in the region who often observe the species during their various daily hunting activities. A juvenile was observed basking in primary forest in sunlight at forest canopy at about 80cm from the ground on a plant stem. This species is commonly found in rainforest and clearings such a farms in Cameroon. It is listed in Appendix II of the CITES Convention.

Rhampholeon spectrum spectrum (Buchholz, 1874) Voucher specimens: 0056, 0012
Two individuals of this dwarf chameleon were collected during the study. One was at low altitude (350m a.s.l.) on the ground and the other at (1,100m a.s.l.) on the stem of a plant at about 2m from the ground. The species is known to forage on leaf litter during the day. Perching heights f up to around 50cm have been recorded in the Ediango area (Gonwouo & LeBreton, 2004). They are known from coastal lowland and montane cloud forest up to 1900m a.s.l. (Wild, 1994).

*Varanus ornatus (*Daudin, 1803)
The monitor lizard is a well known species in the region. No individuals were collected during this study but hunters indicated that they collect the species on their snares.

Python s. Sebae (Gmelin, 1788)
An African rock python was observed basking beside a water pond along the old logging road. Many of such ponds exist along the survey site and seem to provide a suitable habitat for this species. It is hunted and eaten locally and the skin used for decoration. It is listed in Appendix II of the CITES convention.

Hormonotus modestus (Duméril, Bibron and Duméril, 1854). Voucher specimen: 0055.

One specimen of the modest snake was found on the roof at the second ECOFAC research station. Little is known of its ecology.

Plate 20. Nono Gonwouo with *Hormonotus modestus* (modest snake) (© T.C.H. Sunderland)

Bothrolycus ater (Gunther, 1874) Voucher specimen: 0053
One female was collected on Monte Mitra near a swampy area at 950m.a.s.l. in the morning.

Dipsadoboa viridis viridis (Peters, 1869) Voucher specimen : 0010
An individual was collected by the botany team when defining a 1ha plot for a plant survey about 1km from the first ECOFAC research station.

Hapsidophris lineatus ((Fischer, 1856) Voucher specimen: 0050
A specimen was collected by the botany team when defining a 1ha plot for plant survey 500m from the second ECOFAC research camp.

Hydraethiops melanogaster (Cope, 1861) Voucher specimen: 0054
One individual was collected by the mammal team along the part on the logging road between the two ECOFAC research camps.

Mehelya stenophthalmus (Mocquard, 1908) Voucher specimen: 0011
An individual was collected under stacked planks at the first ECOFAC research camp. It is sometimes found in secondary forest but this record indicates it can frequent human settlements.

Philothamnus carinatus (Andersson, 1901) Voucher specimen: 0009
An individual was collected on the path in the secondary forest of the logging road about 2km from the first ECOFAC research station.

Naja melanoleuca (Hallowel, 1857)
The forest cobra was observed but not collected in a 1ha plot set for botany survey during the study period. This species has a wide distribution in African rain forest. It is the most commonly encountered venomous snake in southern Cameroon (Gonwouo *et al.*, 2005).

Atheris squamigera (Hallowel, 1854) Voucher specimens: 0051, 0052
Two individuals were collected along the logging path in the morning and afternoon. Tree vipers are often found in the day at perch heights of around 2m (Luiselli *et al.* 2000) but can also be found on the ground during early night hours or early in the morning. The specimens observed were possibly hunting as no food was noticed in their stomachs.

Plate 21. The tree viper, *Atheris squamigera* (© N.L. Gonwouo)

Bitis gabonica (Dumeril and Bibron, 1854)
The Gabon viper was observed (N 1° 22’ 70” and E 9° 58’ 21”) basking along the old logging road 2.5 km NW of the second ECOFAC research camp in secondary forest. This species is killed and collected for eating whenever encountered by locals.

Bitis nasicornis (Sshaw, 1802)
An individual of this species was observed camouflaged in leaf litter about 4km from the abandoned hunting camp on the way to the first ECOFAC camp. Like *B. gabonica* it is eaten locally and often killed when ever encountered. Locals recognise these species as very poisonous and as such always kill them, big or small.

Amphibians

Hymenochirus beottgeri camerunensis (Perret & Mertens, 1957) Voucher specimens : 0022, 0023, 0041
Seven individuals of this species were collected in the pitfall trap early in the morning after a heavy overnight rainfall. This species is found in stagnant water bodies and water ponds in forest. They can also be found in humid leaf litter in the vicinity of stagnant water bodies (Perret, 1966)

Xenopus fraseri (Boulanger, 1905) Vouchers specimens: 0021, 0024, 0025
This species seems to be abundant in this area 21, individuals where observed during the study. We collected 9 during opportunistic encounter surveys in the various water ponds along the old logging road and 12 in the pit fall traps. This species is distributed in forested central Africa from Cameroon to the Democratic Republic of Congo and Uganda (Frost, 1985)

Bufo maculatus (Hallowell, 1885, 1854)
The widespread and common African toad was observed at the village of Sendje after a small rain. Individuals of the species were also heard calling in the night. They are said to be common in all habitat types except very dry savannas and primary rain forest (Rödel, 2000). They are also known to occur along roads and disturbed sites throughout the forest (Lawson, 1993)

Bufo camerunensis (Parker, 1936):
Individuals of this species were observed in secondary forest along the old logging road. Lawson (1993) reported the species is more common in Primary forest than in disturbed sites.

Bufo superciliaris (Boulenger, 1887b) Voucher specimen: 0042
A baby of this species was collected in a pitfall trap. They are known to range from the forest of Ivory Coast to Northern Democratic Republic of Congo. They are found throughout the lowland forest of Korup National park (Lawson 1993). It is listed in Appendix I of the CITES convention and should be considered when developing conservation measures.

Bufo tuberosus (Gunther, 1858) Voucher specimen: 0047
A juvenile of this species was collected along the logging road. It is known to be confined to primary forest of the lowlands (Lawson 1993).This observation reveals it can also frequent secondary and disturbed forest.

Astylosternus batesi (Boulenger, 1900) Voucher specimen : 0064
An individual of this species was collected on leaf litter in the morning near the pitfall traps set in the second ECOFAC research station.

Trichobatrachus robustus (Boulanger, 1900) Voucher specimen: 0001
A non-gravid female was collected in secondary forest about 20m from a fast moving stream entering into a small river. This species is said to be confined to the western rainforest of central Africa. Males have hair-like epidermal projections on their flanks and back, giving rise to the common name -hairy frog. This species is collected smoked and eaten locally. However, no high collection pressure was noticed during the study.

Cardioglossa elegans (Boulenger, 1906) Voucher specimens: 0015, 0058

Two individuals one adult and one juvenile were collected in the pitfall trap set in the primary forest. This genus is easily recognised with its very well marked colorations. They are said to be common in rocky areas of primary forest at lowland (Amiet, 1972)

Plate 22. *Cardioglossa elegans* (© N.L. Gonwouo)

Amnirana amnicola (Perret, 1977) Voucher specimen: 0067
A specimen was collected on leaf litter in primary forest at about 400m a. s.l. some 600m from the second ECOFAC research station. It known from lowland forest of Cameroon, Gabon and Congo where the species was first observed and described (Perret, 1977)

Plate 23. *Amnirana amnicola* (© N.L. Gonwouo)

Ptychadena mascaraniensis (Duméril and Bibron, 1841) Voucher, 0004, 0007
Individuals of this species were collected in secondary forest around the first ECOFAC research station. They were often heard calling in the early hours of the night.

Arthroleptis variabilis (Matschie, 1893), Voucher, 0016, 0023
This species was commonly observed feeding on insects in leaf litter of primary forest. An individual was collected at around 800m.a.s.l on Monte Mitra;

Phrynobatrachus auritus (Boulanger, 1900) Voucher specimen: 0021, 0022
Specimens of this species were collected in primary forest on leaf litter. Three of the individuals were from the pitfall traps.

Phrynobatrachus sp. Voucher specimens: 0025, 0026
Two small leaf litter frogs found in the pit fall traps at the second ECOFAC research station.

Leptopelis calcaratus (Boulanger, 1906) Voucher specimen: 0020
An individual was found on branches of a tree 2.5m from the ground, at the abandoned hunting camp.

Leptopelis boulengeri (Werner 1898) Voucher specimen: 0003
Two individuals of this species were collected at night on leaves and branches beside the abandoned hunting camp. Both individuals collected were males females are known to be at least twice the size of males.

Leptopelis brevirostris (Werner, 1898) Voucher specimen: 0008
One individual of this species was collected by the mammal team in primary forest some distance from the fist ECOFAC research station. It is known to occur from lowland at sae level to about 845m a.s.l. (Lawson, 1993)

5. AN ASSESSMENT OF THE PATTERNS OF PLANT DIVERSITY AND ENDEMISM OF MONTE MITRA USING STANDARDISED TRANSECT METHODS

Miguel Leal

5.1. Introduction

Species are not distributed at random within the rain forest and except for common species, most other species are restrained to a certain habitats or environments. Within such a geographically bound environment, only the most competitive species will be able to co-exist. The repeated co-occurrence of species at a spatial scale is an indication for underlying environmental arranging forces. In areas of rugged terrain, two well known arranging forces are; altitude and aspect.

In temperate regions the impact of these two forces on the distributions of plant species is clearly visible. With increasing altitude the vegetation changes from oak/beech-dominated forest to pine forest and finally alpine pastures. The impact of aspect is evident when comparing south and north facing slopes. The southern slopes are covered by xeric (drought resistant) shrubby/grassy vegetation and north slopes by forest.
In tropical regions the impact of these arranging forces are less visible and the outer appearance of the rain forest changes little along slopes with altitude and aspect. But actually recording plant species along hill slopes or at two opposing sides reveals differences in species composition. How big these differences are, is an indication for the biodiversity of the area in general: “the bigger the differences, the greater the biodiversity”.

Using a standardized transect methodology, species composition was recorded in the montane forest and tropical rain forest covering Mt Mitra along the slopes from the base (300m) to the summit (1000m). The influence of aspect could not be studied since all transects are located at the eastern slope of Mt Mitra.

5.2. Methods

The transects used to record species composition were 200 m long and 5 m wide. Each individual tree with a diameter at breast height (dbh) of 5 cm and greater was recorded and identified. For each species which remained unidentified a voucher specimen was taken for further examination in the herbarium of Libreville or Wageningen. Often these specimens were without flowers or fruits in which case species were identified only on sterile e.g. leaf characteristics. Such identifications are less confident and are referred to as morpho-species.

Three transects were placed along the east facing slope of Mt Mitra at 1000m, 700m, 500m and two at 300m. Transects were put in after the altitudinal zone was prospected to estimate the heterogeneity of the environment, and habitat diversity. This procedure

ensures to record maximum species diversity present within a certain altitudinal zone and avoids replication, i.e. transects with a similar species composition.

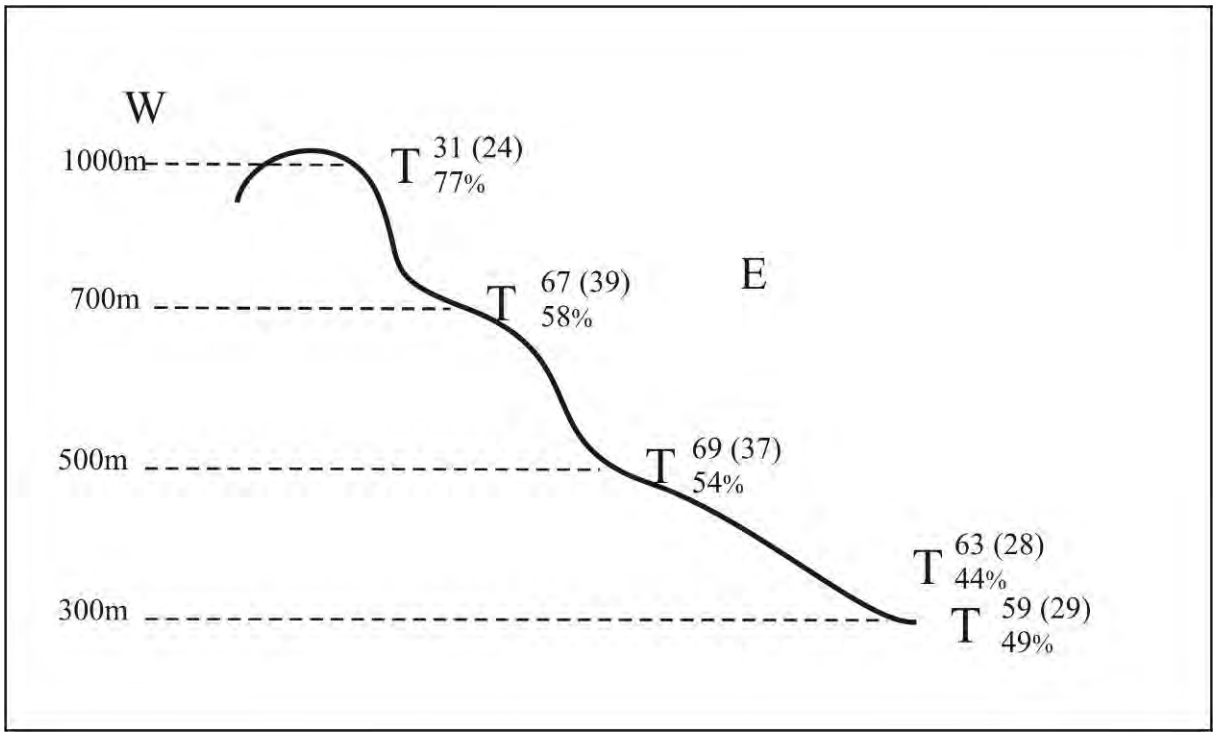


Figure 9. Profile of the Monte Mitra range showing the distribution of the transects (T) from bottom to summit, the figures at each transect are the total number of species, between brackets the number of species restricted to that transect (endemic) and the percentage.

5.3. Results

In total species 213 (morpho-) species were recorded on the 5 transects, on average 60 species were recorded per transect. The lowest number was 31 species at 1000m and the highest number was 69 species at 500m, closely followed by the transect at 700m with 67 species. The majority of the species (157) were restricted to a single transect. The high number of restricted species will most likely decrease when more transects are put in along these slopes.

5.3.1. Species richness

Species richness generally tends to increase with sampled area until after a certain surface area or “ceiling” (maximum) is reached, i.e. the species-area curve (see below). Such curves are used to estimate the potential maximum number of species within a certain area. To do the same for Mt Mitra has its limitations, because the total surface area (number of transects) only represents 5,000m^2 (0.5 ha) of the Mt Mitra area, an area which itself comprises several km^2.

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Species richness seems lowest on the summit (31 species), highest below the top at the mid-altitudes (67 and 69 species) and gradually decreasing to the base (63 and 59 species). This may be a genuine trend, at last for the summit as exploration walks showed that the summit and ridges almost all had the same forest type and species composition. Further sampling has to show whether the mid-altitudes are more species rich than the lower-altitudes. But the difference is only a few species.

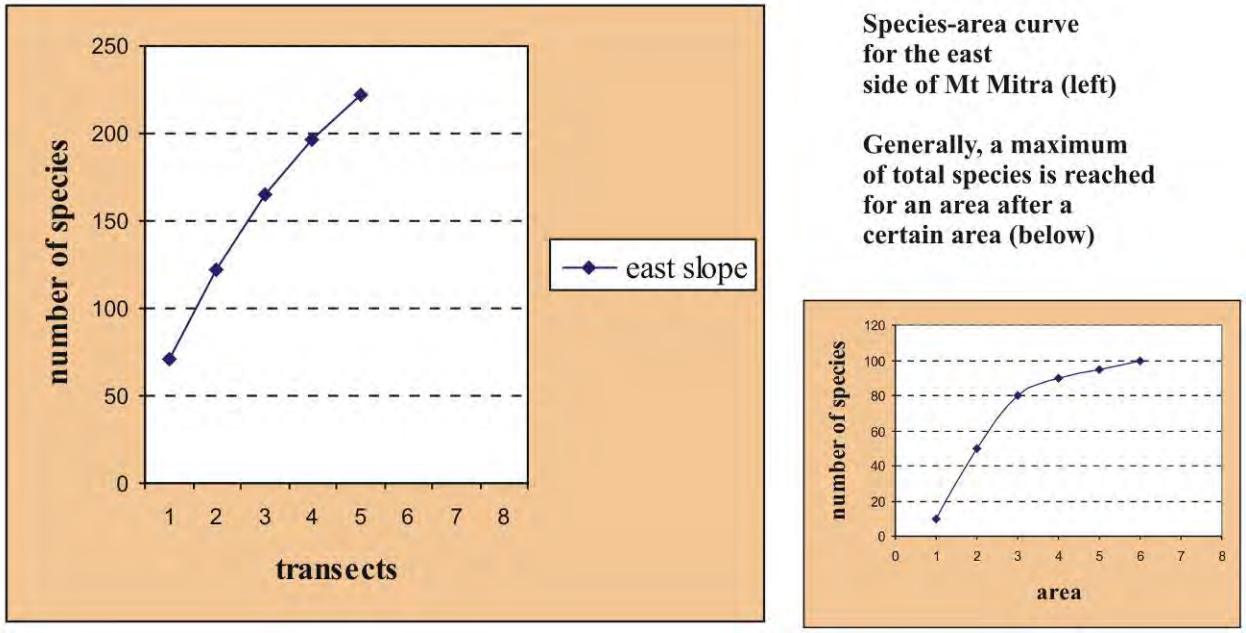


Figure 10. Species area curves for Monte Mitra

The species-area curves for the east side is steep, but already slightly bending which suggests a high maximum number of species for Mt Mitra (above left). However, the sampling procedure used here was designed to maximize species recording and avoid replication. Additional transects may not necessarily lead to more species. The curve could also start bending with increased sample area without significantly changing the total number of species already recorded.

Which of the two possibilities is most plausible is difficult to say, because the differences among transects are large. Although the two base transects at 300 m, which are the most similar transects in habitat and environment, have 20 species in common. This is 31 and 32 % of the total number of species recorded on each transect and not a very large difference in species composition. Species richness will still increase but probably level off after a few more transects are installed.

5.3.2. Aspect and altitude

In hilly or mountainous areas altitude and aspect are strong arranging forces determining species distributions. On Mt Mitra only the force of altitude could not be assessed, as the opposing slope has not been sampled. But the force of altitude is apparent. There are two

basic groups: more common species (see table below) and altitude endemics (see appendix 1).

Among the common species, altitude is the principle force causing a gradient in species composition from bottom to summit. At one end of the gradient are species likely to be restricted to the bottom such as *Cyrtogonone argentea*, and at the other end species likely to be restricted to the summit like *Xylopia rubescens* with intermediate species in between like *Santiria trimeria*, which are unaffected by altitude. The second group of species (74 %) consists of species which are restricted to one transect or altitude. Several of these altitude restricted species may turn out to be more common due to the low number of transects.

5.2.3. Endemism and species turnover

The level of endemism (defined here as species restricted to a single transect in this study) is high partially due to the small number of transects which overestimates endemism. More species may turn out to be less restricted as concluded from this data when more transects are put in along these slopes. This would also change the size of the common group, as they will become larger at the expense of the group of endemics. Endemism is highest at the top (77%) and gradually decreases towards the base (44%). It is curious to see that the forest at the summit is most unique in species (endemics) but is also the species poorest. Comparing the two 300m transects gives an idea of species turnover with distance (beta-diversity). These two transects differ from each other by roughly 2/3 of their species composition which is high considering that they are only one km apart from each other. Another interesting observation is the find of *Korupodendron songweneanum* previously endemic to Korup National Park, recently it was found in the Monts de Cristal (Sunderland *et al*., 2004) and now also in between in Monte Mitra.

5.3. Conclusions

Prior to this biodiversity assessment, Monte Mitra was identified as a potentially species rich area. The assessment has shown for the first time that biodiversity and endemism are not only high, but exceptional. Endemism ranged from 47 to a very high 78%. Most of the biodiversity recorded is represented by endemic species at the higher altitudes, which supports the unique character of this mountainous area. Several new collections mirror this uniqueness including the new record for Rio Muni of *Pseudagrostistachys africana*, a high altitude species (above 1000m) and *Korupodendron songweneanum*. Botanical collections also promise a few potentially new species including at least one new *Scaphopetalum* (Sterculiaceae). The analysis has indisputably shown that altitude is an important arranging force in this mountainous area. Therefore, it would be interesting and imperative to see whether biodiversity and endemism continues along nearby slopes. This area is especially important for conservation as new endemic species have been found and which are susceptible to permanent extinction by any form of human disturbance.

Appendix 1. Altitude endemics

species	300m	species	300m	species	500m
Tricalysia macrophylla	2	Afrostyrax kamerunensis	1	Dacryodes edulis	4
Alstonia boonei	1	Allanblackia floribunda	1	Afrostryx lepidophyllum	1
Anisophyllea 5d	2	Allophyllus cobbe	1	Anisophyllea polyneura	1
Anisophyllea myristica	2	Cleistanthus 4c	3	Chrysobalanaceae 2d	1
Annonidium 5d	1	Cola ficifolia	1	Chrysophyllum africana	1
Anopixis klaineana	1	Diospyros 4a	2	Cola 2b	2
Baphia 5b	1	Diospyros 4a2	1	Cola 2c	1
Dacryodes macrophylla	2	Diospyros 4d	1	Cola altisima	2
Daniellia klaineana	1	Diospyros spp 2	1	Croton 2d	1
Dicranolepis distachis	1	Drypetes 4a	1	Diospyros 2b	1
Drypetes 5c	1	Drypetes 4c	1	Diospyros 2b2	1
Drypetes arborescens	1	Drypetes 4d	1	Diospyros spp	1
Duquetia staudtii	1	Homalium letestui	1	Drypetes 2a	3
Euph 5d	1	Napoleanea vogelii	1	Drypetes 2b	1
Gilbertiodendron ogoouensis	1	Ochnaceae 4d	1	Drypetes 2d	1
Irvingia gabonensis	2	Ochtocosmus africana	1	Drypetes 2d2	1
Lovoa trichiloides	2	Plagiostyles africana	1	Drypetes spp	1
Mamea africana	1	Prioria joveri	1	Enantia chlorantha	1
Newtonia griffionia	1	Rothmannia spp (Rub 4d)	1	Eriocoelum 2b	1
Ochtocosmus 5a	1	Soyauxia 4a	3	Euphorbia 2a	1
Odyendia gabonensis	3	Staudtia gabonensis	1	Euphorbia 2a2	1
Pancovia pedicellaris	1	Strephonema 4b	1	Garcinia mannii	3
Pycnanthus angolense	2	Syzygium 4a	1	Hymenostegia 2d	1
Rhabdophyllum 5a	1	Trichilia tessmannii	1	Korupodenderon sogweneanum	1
Strephonema sericeum	2	Trichoscypha 4a	1	Lecomtadoxa heitziana	2
Treculia africana	1	Trichoscypha 4b	1	Pauridiantha callicarpoides	2
Trichilia 5d	1	Vitex grandifolia	1	Piptadeniastrum africana	1
Warneckia 5c	1	Warneckia 4b	1	Plagiosiphon gabonensis	2
Xylopia staudtii	1			Sapindaceae spp	1
				Sapium ellipticus	1
				Soyauxia floribunda	1
				spp 2a	2
				Strephonema 2d	1
				Strephonema pseudocola	1
				Trichilia 2b	1
				Trichilia welwitschii	1
				Zanthoxyllum heitzii	3

species	700m
Anisophyllea 3a	1
Anisophyllea 3c	3
Anonaceae 3a	2
Anthonotha 3a	6
Anthonotha accuminata	3
Aphanocalyx microphy	1
Beilschiedia 3d	1
Berlinia 3a	1
Caes 3c	1
Cola 3a	2
Cola 3c	1
Dacryodes 3b	4
Dactyladenia laevis	2
Diospyros 3c	1
Diospyros 3d	2
Drypetes 3?	1
Drypetes 3a	1
Drypetes 3a2	1
Drypetes 3d	1
Drypetes spp 2	1
Erismadelphus excul	2
Euph 3b	2
Euph waka	1
Grewia coreacea	1
Isolona 3c	1
Maesobotrya 3c	1
Maesobotrya 3b	1
Maesobotrya 3b2	1
Marypsis 3d	2
Memecylon 3d	1
Rhabdophyllum 3d	1
Rub 3c	1
Rub 3c2	1
Rub 3c3	1
Souyauxia grandifolia	2
Trichoscypha eugong	2
Uapaca staudtii	1
Warneckia 3c	2
Warneckia 3d	1

species	700m
Amanoa strobilacea	1
Anthonotha lamprophylla	1
Carapa 1c	1
Dactyladenia 1d	1
Drypetes 1d	2
Duquetia 1b	2
Garcinia 1c	1
Garcinia 1d	2
Manilkara 1b	3
Memecylon 1c	1
Ochtocosmus 1b	1
Pentadesma grandifolia	39
Pseudagrostistachys africana	1
Psychotria 1a	5
Psychotria 820	1
Rub 1a	3
Sapotaceae 1b	1
Sapotaceae 809	1
Syzygium 1a	9
Syzygium 1a2	5
Trichoscypha 1b	1
Uapaca 1d	5
Warneckia 1c	1
Xylopia rubescens	12

Appendix 2. Common species along the eastern slopes of Monte Mitra

Species	300m	300m	500m	700m	1000m
Garcinia 3a2	1			1	
Scytopetalum klaineanum	1			1	
Symphonia globuliflora	2			2	
Sorindeia	3			1	
Strombosiopsis tetandra	4			2	
Dialium 4a	1	2			
Xylopia quintasii	1	2			
Cyrtogonone argentea	1	1			
Drypetes moulunduana	1	1			
Hymenostegia pellegrinii	1	1			
Klaineanthus gaboniae	3	2			
Dacryodes 4b	2	1			
Aptandra zenkeri	3	1			
Centroplacus glaucinus	3	1			
Garcinia 4a	3	1			
Greenwayodendron suaveolens	4	3			
Coula edulis	1	1	1		
Diogea zenkeri	3	3	2		
Oubangia africana	1	10	1		
Bridelia atroviridis	1		1		
Octoknema affinis	3		2		
Berlinia congolensis	1		1	5	
Coelocaryon preusii	1		1	4	
Scaphopetalum blackii	9		3	1	
Dacryodes klaineana	3	1		2	
Heisteria parvifolia	3	1		2	
Dichostemma glaucescens	10	11	7	17	
Garcinia smeathmannii	1	3		4	1
Santiria trimeria	5	6	4	2	4
Plagiosiphon emarginatus		5	1		
Cleistanthus 2a		2	2		
Pausinystalia macrocera		2	1		
Caloncoba glauca		1	1		
Diospyros melocarpa		1	1		
Heisteria trillesiana		1	1		
Hylodendron gabonensis		1	1		
Strombosia pustulata		3	1		
Strombosia grandifolia			3	3	
Piptostigma glabrescens			1	3	
Vepris spp			1	2	
Chrysophyllum boukokou			1	1	
Calpocalyx 2c			2	1	
Eriocoelum petiolare			2	1	
Rhabdophyllum biseratum			1	1	
Xylopia aethiopica			1	1	
Tetraberlinia bifoliolata		3	4	5	
Strombosia scheffleri		2	2	3	
Anisophyllea purpurescens		1	2	5	
Dialium pachyphyllum		1	3	2	
Garcinia 3a		2		3	
Drypetes gross feullies		1		1	
Coffea 1d			1		1
Trichoscypha 1c				1	3
Scytopetalum 1a			1		6
Pellegriniodendron diphyllum	1	1			17
Garcinia conraunana		1			48

6. QUANTITATIVE VEGETATION ASSESSMENT OF THE MONTE MITRA FOREST USING 1 HECTARE BIODIVERSITY PLOTS (BDP's)

Michael P.B. Balinga, Yves A. Issembe, Terry C.H. Sunderland, Thomas Nzabi, Diosdado Obiang & Raoul Nyangadouma

6.1 Introduction

As part of an on-going assessment of the vegetation of the Congo Basin a network of permanent biodiversity plots are being established throughout the region. These plots not only provide a means of assessing the diversity and structure of vegetation, but also provide baseline information for future forest monitoring. As they are of standard design, 1 ha (or 100m x 100m) these plots allow for direct comparisons both within and between sites. To date, 33 of these plots have been established in a number of landscapes within Central Africa. This report presents the preliminary findings from the analysis of information collected during the establishment of three biodiversity plots at Monte Mitra within the Monte Alen National Park.

6.2. Materials and methods

6.2.1. Plot establishment

The standardised methodology for the establishment of permanent BDP's follows that of Dallmeier (1990). In the one-hectare configuration used for SI/MAB 1ha BDP's, the area is first geo-referenced using a GPS. Normally the area is then surveyed in a horizontal plane using a compass, tape and clinometer. However, for the purposes of this fieldwork a laser range finder was used in the establishment of permanent plots. This equipment calculates distance, angle and corrects for slope and, in forest with relatively undeveloped understorey and, once the use of the range finder is mastered, is an extremely efficient means of laying out a plot.

During the establishment, the one-hectare plot is divided into 25 quadrats, each 20 x 20 meters in size. It should be noted that, generally, 20 meters is the longest distance that can be accurately surveyed in dense forest. All the quadrat corners are marked with stakes topped with flagging tape marked with the distance from the baseline.

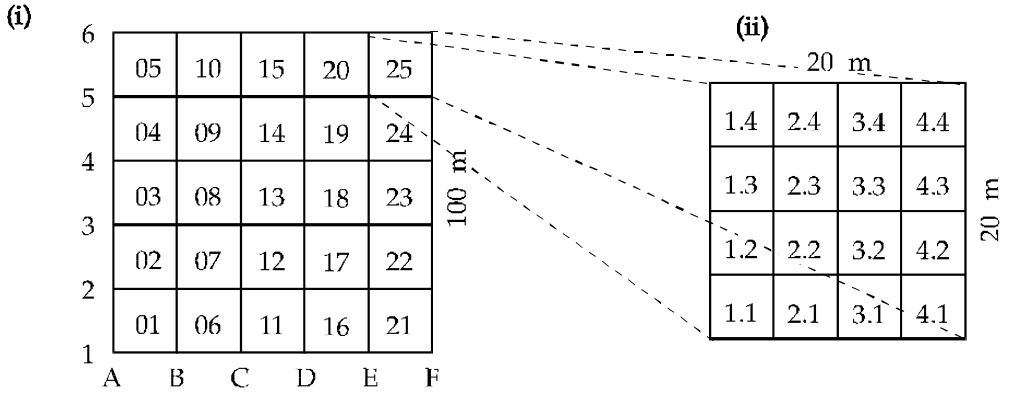


Figure 11: One hectare Biodiversity Plot (BDP) layout

6.2.2. Tree enumeration

Tree tagging and identification begins as soon as the corner stakes of the quadrats are set. The process includes locating all trees with a diameter 10 centimetres in diameter at breast height (dbh), then measuring, marking and identifying the species; these specific activities are elaborated upon below. During the enumeration process, a team of three to five individuals walks the quadrat, starting at the left corner baseline and moving in concentric clockwise circles of decreasing size, ending in the centre of the quadrat in order to systematically encounter and record all trees of appropriate size.

All trees >10cm diameter at breast height (dbh) are measured. The dbh is measured with a diametric tape at approximately 1.3m, avoiding any protrusions or lianas growing on the trunk. Trees with stilt roots and buttresses are measured at the lowest point at which the diameter of the bole can be accurately measured without the influence of these additional protuberances. Measuring above buttress and stilt roots often requires the use of a skilled tree climber. The measurement of trees above the dbh point is known as the diameter at reference height (drh). The point of measurement is marked with an "X" with the sharp point of the dbh tape. At this exact point, a ring is then painted around the tree. This marking ensures that future measurements of the same tree are taken at exactly the same point.

Plate 24 Measuring diameter at reference height (© T.C.H. Sunderland)

Plate 25. Tagged and painted tree (© T.C.H. Sunderland)

Each individual tree is tagged with a different number consisting of a sequence of three double digits. Using (01-24-09) as an example, the first two numbers (01) corresponds to the one-hectare plot within the zone, second pair (24) identifies the number of the quadrat and the last two numbers (09) represent an individual tree within the quadrat. No other tree receives this unique number. The tree numbers start at 1 in each quadrat and continue until the last tree is

labelled. Prior to all trees being permanently tagged with aluminium labels a temporary ribbon is tied to each tree with the number written in indelible ink. Once aluminium labels are produced with the correct numbers, they are nailed to the tree 10cm above the point of measurement, and as marked by the ring of paint on the trunk. The aluminium label faces outwards and is oriented toward the baseline of the plot. The nail is driven to angle down and just far enough in so that it will not fall out when pulled or when bark falls off, leaving enough room for the tree to grow before "eating" the tag.

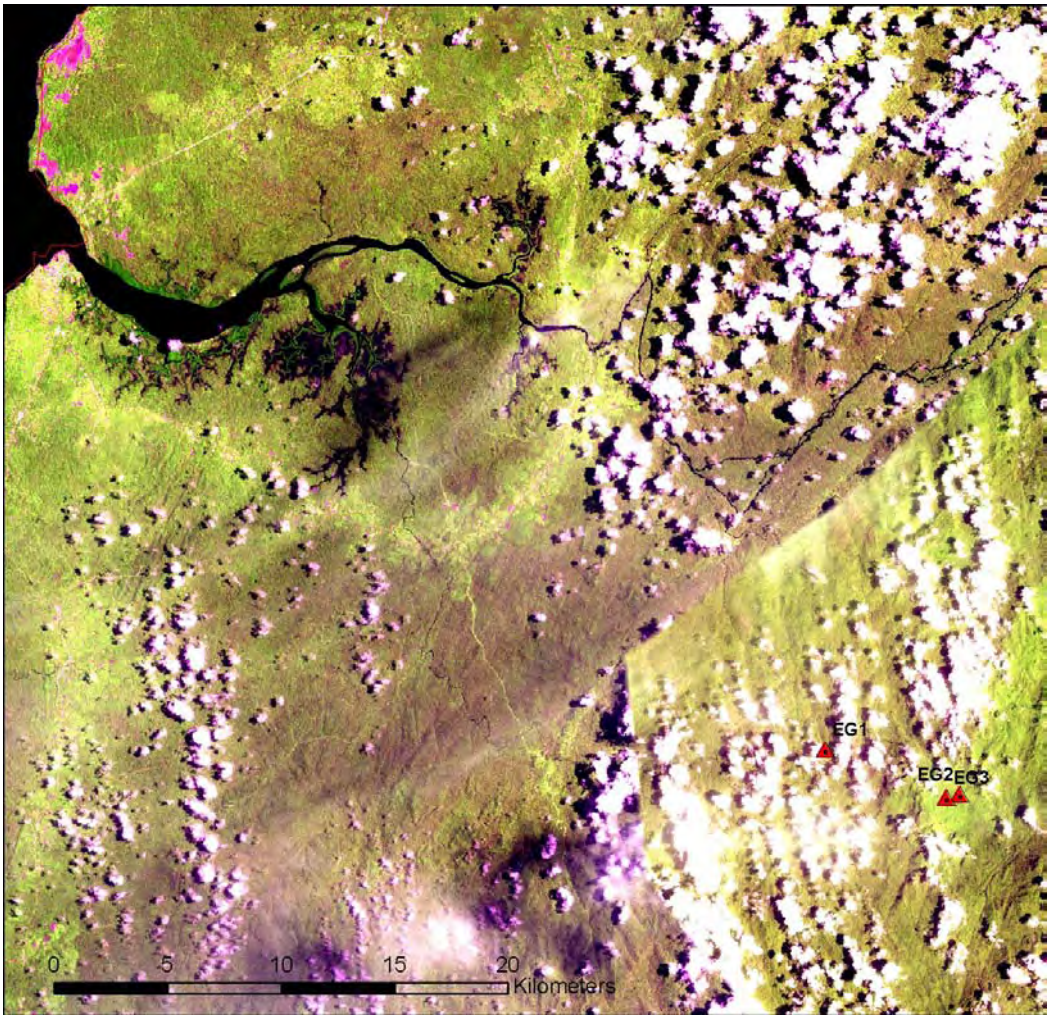


Figure 12. Location of the 3 Biodiversity Plots in Monte Mitra overlain on a satellite image of the area (map generated by Dan Slayback)

As far as possible, individual trees within each BDP are identified in the field often using bark and slash characters. However, to verify the field determinations, voucher specimens are collected for each taxon encountered, whether the species has been identified with confidence or not. For problematic genera such as *Drypetes, Diospyros, Memecylon* and *Bielschmeidia*, all individuals encountered were vouchered. Unidentified species were sorted into "morphospecies" and at least one voucher was collected for each. The use of a tree climber greatly facilitated access to the forest canopy and ensured that very few, if any individual species were not represented in the voucher collections. The specimens are preserved in the field using a portable aluminium field dryer with kerosene stoves providing the heat source.

During the plot enumeration, more than 150 vouchers, the majority of which were sterile, were collected. The first set of these vouchers were deposited at the INDEFOR herbarium with an additional set going for determination at the Herbier National du Gabon in Libreville. As with all CARPE-supported activities in the Congo Basin implemented by SI and MBG, duplicates of these vouchers will be kept in a sterile voucher collection at MBG and will be entered onto the TROPICOS database. This database provides taxonomic, ecological and geographical information on each accession and can be accessed via the internet (http://mobot.mobot.org/W3T/Search/vast.html).
Undetermined plants will be sent to family specialists to complete the identification process and identify potential new species.

6.2.3. Data analysis

The Smithsonian Institution's Monitoring and Assessment of Biodiversity Programme (SI/MAB) has developed a Windows driven computer programme that manages and analyses data collected on the 1ha BDP's. BIOMON[1] undertakes basic assessments based calculations of species numbers, frequencies, basal areas and mean dbh as well as on species "importance value index" (IVI) i.e. species with the highest IVI are referred to as the most "important" at that site. The IVI is calculated as follows:

$$\text{Relative density} = \frac{\text{Number of individuals of a species} \times 100}{\text{Total number of individuals of all species}}$$

$$\text{Relative dominance} = \frac{\text{Total basal area of the species} \times 100}{\text{Total basal area of all species}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of species} \times 100}{\text{Sum of all frequencies}}$$

Frequency = Number of quadrats in which a species is found.

Cover value index (CVI) = Relative density + Relative dominance.

Important value index (IVI) = CVI + Relative frequency.

[1] BIOMON can be downloaded at www.si.edu/simab

6.3. Summary of results

6.3.1. Species composition

A total of 1,605 individual trees above 10cm dbh were identified, belonging to 194 species, 128 genera and 42 families. The trees had a cumulative mean dbh of 27.18cm, and mean basal area (BA) of 31.12m^2/ha.

Table 5. Summary of plot data from Monte Mitra

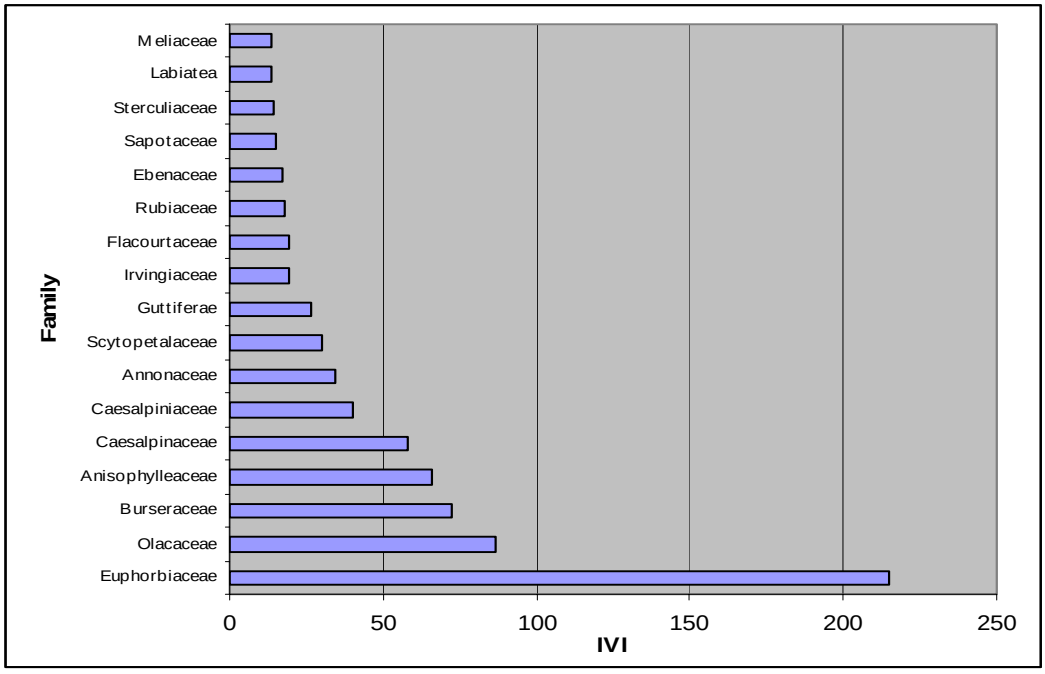
	# families	# genera	# species	# trees	# stems	Mean dbh (cm)	Total BA (m^2)	Altitude (m)
Plot 1	34	88	122	434	437	29.12	29.11	382
Plot 2	32	70	89	632	649	24.25	29.97	485
Plot 3	31	77	109	539	550	28.17	34.28	548
Mean	32.33	78.33	106.67	535	545.33	27.18	31.12	

In terms of family importance, the Euphorbiacea exhibits the greatest species diversity, followed by the Caesalpiniaceae and the Rubiaceae. When the family importance is calculated in terms of cumulative IVI, the Euphorbiaceae is again by far the dominant family within the study site due to the presence of high densities of *Uapaca spp.*.

Table 5. Summary of number of species per family

Familly	Number of species
Euphorbiaceae	29
Caesalpiniaceae	20
Rubiaceae	12
Annonaceae	11
Olacaceae	10
Anisophylleaceae	6
Burseraceae	6
Meliaceae	6
Sapotaceae	6
Ebenaceae	5
Flacourtaceae	5
Guttiferae	5
Chrysobalanaceae	4
Melastomataceae	4
Mimosaceae	4
Rutaceae	4
Sapindaceae	4
Steculiaceae	4

Figure 13. Family importance when calculated by IVI



Having retained the Importance Value Index as the primary means of comparison between the sites surveyed, the following graphs present results of the ten most important species within each plot.

Figure 14. Most important species in terms of IVI in Plot 1

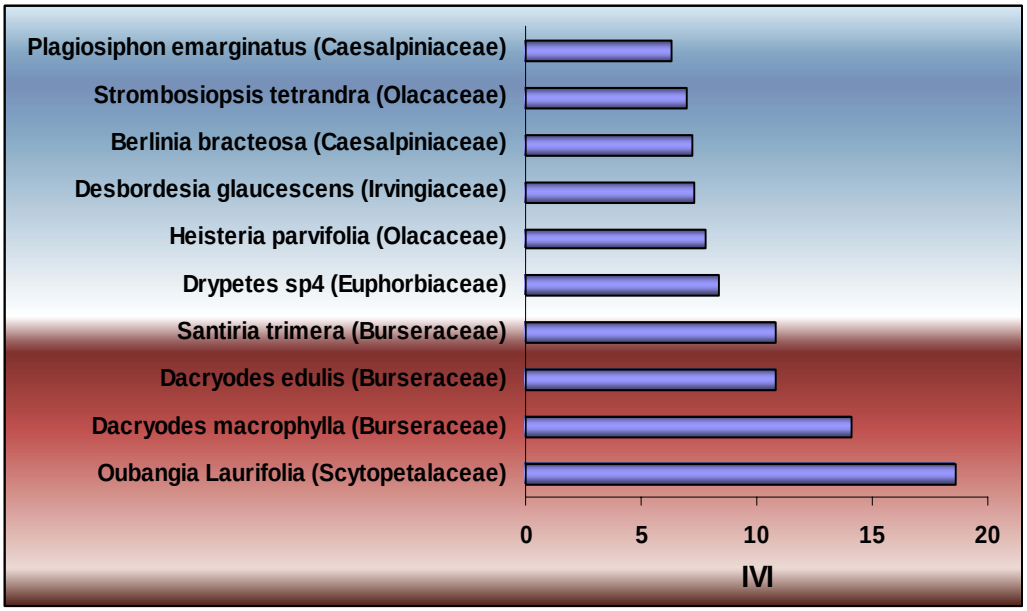


Figure 15. Most important species in terms of IVI in Plot 2

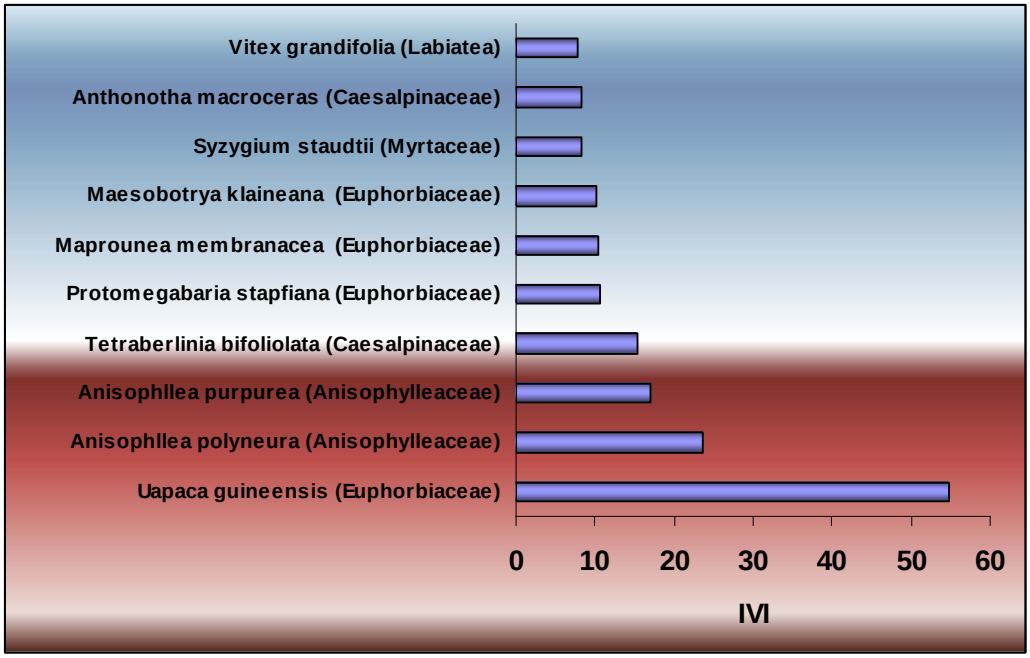
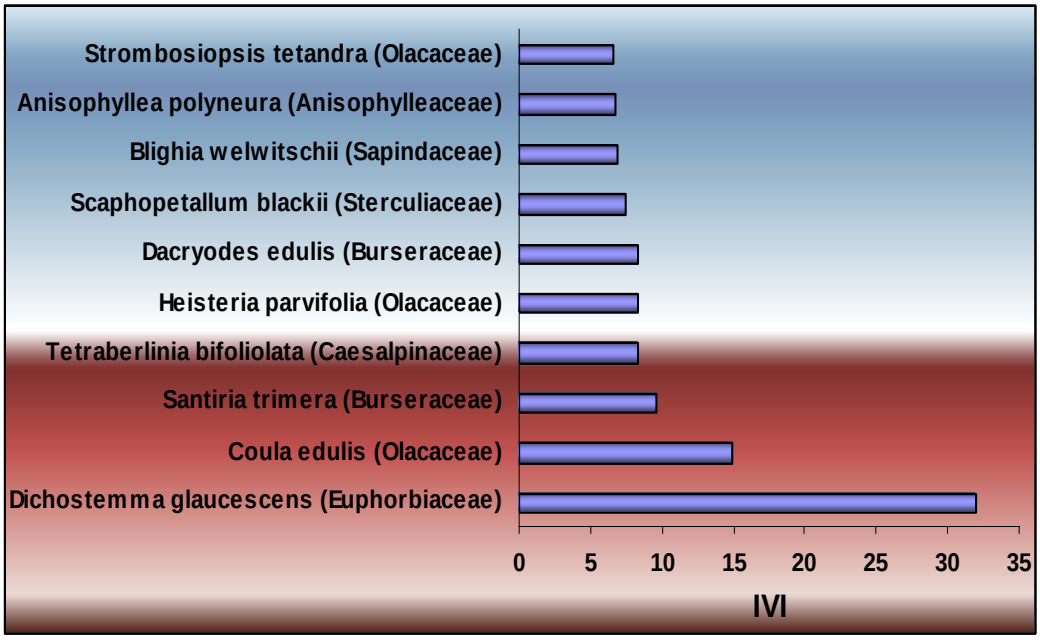


Figure 16. Most important species in terms of IVI in Plot 3



Generally the most common species observed across the three plots are representatives of the Euophorbiaceae, Burseraceae and Caesalpiniaceae. There is however a clear change in IVI importance across the three plots with *Oubangia laurifolia* (Scytopetalaceae), *Dacryodes macrocera*, and *Dacryodes edulis* (Burseraceae) dominating Plot 1, *Uapaca guineensis* (Euphorbiaceae), *Anisophyllea polyneura* and *Anisophyllea purpurea* (Anisophylleaceae)

dominating Plot 2 and *Dichostema glaucescens* (Euphorbiaceae), *Coula edulis* (Olacaceae), and *Santiria trimera* (Bursearaceae) dominating plot 3. This would reflect a clear change in micro habitat factors such as altitude, drainage, rainfall, slope, substrate, etc.

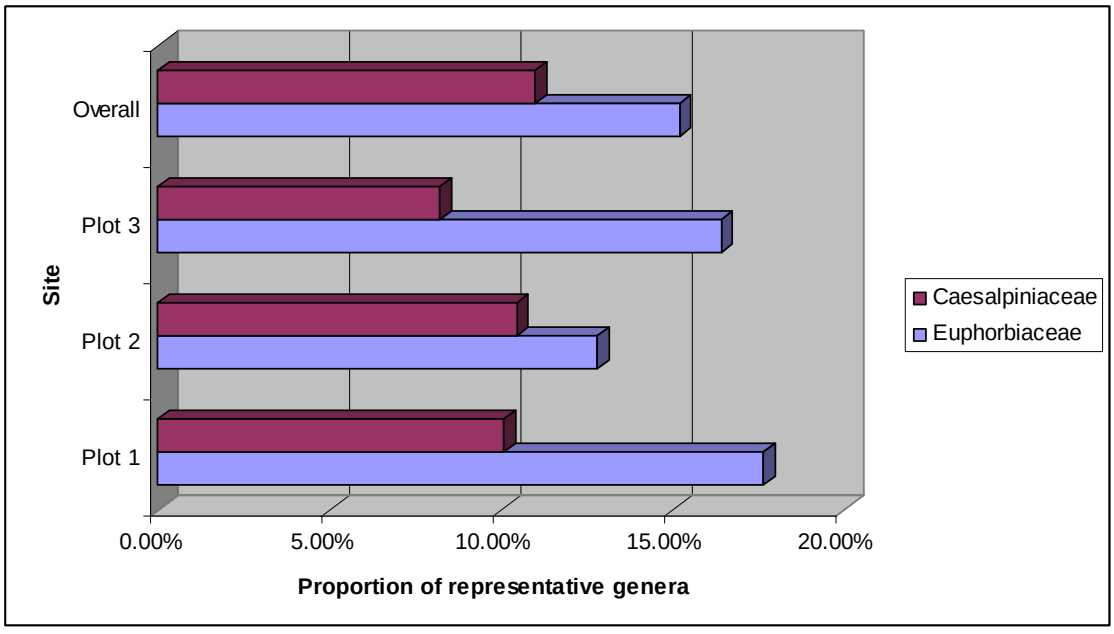
Considering the ten most represented families in terms of the number of occurring genera per family, the forests around Monte Mitra are dominated by Euphorbiaceae (15%) and Caesalpiniaceae (11%). This is true both at both site and plot levels.

Beyond these two families, the overall picture presents relative abundance of Rubiaceae, Annonaceae, Olacaceae and Anisophylleaceae in that order. A detailed look at the plot data however shows that there are certain variations in the frequency of occurrence of these families due to the influence of altitude, humidity, slope, or soil substrate. These gradients were of course reflected in each of the different plots as described in the choice of plot location.

With the exception of Plot 2, Euphorbiaceae, Caesalpiniaceae and Olacaceae respectively seem to be the dominant families. In Plot 2 which had a high humidity influence, relatively flat micro-topography, and less rocky substrate compared o the other two plots. In this plot other families such as Anisophylleaceae seem to occur more readily.

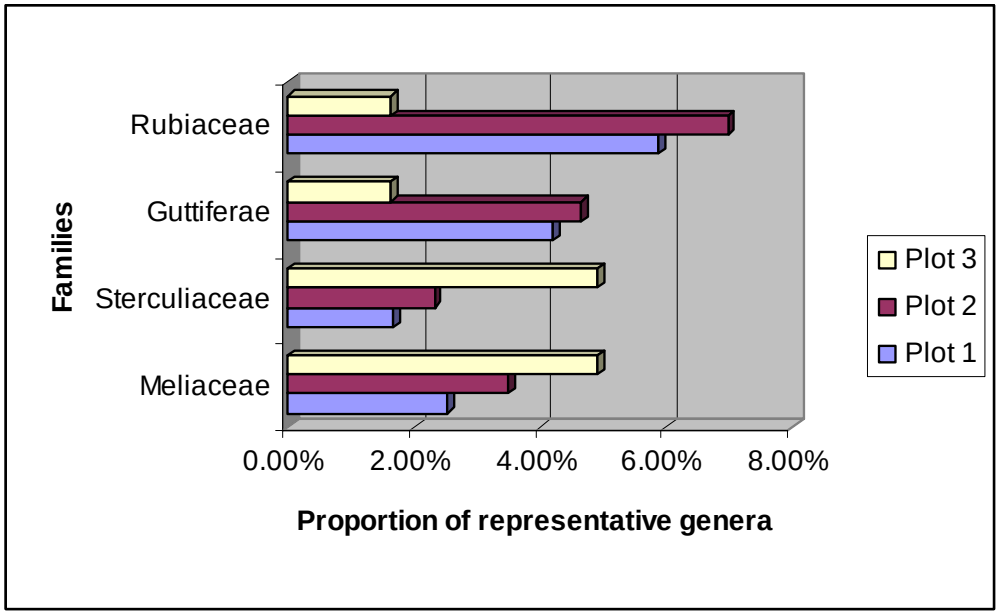
The proportion of genera of the Caesalpiniaceae remains relatively stable across the three altitudinal levels observed indicating that this family does not respond readily to the influence of the factors considered. On the other hand the family Euphorbiaceae shows greater variation being much more represented at the lowest and highest altitudes. By implication altitude does not seem to be the major factor influencing its proportions but rather humidity, slope or substrate.

Figure 17. Family importance for Caesalpinaceae and Euphorbiaceae by constituent genera



Rubiaceae and Guttifereae seem to occur much less above 500m altitude whereas Meliaceae and Sterculiaceae seem to appear more often at that altitude.

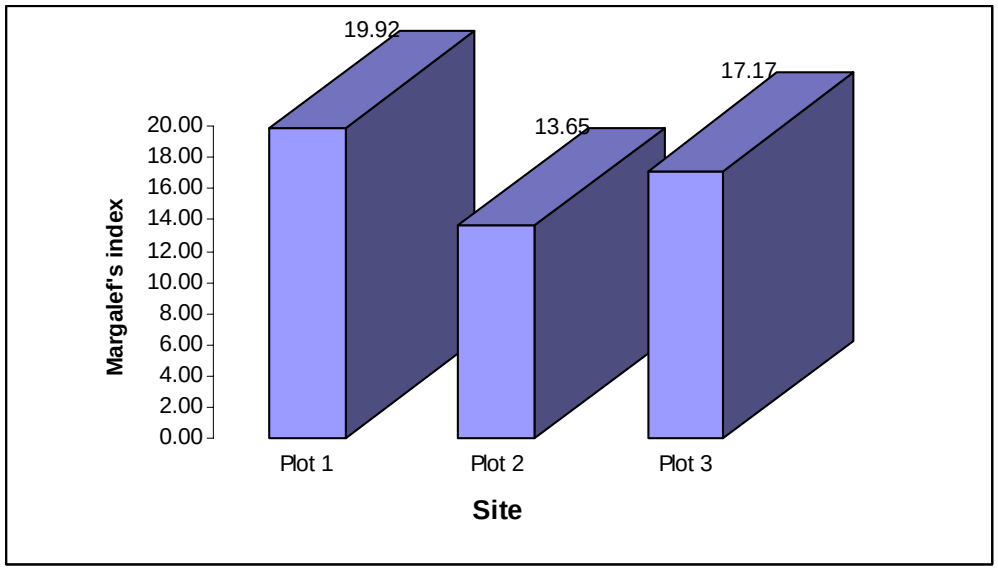
Figure 18. Family importance by constituent genera for Rubiaceae, Guttiferae, Sterculiaceae and Meliaceae



6.3.2. Diversity indices

6.3.2.1. Species richness

Figure 19. Margalef's index (D)



6.3.2.2. Species diversity

Figure 20. Shannon's index (H)

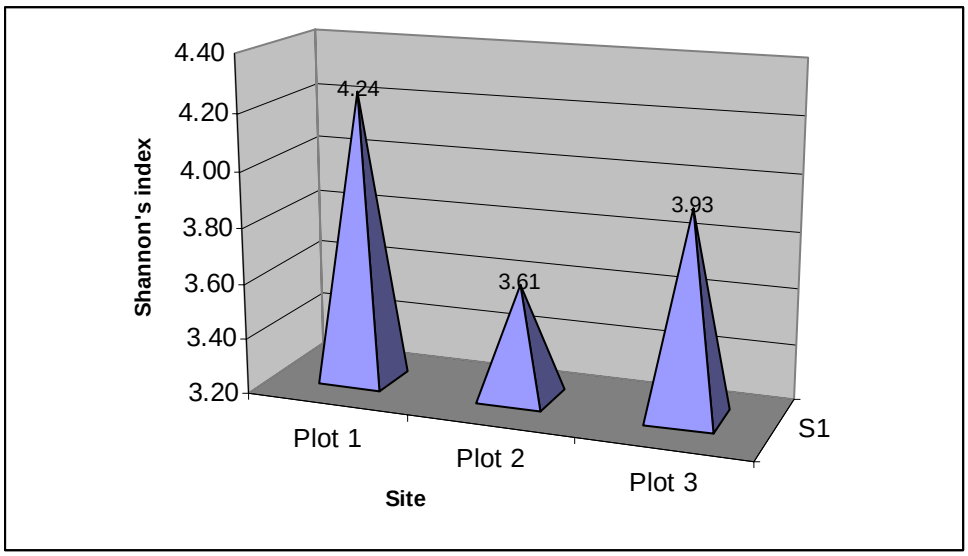
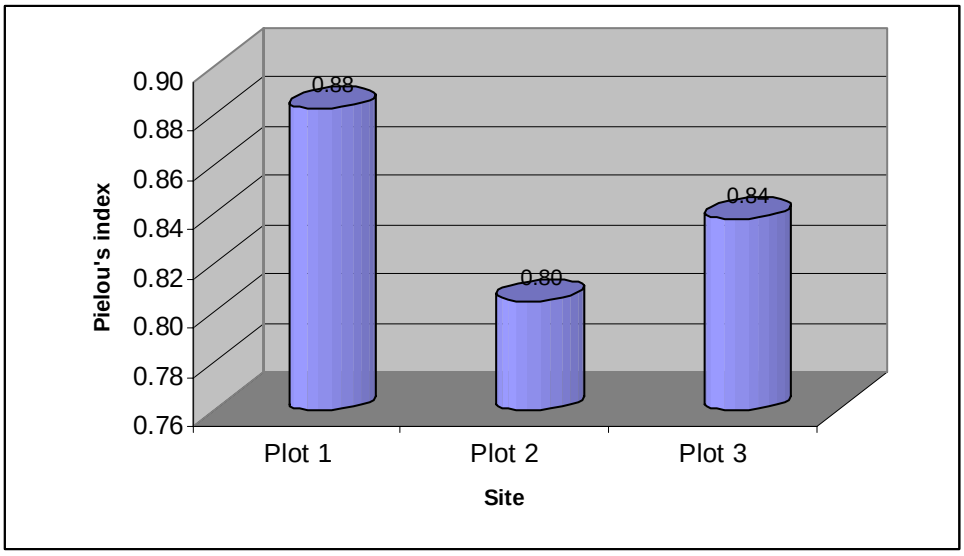


Figure 21. Pielou's Evenness



Comparing the diversity of the three plots assessed using Margalef, Shannon and Pielous' indices shows that without question Plot 1 is the richest, most diverse plot with the most even distribution of species across the plot. Conversely, Plot 2 is consistently last according to all three measures of diversity. It would have been expected that the altitudinal gradient might have resulted in a consequent and more or less stable variation in the species richness and composition. This is evidently not the case however, thus highlighting the influence of other factors such as slope, soil type and drainage, proportion of stones or rock formation relative to the horizontal area surveyed.

Plot 1 was noticed during the survey period to have the highest levels and frequency of rainfall thus favoring increased diversity and abundance. This was found to be true upon examining the results of the survey. Plots 2 and 3 with basically the same rainfall frequency were separated for the most part by the site characteristics, with Plot 2 being much more flat land suffering from poorer drainage. As a result the disappearance of certain species such as *Uapaca paludosa*, and visual and numeric abundance of *Uapaca guineensis* which emerges as the dominant species in Plot 2 although entirely absent in all other plots. On the contrary, Plot 3 exhibits steeper slopes, rocky terrain and good drainage favorable to other species hence greater opportunities for plant diversity in a milieu more favorable to different classes of trees with shallow or deeper rooting systems, lower flood tolerance, etc.

Plate 26. Forest dominated by *Uapaca guineensis* on Plot 2 (© T.C.H. Sunderland)

6.4. Discussion

The forests of Monte Mitra are largely dominated by the Euphorbiaceae irrespective of the evaluation criteria considered. Other very important families are the Caesalpiniaceae, Olacaceae and Bursearaceae respectively. Although altitudinal change showed a clear influence on most important species in terms of IVI it does not easily account for the distribution and proportions of the various genera across the different altitudinal levels considered. On the whole however, Plot 1 representing the lowest altitudinal level was found to be the most diverse and rich in species confirming that relatively low lying forests with greater frequency of rainfall tend to show higher species diversity and species richness.

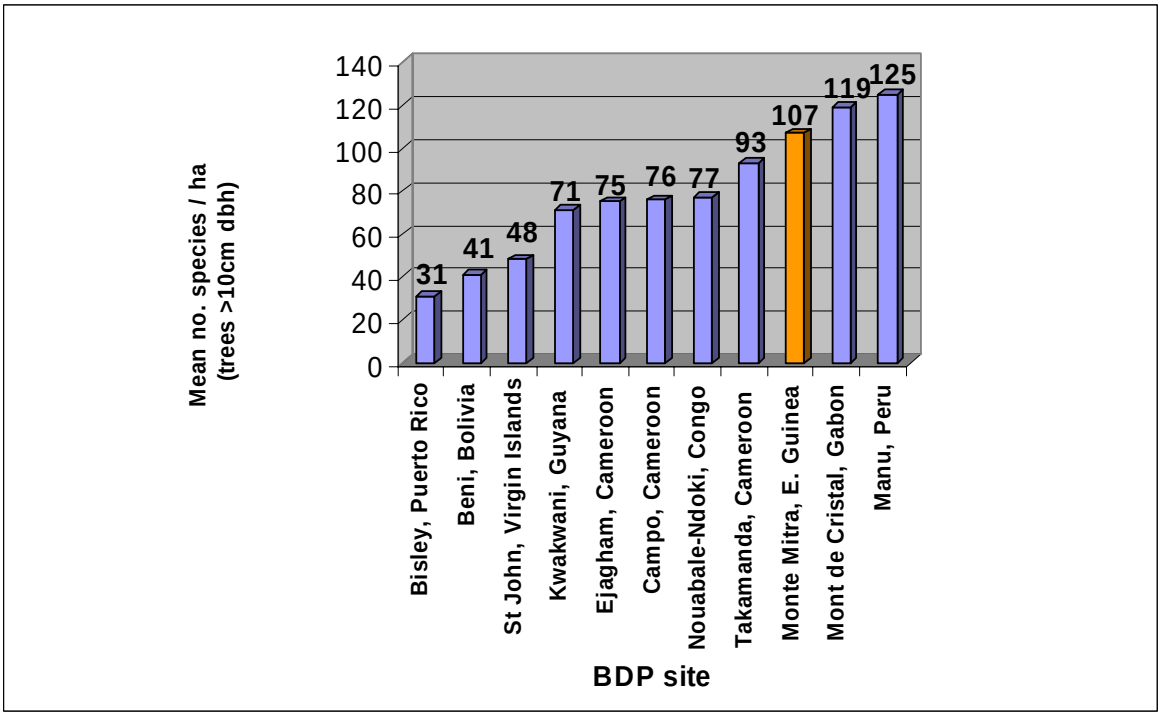
The forests of Monte Mitra are second only to Monts de Cristal (Gabon) in terms of mean number of trees, as well as mean number of species. Only in terms of mean total basal area are they relegated to third position by Campo in Cameroon.

Table 6. Summary of SI/MAB BDP's in Central Africa.

	Campo, Cameroon	Ejagham, Cameroon	NNNP & Buffer Zone Congo	Takamanda Cameroon	Monts de Cristal Gabon	Monte Mitra Equatorial Guinea
No. of plots	3	2	5	10	5	3
Mean no. of trees (min. dbh)	397 (>10cm)	525 (>10cm)	323 (>10cm)	463 (>10cm)	539 (10cm)	535 (>10cm)
Mean total BA (m^2/ha)	31.9	33.6	29.24	30.8	37.23	31.12
Mean no. of species/ha (standard deviation)	76 (4.04)	75 (6.36)	77 (2.63)	93 (16.54)	119 (8.71)	107 (16.62)

Once again as in the results obtained from other MAB network plots, it is confirmed that in the humid tropics with high rainfall covering a good proportion of the year, the species richness and diversity is comparatively high as opposed to the drier regions of the tropics.

Figure 22. Comparison between SI/MAB sites in the tropics in terms of mean number of species per hectare



6.5. Conclusion

The findings of this vegetation assessment supports the theory that the Pleistocene refugia of the Atlantic Equatorial Coastal forests are the greatest reservoirs of Africa's plant diversity. The Monte Mitra forest area, contiguous to the Monts de Cristal and comprising the transboundary CARPE Landscape show high levels of tree diversity. In terms of Monte Mitra, itself further sampling will surely increase the numbers of species recorded for the area.

The training and capacity building component of this field work will hopefully lead to the continuation of a more standardised and comparable approach to vegetation assessments throughout the Congo Basin and the data generated will provide the biological baseline data required for the monitoring of forests for both natural and anthropogenic processes, within the CARPE Landscapes. Furthermore, the collaboration of a regional team is critical to strengthen internal capacity to evaluate vegetation across the Congo Basin CARPE Landscapes. This is very important to note since conservation is acknowledged to be a cross boundary and regional issue.

With the integration of both the Monte Alen National Park to the Monts de Cristal within a single landscape a clear transboundary approach must be taken in the conservation of these highly diverse forest areas. The success of any such initiatives in both Equatorial Guinea and Gabon must be based on clear cross border collaboration and the sharing of scientific and institutional capacity.

7. MANAGEMENT ISSUES CONCERNING THE MONTE ALEN LANDSCAPE AND THE WIDER RIO MUNI REGION

Anthony C. Nchanji, Terry C.H. Sunderland, Miguel Leal & Nono Legrand Gonwouo

7.1. Introduction

This chapter summarizes the pertinent management issues concerning the conservation of the biodiversity of the Monte Mitra area within the Monte Alen National Park. The following is based on quantitative field assessments and qualitative observations and recommendations of the research team. A summary discussion of the wider biodiversity issues relating to the region, including the importance of biodiversity sanctuaries, is also included.

7.2. Recording human presence and threats

All signs of human presence were recorded by the wildlife research team as the census paths and recce transects were surveyed. These signs essentially include empty cartridge shell, wire snares, waste carbide from hunting lamps, hunting lines (indicated by cuts on vegetation), paths, felled logs or stumps, temporary or permanent hunting camps and abandoned logging equipment. The make and caliber of each cartridge shell encountered was noted and it was aged according to the following criteria:

- *Fresh*: looks new with strong gun-powder smell;
- *Recent*: looks new without gun-powder smell;
- *Old*: bronze part carries some rust, and;
- *Very old*; bronze part completely covered with rust or only the plastic remains.

Cable snares employ the use of a flexible sapling, armed with a wire loop, which is then bent down and attached to a trigger mechanism. Often hunting snares are accompanied by long line fences of comprised sticks which force an animal to follow the line until it reaches a gap in the fence. This gap is then primed with a cable snare. The cable used for wire snares consists of six units of six tiny wires entwined into a single roll; hunters use the wire whole or unravel the cable into individual units for different species or animal sizes anticipated. The age of cable snares can also be classified and we used the categories as follows:

- *New*: sticks used are new with fresh leaf litter covering snare;
- *Recent*: sticks and leaf litter covering snare are dry;
- *Old*: sticks used are dry and leaf litter covering snare is rotten;
- *Dead*: snare not in position or loosened and unable to capture or stick standing with wire cable destroyed (might have caught an animal).

Hunting camps encountered in the field were geo-referenced and assessed with particular attention to ownership (individual or communal), level of local agriculture (indicating how much habitation occurs in the site) and durability (i.e. whether they are made as constructed as permanent or temporary camps). Finally informal interviews and interpersonal discussions were conducted with 12 hunters opportunistically encountered to understand the hunting practices of the region.

Plate 27. Hunting camp within the Monte Alen National Park (© A. Nchanji)

7.3. Data Analysis

All human presence and sign recorded on the path and recce transects by the field teams were used to determine encounter rates (signs per kilometer) as the index of abundance. Other information was collated and expressed as percentages of occurrence in the sample.

Plate 28. Wire snares units used by hunters in Monte Mitra forest (© A. Nchanji)

7.4. Human activities and threats

7.4.1. Introduction

Various human signs were recorded in the Monte Mitra region and these indicated three main human activities;

- Hunting
- Previous logging
- Human access

There is a prominent path that links villages to the northwest of the park with those to the east. However, this access route is not in frequent use except for hunters. The presence of 18 abandoned metallic logging chains; all in an advanced state of rust and five logging roads in advanced secondary regrowth stage confirmed previous extensive logging in this forest. Despite this, the presence and continued utilization of hunting camps, wire snares, hunting trails and empty cartridge shells confirm active commercial hunting as the prevalent human activity in the Monte Mitra forest which is clearly detrimental to the conservation of the biodiversity contained within.

7.4.2. Hunting in the Monte Mitra region

Hunters in the Monte Mitra forest originate predominantly from the villages of Sendje, Binguru, Mitomo and Emangos to west and northwest of the park. These hunters undertake 4–5 day hunting expeditions to the Monte Mitra forest either in groups or individually and return on pre-arranged days (Mondays, Wednesdays or Fridays) to supply bushmeat to intermediate traders from Bata. In the forest the hunter(s) stay in hunting camps comprised of either large single huts or several smaller huts. Some hunters also stay in the abandoned ECOFAC camps. Hunting is undertaken both with shotguns and wire snares. The majority of the animals captured are smoked in the field but some are carried back to the villages fresh and sometimes alive. Unusually, hunters based at the hunting camps do not eat much of the meat themselves and restrict themselves to cook and eat the internal organs of animals captured or the offal is smoked and taken back to the villages for subsistence use. This is a clear indication that the majority of hunting is mainly commercial and concurs with the findings of Fa and Yuste (2001).

Sendje, west of the Park, is the principal hunting village well known for bushmeat extraction from the Monte Mitra forest (Fa and Yuste, 2001). Intermediate traders, predominantly women, routinely collect bushmeat at Sendje from hunters arriving from the Monte Mitra forest every Monday, Wednesday and Friday. These traders supply more than 70% of the bushmeat sold in the Bata markets.

7.4.2.1. Shotgun hunting

The field team observed 108 empty cartridge shells of the 15mm barrel shotgun type in 32.2km (an encounter rate of 3.4 shells/km). These were of two calibers with trade marks originating from four different countries; Cameroon, Congo Republic, Italy and Nigeria. The ammunition from Cameroon constituted about 47% and Nigeria 27% of the total. However, and most worryingly, 38.9% of the ammunition found is

specifically for hunting medium and large mammal species, originating from Italy, Congo and Cameroon, again confirming that large-scale commercial hunting involving a complex chain of custody is the main threat to the large mammals of the Monte Mitra area.

Table 7. The range of shotgun ammunition used for hunting in Monte Mitra

Ammunition	Manufacturer	Calibre*	Target game†	Number observed	Age			
					Fresh	Recent	Old	Very Old
FOB chase 32	Nigeria	1	S/M	27	3	7	9	8
MACC Grand chase	Congo Republic	2	M/L	21	3	2	9	7
ARMUCAM SG	Cameroon	2	M/L	12	-	-	6	6
Armurerie Ane-Cameroun 34DJ	Cameroon	1	S/M	39	4	17	10	8
Paliotto - SG	Italy	2	M/L	9	-	3	3	3
Total				**108**	**10**	**29**	**37**	**32**

* 1 = contains 20 – 34 bullets, 2 = contains 5 – 9 bullets † S/M = Small/Medium, M/B = Medium/Large

Plate 29: Empty shells of different shotgun ammunitions used for hunting in Monte Mitra (© A. Nchanji)

7.4.2.2. Wire Snare Hunting

The field team recorded 130 wire snares on 32.2 km of transect (an encounter rate of 4.04 wire snares/km). About 77% of these were new wire snares. 66% (n = 100) of the active wire snares were either newly or recently set but 93% (n = 30) of the dead wire snares were either old or very old. About 79% of new and active wire snares and 79.2% of total snares were 2 to 4 cable units.

Table 8. Distribution of wire snares recorded in Monte Mitra Forest

			Age category			
Snare proficiency	**Snare unit class**	**# in unit class**	**New**	**Recent**	**Old**	**Very Old**
Dead	1	5	-	-	3	2
	2	7	-	-	6	1
	3	11	1	-	6	4
	4	6	-	1	3	2
	5	1	-	-	-	1
	6	-	-	-	-	-
Sub total		***30***	***1***	***1***	***18***	***10***
Active	1	7	4	9	3	-
	2	25	3	9	13	-
	3	30	8	9	10	3
	4	24	4	9	7	3
	5	11	6	4	1	-
	6	3	-	1	2	-
Sub total		***100***	***25***	***41***	***36***	***6***
Grand total		**130**	**26**	**42**	**54**	**16**

Plate 30. Decomposing blue duiker (*Cephalophus monticola*) trapped in unchecked snare (© A. Nchanji)

The hunters in Monte Mitra forest have no limits to the number of wire snares each person sets in the forest; it is dependent on the individual's ability to inspect all active traps in a single foray. The hunters interviewed had a mean of 93 live and active wire snares in the forest at any one time. However, during each foray a hunter can expect to inspect 15 to 25 traps in a hunting day depending on the size of a hunters' individual catchment. These catchments vary in radius from 5 to12 km. Often, animals decompose on wire snares in cases of delayed inspections or when a hunter sets too many snares. The capture success of a wire snare could occur from between a single day to several months, therefore snares were sometimes forgotten and abandoned, leading to more wastage.

Table 9. Usual number of wire snares set by a sample of 12 hunters at Monte Mitra

Hunter number	Usual number of snares set
01	80
02	75
03	120
04	90
05	85
06	70
07	75
08	125
09	110
10	95
11	70
12	115
Mean	**93**

7.4.3. Crop raiding and elephant culling

As reported by Nchanji *et al*., (this volume) Monte Mitra exhibits a very high encounter rate for elephant signs and the villagers of Sendje reported constant crop raiding by elephants. Although, given the wide expanse of pristine forest within the Monte Alen National Park, it is not clear why elephants damage crops around the villages. However, the notable lack of fruiting tree species during the field work period was observed, and may be a potential reason why elephants are trying to locate alternative sources of food. Crop damage by elephants has become an important issue to such as extent that the government has recently undertaken "administrative killing" of two elephants close to village agricultural land. Crop damage by elephants is an issue that needs to be addressed urgently and this will entail studies of the of causes of elephant movements, seasonality in damage and levels of agricultural damage in the area before appropriate mitigation measures are taken rather than the current blind killing of elephants that the government has recently adopted.

Plate 31. Crop raiding by elephants (© A. Nchanji)

7.4.4. Collection of tortoises

Aside from the extensive hunting of large mammals the rate of collection of tortoises (*Kynixis erosa*), a protected species, is alarming. Twenty-three tortoises (15 females and 8 males) were collected by three hunters in 5 days. These tortoises are eaten locally and the scale of this exploitation is of particular conservation concern (see Gonwouo, this volume).

Plate 32. Tortoises (*Kynixis erosa*) collected by hunters in the Monte Mitra forest (© A. Nchanji)

7.4.5. Hunting of protected species

Aside from the tortoises described above, species protected by both National and International legislation are persistently hunted within the Monte Alen National Park. Many hunters do not distinguish between species in terms of whether they are protected or not and hence a wide range of species listed as protected are still hunted on a commercial basis to an extent that they are commonly recorded in the bushmeat markets of Sendje and Bata. The conservation of species protected by law should be a major priority in the management of the Monte Alen National Park

Plate 33. (left) Red-eared monkeys (*Cercopithecus erythrotis*) a species protected by National and International law, and classified by the IUCN as Endangered, are commonly hunted in the Monte Alen National Park, along with many other protected species (© T.C.H. Sunderland)

Plate 34. (below) Boundary marker (© A. Nchanji)

7.5. Conservation observations

Conservation activities in Equatorial Guinea are the responsibility of the government through INDEFOR, a para-statal organization within the Ministry of Agriculture. The boundary of Monte Alen National Park was recently delimited by INDEFOR and sign posts used to mark the boundaries, informing the public of restricted access have been erected. INDEFOR has some staff trained for conservation and has some education material on protected species of the country including those of the Monte Mitra forest. The Government of Equatorial Guinea through INDEFOR has a financial and technical agreement with Conservation International (CI), an international conservation NGO to promote conservation in the Monte Alen/Monts de Cristal

Landscape. There exists a financial and technical accord between CI and INDEFOR, but there are no CI technical staff in the field and INDEFOR staff appear to poorly resourced and motivated. INDEFOR are also paralyzed by an insufficient budgetary allocation from the Equato-Guinean government. These reasons account for the low-key conservation activities currently being undertaken in the Monte Mitra forest.

7.6. Wider conservation issues in Rio Muni: biodiversity sanctuaries

During the last ice age, 20,000 years ago, central Africa looked very much different from today. The vast tropical rain forest now covering central Africa had been reduced to several larger fragments, so-called forest refugia. Presently, these forest refugia lay hidden within the present-day rain forest.

One way to highlight them is by overlapping elevated areas with a relatively high rainfall (see below in green). This is however an estimation based on knowledge how the climate was during the last ice age. Since it is an estimation, these former forest refugia still have a postulated status. Therefore, it is important to verify their status in the field.

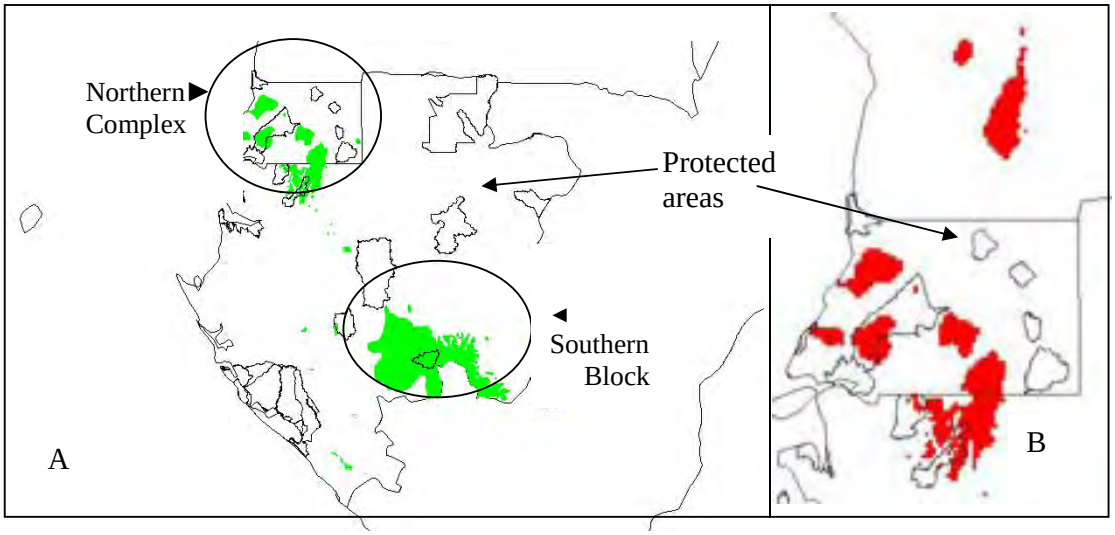


Figure 23. The West Central Africa (Southern Lower Guinea) showing the Pleistocene forest refuge landscape in green (A) and the Northern Complex in more detail in red (B) and the park system.

One of the indicators are the presence of so-called narrow endemics such as, for instance, the newly found *Scaphopetalum* species. Another example is the distribution of *Korupodendron songweanum*, which seems to overlap with the former Pleistocene forest landscape (Senterre and Obiang, 2005). Their presence and the data collected here confirm that Mount Mitra is a former forest refuge area and that conservation money, time and efforts are justified in the region. However, the detailed map of Equatorial Guinea (above B) also shows that some postulated forest refugia are situated in between the protected areas. The status of these areas should be verified, because these are potentially very valuable components of the present-day forest.

Another observation is the high concentration of postulated refuge areas in Equatorial Guinea, moreso than in adjacent Gabon. Gabon is known for its botanical richness, which is partially attributed to the presence of forest refuge areas. Accordingly, the high number of postulated refuge areas on mainland Equatorial Guinea (Rio Muni) could be potentially richer than Gabon. However, this baseline information is missing for Equatorial Guinea, since it does not have a formal descriptive flora, unlike Gabon or Cameroon.

7.7. Conclusion

Given the high levels of hunting in the Monte Alen National Park, and the Monte Mitra area in particular, the protection of large mammals is by far considered the most pressing conservation issue. It was suggested by INDEFOR that CI may further help in this activity by committing more of its financial assistance directly to conservation measures e.g. recruiting, equipping and paying of eco-guards to patrol the forest. Undeniably, the government of Equatorial Guinea needs to increase its commitment to conservation by increasing, or at the very least, making available current INDEFOR budgets ensuring that conservation measures for protected areas may be implemented. It has been mooted by INDEFOR that Conservation International should recruit technical field staff that will initiate and implement research and conservation activities in close collaboration with INDEFOR staff to improve national staff capacity to manage recognized protected areas, particularly within the Monte Alen/Monts de Cristal Landscape. In the wider context, much more emphasis needs to be given to the management of the excellent network of protected areas established, not only in Rio Muni but in the country as a whole.

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