Biotic Surveys of Bioko and Rio Muni, Equatorial Guinea

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

INTRODUCTION 5

PART I. BIOTIC SURVEYS OF RIO MUNI

Chapter 1. Bird and Mammal surveys of Rio Muni
- INTRODUCTION 9
- METHODS 9
- RESULTS
  - BIRD SURVEYS 16
  - MAMMAL SURVEYS 46
  - SOCIO-POLITICAL CONTEXT 51
- DISCUSSION 53

PART II. BIOTIC SURVEYS OF BIOKO

Chapter 2. Preliminary Report on a Survey of The Herpetofauna of Bioko, Equatorial Guinea
- INTRODUCTION 58
- METHODS 58
- RESULTS 58
- TENTATIVE CONCLUSIONS 60

Chapter 3. Arthropod surveys on Bioko, Equatorial Guinea
- INTRODUCTION 62
- METHODS 62
- RESULTS
  - FLIES (DIPTERA) 63
  - CARABID BEETLES (CARABIDAE) 64
  - SPIDERS (ARANEAE) 65
- DISCUSSION OF TARGET TAXA 112
- CONSERVATION IMPORTANCE OF BIOKO 114

PART III. BIOGEOGRAPHY

Chapter 4. Comparative avian phylogeography of Cameroon andEquatorial Guinea mountains: implications for conservation
INTRODUCTION 115
METHODS 116
RESULTS
PHYLOGEOGRAPHIC PATTERNS 120
PHYLOGENETIC DIVERSITY ANALYSIS 121
GEOGRAPHIC PATTERNS OF ENDEMISM 123
DISCUSSION 125

PART IV. ANNOTATED BIBLIOGRAPHY
GENERAL 129
FLORA
ALGAE 129
PLANTS 129
FAUNA
PROTISTS 135
INVERTEBRATES 135
Gastropods
Arthropods
VERTEBRATES 138
Fish
Herpetofauna
Birds
Mammals
CONSERVATION ISSUES 151

PART V. CONSERVATION RECOMMENDATIONS 155

EXECUTIVE SUMMARY

Biotic surveys and a comprehensive literature review were undertaken to improve our knowledge of the biodiversity of Bioko and mainland Equatorial Guinea. Bird and mammal surveys were conducted on the mainland, and herpetological and arthropod surveys on Bioko, providing new information on species distributions and abundance. On the mainland, five areas within the proposed preserve system for Equatorial Guinea; Reserva Natural de Rio Campo, Parque Nacional de Los Altos de Nsork, Parque Nacional de Monte Alen (including Montes Mitra), and Reserva Natural del Estuario del Muni, were examined. On Bioko, the two proposed reserve areas, Parque Nacional de Pico Basilé Reserva Científica de la Caldera de Luba, as well as some lowland areas near Luba were examined. Additionally, genetic data were gathered for birds, and combined with previous data from Cameroon, to assess patterns of genetic differentiation within and across mountains in Cameroon and Bioko.

We recorded only one species of bird (*Malimbus scutatus*) that had not been previously reported for mainland Equatorial Guinea, and no new mammals. However, valuable new information on bird and mammal distributions within Rio Muni are presented. In addition, several species and one genus of amphibians were recorded on Bioko for the first time. Approximately a third of the arthropods, including 372 species of spiders were previously unrecorded, and many are unidentifiable from the literature and may be new species. At least three endemic species of Carabid beetles were also discovered. Conservation implications are discussed in each chapter, and in a separate section (Part V) devoted to conservation recommendations. Conservation actions we recommend include:

1) Maximize protection of regions with high numbers of endemic species (Mountains/Bioko)
2) Preserve elevational gradients whenever possible
3) Create a network of preserves representing different habitat types and climatic zones, as proposed by C.U.R.E.F.
4) Increase conservation education and develop sustainable alternatives to hunting and logging.

Thirteen areas have been proposed for conservation by Proyecto Conservacion Utilizacion Racional de los Ecosystemas Forestales des Guinea Equatorial (C.U.R.E.F.). These include two on Bioko, Parque Nacional de Pico Basilé and Reserva Científica de la Caldera de Luba; Nine on the mainland, Parque Nacional de Monte Alen (including Montes Mitra), Reserva Natural del Estuario del Muni, Parque Nacional de Los Altos de Nsork, Reserva Natural de Rio Campo, Reserva Natural de Monte Timeline, Monumento Natural de Piedra Bere, Monumento Natural de Piedra Nzas, Reserva Natural de Punta Llende, Reserva Científica de Playa Nendyi; one comprised of offshore islands, Reserva Natural de Corisco y Elobeyes; and Reserva Natural de Annobon, a small oceanic island.

Pico Basilé and Reserva Científica de la Caldera de Luba cover a range of habitats including lowland rainforest, montane and mossy forest, forest, high elevation shrub formation, and subalpine meadows. The island is regionally important because of its genetic uniquenes and high levels of endemism. The island's one endemic bird, *Speirops brunneus,* is found only on Pico Basilé, and three species of flightless Carabid beetles discovered there are likely to be endemic. The area is threatened by hunting and selective logging. Reserva Científica de la Caldera de Luba would preserve a rainforest gradient from sea level to 2260m, rivaled only by that found on Mt. Cameroon, which is threatened by considerable population pressure. Caldera de Luba is home to seven primate species, four of which are endemic subspecies, and four of which are listed as endangered by IUCN. Primate densities in this area are among the highest recorded anywhere in Africa.

However, more recent surveys indicate significant declines in primate populations due to hunting.

On the mainland, a number of conservation areas are proposed that would protect a variety of habitats. Parque Nacional de Monte Alen (including Montes Mitra), would, in conjunction with Reserva Natural del Estuario del Muni preserve a potentially important forested elevational gradient for species that undergo seasonal migrations or nomadic movements. The area harbors fifteen species of primates, including several which are vulnerable or endangered. Monte Alen proper is the only area in Equatorial Guinea which has formal protection (there is no hunting or gathering allowed in the park), and is the most well studied area on the mainland. Montes Mitra is a proposed extension of Monte Alen, but logging concessions have been granted within the proposed conservation area, which, together with the bushmeat industry, represent a primary threat to the preservation of an intact elevational gradient. Reserva Natural de Rio Campo will likely be one of the more difficult areas to protect, in that it is bisected by roads, and elephant and buffalo populations have reportedly already suffered from government intervention to protect crops of the local inhabitants. Nonetheless, there are some sound reasons for pursuing some level of conservation here, and the possibility of connecting this area with Cameroon's Rio Campo Reserve, adds to its conservation value. Parque Nacional de Los Altos de Nsork has only a sparse human population around its perimeter, and has poor access to markets. Nsork is the only area (among Nsork, Rio Campo, and Montes Mitra) where we encountered sign of all three of the large primates, Gorilla, Mandrill and Chimpanzee, and the lack of access to markets may, in part, account for this. Reserva Natural del Estuario del Muni contains the largest, best preserved expanse of mangroves in the country. The area is sparsely populated and has important fisheries. The area is rich in aquatic avifauna and contains prime habitat for the manatee. Reserva Natural de Monte Temelon, Monumento Natural de Piedra Bere, and Monumento Natural de Piedra Nzas are characterized by the presence of inselbergs surrounded by well-preserved forest. These spectacular rocky formations may host endemic arthropods and herpetofauna due to their high degree of isolation, and constitute a potential ecotourist destination. Reserva Natural de Punta Llende is part of the coastal savanna/rainforest mosaic. The savanna areas include birds species found nowhere else in the country and further surveys and research are needed. Reserva Científica de Playa Nendyi includes isolated turtle nesting beaches with associated marine habitat.

Additionally, two other offshore areas, Reserva Natural de Corisco y Elobeyes and Annobon are proposed for protection. Reserva Natural de Corisco y Elobeyes includes several offshore islands with important marine bird colonies, and associated marine habitat providing feeding grounds for marine turtles. Reserva Natural de Annobon, an oceanic with its associated marine habitat, is rich in animal and plant endemics, and coral reefs.

RESUMEN

Se llevaron a cabo relevamientos bióticos y una revisión de la literatura a fin de mejorar el conocimiento de la biodiversidad de Bioko y la parte continental de Guinea Ecuatorial. Los muestreos de mamíferos y aves fueron efectuados en la zona continental, y los de reptiles, anfibios y artrópodos tuvieron lugar en Bioko, aportando nueva información sobre la distribución y abundancia de especies. En la zona continental se visitaron cinco áreas incluidas en el sistema de reservas propuesto recientemente para Guinea Ecuatorial: la Reserva Natural de Río Campo, el Parque Nacional de Los Altos de Nsork, el Parque Nacional de Monte Alen (incluyendo Montes Mitra), y la Reserva Natural del Estuario del Muni. En Bioko se visitaron las dos reservas propuestas para la isla, el Parque Nacional de Pico Basilé y Reserva Científica de la Caldera de Luba, asi como algunas partes bajas cerca de Luba. Asimismo, se colectaron datos genéticos y se

combinaron con datos obtenidos en Camerún para evaluar los patrones de diferenciación genética a lo largo y ambos lados de cadenas montañosas en Camerún y Bioko.

Registramos solamente una especie de ave (*Malimbus scutatus*) que no había sido todavía reportada para la zona continental de Guinea Ecuatorial, y ninguna especie nueva de mamífero. Sin embargo, se obtuvo valiosa información sobre sobre la distribución de aves y mamíferos en la región continental. Además, varias especies y un género de anfibios fueron registrados en Bioko por primera vez. Aproximadamente un tercio de los artrópodos, incluyendo 372 especies de arañas, no habian sido registrados anteriormente, y varias no pueden ser identificadas con las referencias existentes y pueden representar nuevas especies. Al menos tres especies de escarabajos Carábidos fueron también descubiertos. En cada capítulo se discuten las implicaciones para la conservación, asi como en una sección especial (Parte IV) dedicada a recomendaciones especificas. Las acciones de conservación que recomendamos incluyen:

1) Maximizar la protección de regiones con alto número de especies endémicas (Montañas/Bioko)
2) Preservar los gradientes altitudinales siempre que sea posible.
3) Crear una red de reservas que representen distintos tipos de hábitat y zonas climáticas, como ha sido propuesto por C.U.R.E.F.
4) Aumentar la educación ambiental y desarrollar alternativas sostenibles a la caza y la extracción de madera.

Trece áreas han sido propuestas para su conservación por el Proyecto para la Conservación y Utilización Racional de los Ecosistemas Forestales de Guinea Equatorial (C.U.R.E.F.). Estas incluyen dos en Bioko, el Parque Nacional de Pico Basile y Reserva Científica de la Caldera de Luba; nueve en la región continental, Parque Nacional de Monte Alen (incluyendo Montes Mitra), Reserva Natural del Estuario del Muni, Parque Nacional de Los Altos de Nsork, Reserva Natural de Río Campo, Reserva Natural de Monte Timeline, Monumento Natural de Piedra Bere, Monumento Natural de Piedra Nzas, Reserva Natural de Punta Llende, Reserva Científica de Playa Nendyi; una compuesta por islas oceánicas, la Reserva Natural de Corisco y Elobeyes; y la Reserva Natural de Annobon, una pequeña isla oceánica. Pico Basilé y Reserva Cientifica de la Caldera de Luba cubre varios tipos de hábitat incluyendo la pluvisilva de baja altitud, pluvisilva de montaña, formaciones arbustivas de altura, y prados subalpinos. La isla es importante a nivel regional debido a su singularidad genetica y los altos niveles de endemismo. La unica especie endémica de la isla, *Speirops brunneus*, se encuentra exclusivamente en el Pico Basilé, y tres especies de escarabajos carábidos no voladores son probablemente endemicos. El área esta amenazada por la caza y la extracción selectiva de madera. La Reserva Cientifica de la Caldera de Luba preservaría un gradiente de bosque tropical desde el nivel del mar hasta 2260 m, comparable sólo al del Monte Camerún, y el cual esta amenazado por considerables presiones humanas. La Caldera de Luba acoge a siete especies de primates, cuantro de las cuales son subespecies endémicas, y cuatro de ellas estan listadas por la IUCN. Las densidades de primates en esta zona se encuentran entre las más altas registradas en todo Africa. Sin embargo muestreos recientes sugieren que las poblaciones de primates han sufrido decrementos debido a la presión cinegética.

En la región continental se han propuesto varias reservas para proteger diversos tipos de hábitat. El Parque Nacional Monte Alen (incluyendo Montes Mitra), protegería, en conjunción con la Reserva Natural del Estuario del Muni, un gradiente altitudinal potencialmente importante para espeices que llevan a cabo migraciones estacionales o movimientos nomádicos. El área contiene 15 especies de primates, incluyendo varias amenazadas o en peligro. El área de Monte Alen es el unico de Guinea Ecuatorial que cuenta con protección oficial (no se permite la caza ni la recolección dentro del parque), y es la mejor estudiada en la región continental. Montes Mitra se ha propuesto como extensión del Monte Alen, pero las concesiones madereras dentro de la zona propuesta, combinado con el mercado de carne de monte, consituyen la principal amenaza para la conservación del gradiente. La Reserva Natural de Río Campo sera probablemente una de las áreas más difíciles de proteger debido a que esta dividida por carreteras y a que las poblaciones de búfalo y elefante han sufrido decrementos debido a los esfuerzos del gobierno por proteger los cultivos de los habitantes locales. Sin embargo, hay varias razones para justificar algún tipo de conservación en este área, y la posibilidad de conectar el área con la Reserva Rio Campo de Camerún aumenta su valor de conservación. El Parque Nacional de los Altos de Nsork esta dispersamente poblado a lo largo del perímetro de la reserva y tiene acceso limitado a los mercados. Nsork es el único area (entre Nsork, Río Campo y Montes Mitra) donde encontramos evidencia de la presencia de los tres grandes primates, gorila, mandril y chimpance, y la inaccesibilidad a los mercados puede ser la causa. La Reserva Natural del Estuario del Muni contiene las extensiones de manglar más extensas y mejor conservadas del país. El área tiene densidades humanas bajas y contiene importantes recursos pesqueros. La zona tiene abundante fauna acuática y contiene hábitat óptimo para el manatí. La Reserva Natural Temelon, el Monumento Natural de Piedra Bere, y el Monumento Natural de Piedra Nzas se caracterizan por la presencia de cúpulas rocosas rodeadas por bosque en buen estado. Estas espetaculares formaciones rocosas pueden albergar artrópodos, reptiles o anfibios endemicos debido a su alto grado de aislamiento, y constituyen un potencial destino ecoturístico. La Reserva Natural de Punta LLende es parte del mosaico costero de bosque y savana. Las áreas de savana incluyen especies de aves no encontradas en ningún otro hábitat del pais y requieren muestreos e investigación adicionales. La Reserva Científica de Playa Nendyi incluye playas aisladas importantes para la anidación de las tortugas marinas y hábitats marinos asociados.

Además se han propuesto para su conservación dos áreas marinas, la Reserva Natural de Corisco y Elobeyes, y Annobon. La Reserva Natural de Corisco y Elobeyes incluye varias islas con importantes colonias de aves marinas y hábitats marinos que aportan alimento a las tortugas marinas. La Reserva Natural de Annobon, una pequeña isla oceánica, cuenta con diversos endemismos florales y faunísticos, así como con arrecifes coralinos.

INTRODUCTION

BACKGROUND

Geographically, the country of Equatorial Guinea comprises a continental region, Rio Muni, and two islands, Bioko and Annobon. The country is poorly known biologically, but as part of the Guinea-Congolian rainforest block, which contains the highest levels of biodiversity in Africa, it likely harbors significant populations of endangered rainforest species. Further, because of its islands and associated endemics, it is of particular biotic interest. Besides lowland rainforest, the country contains an array of habitat types from mangrove swamp to montane forest and alpine heath (Fa 1991, 1992, Jones 1994). Until recently, little attention has been paid to the biodiversity of this region (Fa 1991, Juste and Fa 1994). A network of protected areas was proposed for the country, by Fa (1991, 1992). This network has recently been redesigned based on land use, vegetation, topography, and such information on biodiversity as is currently available, by Proyecto Conservacion Utilizacion Racional de los Ecosystemas Forestales des Guinea Equatorial (C.U.R.E.F.), a European Union funded project under the Ministry of Forestry and Environment Figures I.1 and I.2). Monte Alen is the only one of the recommended protected areas so far for which there is formal protection, and for which conservation measures have been instituted. Further information on patterns and processes of biodiversity is needed to prioritize and invigorate conservation actions in Monte Alen and other, as yet unprotected areas.

OBJECTIVES

To provide baseline data on the biodiversity of Equatorial Guinea, bird and mammal surveys were conducted on the mainland in May-June 1998, and arthropod and herpetological surveys were conducted on Bioko in September-October 1998. In addition, molecular genetic data on birds in Bioko and mainland Cameroon are analyzed here in order to give an evolutionary perspective to the region as a whole.

The primary objectives of our work were to:

1) fill major gaps in our understanding of the biodiversity of this ecologically important region through surveys of birds and mammals on the mainland (Part I of this report) and herpetofauna and arachnids on Bioko (Part II).

2) identify genetically distinctive avian populations, and biogeographically distinct herpetological and arthropod populations and increase our understanding of the processes important in maintaining biodiversity in the region (Part III).

3) evaluate current and future human impacts on the biodiversity of the region, Rio Muni in particular (Part I).

4) summarize previous information on the biodiversity of the region in an annotated bibliography (Part IV), and

5) recommend conservation priorities for the country (Part V).

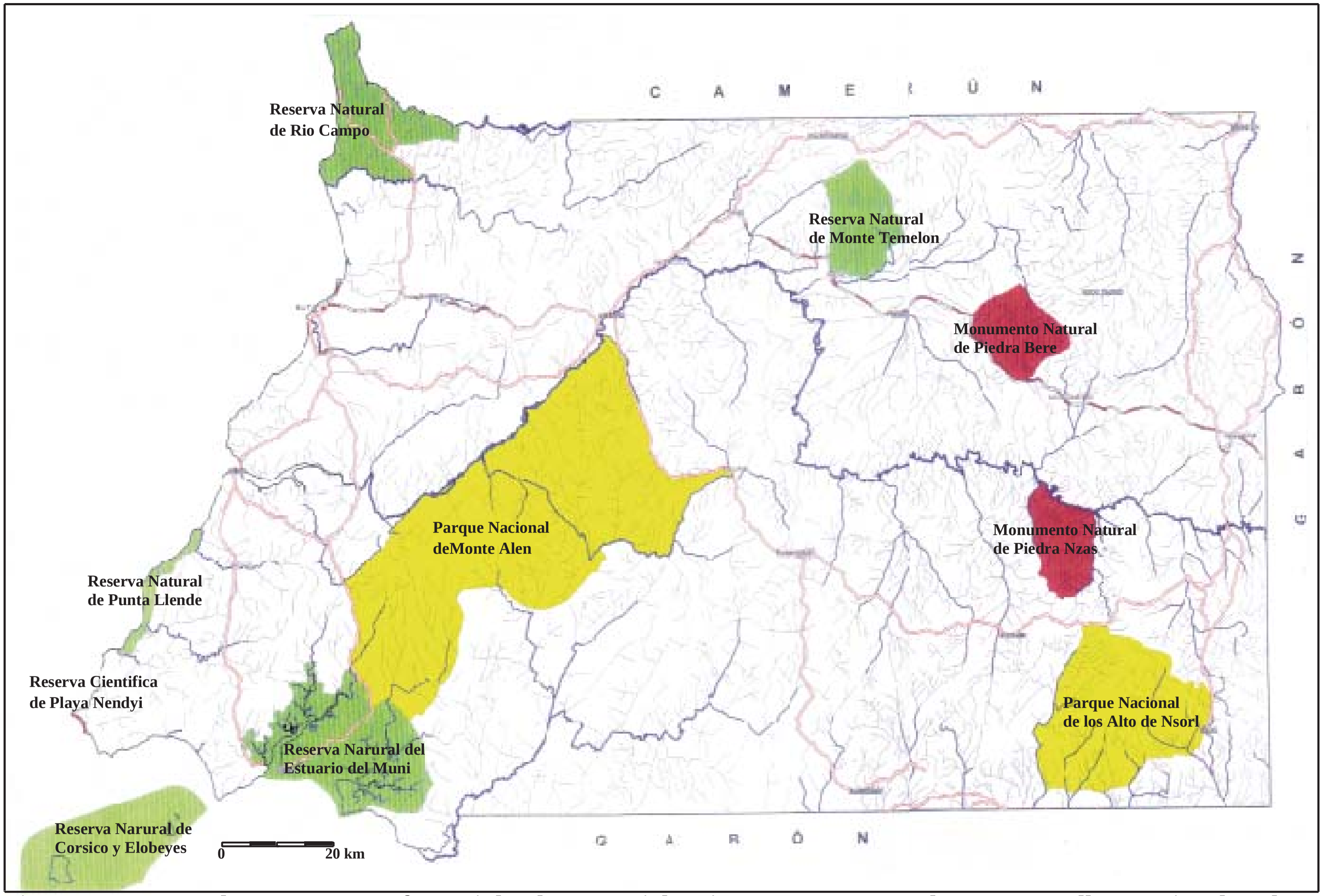

Figure I.1. Proposed reserve system for mainland Equatorial Guinea. Green, natural reserves; Yellow, national parks; Magenta, national monuments; Red, scientific reserves.

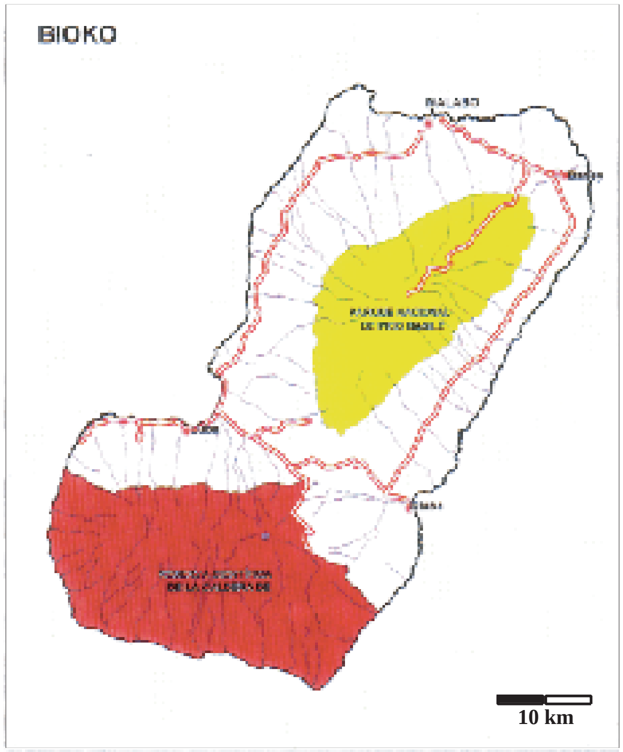

Figure I.2. Proposed reserves on Bioko and Annobon. Green, natural reserve; Yellow, national park; Red, scientific reserve.

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PART I.

BIOTIC SURVEYS OF RIO MUNI

Chapter 1. Bird and Mammal Surveys of Rio Muni

Brenda Larison, Thomas B. Smith, Borja Milá, Donald Stauffer, and José Nguema

INTRODUCTION

The bird and large mammal faunas are well known on Bioko (Eisentraut 1968, 1973, Butynski and Koster 1994, Pérez del Val et al. 1994, Butynski and Koster 1994, Butynski et al. 1995, Eisentraut 1968,1973, Juste and Ibañez 1994, see also Part V., annotated bibliography) however, much less information is available for the mainland. Available information mostly focuses on primates (Sabater-Pi 1967, Fa 1991, Garcia and Mba 1997), and a brief list of birds was produced in 1910 by Reichenow. Thus, not enough is known about the distribution and abundance of birds and mammals in Rio Muni to set clear conservation goals. In recent years the situation has improved, with surveys conducted on Monte Alen (Dowsett-Lemaire 1998) and near Montes Mitra (Pérez del Val 1998). At Estuario del Muni, local biologists are also conducting ongoing surveys designed by Pérez del Val. We conducted bird and mammal surveys in Rio Muni, including areas that had not previously been surveyed.

Before attempting to implement conservation measures in any area, it is essential to understand how human populations are utilizing resources, and what the impacts of this use are on biodiversity. In addition, it is also necessary to carefully assess whether changes can be successfully implemented given the social and political structure of the region. Thus, interviewing indigenous peoples, NGO's, and government agencies was an integral part of this project.

METHODS

STUDY SITES

Surveys of birds and mammals were conducted in Rio Muni from 1 May to 3 June 1998. Both bird and mammal surveys were conducted at three sites, including Reserva Natural de Rio Campo, Parque Nacional de los altos de Nsork, and Montes Mitra (Table 1.1, Fig. I.1, 1.1a,b). Montes Mitra is proposed to become part of Parque Nacional de Monte Alen (Machado 1998), but we will refer to it as Montes Mitra throughout this report. We also conducted bird surveys, but no mammal surveys, at Monte Alen. Additionally, we made daylong visits to Reserva Natural de Estuario del Muni, and to a coastal savanna area just south of Bata (Table 1.1, Fig. I.1).

Table 1.1. Rio Muni Itinerary

Site	*Location*	*Elev.*	*Date*	*Activity*
Bata	—	—	1-4 May 1998	Meetings with NGO's
Monte Alen	N 1˚02.9', S 9˚57.1'	900 m	5-8 May 1998	Bird surveys
Rio Campo	N 1˚14.2', S 9˚57.1'	0 m	9-12 May 1998	Bird/mammal surveys
Altos de Nsork	N 1˚02.9', S 11˚09.8'	457 m	14-22 May 1998	Bird/mammal surveys
Savanna near Bata	—	0 m	24 May 1998	Bird surveys
Estuario del Muni	—	0 m	26 May 1998	Bird surveys
Montes Mitra	N 1˚14.2',S 9˚57.1'	213 m	27-31 May 1998	Bird/mammal surveys

Parque Nacional de Monte Alen is located near the center of the country (Fig. I.1) a few montane species can be expected to occur here. This is the first reserve in Equatorial Guinea for which protection, such as bans on hunting and agriculture within the conservation zone, has been implemented. We surveyed birds near ECOFAC, between Niefang and Bicurga, and mist-netted at an elevation of 900 m.

Reserva Natural de Rio Campo, a proposed reserve of 20,000 ha, is located in the northwest part of the country bordering Cameroon and Rio Campo (Fig. 1.1a). Forest in the region had been logged in the last five years, and was quite disturbed, with numerous drag lines, stumps, and large numbers of *Rattan sp.* and *Mussanga sp.* We surveyed birds and mammals in coastal forest in the western part of the proposed reserve. Birds were mist-netted in coastal forest near the village of Elende, and mammal and large bird surveys were conducted 8 km south of Elende, approximately halfway between Elende and Bongoro, away from settlements. Two 2.5 km transects were cut, one proceeding north from the road, and the other south.

Parque Nacional de los Altos de Nsork is located in the southeast (Fig. 1.1b). It is necessary to visit officials either in Aconibe, if you wish to enter on the north side, or Nsork if you plan to enter from the south side. We accessed the area from the south, driving to Macula along a four-wheel drive road 15 km from the town of Nsork. At Macula we walked in 4-5 km and set up camp in the forest. Forest appeared relatively undisturbed, but locals indicated that logging had taken place about 20 years ago. A total of 7.5 km of transects were cut, and mist netting was also conducted.

Montes Mitra is in the southeast of the country. It is now proposed to be part of an extended Parque Nacional de Monte Alen (Fig. 1.1c). We took an abandoned logging road going east from the village of Ncoho. The road ends 22 km from Ncoho, just 3.7 km past a trappers camp, which has been set up in buildings left by the logging company. Since the forest had been recently logged between Ncoho and the trappers camp, we decided to work from the end of the road just beyond the trappers camp. The road from the trappers camp is new, and the area has not yet been logged because of the rugged terrain. A total of 5 km of transects were cut, and mist netting was also conducted.

Additionally, we surveyed an area of coastal savanna with gallery forest, just south of Bata. This area was proposed as a preserve by Fa (1991), but the current location of the proposed preserve is farther south than that surveyed (Fig. I.1). We also visited Reserva Natural de Estuario del Muni on the way to Montes Mitra, and spent one morning on the estuary counting birds along the three main tributaries of the estuary with Jose Nguema, who is conducting surveys in collaboration with Jaime Pérez del Val.

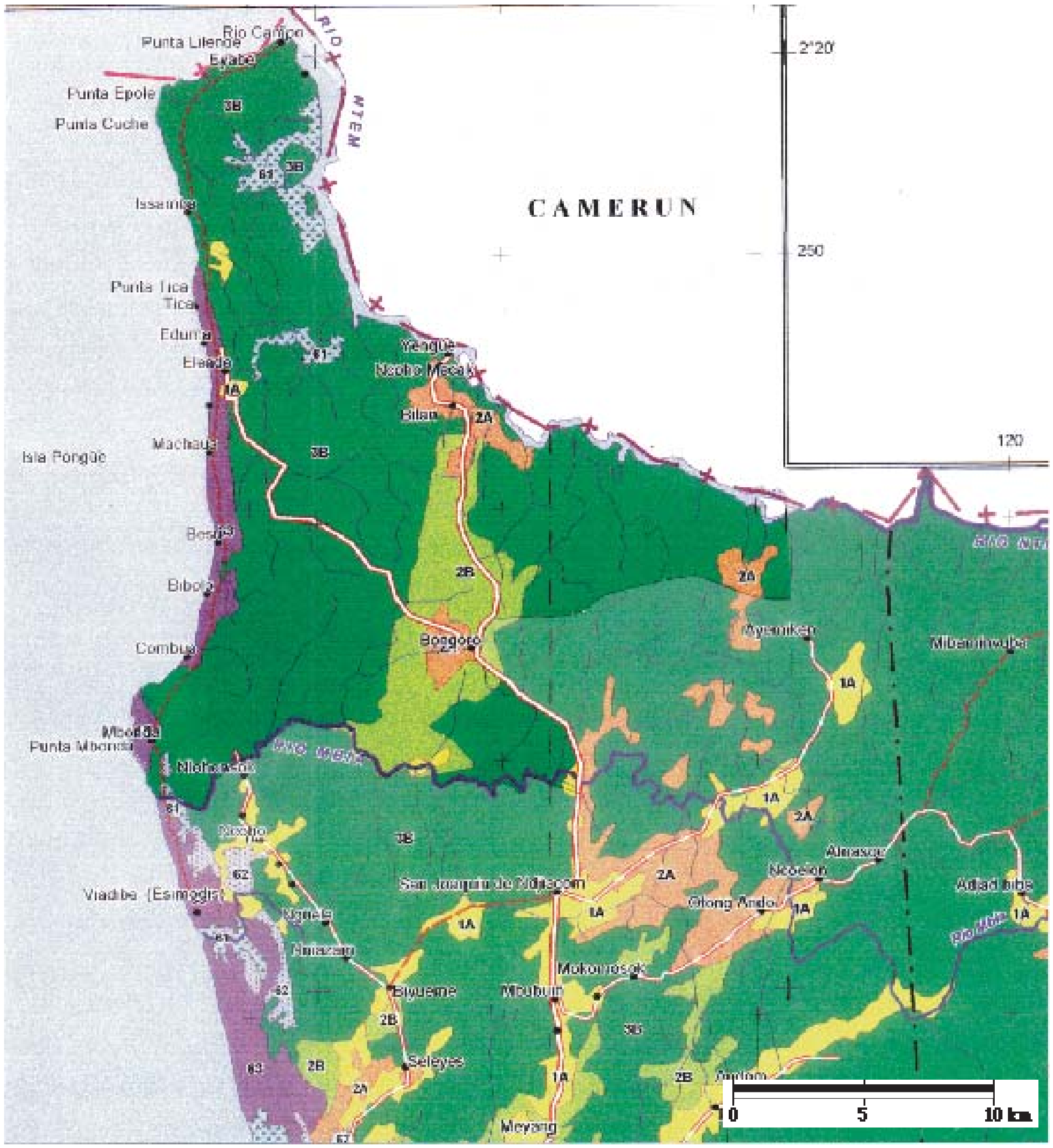

Figure 1.1a. Map of Reserva Natural de Rio Campo, in darker print, with surroundings lightened (C.U.R.E.F. 1998). See legend page 14 for vegetation types. Vegetation classifications do not indicate whether logging has occured. Survey sites are indicated by 𝕏**.**

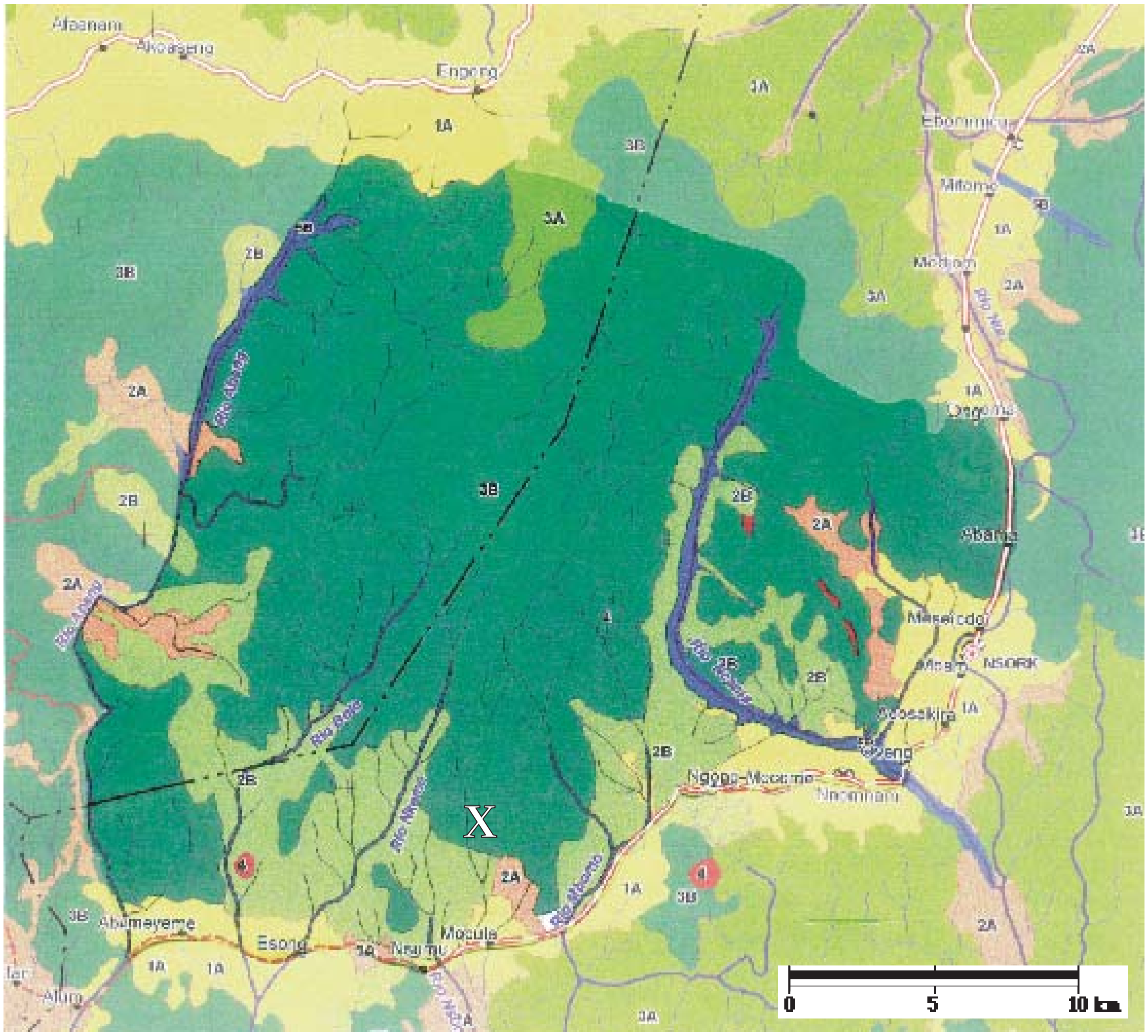

Figure 1.1b. Map of Parque Nacional de los Altos de Nsork, in darker print, with surroundings lightened (C.U.R.E.F. 1998). See legend page 14 for vegetation types. Vegetation classifications do not indicate whether logging has occured. Survey sites are indicated by X.

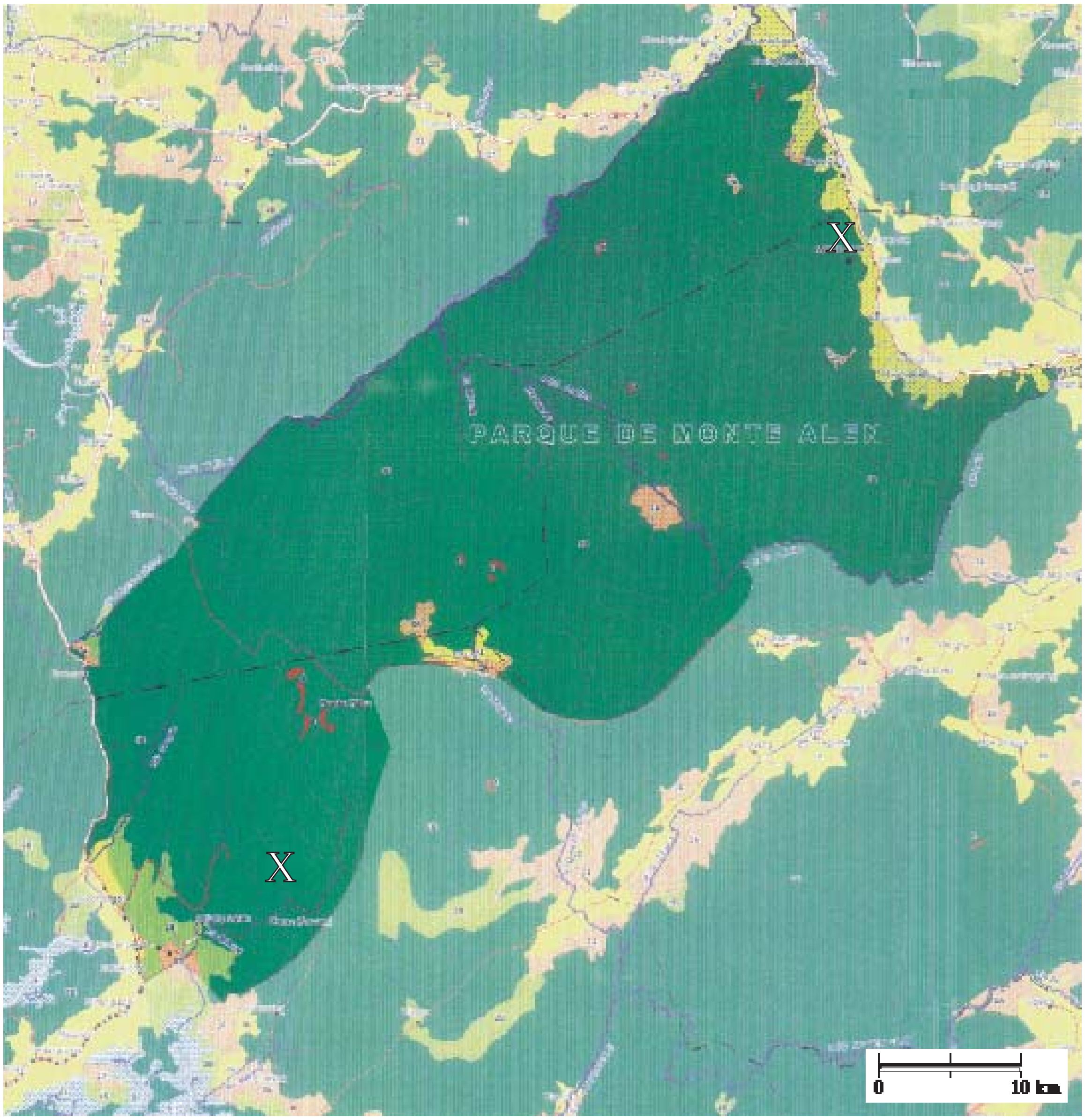

Figure 1.1c. Map of Parque Nacional de Monte Alen (with proposed extension to include Montes Mitra shown) in darker print, with surroundings lightened (C.U.R.E.F. 1998). See legend page 14 for vegetation types. Vegetation classifications do not indicate whether logging has occured. Survey sites are indicated by X.

Legend for Maps 1.1a-c.

Crops and secondary vegetation

Old plantations: (P = palms, C = coffee, Ca = cacao)

Dispersed crops and secondary vegetation of variable age

Old secondary vegetation plots, scattered cultivation, forest fragments

Heterogeneous forest

Continuous forest

Forest or other vegetation on thin soil and rock

Coastal forests and marshes

Forests and marshes on alluvial plains

Mangroves

Coastal savanna

Coastal forest on sandy soils

BIRD SURVEYS

Avian species richness and relative abundance were examined using visual sightings and mist-netting. Mist-nets (12 m length, 30 x 30 mm mesh) were erected in primary forest at each site. Nets were opened at sunrise (0600) and closed at between 1100 or 1200 depending on ambient conditions. Afternoon mist-netting was done when conditions permitted. Birds were banded with numbered aluminum bands, sexed, aged and measured. Measurements included tarsus length, wing length, and weight, as well as several bill measures including length, depth and width of both upper and lower bills following Smith (1990). A small volume of blood (one or two drops) was removed by venipuncture of the caudal vein following Smith (1990), and preserved in a buffer solution for subsequent molecular genetic analysis. Standardized capture rates (birds/1000mhrs) were produced by keeping track of netting hours and number of nets used. Large, frugivorous birds (such as hornbills and turacos) seen or heard within 100 m of transects were recorded as we walked them looking for mammals (see below). Additionally, visual sightings of small birds were obtained by slowly walking and recording all species seen or heard along transects or trails, around the mist-netting area, and around villages in the area. Relative abundance was compared among sites using G-tests. For large birds observed on transects, group size was compared using Kruskal-Wallace tests (Sokal and Rolph 1995).

Nomenclature and information follows the five volume Birds of Africa (Brown et. al 1982-1997) for all species covered by that work. The nomenclature of the Illadopsis group follows that proposed by Ripley and Beehler (1985). The remainder of scientific names are taken from Louette (1981), with common names derived from Macworth-Praed and Grant (1970). Hall and Moreau (1970) and Snow (1978) and Birds of Africa (Brown et. al 1982-1997) were used to examine species distributions.

MAMMAL SURVEYS

Line transects were cut, and mammal sign and direct visual sightings recorded, following standard protocols for determining species richness and relative abundance (NRC 1981; Barnes and Jensen 1987; Fay 1988; Wilson 1997). All animal sign which could be seen from transects, and all visual or aural detections estimated to be within 100 m of transects were recorded and used to calculate relative abundance. Local guides and hunters were employed to assist with transect cutting and identifying animal sign. Guides typically used the Fang name for species, which we compared to lists of Fang and scientific names (Alcala 1995), and confirmed with them using field guides (Kingdon 1997). We compared mammal abundance among sites using G-tests, and group size using Kruskal Wallis tests (Sokal and Rolph 1995). We tested for the effects of hunting using Spearman rank tests with number of traps seen as an index. Additionally, interviews were conducted with local people, asking them to identify those mammals they knew to occur in the area, from color plates in various field guides. Our nomenclature follows Kingdon (1997) unless otherwise noted.

SOCIO-POLITICAL CONTEXT

We attempted to conduct formal interviews following Larison et al. (1995), but soon discovered that this was not feasible. There have been a number of prior visits by NGO's and researchers seeking the same information (Fa 1991, C.U.R.E.F.). Thus, in numerous regions, the locals have begun to feel suspicious of such surveys and are now refusing to cooperate, because they have not seen any advantages accrue to them from their cooperation. Information gathering therefore was limited to what we could ascertain from conversation and from information from other sources (C.U.R.E.F., Fa 1991). Nonetheless using all available information we attempt to: 1) determine the extent of utilization of the forest by humans, including both the impacts on the forest and the degree of reliance by locals on forest products; 2) understand local attitudes about conservation; and 3) understand what local needs must be met for effective conservation to take place.

RESULTS

BIRD SURVEYS

Equatorial Guinea lies within two high priority areas for bird conservation. These areas, 1) the Cameroon mountains, including Bioko, and 2) the Cameroon and Gabon Lowlands including mainland Equatorial Guinea, are defined by relatively high concentrations of restricted range species, ones with a range of less than 50,000 km^2 (Bibby et al. 1992). These same general areas had previously been identified as important areas for rare birds by Hall and Moreau (1962), using a similar criterion of birds with ranges not extending more than 250 miles in any direction. Ten restricted range species have been recorded for Equatorial Guinea, but most of these are only found on Bioko. On the mainland, only two restricted range species have been recorded, Grey-necked picathartes, *Picathartes oreas*, and Black-capped woodland-warbler, *Phylloscopus herberti* (Table 1.2). We found nests of *Picathartes* at Monte Alen, where we also captured an individual, and at Nsork. In each case, we found a single nest that did not appear to be in current use. Equatorial Guinea has many areas where such rocky outcrops exist, such as Monte Alen, Nsork and the areas with inselbergs that have been proposed for preservation in the eastern part of the country (Fig 1.1). *Picathartes* has also been recorded in Caldera de Luba on Bioko (Pérez del Val 1994). We found no evidence of Picathartes in Rio Campo or Montes Mitra. The terrain of Rio Campo is unlikely to be appropriate for Picathartes, because it lack hills and rocky outcrops, but they seem likely at Montes Mitra. Pictures of *Picathartes* were not recognized by locals at either site.

Compared to other Congo Basin countries, avian diversity seems low in Equatorial Guinea. The number of species is markedly lower than the number reported for other countries of similar size, even if all probable species for the mainland and Bioko are included (Fig. 1.2).

Table 1.2 lists 442 species for mainland Equatorial Guinea and Bioko. Species are included in the table if they have been confirmed by a biologist, reported by locals, or listed as probable in previous literature, as long as their inclusion is supported by their known distribution. Unconfirmed species from previous literature (Dowsett 1993, Fa 1991), that seem unlikely based on known distributions, have been excluded from the table. Of the species listed in Table 1.2, 387 have been confirmed for Equatorial Guinea (including Bioko), 311 of which have been confirmed on the mainland. The distributions of the 136 species we recorded in the course of our survey are presented in Table 1.2, along with recent records from other observers, including Dowsett (1998) and Pérez del Val (1998). We detected two species, Red-vented malimbe, *Malimbus scutatus*, and Abdims stork, *C. abdimii, w*hich had not been previously reported. *M. scutatus* is likely to be a breeding resident, but *C. abdimii* is a non-breeding visitor. *M. scutatus* is limited in its distribution to the western African forest and the western Congo Basin (MacWorth-Praed and Grant 1970).

It should be noted that the numbers of species listed for Monte Alen and Bioko are much higher than for the other areas because much more work has been done in there than in the rest of the country, and many more species are likely to be recorded in these areas over time. The maximum number of species we recorded at any one site was Nsork, but the number of birds recorded per site were not significantly different (G-test = 3.8, df = 3, $P > 0.50$). We recorded the greatest number of Congo Basin endemics at Monte Alen (G-test = 8.0, df = 3, $P < 0.05$). Thirteen of the species found at Monte Alen are found only in the Congo Basin.

There is some uncertainty whether the *Cisticola* species we observed in the coastal savanna was *C. brunnescens or C. ayersii*. They have very similar plumage and flight/song patterns. However, *C. brunnescens* is the common species in coastal savanna in nearby Gabon (Brown et al. 1982-1997).

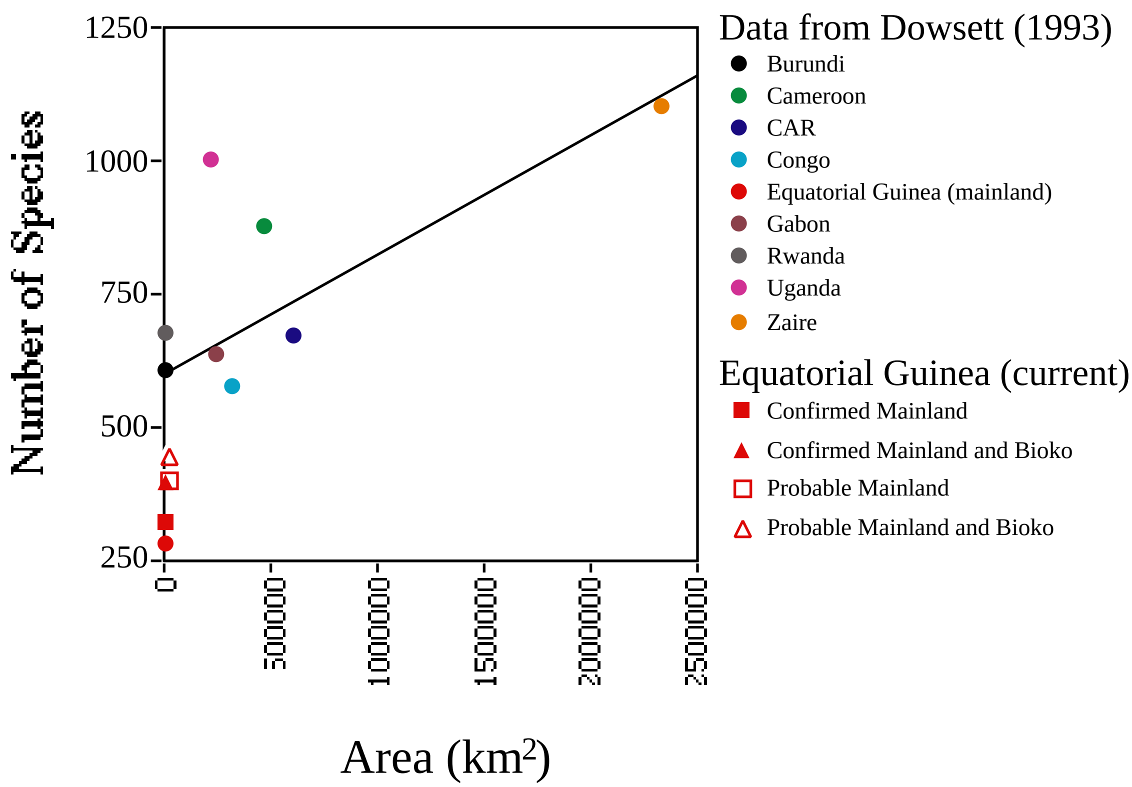

Figure 1.2. Comparison of number of avian species reported for Equatorial Guinea and other countries in the Congo Basin. Filled circles represent data on total number of species (including migrants) from Dowsett (1993). Data for Equatorial Guinea include that from Dowsett (filled circle) and additional data from recent surveys (other symbols), and are shown in red.

Table 1.2. Bird species known to occur or likely to occur either on mainland Equatorial Guinea or Bioko. Numbers in table refer to source: 1 = Recorded on this survey, 2 = Pérez del Val (1998), 3 = Dowsett-Lemaire and Dowsett (1998), 4 = Reichenow (1910), 5 = Dowsett (1993), 6 = Fa (1992). Information on Bioko is drawn from Pérez del Val (1996). Status: V = non-breeding visitor or vagrant, R = resident, widespread, F = resident, primary habitat is rainforest, CB = range restricted to the Congo Basin, M = restricted to montane rainforest.

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Calonectris diomedea Cory's shearwater							•		V
Puffinus griseus Sooty shearwater							•		V
Hydrobates pelagicus British storm-petrel							•		V
Tachybaptus ruficollis Little grebe				•[3]			•		R
Phaethon lepturus White-tailed tropicbird							•		V
Sula capensis Cape gannet							•	•[6]	V
Sula leucogaster Brown booby							•		V
Phalacrocorax africanus Reed cormorant	•[1]						•	•[6]	R
Anhinga melanogaster Darter							•	•[6]	R
Pelecanus rufescens Pink-backed pelican								•[6]	R
Ixobrychus minutus Little bittern								•[4]	R
Ixobrychus sturmii Dwarf bittern								•[5]	R
Tigriornis leucolophus White-crested tiger heron				•[3,4]					F
Nycticorax nycticorax Black-crowned night heron								•[6]	R
Ardeola ralloides Squacco heron							•	•[6]	R
Bubulcus ibis Cattle egret				•[3,4]			•		V
Butorides striatus Green heron					•[1]		•	•[4]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Egretta gularis Western reef heron							•	•[4]	R
Egretta garzetta Little egret	•[1]				•[1]	•[1]	•	•[4]	R
Egretta alba Great egret					•[1]			•[4]	R
Ardea purpurea Purple heron								•[4]	V
Ardea cinerea Grey heron							•	•[4]	V
Ardea melanocephela Black-headed heron				•[3]				•[4]	R
Ardea goliath Goliath heron								•[4]	R
Scopus umbretta Hamerkop					•[1]			•[6]	R
Mycteria ibis Yellow-billed stork								•[6]	R
Anastomus lamelligerus African open-bill stork								•[6]	V
Ciconia abdimii Abdim's stork	•[1]								V
Ciconia episcopus Woolly-necked stork					•[1]	•[1]		•[6]	R
Ephippiorhynchus senegalensis Saddle-billed stork								•[6]	R
Bostrychia hagedash Hadada							•	•[4]	R
Bostrychia rara Spot-breasted ibis				•[3,4]				•[4]	F
Threskiornis aethiopica Sacred Ibis								•[6]	R
Platalea alba African spoonbill								•[6]	R
Dendrocygna viduata White-faced whistling duck								•[6]	R
Alopochen aegyptiacus Egyptian goose								•[6]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Pteronetta hartlaubii Hartlaub's duck				•[3]				•[5]	R
Sarkidiornis melanotos Knob-billed duck								•[6]	R
Nettapus auritus African pigmy goose								•[6]	R
Anas sparsa African black duck				•[3]				•[6]	R
Pandion haliaetus Osprey								•[6]	R
Aviceda cuculoides African cuckoo falcon								•[4]	R
Pernis apivorus Honey buzzard							•	•[6]	V
Machaerhamphus alcinus Bat hawk				•[3]					R
Elanus caeruleus Black-shouldered kite	•[1]					•[1]		•[6]	V
Milvus migrans Black-kite	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1]	•	•[4]	R
Haliaeetus vocifer African fish eagle				•[3]			•	•[6]	R
Gypohierax angolensis Palm-nut vulture	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1]	•	•[4]	R
Dryotriorchis spectabilis Congo serpent eagle				•[3,4]				•[4]	F
Polyboroides typus African harrier hawk				•[3,4]				•[4]	R
Accipiter tachiro African Goshawk				•[3]			•		R
Accipiter erythropus Red-thighed sparrowhawk								•[6]	F
Accipiter melanoleucus Great sparrowhawk								•[6]	R
Accipiter castanilius Chestnut-flanked sparrowhawk				•[3]					F
Urotriorchis macrourus Long-tailed hawk				•[3]				•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Kaupifalco monogrammicus Lizard buzzard				•[3]				•[6]	R
Buteo auguralis Red-necked buzzard				•[3]				•[6]	R
Hieraaetus dubius Ayres' hawk-eagle								•[6]	R
Lophaetus occipitalis Long-crested eagle				•[3]				•[4]	R
Spizaetus africanus Cassin's hawk eagle				•[3]					F
Stephanoaetus coronatus Crowned eagle				•[3]				•[6]	R
Falco ardosiaceus Grey kestrel								•[6]	R
Falco peregrinus Peregrin falcon							•	•[6]	V
Agelastes niger Black guineafowl				•[3]					CB
Guttera plumifera Plumed guineafowl	•[1]			•[3]				•[4]	CB
Corturnix chinensis Blue quail								•[6]	R
Corturnix delegorguei Harlequin quail							•	•[6]	V
Francolinus lathami Latham's forest francolin				•[3]				•[4]	F
Francolinus squamatus Scaly francolin		•[1]	•[1]	•[1,3]				•[4]	F
Himantornis haematopus Nkulengu rail				•[3,4]				•[4]	F
Canirallus oculeus Grey-throated rail				•[4]				•[6]	F
Sarothrura pulchra White-spotted flufftail				•[3]					R
Sarothrura elegans Buff-spotted flufftail							•	•[6]	R
Crex egregia African crake						•[1]	•	•[6]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Amaurornis flavirostris Black crake				•[3]				•[6]	R
Porphyrio alleni Allen's gallenule							•	•[6]	R
Gallinula angulata Lesser moorhen							•		R
Podica senegalensis African finfoot				•[3,4]			•	•[4]	R
Actophilornis africana African jacana								•[6]	R
Glareola nuchalis Rock pratincole				•[3]			•	•[4]	R
Glareola cinerea Grey pratincole								•[6]	R
Charadrius dubius Little ringed plover							•	•[4]	V
Charadrius hiaticula Ringed plover							•	•[6]	V
Charadrius forbesi Forbes' plover								•[6]	R
Charadrius marginatus White-fronted plover							•	•[6]	R
Pluvialis squatarola Grey plover							•	•[5]	V
Vanellus lugubris Lesser black-winged lapwing								•[6]	R
Calidris alba Sanderling								•[6]	V
Calidris minuta Little stint								•[6]	V
Philomachus pugnax Ruff								•[6]	V
Gallinago gallinago Common snipe							•	•[6]	V
Numenius phaeopus Whimbril							•		V
Tringa totanus Common redshank							•	•[6]	V

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Tringa stagnatilis Marsh sandpiper							•		V
Tringa nebularia Greenshank							•	•[6]	V
Tringa ochropus Green sandpiper							•	•[6]	V
Tringa glareola Wood sandpiper							•	•[6]	V
Actitis hypoleucos Common sandpiper				•[3]			•	•[5]	V
Sterna caspia Caspian tern								•[5]	V
Sterna maxima Royal tern							•		V
Sterna hirundo Common tern							•	•[6]	V
Sterna paradisaea Arctic tern							•	•[6]	V
Sterna anaethetus Bridled tern								•[5]	V
Sterna fuscata Sooty tern							•		V
Sterna albifrons Little tern								•[6]	V
Chlidonias hybridus Whiskered tern							•	•[6]	V
Chlidonias niger Black tern							•	•[6]	V
Chlidonias leucopterus White-winged black tern								•[6]	V
Anous stolidus Brown Noddy							•		V
Rynchops flavirostris African skimmer								•[6]	V
Treron calva African green pigeon	•[1]	•[1]		•[1,3]	•[1]	•[1]	•	•[4]	R
Turtur brehmeri Blue-headed wood dove	•[1]		•[2]	•[3]				•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Turtur tympanistria Tambourine dove	•[1]	•[1]	•[1,2]	•[1,3]			•	•[4]	R
Turtur afer Red-billed wood dove	•[1]			•[3]				•[4]	R
Columba iriditorques Western bronze-naped pigeon				•[3]				•[4]	F
Columba larvata Lemon dove							•	•[4]	R
Columba sjostedti Cameroon olive pigeon							•		M
Columba unicincta Afep pigeon				•[3,4]					F
Streptopelia semitorquata Red-eyed dove	•[1]	•[1]		•[1,3]	•[1]	•[1]	•	•[4]	R
Psittacus erithacus African grey parrot	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1,3]	•	•[4]	F
Poicephalus gulielmi Red-fronted parrot				•[3]				•[4]	F
Agapornis pullaria Red-headed lovebird							•	•[4]	R
Agapornis swinderniana Black-collared lovebird				•[3]					F
Corythaeola cristata Great blue turaco	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1]	•	•[4]	F
Tauraco persa Green turaco	?	?	•[1]	•[1,3,4]					R
Tauraco macrorhynchus Verraeux's turaco	?	?		•[1,3,4]			•		F
Oxylophus levaillantii Stripe-crested cuckoo				•[3]			•	•[6]	V
Cuculus solitarius Red-chested cuckoo				•[3]			•	•[4]	R
Cuculus clamosus Black cuckoo				•[3,4]				•[4]	R
Cercococcyx mechowi Dusky long-tailed cuckoo				•[3]				•[4]	F
Cercococcyx olivinus Olive long-tailed cuckoo				•[3]					F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Chrysococcyx cupreus African emerald cuckoo				•[3]			•	•[4]	R
Chrysococcyx flavigularis Yellow-throated cuckoo				•[3]					F
Chrysococcyx klaas Klaas's cuckoo				•[3]			•	•[4]	R
Chrysococcyx caprius Didric cuckoo				•[3]			•	•[6]	R
Ceuthmochares aereus Yellowbill				•[3,4]			•		R
Centropus leucogaster Black-throated coucal	•[1]							•[6]	F
Centropus anselli Gabon coucal	•[1]	•[1]	•[1]	•[1,3]					F
Centropus grillii Black coucal								•[6]	R
Centropus monachus Blue-headed coucal				•[3,4]				•[4]	R
Tyto alba Barn owl							•	•[6]	R
Jubula lettii Maned owl								•[6]	F
Bubo poensis Fraser's eagle-owl				•[3]			•	•[4]	F
Bubo leucostictus Akun eagle-owl				•[4]				•[4]	F
Scotopelia peli Pel's fishing-owl								•	R
Glaucidium tephronotum Red-chested owlet				•[3]					F
Glaucidium stjöstedti Chestnut-backed owlet			•[2]	•[3]				•[4]	CB
Strix woodfordii African wood owl				•[3,4]			•	•[4]	R
Caprimulgus climacurus Long-tailed nightjar								•[6]	V
Caprimulgus fossii Square-tailed nightjar								•[5]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Caprimulgus nigriscapularis Fiery-necked nightjar		•[1]						•[6]	R
Caprimulgus tristigma Freckled nightjar								•[6]	R
Macrodipteryx vexillaria Pennant-winged nightjar							•	•[6]	V
Raphidura sabini Sabine's spine-tail				•[3]			•	•[6]	F
Telacanthura ussheri Mottled spinetail				•[1,3]			•	•[6]	R
Neafrapus cassini Cassin's Spinetail				•[1,3]			•	•[6]	F
Schoutedenapus myioptilus Scarce swift							•		R
Cypsiurus parvus African palm swift	•[1]	•[1]	•[1]	•[1,3]	•[1]	•[1]	•	•[5]	R
Apus barbatus African black swift							•		V
Apus apus European swift				•[3]					V
Apus batesi Bate's swift				•[3]					F
Apus affinis Little swift	•[1]	•[1]	•[1]	•[1]	•[1]	•[1]	•	•[6]	R
Colius striatus Speckled mousebird						•[1]		•[4]	R
Apaloderma vittatum Bar-tailed Trogon							•		M
Apaloderma narina Narina's trogon				•[3]				•[6]	R
Apaloderma aequatoriale Bare-cheeked trogon				•[3]				•[4]	CB
Halcyon badia Chocolate-backed kingfisher				•[3]			•	•[4]	F
Halcyon leucocephala Grey-headed kingfisher					•[1]			•[6]	R
Halcyon malimbica Blue-breasted kingfisher	•[1]			•[3,4]				•[4]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Halcyon senegalensis Woodland kingfisher				•[3]	•[1]	•[1]	•	•[4]	R
Ceyx lecontei Dwarf kingfisher		•[1]	•[2]	•[1,3]					F
Ceyx picta African pigmy kingfisher				•[3]				•[4]	R
Corythornis leucogaster White-bellied kingfisher	•[1]	•[1]	•[1,2]	•[3]			•	•[4]	F
Corythornis cristata Malachite kingfisher					•[1]			•[6]	R
Alcedo quadribrachys Shining-blue kingfisher		•[1]	•[1]	•[3]				•[6]	F
Megaceryle maxima African giant kingfisher				•[3]	•[1]		•	•[6]	R
Ceryle rudis Pied kingfisher							•	•[6]	R
Merops muelleri Blue-headed bee-eater				•[3]			•	•[6]	F
Merops gularis Black bee-eater		•[1]		•[3]				•[4]	F
Merops variegatus Blue-breasted bee-eater						•[1]		•[5]	R
Merops albicollis White-throated bee-eater								•[5]	V
Merops apiaster European bee-eater								•[6]	V
Merops malimbicus Rosy bee-eater								•[4]	R
Eurystomus gularis Blue-throated roller				•[3,4]			•	•[4]	F
Eurystomus glaucurus Broad-billed roller								•[4]	R
Tockus albocristatus White-crested hornbill	•[1]	•[1]	•[1]	•[1,3,4]				•[4]	F
Tockus hartlaubi Black Dwarf hornbill	•[1]			•[1,3]				•[4]	F
Tockus camurus Red-billed dwarf hornbill	•[1]	•[1]	•[1,2]	•[1,3,4]				•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Tockus fasciatus African pied hornbill	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1]		•[4]	F
Ceratogymna fistulator Piping hornbill	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1]		•[4]	F
Ceratogymna subcylindricus Black and white casqued hornbill			•[4]						F
Ceratogymna cylindricus White-thighed hornbill		•[1]		•[3,4]				•[4]	F
Ceratogymna atrata Black-casqued hornbill	•[1]	•[1]	•[1]	•[1,3,4]			•	•[4]	F
Gymnobucco bonapartei Grey-throated barbet				•[3,4]				•[4]	F
Gymnobucco peli Bristle-nosed barbet				•[3]					F
Gymnobucco calvus Naked-faced barbet	•[1]			•[3]				•[6]	F
Pogoniulus scolopaceus Speckled tinkerbird	•[1]	•[1]	•[1,2]	•[3]		•[1]	•	•[4]	F
Pogoniulus atroflavus Red-rumped tinkerbird	•[1]		•[2]	•[3]				•[4]	F
Pogoniulus subsulphureus Yellow-throated tinkerbird		•[1]		•[1,3]			•	•[4]	F
Pogoniulus bilineatus Yellow-rumped tinkerbird	•[1]	•[1]	•[1]	•[1,3]	•[1]	•[1]	•	•[4]	R
Buccanodon duchaillui Yellow-spotted barbet				•[3,4]				•[4]	F
Trycolaema hirsuta Hairy-breasted barbet				•[3]				•[6]	F
Lybius bidentatus Tooth-billed barbet								•[4]	R
Trachyphonus purpuratus Yellow-billed barbet	•[1]	•[1]	•[1]	•[1,3]				•[4]	R
Melignomon zenkeri Zenker's honeyguide				•[3]				•[6]	CB
Melichneutes robustus Lyre-tailed honeyguide								•[6]	F
Indicator maculatus Spotted honeyguide			•[2]	•[1,3,4]				•[6]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Indicator exilis Least honeyguide			•[2]				•	•[6]	F
Sasia africana African piculet				•[1,3]				•[6]	CB
Campethera cailliautii Green-backed woodpecker				•[3]				•[6]	R
Campethera tullbergi Tullberg's woodpecker *							•	•[6]	M
Campethera nivosa Buff-spotted woodpecker			•[2]	•[3]			•	•[4]	F
Campethera caroli Brown-eared woodpecker	•[1]	•[1]	•[1]	•[1,3]				•[4]	R
Dendropicos gabonensis Gabon woodpecker				•[3]				•[4]	F
Dendropicos elliotii Elliot's woodpecker				•[3]			•	•[6]	F
Smithornis sharpei Grey-headed broadbill				•[3]			•	•[4]	CB
Smithornis rufolateralis Rufous-sided broadbill	•[1]	•[1]	•[1,2]	•[1,3]				•[4]	F
Smithornis capensis African broadbill								•[6]	R
Pitta angolensis African pitta								•[5]	R
Psalidoprocne nitens Square-tailed saw-wing			•[1]	•[3]				•[6]	F
Psalidoprocne pristoptera Black saw-wing								•[4]	R
Psalidoprocne fuliginosa Mountain saw-wing *							•		CB
Pseudhirundo griseopyga Grey-rumped swallow								•[5]	R
Hirundo semirufa Red-breasted swallow					•[1]			•[4]	R
Hirundo senegalensis Mosque swallow								•[4]	R
Hirundo abyssinica Lesser striped swallow					•[1]		•	•[6]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Hirundo fuliginosa Forest swallow				•[1,3]				•[6]	CB
Hirundo nigrita White-throated blue swallow			•[1]	•[3]	•[1]			•[4]	F
Hirundo rustica Barn swallow							•	•[5]	V
Motacilla flava Yellow wagtail							•	•[6]	V
Motacilla clara Mountain wagtail			•[1]	•[3]			•		R
Motacilla aguimp African pied wagtail				•[3]				•[4]	R
Anthus pallidiventris Long-legged pipit						•[1]		•[6]	R
Anthus trivialis Tree pipit							•		V
Campephaga quiscalina Purple-throated cuckoo-shrike				•[3]				•[4]	R
Coracina caesia Grey cuckoo-shrike				•[3]			•		R
Coracina azurea Blue cuckoo-shrike			•[1]	•[3]				•[4]	F
Andropadus tephrolaemus Mountain greenbul							•		M
Andropadus virens Little greenbul	•[1]	•[1]	•[1,2]	•[1,3,4]	•[1]	•[1]	•	•[4]	R
Andropadus gracilis Little grey greenbul				•[3]				•[6]	F
Andropadus ansorgei Ansorge's greenbul				•[3,4]				•[6]	F
Andropadus curvirostris Cameroon somber greenbul			•[2]	•[3]			•	•[4]	F
Andropadus gracilirostris Slender-billed greenbul		•[1]		•[3]			•	•[4]	R
Andropadus latirostris Yellow-whiskered greenbul	•[1]	•[1]	•[1,2]	•[1,3]			•	•[4]	F
Calyptocichla serina Golden greenbul				•[3,4]			•	•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Baeopogon indicator Honeyguide greenbul	•[1]	•[1]	•[1]	•[1,3]				•[4]	F
Baeopogon clamans Sjöstedt's honeyguide greenbul				•[3]					C
Ixonotus guttatus Spotted greenbul		•[1]		•[1,3,4]				•[4]	F
Chlorocichla falkensteini Yellow-necked greenbul								•[4]	R
Chlorocichla simplex Simple greenbul		•[1]		•[3]		•[1]		•[4]	R
Thescelocichla leucopleura Swamp palm bulbul		•[1]		•[3]		•[1]		•[4]	R
Pyrrhurus scandens Leaf-love								•[6]	R
Phyllastrephus poensis Cameroon olive greenbul							•	•[6]	M
Phyllastrephus icterinus Icterine greenbul			•[1,2]	•[3]			•	•[6]	F
Phyllastrephus xavieri Xavier's greenbul		•[1]		•[1,3]					CB
Phyllastrephus albigularis White-throated greenbul				•[3]				•[6]	F
Bleda syndactyla Red-tailed bristlebill	•[1]	•[1]	•[1,2]	•[3]				•[4]	F
Bleda eximia Green-tailed bristlebill	•[1]	•[1]	•[1,2]	•[1,3]			•	•[4]	F
Criniger chloronotus Eastern bearded greenbul	•[1]		•[1]	•[3]				•[4]	CB
Criniger calurus Red-tailed greenbul	•[1]	•[1]	•[1,2]	•[3]		•[1]	•	•[4]	F
Criniger ndussumensis White-bearded greenbul				•[3]					F
Pycnonotus barbatus Common bulbul	•[1]	•[1]	•[1]	•[1,3]	•[1]	•[1]		•[4]	R
Stiphrornis erythrothorax Forest Robin	•[1]	•[1]	•[1,2]	•[1,3]			•	•[4]	F
Sheppardia bocagei Bocage's akalat							•	•[6]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Sheppardia cyornithopsis Lowland akalat			•[1,2]	•[3]				•[6]	F
Cossyphicula roberti White-bellied robin-chat							•	•[6]	M
Cossypha cyanocampter Blue-shouldered robin-chat								•[4]	F
Alethe diademata Fire-crested alethe		•[1]	•[1,2]	•[3]			•	•[4]	F
Alethe poliocephala Brown-chested alethe		•[1]	•[1,2]	•[1,3]			•		F
Neocossyphus rufus Red-tailed ant thrush				•[3]				•[5]	R
Neocossyphus poensis White-tailed ant-thrush			•[1,2]	•[3]			•	•[5]	F
Neocossyphus fraseri Rufous flycatcher-thrush			•[2]	•[1,3]			•	•[4]	R
Saxicola torquata Common stonechat							•		R
Turdus pelios African thrush							•	•[4]	R
Zoothera camerunensis Black-eared ground thrush		•[2]							CB
Bradypterus lopesi Lopez's Warbler							•		R
Bathmocercus rufus Black-faced rufous warbler				•[3]				•[6]	CB
Acrocephalus arundinaceus Great reed-warbler								•[6]	V
Acrocephalus rufescens Greater swamp-warbler							•	•[6]	R
Cisticola anonymus Chattering cicticola				•[1,3]				•[4]	F
Cisticola galactotes Winding cisticola								•[6]	R
Cisticola juncidis Fan-tailed cisticola								•[5]	R
Cisticola brunnescens Pectoral-patch cisticola						•[1]			R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Cisticola ayresii Wing-snapping cisticola								•[6]	R
Prinia bairdii Banded prinia				•[3]				•[4]	F
Urolais epichlora Green longtail *							•	•[6]	M
Apalis binotata Masked apalis								•[6]	F
Apalis jacksoni Black-throated apalis				•[3]					R
Apalis nigriceps Black-capped apalis				•[3,4]			•	•[4]	F
Apalis rufogularis Buff-throated apalis				•[3]			•	•[5]	F
Apalis cinerea Grey apalis							•	•[6]	M
Poliolais lopesi White-tailed warbler *							•	•[6]	M
Camaroptera brachyura Bleating warbler				•[3]		•[1]		•[4]	R
Camaroptera superciliaris Yellow-browed Camaroptera	•[1]	•[1]	•[1]	•[1,3]			•	•[5]	F
Camaroptera chloronata Olive-green camaroptera				•[3]			•	•[5]	F
Macrosphenus flavicans Yellow longbill			•[2]	•[3]			•		CB
Macrosphenus concolor Grey longbill	•[1]	•[1]	•[1]	•[3]			•	•[6]	F
Eremomela badiceps Rufous-crowned eremomela				•[1,3,4]			•	•[4]	F
Sylvietta virens Green crombec		•[1]		•[3]					F
Sylvietta denti Lemon-bellied crombec				•[3]					F
Phylloscopus trochilus Willow warbler							•	•[6]	V
Phylloscopus sibilatrix Wood warbler				•[3]			•	•[6]	V

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Phylloscopus herberti Black-capped woodland-warbler *				•[3]			•		M
Phylloscopus budongoensis Uganda woodland-warbler				•[3]					F
Sylvia borin Garden warbler							•	•[5]	V
Hyliota violacea Violet-backed hyliota				•[3]				•[6]	F
Hylia prasina Green hylia	•[1]	•[1]	•[1]	•[1,3,4]	•[1]	•[1]	•	•[4]	F
Fraseria ochreata Fraser's forest flycatcher		•[1]		•[3,4]			•	•[4]	F
Fraseria cinerascens White-browed forest flycatcher	•[1]			•[3]		•[1]			F
Muscicapa striata Spotted flycatcher							•	•[6]	V
Muscicapa caerulescens Ashy flycatcher				•[3]					R
Muscicapa cassini Cassin's flycatcher				•[3]				•[6]	F
Muscicapa olivascens Olivaceous flycatcher				•[3]				•[4]	F
Muscicapa adusta African dusky flycatcher							•		R
Muscicapa epulata Little grey flycatcher				•[4]				•[4]	F
Muscicapa sethsmithi Yellow-footed flycatcher			•[2]	•[3]			•	•[6]	F
Muscicapa comitata Dusky blue flycatcher								•[6]	F
Muscicapa tessmanni Tessmann's flycatcher				•[3]				•[4]	F
Muscicapa infuscata Sooty flycatcher			•[1]	•[3]				•[4]	F
Myioparus griseigularis Grey-throated tit-flycatcher				•[3]				•[5]	F
Myioparus plumbeus Grey tit-flycatcher								•[6]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Erythrocercus mccallii Chestnut-capped flycatcher				•[3]				•[4]	F
Elminia longicauda African blue flycatcher		•[1]		•[1]				•[4]	R
Elminia nigromitrata Dusky crested flycatcher		•[1]	•[1]	•[3]					F
Elminia albiventris White-bellied crested flycatcher							•		M
Trochocercus nitens Blue-headed crested flycatcher		•[1]		•[3]				•[4]	F
Terpsiphone viridis African paradise-flycatcher				•[3]				•[4]	R
Terpsiphone rufocinerea Rufous-vented paradise-flycatcher								•[4]	F
Terpsiphone rufiventer Red-bellied paradise-flycatcher	•[1]	•[1]	•[1,2]	•[1,3]			•	•[4]	F
Megabyas flammulatus Shrike-flycatcher				•[3]			•	•[6]	F
Bias musicus Black-and-white flycatcher		•[1]		•[3]				•[4]	R
Dyaphorophyia castanea Chestnut wattle-eye		•[1]	•[2]	•[3,4]			•	•[4]	F
Dyaphorophyia tonsa White-spotted wattle-eye			•[2]	•[3]					F
Dyaphorophyia blissetti Red-cheeked wattle-eye				•[3]			•	•[6]	F
Dyaphorophyia concreta Yellow-bellied wattle-eye				•[1,3]					F
Platysteira cyanea Brown-throated wattle-eye				•[3]	•[1]				R
Batis minima Gabon Batis				•[3]					CB
Batis poensis Bioko batis				•[3]			•		F
Illadopsis fulvescens Brown illadopsis				•[3]				•[6]	F
Illadopsis rufipennis Pale-breasted illadopsis		•[1]	•[1,2]	•[1,3]			•	•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Illadopsis cleaveri Black-cap iliadopsis		•[1]	•[1,2]	•[1,3]			•	•[5]	F
Kakamega poliothorax Grey-chested illadopsis							•		M
Alcippe abyssinica Abyssinian hill-babbler							•		M
Dicrurus adsimilis Drongo			•[1]	•[3]			•	•[4]	R
Dicrurus atripennis Shining drongo	•[1]	•[1]	•[2]	•[3]					F
Dicrurus ludwigii Square-tailed drongo				•[3]				•[4]	R
Prionops caniceps Red-billed shrike				•[3]				•[4]	F
Lanius mackinnoni Mackinnon's shrike								•[4]	F
Laniarius leucorhynchus Sooty Boubou				•[3]				•[4]	F
Laniarius ferrugineus Tropical boubou						•[1]		•[6]	R
Laniarius fülleborni Mountain sooty boubou							•		M
Laniarius luhderi Luhder's bush shrike				•[3]				•[4]	F
Dryoscopus senegalensis Zanzibar puffback				•[3]				•[4]	F
Dryoscopus gambensis Northern puffback								•[6]	R
Dryoscopus angolensis Pink-footed puffback				•[3]					F
Dryoscopus sabini Sabine's puffback				•[3]				•[4]	F
Malaconotus bocagei Grey bush shrike				•[3]					F
Malaconotus multicolor Many-colored bush shrike				•[3]				•[6]	F
Malaconotus cruentus Fiery-breasted bush shrike				•[3]				•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Nicator chloris Nicator	•[1]	•[1]		•[3,4]		•[1]		•[4]	R
Nicator vireo Yellow-throated nicator				•[3]				•[4]	F
Parus funereus Dusky tit								•[6]	F
Oriolus oriolus European golden oriole							•	•[6]	V
Oriolus brachyrhynchus Western black-headed oriole				•[3]					F
Oriolus nigripennis Black-winged oriole				•[3,4]			•	•[4]	F
Corvus albus Pied crow	•[1]	•[1]		•[3]	•[1]	•[1]	•	•[6]	R
Cinnyricinclus leucogaster Amethyst starling								•[6]	R
Lamprotornis splendidus Splendid glossy starling				•[4]			•	•[4]	R
Lamprotornis purpureiceps Purple-headed glossy starling				•[3]				•[4]	F
Onycognathus fulgidus Forest chestnut-winged starling				•[3]			•		R
Onchygnathus walleri Waller's red-winged starling							•	•[6]	R
Poeoptera lugubris Narrow-tailed starling				•[3]			•	•[4]	F
Buphagus africanus Yellow-billed oxpecker								•[6]	R
Picathartes oreas Grey-necked picathartes * †		•[1]		•[1,3]			•	•[5]	CB
Zosterops senegalensis Yellow white-eye				•[1,3]			•	•[6]	R
Speirops brunneus Fernando Po speirops *							•		M
Nectarinia superba Superb sunbird				•[3]				•[4]	R
Nectarinia johannae Madame Verreaux's sunbird				•[3]				•[4]	F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Nectarinia bouvieri Orange-tufted sunbird								•[6]	R
Nectarinia chloropygia Olive-bellied sunbird				•[3]			•	•[4]	R
Nectarinia preussi Preuss's sunbird			•[1]	•[1]	•[1]		•	•[6]	M
Nectarinia minulla Tiny sunbird				•[3]			•	•[6]	F
Nectarinia fuliginosa Carmelite sunbird								•[5]	F
Nectarinia rubescens Green-throated sunbird				•[3]			•	•[4]	R
Nectarinia ursulae Ursula's mouse colored sunbird *							•	•[6]	M
Nectarinia verticalis Green-headed sunbird								•[5]	R
Nectarinia cyanolaema Blue-throated sunbird				•[3]		•[1]	•	•[4]	F
Nectarinia oritis Cameroon blue-headed sunbird *							•	•[6]	M
Nectarinia olivacea Olive sunbird	•[1]	•[1]	•[1,2]	•[1,3]		•[1]	•	•[4]	R
Nectarinia batesi Bate's sunbird				•[3]			•	•[6]	R
Nectarinia seimundi Little green sunbird				•[1,3]			•		F
Anthreptes collaris Collared sunbird	•[1]	•[1]		•[1,3]		•[1]	•	•[4]	R
Anthreptes rectirostris Yellow-chinned sunbird				•[3]			•	•[4]	F
Anthreptes fraseri Fraser's sunbird			•[2]	•[3]			•	•[4]	F
Anthreptes gabonicus Brown sunbird								•[4]	F
Pholidornis rushiae Tit-hylia				•[3]			•	•[6]	F
Passer griseus Grey-headed sparrow		•[1]		•[3,4]	•[1]		•	•[4]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Ploceus cucullatus Village weaver	•[1]	•[1]		•[1,3,4]	•[1]	•[1]	•	•[4]	R
Ploceus bicolor Dark-backed weaver							•	•[6]	R
Ploceus nigricollis Black-necked weaver							•	•[4]	R
Ploceus ocularis Spectacled weaver								•[6]	R
Ploceus melanogaster Black-billed weaver							•		M
Ploceus aurantius Orange weaver				•[3]				•[6]	F
Ploceus insignis Brown-capped weaver							•	•[6]	M
Ploceus preussi Golden-backed weaver				•[3]				•[6]	F
Ploceus tricolor Yellow-mantled weaver				•[3]					F
Ploceus nigerrimus Viellot's weaver	•[1]			•[3]	•[1]	•[1]		•[4]	F
Ploceus albinucha White-naped weaver				•[3]			•		F
Malimbus malimbicus Crested malimbe		•[1]		•[3]				•[4]	F
Malimbus rubricollis Red-headed malimbe				•[3]			•	•[4]	F
Malimbus cassini Cassin's malimbe				•[3]					CB
Malimbus nitens Gray's malimbe	•[1]		•[2]	•[3]				•[4]	F
Malimbus coronatus Red-crowned malimbe				•[3]				•[4]	F
Malimbus scutatus Red-vented malimbe				•[1]					F
Malimbus racheliae Rachel's malimbe		•[1]		•[3]				•[6]	F
Malimbus erythrogaster Red-bellied malimbe				•[3]					F

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Amblyospiza albifrons Thick-billed weaver								•[6]	R
Quelea erythrops Red-headed quelea							•	•[4]	R
Euplectes capensis Yellow bishop							•	•[6]	R
Euplectes afer Yellow-crowned bishop								•[6]	R
Euplectes macrourus Yellow-mantled whydah								•[6]	R
Lonchura cucullata Bronze mannikin	•[1]	•[1]		•[1,3]	•[1]	•[1]	•	•[4]	R
Lonchura bicolor Black and white mannikin				•[1,3]	•[1]		•	•[4]	R
Parmoptila woodhousei Flower-pecker weaver-finch			•[2]	•[3]				•[4]	F
Nigrita canicapilla Grey-crowned negro-finch				•[3]			•	•[4]	F
Nigrita bicolor Chestnut-breasted negrofinch	•[1]			•[3]				•[4]	F
Nigrita luteifrons Pale-fronted negro-finch				•[3]			•	•[4]	F
Nigrita fusconota White-breasted negro-finch		•[1]		•[3]			•		F
Spermophaga haematina Bluebill			•[1]	•[3,4]				•[4]	F
Pyrenestes ostrinus Black-bellied seedcracker	•[1]			•[3]				•[4]	R
Cryptospiza reichenowii Red-faced crimson-wing							•		M
Ortygospiza gabonnensis Black-chinned quailfinch								•[6]	R
Hypargos nitidulus Green-backed twin-spot							•		R
Estrilda astrild Common waxbill		•[1]		•[1,4]			•	•[4]	R
Estrilda melpoda Orange-cheeked waxbill		•[1]		•[1,3]				•[4]	R

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
Estrilda atricapilla Black-headed waxbill				•[1,3]				•[4]	F
Estrilda nonnula Black-crowned waxbill				•[1]			•	•[5]	R
Nesocharis ansorgei Fernando Po olive-back *							•		M
Vidua macroura Pin-tailed whydah	•[1]						•	•[4]	R
Serinus burtoni Thick-billed seed-eater							•		M
Linurgus olivaceus Oriole finch							•		M
Emberiza cabanisi Cabani's bunting								•[4]	R

* Rare Bird, Hall and Moreau (1962), Collar and Stuart (1985)
† Threatened species, Collar and Stuart (1985)

Relative abundance of birds was lowest at Monte Alen (Table 4; 33.6 birds/1000mhrs), and highest at Montes Mitra (Table 1.3; 67.5 birds/1000mhrs; $G = 11.4$, df = 3, $P < 0.01$). Relative abundance at Nsork and Rio Campo was intermediate, but was not significantly different from either Montes Mitra or Monte Alen ($P > 0.25$). The Little greenbul, *Andropadus virens* was very common at Rio Campo, (Table 1.3) which is a good indicator of the level of disturbance of the forest. *A. virens* is most common in secondary forest, whereas the Yellow-whiskered greenbul, *A. latirostris* tends to be more common in mature forest, and high elevation forest (Brown et al. 1982-97, Louette and Fotso 1995). We caught our target species, the Olive sunbird, *Nectarinia olivacea*, at all four sites, and *A. virens* at two. Additionally, we have genetic samples from previous work on Bioko for both of these species, as well as the montane species, Blue-headed sunbird, *N. oritis*, and Mountain greenbul, *A.tephrolaemus.*

Table 1.3. Bird species captured/1000mhrs at four sites in Equatorial Guinea. Status: E = species whose range is limited to the vicinity of the rainforest block, including the Congo basin and West Africa. Status: R = resident, widespread, F = resident, primary habitat is rainforest, CB = range restricted to the Congo Basin.

Species	Site				Status
	Rio Campo	Nsork	Montes Mitra	Monte Alen	
Turtur brehmeri Blue-headed wood-dove	0.86	—	—	—	F
Turtur tympanistria Tambourine dove	0.43	—	—	—	R
Halcyon malimbica Blue-breasted kingfisher	1.29	—	—	—	R
Ceyx lecontei Dwarf kingfisher	—	0.39	—	0.43	F
Corythornis leucogaster White-bellied kingfisher	—	0.39	1.52	—	F
Alcedo quadribrachys Shining-blue kingfisher	—	—	0.38	—	F
Pogoniulus atroflavus Red-rumped tinkerbird	0.86	—	—	—	F
Pogoniulus subsulphureus Yellow-throated tinkerbird	—	—	—	0.43	F
Sasia africana African piculet	—	—	—	0.43	CB
Campethera caroli Brown-eared woodpecker	—	0.39	—	—	R
Motacilla clara Mountain wagtail	—	—	0.38	—	R
Andropadus virens Little greenbul	9.47	—	1.90	—	R

Species	Site				Status
	Rio Campo	Nsork	Montes Mitra	Monte Alen	
Andropadus latirostris Yellow-whiskered greenbul	2.15	2.76	0.38	6.08	F
Phyllastrephus icterinus Icterine greenbul	—	—	0.38	—	F
Phyllastrephus xavieri Xavier's greenbul	—	0.39	—	0.87	CB
Bleda syndactyla Red-tailed bristlebill	—	0.39	0.76	—	F
Bleda eximia Green-tailed bristlebill	—	2.76	3.81	—	F
Criniger chloronotus Eastern bearded greenbul	—	—	1.90	—	CB
Criniger calurus Red-tailed greenbul	—	—	0.76	—	F
Stiphrornis erythrothorax Forest Robin	—	1.18	1.52	—	F
Sheppardia cyornithopsis Lowland akalat	—	—	1.14	—	F
Alethe diademata Fire-crested alethe	—	2.37	1.14	—	F
Alethe poliocephala Brown-chested alethe	—	1.18	3.42	0.43	F
Neocossyphus poensis White-tailed ant-thrush	—	—	1.52	—	F
Neocossyphus fraseri Rufous flycatcher-thrush	—	—	—	0.43	R
Macrosphenus concolor Grey longbill	0.43	—	0.38	—	F
Hylia prasina Green hylia	—	0.39	0.38	0.43	F
Fraseria cinerascens White-browed forest-flycatcher	1.72	—	—	—	F
Elminia nigromitrata Dusky crested flycatcher	—	0.39	0.38	—	F
Terpsiphone rufiventer Red-bellied paradise flycatcher	—	0.39	0.38	—	F
Dyaphorophyia concreta Yellow-bellied wattle-eye	—	—	—	1.30	F
Illadopsis cleaveri Black-cap iliadopsis	—	0.39	—	—	F

Species	Site				Status
	Rio Campo	Nsork	Montes Mitra	Monte Alen	
Illadopsis rufipennis Pale-breasted illadopsis	—	1.97	1.14	0.43	F
Nicator chloris Nicator	0.86	—	—	—	R
Picathartes oreas Grey-necked picathartes	—	—	—	0.43	CB
Nectarinia olivacea Olive sunbird	1.72	4.34	3.04	1.30	R
Nectarinia seimundi Little green sunbird	—	—	—	0.43	F
Nigrita bicolor Chestnut-breasted negrofinch	0.43	—	—	—	F
Spermophaga haematina Bluebill	—	—	0.38	—	F
Pyrenestes ostrinus Black-bellied seedcracker	0.43	—	—	—	R
Netting intensity (meter-hours):	2322	2535	2628	2304	
Birds captured/1000mhrs:	20.67	20.12	27.02	13.45	

As seed dispersers, hornbills play an important role in rainforest dynamics, dispersing many different species of fruit. They have also been shown to travel large distances and to track fruit abundance, thus they are likely critical to rainforest regeneration, especially as populations of other large frugivores decrease with human exploitation (Whitney et al. 1998, Whitney and Smith 1998). Black-casqued hornbills, *Ceratogymna atrata*, were significantly more common at Rio Campo than at the other two sites (Fig. 1.3; G-test = 15.2, df = 2, $P < 0.001$), although group size was similar at all sites (Fig. 1.3, $P > 0.35$). The large numbers of black-casques at Rio Campo may have been indicative of greater fruit availability at Rio Campo at this point in time. While we did not conduct phenology studies, we saw little evidence of fruiting throughout Equatorial Guinea. An exception to this may have been in Rio Campo, where many *Mussanga cercopiodes* and *Picanthus sp*. were in fruit. What we saw would be considerably less than normal for this time of year in the Dja Reserve, Cameroon, from which we have extensive phenological data. Preliminary data from the Dja shows that fruiting was reduced there as well in May 1998 (unpublished data). White-thighed Hornbills, *Ceratogymna cylindricus*, were recorded only at Nsork (but not on transects), and Black-billed Dwarf Hornbills, *Tockus hartlaubi*, were recorded only at Rio Campo and Monte Alen (Table 1.2).

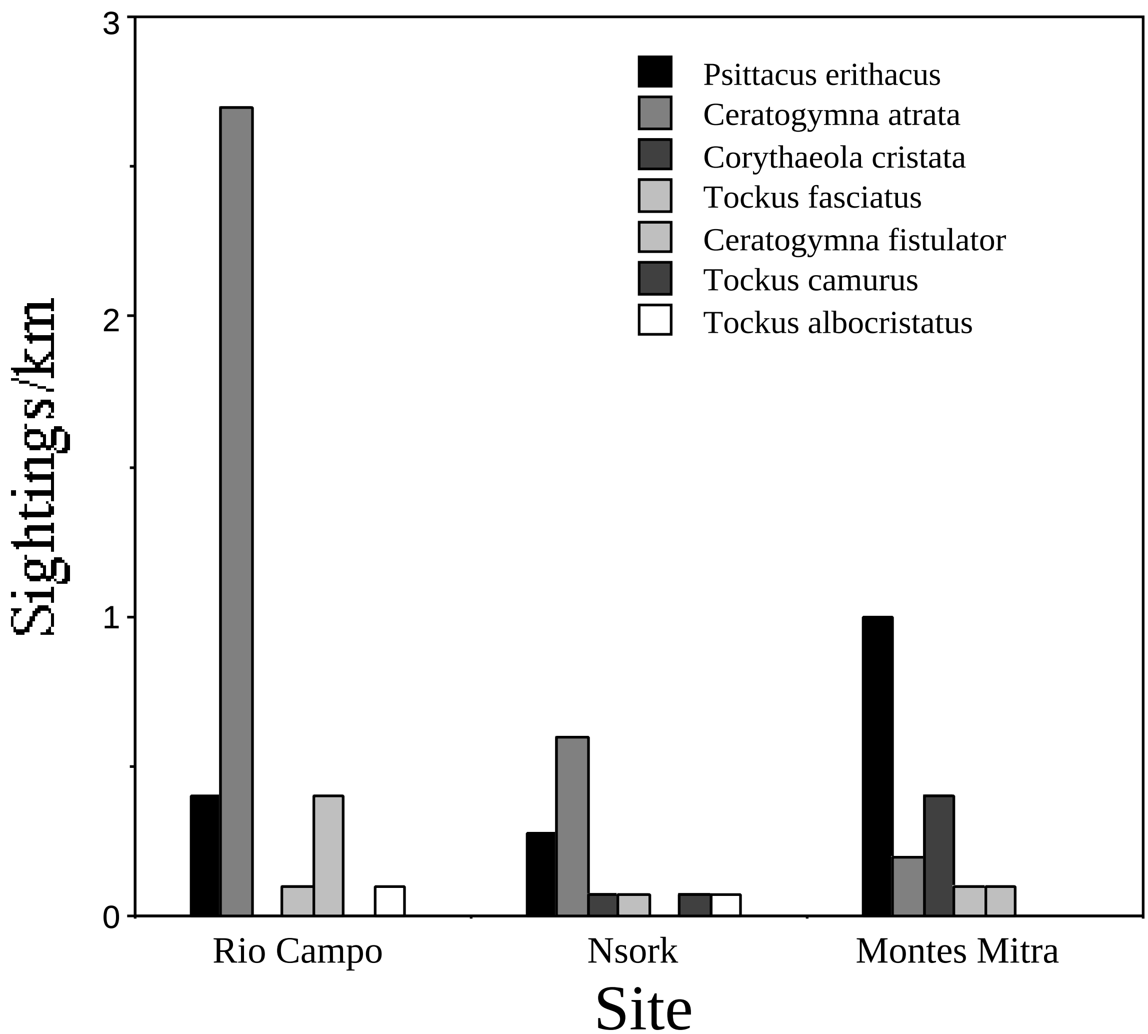

Figure 1.3. Relative abundance of large, frugivorous birds observed along transects at three sites in Rio Muni, Equatorial Guinea.

MAMMAL SURVEYS

The distribution of large mammals among the three proposed protected areas visited in Rio Muni is presented in Table 1.4. One notable omission from previous surveys such as Sabater Pi and Jones (1967) and Fa (1991) is the presence of the Crowned monkey, *Cercopithecus pogonias* in Rio Muni. The Crowned monkey was common in all three areas we visited (Table 1.4), and has been recorded at Monte Alen (Garcia and Mba 1997). The two other common species were Moustached monkey, *Cercopithecus cephus*, and Putty-nosed Monkey, *Cercopithecus nictitans*. Relative abundance of monkeys was similar among the three sites (G-test = 0.56, df = 2, $P > 0.90$) and the abundance of individual monkey species was also similar among sites ($P > 0.50$ in all cases). *P. nictitans* was observed the most often of the common species, and *C. pogonias* the least, but neither was significantly more or less common than the other two ($P > 0.50$). Black colobus, *Colobus satanus*, were observed only at Montes Mitra, in a mixed group of Crowned, Moustached and Putty-nosed monkeys. Black colobus are limited to the far western part of the Congo Basin, and are listed as Endangered by IUCN (Lee et al. 1988). Red-capped mangabey, *Cercocebus torquatus*, is a riverine species and was not recorded by us but has been recorded along rivers in Rio Campo and Montes Mitra (Sabater Pi and Jones 1967), and along rivers in Monte Alen (Garcia and Mba 1997). Fa (1991) reports it from Nsork, based on information from locals, but there are no records from there that we know of. The Red-capped mangabey has a very limited distribution, restricted to the far west Congo Basin and a small part of Nigeria. The species is not compatible with extensive cultivation and is heavily hunted, thus is disappearing from many areas (Kingdon 1997), and is listed as Vulnerable by IUCN (Lee et al. 1988). In addition to monkeys observed at our survey sites, we recorded a De Brazza's Monkey, *Cercopithecus neglectus*, in gallery forest in the savanna near Bata.

We observed two Chimpanzee nest at Nsork, but they were over a month old. a Gorilla was heard and fresh sign was found along transects (Fig.1.4). No sign of Chimpanzee or Gorilla, old or new, was recorded at Rio Campo or Montes Mitra, however, both are reported by locals to be present. Locals at Rio Campo reported that Gorilla and Chimpanzee commonly raid their plantations. Gorilla and Chimpanzee are listed as Vulnerable (IUCN) in the western Congo Basin, but are endangered in other parts of their range. Mandrill, *Mandrillus sphinx*, was reported to occur in all three areas, but fresh sign of Mandrill was recorded only at Nsork, while some older sign was seen at Rio Campo, and none at Montes Mitra. Mandrill are listed as Vulnerable by IUCN.

Red River Hogs were recorded at extremely high frequencies in Rio Campo, and at significantly lower densities at the other two sites (Fig. 1.4; G-test = 21.3, df = 2, $P < 0.001$). This difference may partly be due to the hog's preference for stream courses and swampy areas which were abundant at Rio Campo (3.2/km), while Nsork had fewer (1.7/km) and Montes Mitra very few (0.4/km). River Hogs were positively correlated with the number of streams on a transect (Spearman coefficient = 0.796, n = 7, $P < 0.05$). Sitatunga, *Tragelaphus spekei*, a riverine species, was only recorded at Rio Campo and Nsork, the two areas with numerous streams (Fig 1.4, Table 1.4). It is reported by locals at Montes Mitra, however, the area we surveyed was very rugged and lacked many streams, and may not be good habitat for Sitatunga. We observed a bushbuck , *Tragelaphus scriptus*, carcass on display in front of a hut in the northeast as we passed through (Table 1.4), but none was detected at any of our sites. Although it is reported to occur in all of the proposed protected sites (Fa 1991), it is not a true forest species (Kingdon 1997, Castroviejo et al. 1990), and we would not expect it to be present in heavily forested areas such as the ones we surveyed.

No significant differences in abundance were noted for any duiker species (P > 0.05 in all cases), or for duikers as a group (P > 0.50). A Blue duiker, *Cephalophus monticola*, was seen while walking transects at Montes Mitra, and one was found caught in a trap and released. While no duikers are globally threatened, many are declining and vulnerable to extinction in parts of their range (Kingdon 1997).

Elephants are quite rare in Equatorial Guinea and unlikely to comprise more than 500 of the 200,000 animals thought to exist in central African rainforests (Barnes at al. 1993). Elephants are listed as endangered by the IUCN (Inskipp 1993). Equatorial Guinea, however, is one of the few countries where the elephants are apparently not currently threatened by commercial poaching for ivory (Barnes et al. 1993). The important areas for them are the mountains in the southwest and two areas in the southeast (Barnes 1993). Some very old elephant tracks and one skeleton were recorded at Montes Mitra, but no sign was observed at either of the other two sights, although locals reported their presence. At Rio Campo, the elephant population was alleged to have been decimated by a government sponsored program of hunting to reduce crop damage instituted 15 years ago (pers. comm., Frank Stenmanns, C.U.R.E.F.). The few that currently exist in the eastern part of the proposed reserve are probably emigrants from the Campo population in Cameroon (pers. comm. Frank Stenmanns, C.U.R.E.F.).

Forest buffalo, *Syncerus caffer nanus*, was reported to us by locals at Montes Mitra and we noted a skull hanging outside a hut, which the inhabitants said came from the area. At Rio Campo, locals said forest buffalo used to be common, but like elephants, were targeted by the government 15 years ago in response to complaints of crop destruction.

No sign of any cats or other carnivores was detected by us, but at Montes Mitra, locals reported that a hunter had taken a leopard the week before. Assessing carnivores will require other methods not employed by us, and would be useful.

Small mammals commonly recorded include Brush-tailed porcupine, *Atherurus africanus,* Giant Pouched Rat, *Cricetomys emini,* and Tree Hyrax, *Dendrohyrax dorsalis* (Table 1.4). Fa (1991) reports *Dendrohyrax arboreus* from all sites in Equatorial Guinea, rather than the one we list here, but *D.arboreus* is an eastern species, and we assume he meant *D. dorsalis*.

While traps are not used to hunt all animals, traps are easy to record and may provide a useful index of hunting activity in an area. Hunters often set traps while hunting with guns, since traps only need to be checked periodically.

Using traps as an index of hunting activity and intensity, we noted that the number of some species detected on transects was inversely correlated with the number of traps seen along them (Fig. 1.4). These species included Mandrill (Spearman coefficient = -0.872, n = 7, $P < 0.05$), Manids (sign of the three species was not readily distinguished) (Spearman coefficient = -0.833 , n = 7, $P < 0.05$), and Sitatunga (Spearman coefficient = -0.791 , n = 7, $P < 0.05$). Numbers of Bay duiker were not strongly associated with traps, but were negatively correlated with overall human activity as indexed by summing hunting trails and traps (Spearman coefficient = -0.793 , n = 7, $P < 0.05$). Bay duikers are thought to be over hunted in the littoral zone of Equatorial Guinea (Fa et al. 1995).

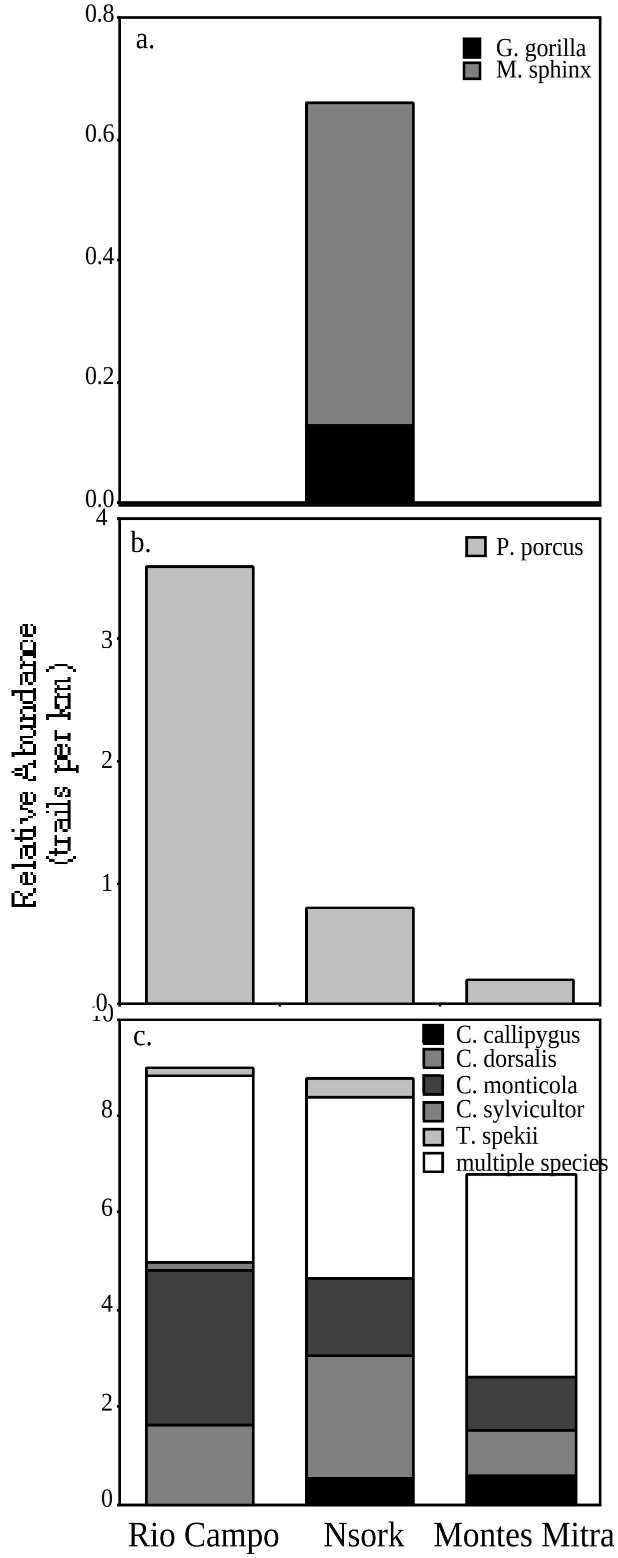

Figure 1.4. Relative abundance of mammals at three sites in Equatorial Guinea, estimated from sign along transects: a) primates, b) Suidae, c) Bovidae.

Table 1.4. Distributions of large mammals in three proposed protected areas of Rio Muni. A = species seen or heard by us; B species for which sign was recorded (old or new); C species reported by locals to us. Numeric entries refer to reports of species by other sources. Table includes a complete list of large mammals reported to occur in Equatorial Guinea (cercopithids, hominids, felids, elephantidae, and artyodactyls), as well as some smaller mammals such as rodents, manids, and viverids recorded by us or reported to us. Status: E = species which are rainforest endemics, CB = species limited to the Congo Basin, W = species limited to the west Congo Basin.

Species	Fang Name	Rio Campo	Nsork	Montes Mitra	Status
Primates					
Chimpanzee *Pan troglodytes*[4]	Ngoro	C[1,2]	B[1,2]	C[1,2]	E
Gorilla *Gorilla gorilla*[4,5]	Ngui	C[1,2,6]	A[1,2,6]	C[1,2,6]	CB
Black colobus *Colobus satanus*[4,5]	Nvam	1,2	2	A[1,2]	W
Mandrill *Mandrillus sphinx*[4,5]	Esegue	C[1,2]	B[1,2]	C[1,2]	W
Red-capped mangabey *Cercocebus torquatus*[4,5]	Kacfung	1,2	2	1,2	W
Grey-cheeked mangabey *Lophocebus albigena*[4,5]	Kak	1,2	2	1,2	CB
Talapoin *Miopethecus talapoin*[4,5]	Onsem	1,2	1,2	C[1,2]	W
De Brazza's monkey *Cercopithecus neglectus*[5]	Fung	1,2	1,2	1,2	CB
Mona monkey *Cercopithecus mona*[5]		1	—	—	E
Crowned monkey *Cercopithecus pogonias*[4,5]	Essuma	A	A	A	CB
Putty-nosed monkey *Cercopithecus nictitans*[4,5]	Avem	A[1,2]	A[1,2]	A[1,2]	E
Moustached monkey *Cercopithecus cephus*[4,5]	Nguemechog	A[1,2]	A[1,2]	A[1,2]	W
Rodentia					
Fire-footed rope squirrel *Funisciurus pyrropus*[4]	Edon	—	—	A	E
African pigmy squirrel *Myosciurus pumilio*[4]	Nvok-sen	—	—	A	W
Brush-tailed porcupine *Atherurus africanus*[4,5]	Ngom	B[2]	B[2]	A[2]	E
Giant pouched rat *Cricetomys emini*[4,5]	Kuiñ	B	B	B	E
Felidae					
Leopard *Panthera pardus*[4]	Nze	C[2]	C[2]	C[2]	E

Species	Fang Name	Rio Campo	Nsork	Montes Mitra	Status
Golden cat *Felis aurata*[4]	Ebio	2	2	2	CB
Viverridae					
Servaline genet *Genetta servalina*[4,5]	Nsing	2	2	2	
Central African linsang *Poiana richardsoni*[4]	Oyan				
African civet *Civettictis civetta*[4,5]	Nsueñ	2	2	C2	
African palm civet *Nandinia binotata*[4,5]	Nveiñ	2	2	C2	
Manidae					
Long-tailed pangolin *Uromanis tetradactyla*[4]	Ka-chim	—	—	—	E
Tree pangolin *Phataginus tricuspis*[4,5]	Ka	—	B	—	
Giant pangolin *Smutsia gigantea*[4,5]	Fima	—	B	—	E
Procaviidae					
Tree Hyrax *Dendrohyrax dorsalis*[4,5]	Ñok	A2	A2	A2	E
Elephantidae					
Elephant *Loxodonta africana*[4]	Nzok	C	C2	B2	
Hippopotamidae					
Hippopotamus *Hippopotamus amphibius*		C	—	—	
Suidae					
Red River Hog *Potamochoerus porcus*[4,5]	Nguin	B2	B2	B2	
Tragulidae					
Water Chevrotain *Hyemoschus aquaticus*[4,5]	Vioñ	—	—	C	E
Bovidae					
Forest Buffalo *Syncerus caffer nanus*[4]	Ñat	C2	2	C2	
Bushbuck *Tragelaphus scriptus*		2	2	2	
Sitatunga *Tragelaphus spekei*[4,5]	Nvu	B2	B2	C2	
Blue Duiker *Cephalophus monticola*[4,5]	Okuong	A,B2	B2	A,B2	

Species	Fang Name	Rio Campo	Nsork	Montes Mitra	Status
Peter's Duiker *Cephalophus callipygus*[4]	Nvin	3	B3	B3	CB
Black-fronted Duiker *Cephalophus nigrifrons*[4]	Nzom				CB
Bay Duiker *Cephalophus dorsalis*[4,5]	Só	B2	B2	B2	
White-bellied Duiker *Cephalophus leucogaster*[4,5]	Mieñ	3	3	3	B
Ogilby's Duiker *Cephalophus ogilbyi*[3,5]		—	—	C	
Yellow-backed Duiker *Cephalophus silvicultor*[4,5]	Nzip	B2	C2	C2	
Dwarf Antelope *Neotragus batesi*[4,5]	Oyueñ	2	2	2	B

1) Sabater Pi and Jones (1967); 2) Fa (1991); 3) Castroviejo, Blom, and Alers (1990); 4) Alcala (1995), Garcia and Mba (1997); 5) Fa et al. (1995), Juste et al. (1995); 6) Gonzalez-Kirchner (1997).

SOCIO-POLITICAL CONTEXT

Equatorial Guinea is one of the poorest countries in Africa, with cocoa, coffee and wood making up its main exports (Fa 1991, 1992, Juste and Fa 1994). The reliance on timber exports (50% of export income, Fa 1991) poses significant hurdles for establishing sustainable development and illustrates the strong need to develop other forms of exports and sources of foreign exchange. Currently, it is unclear how the recent discovery and production of offshore oil will affect the biodiversity of the country. Most of the population is reliant on subsistence agriculture (primarily manioc, maize, plantains, peanuts, bananas, coffee and cacao) and depends heavily on bushmeat as a source of protein (Fa 1991, Juste and Fa 1994, Colell and Maté 1994, Juste et al. 1995, Fa et al 1995). Alternative sources of protein such as domestic livestock and fisheries are poorly developed, despite the fact that Equatorial Guinea has 300,000 km^2 of fishing grounds (Fa 1991, Juste and Fa 1994). Two differences that stand out between Equatorial Guinea and neighboring Cameroon, are the lack of produce and other agricultural products for sale in local markets, and the lack of public transportation, either buses or bush taxis. The rainforest of Rio Muni is under considerable pressure from both agricultural conversion and logging (Fa 1991, 1992, Juste and Fa 1994). Logging concessions exist within all three of the areas we visited, and the coastal area of Rio Campo has been heavily disturbed by logging within the last five years. Only a restricted area of Montes Mitra has been logged due to the rugged terrain, but there is a new logging road that may come into use in the near future. Logging has occurred mostly on the western edge of Nsork, although some logging has occurred nearly throughout in the past, according to locals. Only Monte Alen enjoys some measure of protection due to the combined presence of conservation organizations and steep terrain (Fa 1991, Lasso et al. 1996, Garcia and Mba 1997).

Interviews:

Reserva Natural de Rio Campo-- Although Rio Campo is dissected by two roads, the area is sparsely settled (Fig. 1.1a). The inhabitants of Elende and other villages in the area, (Besu, Tica) are descendants of people who migrated from Cameroon before World

War I. Most villages have fewer than 50 inhabitants, and there is little infrastructure. A small primary school, clinic, and market are located in Elende, and a secondary school is located in Tica. The difficulties facing local inhabitants include lack of access to larger markets, due to poor transportation, and scarce agricultural products. The main agricultural products on the coast appear to be manioc and coconut (personal observations and data from C.U.R.E.F.), and when we asked if it was possible to buy other produce, the response was "no". Coconuts are one of the few means of monetary income in the area, and the coconut trees are being lost to disease. Fishing is one of the few available sources of income. Fishing could take some pressure off forest animal populations, but fisheries are not well developed. A serious implication of increased fishing, however, is that more Green turtles, *Chelonia mydas*, may be taken. We saw numerous turtles taken in the 4 days we were there. Terrestrial hunting is done with traps and guns. Other uses of the forest include wood for construction and firewood. Extensive logging took place about five years ago in the coastal region, and the forest is quite disturbed, with large numbers of Musanga and Rattan.

Parque Nacional de Los Altos de Nsork-- This region is somewhat larger than Rio Campo, and not bisected by roads. Villages are scattered along the roads surrounding the area, and there are none in the interior. In the southern part, near Nsork, the villages range in size from 50-400 inhabitants. This region was apparently colonized by immigrants from Gabon between 1930 and 1970. There is a dispensary at Esong, as well as pre- and secondary schools. There are also a primary school at Macula and pre- and primary schools at Nsumu. Locals utilize the forest for wood for construction, gathering fruits and other products, hunting, and agriculture. Agricultural products are much more plentiful here than in Rio Campo. Daily, our guides brought us produce, including mangoes, sugar-cane, and papaya, and they also grew corn, manioc, peanuts, and cassava. Hunting is done by traps and guns, but it is done primarily for subsistence, because there is little access to markets. Chickens provide an additional source of protein for these villages. Some of the area was apparently logged about 20 years ago (in the time of Macias, according to locals) by loggers coming from Acurenam.

Montes Mitra--The village nearest our survey site was Ncoho. It is a small village of 100-200 inhabitants. Other nearby villages are Vabe and Basilé, with 1-200 and 400 inhabitants respectively. The opening of the Cogo-Ncoho road in 1949 created an influx of population to the area. There are primary schools in all three villages, and dispensaries in Vabe and Ncoho. The main activities are hunting, fishing and agriculture, with some exploitation of the forest for construction, especially of canoes. The main crop is manioc, and excess is taken to sell in Cocobeach, Gabon.

N.G.O.'s and the New Proposed Reserve System-- N.G.O.'s currently operating in Rio Muni include ECOFAC (Conservation et utilization rationnelle des ecosystemes forestiers en Afrique Centrale) and C.U.R.E.F. (Proyecto Conservacion y Utilazacion Racional de los Ecosystemas Forestales de Guinea Ecuatorial). We met with Luiz Arranz (Director), of ECOFAC and Frank Stenmanns (Asistente Technico Principal) and Jaime Oko (Director Nacional) of C.U.R.E. F. Additionally some local biologists, Jesus Mba and Jose Nguema, are attempting to start an N.G.O. which would work on a grass roots level to educate local people about biodiversity We met briefly with Jesus Mba, and Jose Nguema worked with us at some of our sites. A Spanish N.G.O., Associación de Amigos de Doñana operates only on Bioko, and their primary focus seems to be ecotourism.

ECOFAC's primary focus is studying and preserving the biodiversity of Monte Alen. Efforts are being made to reduce human impacts by banning hunting and agriculture within the park, and developing sustainable industries for locals. A kilometer border around the park has been set aside for agriculture. ECOFAC has set up an ecotourist lodge, trained ecoguards, and is attempting to habituate gorillas (Bermelo 1998). They have research cabins and camps that may be used by researchers free of charge, and can provide logistical assistance to researchers. They have supported a number of studies in this way at Monte Alen, including numerous vertebrate (Alcala 1995, Dowsett-Lemaire 1998, Garcia and Mba 1997) and vegetation surveys (LeJoly and Wilks 1995, LeJoly et al. 1995).

C.U.R.E.F.'s mission is to propose a network of protected areas (Figs. I.1, I.2), based largely on a series of maps showing topography, resources, vegetation, physiography, soils, and actual and projected land use. They have also established nine 100 m transects for detailed examination of vegetation structure in Estuario del Muni, and conducted a primate survey in the eastern part of Rio Campo. Most of the biodiversity data they have to work with comes from interviews with local people, and a small number of surveys by visiting biologists. The proposed network (Machado 1998) attempts to address the variety of habitats in Equatorial Guinea and includes four types of conservation areas, including: 1) National Parks (Monte Alen and Nsork on Rio Muni; Pico Basilé on Bioko), 2) Natural Reserves (Rio Campo, Esturario del Muni, Monte Temelon, Punta Llende on Rio Muni; the small Islands of Corisco and Obeyes off the coast of Rio Muni, and Annobon), 3) National Monuments (Piedra Nzas and Pedra Bere, areas with extensive inselbergs on Rio Muni), and 4) Scientific Reserves (Caldera de Luba on Bioko, Playa Nendyi on the mainland). Monte Alen National Park has been expanded to incorporate the Montes Mitra area (Fig. 1), creating a protected corridor extending from sea level at Estuario del Muni to Monte Alen.

DISCUSSION

The most outstanding region on mainland Equatorial Guinea, with respect to its intact biodiversity, is Monte Alen. Currently, it has protected status, with hunting and agriculture banned from within the park and an emerging potential for ecotourism. There were few marked differences in bird and mammal abundance or levels of endemism among the other three areas that we visited, but of these, Montes Mitra and Nsork seemed to be the most valuable additions to the proposed network of protected areas.

One of the main values of Montes Mitra is that with Monte Alen and the Estuario del Muni, it would form a continuous gradient from sea level to over 1200 m. Such a gradient would be potentially important for animals that migrate altitudinally (Stuart 1986, Levey 1988, Loiselle and Blake 1991). Additionally, it may be an important area for elephants within Equatorial Guinea (Barnes 1993), and is the only area where we saw any sign of them.

Nsork is the only area in which we recorded all three large primates, Gorilla, Chimpanzee and Mandrill. This may be because markets are relatively inaccessible from the area we visited, and the animals are less likely to be hunted. Nsork may also be an important area for *Picathartes oreas* populations. *Picathartes* requires rocky outcrops in undisturbed forest on which to nest. Such conditions are found at both Monte Alen and Nsork, and we found nests at both sites. Due to its narrow nesting requirements, *Picathartes* is classified as rare by IUCN (Collar and Stuart 1985), and is an important species to consider in conservation efforts. Efforts should be made to locate nesting colonies in these and other areas. Three small proposed reserves in the western part of the country, Reserva Natural de Monte Temelon, Monumento Natural de Piedra Bere, and Monumento Natural de Piedra Nzas, are dotted with inselbergs, and may harbor populations of *Picathartes*, but have yet to be investigated.

Rio Campo is the most disturbed forest we visited because of logging within the last five years, nonetheless abundance of most animals were comparable to the other two areas. An advantage to conserving Rio Campo is that in conjunction with Campo Reserve in neighboring Cameroon, it would create a large international protected area. However, because Rio Campo is bisected by two roads (Fig 1.1a), and numerous villages are located within the reserve, the potential for conflict between human populations and wildlife are great. When the local population had difficulty with elephant and forest buffalo destroying their crops 15 years ago, the government intervened, allegedly slaughtering huge numbers of individuals, and the populations have been very slow to recover. Thus, unless conflicts between humans and wildlife in this area can successfully be ameliorated, conservation efforts in the area will be difficult to achieve. Rio Campo may be an important area for hornbills, but to determine whether this is so would require further study. The large numbers we observed may reflect normal conditions, or may have been a rare event caused by fruit scarcity elsewhere. Comparative work on the fruity phenology as a function of latitude should be undertaken. Especially given the fact that hornbills are know to disperse as much as 22% of the seeds of major tree species and that they undergo long-distance movements (Whitney and Smith, Holbrook and Smith in prep).

The major threat facing biodiversity are logging concessions that exist in these three areas. Active logging concessions would mean not only habitat destruction, but increased access to markets of bushmeat, and increased hunting pressure. Our research suggests that hunting may be having a significant effect on the abundance of some species Unlike other west African countries there are no closed hunting seasons in Equatorial Guinea, and at least two species, *Cercopithecus nictitans* and *Cephalophus dorsali*s may be over hunted on Rio Muni (Fa et al. 1995).

Achieving substantive conservation in Equatorial Guinea will be a challenge. An alleged political uprising in southern Bioko in February of this year (reportedly a coup attempt), and the massive change-over in ministers in March are examples. This has already had impacts on the ability of N.G.O.'s to operate in the country. We were informed that after the uprising in southern Bioko, Doñana fell under suspicion, and their boats were destroyed. More recently, we were informed that 7 Spanish scientists working at Monte Alen were expelled, and Monte Alen closed. C.U.R.E.F. has submitted an extensive proposal for a network of reserves to the Ministerio de Bosques y Medio Ambiente, but the project is not slated for renewal, and scientists at C.U.R.E.F. do not hold high hopes for implementation. Never the less, given Equatorial Guinea’s substatial oil reserves and projected revenues from oil, the country could become, if it choose to do so, a leader in preserving biodiversity.

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PART II:

BIOKO

Chapter 2. Preliminary Report on a Survey of The Herpetofauna of Bioko, Equatorial Guinea

Robert C. Drewes, Jens V. Vindum and Lindsay Henwood

INTRODUCTION

The herpetofauna of Bioko, Equatorial Guinea has been only sporadically sampled and as a result has remained very poorly known. To our knowledge, there have been but three publications on the reptile and amphibian fauna, all by Robert Mertens (1941, 1964, 1965), and all based on collections made along the more accessible coastal zone and localities below 1000 m. Until the work detailed below, no reptile or amphibian specimens have ever been collected for scientific purposes on the higher elevations of the predominant massif, Pico Basilé

The present preliminary report is based on a survey conducted by staff of the California Academy of Sciences and San Francisco State University, who were on the island between 15 September to 20 October 1998. This period was chosen to take advantage of the rainy season, during which amphibians are most easily sampled.

METHODS

The team consisted of Robert C. Drewes, Jens V. Vindum and Lindsay Henwood of the Department of Herpetology (CAS, SFSU), Darrel Ubick and Keith Dabney of the Department of Entomology (CAS) and was assisted by Ramon Willy Thomas and Martin-Pedro Ndong of the Ministry of Forestry and Environment (EG). Logistical support and driver were provided by Ramon Castelo Alvarez of Doñana, Malabo.

Field activities consisted of 26 collecting days in 37 sites, for each of which latitude and longitude were recorded. These included sites within the vicinity of Malabo, sites from approximately 2000 m to near the base of Pico Basilé, one on the east Malabo-Riaba road, a number in the vicinity of Moka Malabo, the Rio Lomo, the Luba-Moka road, Lago de Biao, the Moka-Lago de Biao trail, several in the vicinity of Luba, and the Arena Blanca (Luba-Malabo) road. A list of these localities is included in Appendix I.

RESULTS

A total of 117 reptile and 483 amphibian specimens was collected. Specimens were individually tagged, tissues were taken from each presumptive species for molecular analysis, and we attempted to photograph each species in color. In the case of amphibians, breeding calls were recorded for later acoustical analysis.

The specimens are presently being housed, identified and analyzed in the Department of Herpetology, California Academy of Sciences. Inasmuch as the collection has been in the country for a short time, the identifications of the specimens listed in Table 2.1 are tentative, and in some cases, to genus only.

Table 2.1. Reptiles and Amphibians collected on Bioko in September and October 1998.

REPTILIA	**AMPHIBIA**
Gekkonidae *Hemidactylus sp.* *Hemidactylus fasciatus* Agamidae *Agama agama* Chamaeleonidae *Chamaeleo cristatus* *Rhampholeon spectrum* Scincidae *Mabuya sp. A* *Mabuya sp. B* *Lygosoma sp.* *Leptosiaphos sp.* *Melanoseps occidentalis* Lacertidae *Holaspis guentheri* (possible sight record between Luba & Malabo) Varanidae *Varanus niloticus* Boidae *Calabaria reinhardtii* Colubridae *Hapsidophrys lineatus* Elapidae *Dendroaspis jamesoni* Viperidae *Atheris squamiger* *Bitis nasicornis*	Pipidae *Xenopus fraseri* *Xenopus tropicalis* Bufonidae *Bufo camerunensis* *Bufo gracilipes* *Nectophryne sp.* Ranidae cf. Aubria subsigillata *Arthroleptis variabilis* *Arthroleptis adelphus* *Arthroleptis sp. A.* *Arthroleptis sp. B.* *Arthroleptis sp. C.* *Conraua crassipes* *Dimorphognathus africanus* *Hylarana albolabris* *Petropedetes cf. newtoni* (larvae- no adults found) *Phrynobatrachus cornutus* *Phrynobatrachus cf. plicatus* *Phrynobatrachus sp. A* Hyperoliidae *Afrixalus dorsalis* *Afrixalus cf. laevis* *Hyperolius ocellatus* *Hyperolius sp. A* (viridiflavus complex) *Hyperolius sp. B.* (yellow gular) *Hyperolius sp. C.* (no yellow gular) *Hyperolius sp. D.* (marbled dorsal) *Hyperolius sp E.* (mottled lateral) *Leptopelis cf viridis* *Leptopelis sp. A.* *Leptopelis sp. B.* Rhacophoridae *Chiromantis rufescens*

TENTATIVE CONCLUSIONS

All reptile species collected were expected and previously recorded by Mertens (1964). Bioko is clearly a continental island having been connected to the mainland in the recent past. Thus endemism was not expected, nor a fauna as diverse as that of areas in mainland Cameroon such as Korup National Park (Lawson, 1993). However, it would appear that the main contribution of our study will be toward the understanding of the amphibian fauna of Bioko. For instance if our tentative identifications are correct, we record here for the first time, the presence on Bioko of the ranid genus, *Aubria* - a single specimen of *A. subsigillata*. Moreover, Mertens (1965) recorded three species of the ranid genus *Arthroleptis*; our collection would appear to include representatives of at least five species.

In his 1965 amphibian paper, Mertens listed but one species of the hyperoliid genus *Afrixalus*, *A. dorsalis*, occurring on the island; our material indicates there is at least one additional species, *A. laevis*, and perhaps a second. He also listed but two species of the largest hyperoliid genus, *Hyperolius*; we believe we have series of specimens representing six species. On the other hand, Mertens reported seven species of *Leptopelis*, of which we appear to have collected only three.

WORK IN PROGRESS

It is our ultimate intention to complete and provide a color-illustrated document describing the content and diversity of the reptile and amphibian fauna of Bioko, to be presented to CARPE, the Ministry of Forestry and Environment, Equatorial Guinea and other appropriate institutions. In order to complete this project, the following work remains to be accomplished:

1. complete the identification of the material collected on this trip to species level(this frequently requires reference to original species descriptions) and describe any new species contained within it;

2. examine and confirm identification of approximately 60 specimens collected on Bioko in 1906, 1933, 1946 and 1964, presently deposited in the Natural History Museum, London;

3. examine and identify material collected by members of Doñana, housed in Sevilla, Spain;

4. confirm identity and update nomenclature of the species listed
by Mertens (1964, 1965), and collate these and the collections above into a complete list of the herpetofauna of Bioko

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APPENDIX I: Localities collected by the California Academy of Sciences expedition to Bioko, Equatorial Guinea, 1998.

vicinity of Malabo
Malabo: port, 03 45 25.0 N, 08 46 51.5 E
Malabo: town center, 03 45 06.4 N, 08 47 00.3 E
Malabo: 03 45 20.3 N, 08 47 11.3 E

vicinity of Pico Basile (along Pico Basile road)
Pico Basile, along Pico Basile rd, 03 37 42.4 N, 08 48 11.0 E
junction of S coast rd and rd to Pico Basile, 03 42 30.6 N, 08 52 27.5 E
Pico Basile rd, ca 1.2 km E of coast rd, 03 41 45.2 N, 08 52 16.0 E
Pico Basile rd, 03 42 08.6 N, 08 52 24.9 E
03 42 18.6 N, 08 52 46.0 E

South Coast Road
S coast rd, 03 24 41.2 N, 08 44 46.7 E

vicinity of Moka Malabo
Moka Malabo, 03 21 39.4 N, 08 39 43.9 E
vic. Moka Malabo, 03 19 29.7 N, 08 40 16.1 E
vic. Moka Malabo, Rio Lomo, 03 19 29.7 N, 08 40 16.1 E
vic. Moka Malabo, forest slope N side Rio Lomo, 03 19 54.5 N, 08 40 10.3 E
creek on E side of Moka rd, 03 22 00.2 N, 08 39 53.7 E
Moka Malabo, 03 21 39.5 N, 08 40 02.7 E
vic Moka Malabo, along rd cut of Moka rd, 03 21 39.5 N, 08 40 02.7 E
vic. Moka Malabo, 03 21 41.8 N, 08 40 07.7 E
vic. Moka Malabo, 03 19 49.8 N, 08 40 00.1 E
vic. Moka Malabo, 03 20 10.4 N, 08 39 57.5 E
vic. Moka Malabo, Rio Lomo, 03 19 29.7 N, 08 40 16.1 E
Luba-Moka rd, ca 8 km NE (by rd) of Moka
Moka rd, 03 23 18.4 N, 08 39 31.6 E

Lago de Biao
Lago de Biao, W side by outlet, 03 21 19.5 N, 08 37 17.5 E
trail between Moka Malabo and E rim of Lago de Biao, 03 21 07.6 N, 08 38 07.0 E
trail between Moka Malabo and E rim of Lago de Biao, 03 21 09.6 N, 08 38 23.4 E

vicinity of Luba
coast rd, ca 5 km S (by rd) of Luba, 03 27 57.8 N, 08 31 20.3 E
Luba, S edge of town, 03 27 40.8 N, 08 33 08.7 E
ca 2.6 km (by rd) N of Luba, 03 28 58.9 N, 08 34 55.2 E
Arena Blanca rd, 03 31 39.9 N, 08 34 45.8 E
Arena Blanca rd, 03 31 12.2 N, 08 35 09.4 E
rd S of Luba, 03 28 06.1 N, 08 29 34.2 E

between Malabo and Luba
03 42 39.8 N, 08 39 59.9 E

Chapter 3.

Arthropod surveys on Bioko, Equatorial Guinea

Charles E. Griswold, Darrell Ubick, and David Kavanaugh

INTRODUCTION

Arthropods (Insects, arachnids, and myriapods) offer a unique perspective in biodiversity surveys. Arthropods are the most diverse animal group on earth: perhaps 90% of metazoan species richness at any given site comprises arthropods. Arthropod richness may be 1-2 orders of magnitude greater than the next richest group. Arthropod species tend to have narrow distributions than vertebrates, allowing a more fine-grained sampling of geography. They show higher rates of endemism (Scharff 1992) than other taxa at a given site. Taxonomic richness of arthropods offers numerous biotic opportunities for replication of patterns of geography and evolution. This promise is largely unrealized due to what is sometimes called the 'taxonomic impediment.' Most arthropod species are effectively unidentifiable, and many, perhaps most, may be still undescribed. For example, the recorded spider fauna of Madagascar is close to 400 species (Roth 1992a). Yet nearly 400 species were collected in a 6-month survey at one mid elevation site in the southern part of the island (Roth 1992b). Clearly, the arthropod fauna is imperfectly known. Arthropod biologists working in the tropics are usually forced to use the 'morphospecies' concept, i.e., those species that are diagnosable at a given site, whether identifiable or not. Arthropod biologists recognize this problem and realize that the solution will be long-term. General collections are made and maintained for study now and for generations well into the future.

Some advantages of surveying arthropods may be realized now by targeting selected groups that are well known and/or the subject of special study. Spiders are a good example of such a group (Dippenaar-Schoeman & Jocqué 1997). Cladistics has been applied to spider phylogeny since the early 1970's so the taxonomy is reasonably mature (Coddington & Levi 1991; Coddington in press). A research program aimed at understanding the diversity, phylogeny, and geography of African montane rainforests has been ongoing for more the 15 years (Griswold 1991 and references cited therein). The arthropod survey of Bioko requires a general collection but at this time can offer a detailed analysis of the spiders families Cyatholipidae, Migidae, Phyxelididae, and Zorocratidae. Other arthropod groups were also targeted to take advantage of interest and expertise at California Academy of Sciences (CAS). Diptera (flies) were collected generally and reports planned for the Acroceridae, Blepharoceridae, and Therevidae. Ground beetles of the family Carabidae were also targeted.

METHODS

ARTHROPOD SURVEY PERSONNEL:

Dabney, Mr. Keith D.—Curatorial Assistant, Department of Entomology, California Academy of Sciences (fieldwork and specimen preparation)

Griswold, Dr. Charles E.—Schlinger Curator of Arachnida, Department of Entomology, California Academy of Sciences, and Research Professor of Biology, San Francisco State University (specimen preparation and data analysis: spiders)

Kavanaugh, Dr. David—Curator, Department of Entomology, California Academy of Sciences, and Research Professor of Biology, San Francisco State University (specimen preparation and data analysis: carabid beetles)

Ubick, Mr. Darrell—Curatorial Assistant, Department of Entomology, California Academy of Sciences (fieldwork, specimen preparation, and data analysis: spiders)

SURVEY LOCALITIES ON BIOKO

Parque Nacional de Pico Basilé is the highest (elev. 3011) of two volcanic massifs dominating the landscape of Bioko. Vegetation ranges from lowland forest through montane (800 m 1400 m) and mossy/cloud forest (1500 m - 2500 m). Forest gives way to shrub formations above 2500 m and alpine meadow at the summit. Collecting was done at three sites (sites 1--3) along the road and along hunter's trails into the forest.

Reserva Científica de la Caldera de Luba is located in the southern highlands, which rise to an elevation of over 2500 m. Precipitation of over 11,000 mm is typical on the south end of Bioko. A continuous gradient of forest exists on the south slopes of the southern highlands (Reserva Científica de la Caldera de Luba), from lowland forest through montane and mossy forest. Collections were made at 2 sites (sites 4--5) at Moca Valley, a montane forest site with some intrusion of agricultural lands.

Four sites were sampled in the Luba region (sites 6--9). The Luba region is a coastal lowland rainforest with swampy areas and much intrusion of cacao plantation.

1--Pico Basilé: 3°36'9"N, 8°46'38"E, ca.2300 m, 26--27 Sep.1998 - mossy/cloud forest (collecting by beating and sweeping foliage, searching at night, and sifting leaf litter)

2--Pico Basilé: 3°37'38"N, 8°48'15"E, ca.1750 m, 27--29 Sep. 1998 - mossy/cloud forest (collecting by beating and sweeping foliage, searching at night, and sifting leaf litter)

3--Pico Basilé: 3°41'44"N, 8°52'17"E, ca.700m, 17 Sep. 1998 - montane forest (collecting by beating and sweeping foliage, searching at night, and sifting leaf litter)

4--Moca: 3°21'36"N, 8°39'49"E, ca.1300-1400 m, 1--11 Oct. 1998 - mossy/cloud forest (collecting by beating and sweeping foliage, searching at night, and sifting leaf litter)

5--Moca: 3°22'0"N, 8°39'57"E, ca.1500 m, 5--10 Oct. 1998 - mossy/cloud forest (collecting by beating and sweeping foliage, searching at night, sifting leaf litter, and pitfall traps)

6--5 km W Luba: 3°27'54"N, 8°31'17"E, ca. 0-50 m, 12--14 Oct. 1998 - cacao plantation with fig trees (collecting by beating and sweeping foliage, searching at night, and sifting leaf litter)

7--3.5 km W Luba: 3°28'54"N, 8°34'58"E, ca. 0-50 m, 13 Oct. 1998 -swampy forest (collecting by beating and sweeping foliage, searching at night, and sifting leaf litter)

8--Arena Blanca: 3°31'21"N, 8°35'0"E, ca. 0-50 m, 14 Oct. 1998 (collecting by beating and sweeping foliage, and sifting leaf litter)

9--Punta Becrof: 3°43'18"N, 8°39'41"E, ca. 0-50 m, 18 Oct. 1998 (collecting by beating and sweeping foliage, and searching at night)

COLLECTION METHODS

Arthropods were collected by hand searching during both day and night, beating and sweeping of foliage, sieving leaf litter, and pitfall trapping. Flying insects were sampled with malaise traps during the day, and with ultraviolet and mercury vapor light traps at night. Specimens are currently being sorted, labeled, and stored at the California Academy of Sciences, where they will be available to qualified researchers from all over the world.

RESULTS

FLIES (DIPTERA) - Charles E. Griswold

Flies were collected generally using hand held aerial nets sweep nets ,and stationary flight (malaise) traps. Perhaps 100 specimens were collected. An effort was made to collect three target groups for immediate study. Acroceridae ('small headed flies' are a primitive group of brachyceran flies that are worldwide in distribution but rare in collections. As larvae they are obligate endoparasites of spiders. Blepharoceridae ('net winged midges') are delicate nematocera whose larvae cling to rock faces in fast moving streams and waterfalls. Therevidae ('stiletto flies') are fast flying higher Brachycera most characteristic of arid regions. Unfortunately, no individuals of these families were collected.

CARABID BEETLES (CARABIDAE) - David Kavanaugh

Collections made during the Academy's expedition to Bioko, Equatorial Guinea, in September-October 1998, included 98 beetle specimens belonging to the Family Carabidae. This material has been preliminarily sorted to morphospecies and initial study suggests that a total of 28 species are represented. No comprehensive study of the carabid fauna of west Africa in general or of Bioko in particular has been published or even undertaken, and the literature to date for the fauna of the region includes only isolated descriptions of species. It is therefore not possible to accurately identify any of the material collected to species or, except in a few instances, even to genus except by comparison with type material, all of which is deposited in collections in Europe (mainly in Paris). I will not be able to make the necessary comparisons until at least a year from now, so the attached list represents the best determinations that can be made at present.

Table 3.1. list of Carabidae collected on Bioko, Sept.-Oct., 1998

Genus	species	author	number
scaritine	sp. 1		5
Abacetus	sp. 1		2
pterostichine	sp. 2		1
pterostichine	sp. 3		1
Euplynes	sp. 1		2
platynine	sp. 1		2
platynine	sp. 2		1
platynine	sp. 3		1
platynine	sp. 4		4
platynine	sp. 5		7
platynine	sp. 6		7
harpaline	sp. 1		2
harpaline	sp. 2		3
harpaline	sp. 3		1
harpaline	sp. 4		2
harpaline	sp. 5		1
harpaline	sp. 6		1
harpaline	sp. 7		3
harpaline	sp. 8		8
harpaline	sp. 9		2
harpaline	sp. 10		7
harpaline	sp. 11		41
panagaeine	sp. 1		1
Pentagonica	sp. 1		7
dromiine	sp. 1		4
Calleida	sp. 1		1
pericaline	sp. 1		1
Lebia	sp. 1		1
Lebia	sp. 2		1
Totals		29	120

SPIDERS (ARANEAE) - Charles E. Griswold and Darrell Ubick

The collection of Bioko spiders comprises more than 5000 specimens, which represent 372 species. Preparation and sorting to morphospecies was completed at the end of March 1999. Complete study of the material will take years. Many species, perhaps one third, are new, and probably more than one half of the species collected are impossible to identify with the current literature. A complete report on the target groups Cyatholipidae, Migidae, Phyxelididae, and Zorocratidae is presented. Certain other families that are under active study have been sent to specialists.

Below is a list of all families collected with comments on their biology and taxonomic status, selected references on the Afrotropical fauna, and a list of morphospecies (and their identifications, when possible) for each family. Families are arranged in phylogenetic order beginning with Mygalomorphae and ending with Dionychan Entelegynae.

Barychelidae

These spiders may occupy burrows or silken nests on tree trunks: the opening to the nest or burrow is closed by a trap door. There are 10 genera with 55 species recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published.

Several individuals of *Sason* were taken from trap door nests at Moca (1300-1400m), Moca (1500m), 5 km W Luba (0-50m), and 3.5 km W Luba (0-50m).

Selected References on the Afrotropical Barychelid Fauna:

Benoit, P.L.G., 1964. Etude sur les Barychelidae du Centre Africain. La séparation des sous-familles. Rev. Zool. Bot. Afr. (Belgium) 70: 412-416.

Benoit, P.L.G., 1965. Etudes sur les Barychelidae du Centre Africain. II. Leptopelmatinae nouveaux. Rev. Zool. Bot. Afr. (Belgium) 71: 291-303.

Benoit, P.L.G., 1965. Les Barychelidae Diplothelinae africains et malgaches. Rev. Zool. Bot. Afr. (Belgium) 72: 26-40.

Benoit, P.L.G., 1965. Les genres des Barychelidae Leptopelmatinae africains. Rev. Zool. Bot. Afr. (Belgium) 72: 72-78.

Benoit, P.L.G., 1966. Les Barychelidae-Barychelinae africains et malgaches. Rev. Zool. Bot. Afr. (Belgium) 74: 209-241.

Migidae

These spiders are often known as ‘tree trap door spiders’ because many make well-camouflaged nests on the trunks and buttresses of trees. The family occurs in Africa, Australia, Madagascar, New Zealand, and southern South America, describing a typical ‘Gondwanan’ distribution. Five genera and 45 species are recorded from the Afrotropical Region: Griswold (1987a, 1987b, 1998b) has revised the African taxa.

Several individuals of *Moggridgea anactenidia*, which also occurs in Cameroon, were collected on Bioko from one-door trap door nests in tree trunks at Moca (1300-1400m). These represent the first behavioral observations on this species.

Selected References on the Afrotropical Migid Fauna:

Griswold, C. 1987a. The African members of the trap-door spider family Migidae (Araneae: Mygalomorphae), I: The genus Moggridgea O. P. Cambridge, 1875. Annals of the Natal Museum, 28: 1-118.

Griswold, C. 1987b. The African members of the trap-door spider family Migidae (Araneae: Mygalomorphae), 2: The genus *Poecilomigas* Simon. Annals of the Natal Museum, 28: 475-497.

Griswold, C. 1998b. The nest and male of the trap-door spider *Poecilomigas basilleupi* Benoit, 1962 (Araneae, Migidae). Journal of Arachnology 26: 142-148.

Dipluridae

These are terrestrial or arboreal spiders that construct sheetwebs with a funnel shaped retreat. Their long lateral spinnerets aid in applying broad sheets of silk. Three genera with 12 species are recorded from the Afrotropical Region, but no comprehensive treatment of the Afrotropical species has been published.

Two species were collected on Bioko:

Species 1 - Pico Basilé (1750m)
Species 2 - 3.5 km W Luba (0-50m)

Selected references on the Afrotropical diplurid fauna:

Benoit, P.L.G., 1964. Dipluridae de l'Afrique Centrale. I. Genres *Evagrus* Ausserer et *Thelechoris* Karsch. Rev. Zool. Bot. Afr. (Belgium), 70: 417-426.

Benoit, P.L.G., 1965. Dipluridae de l'Afrique Centrale. 2. Genres *Latrothele* nouv. et Macrothele Auss. Rev. Zool. Bot. Afr. (Belgium), 71: 113-128.

Coyle, F.A., 1984. A revision of the African mygalomorph spider genus *Allothele* (Araneae, Dipluridae). Amer. Mus. Novitates, 2794: 1-20.

Theraphosidae

These large, hairy spiders include the 'tarantulas' of the Americas and 'baboon spiders' of Africa. They are much feared and the African species are aggressive. They live either in silk lined burrows or make silken retreats on rocks or tree trunks. The family is the largest in the Mygalomorphae with 26 genera and 162 species recorded from the Afrotropical Region. The southern and eastern African faunas have been the subjects of recent study: by contrast, the west African fauna remains poorly known.

A species of *Hysterocrates* was found to be abundant around Moca.

Selected References on the Afrotropical Theraphosidae Fauna:

De Wet, J. & Dippenaar-Schoeman, A. 1991. A revision of the genus *Ceratogyrus* Pocock (Araneae: Theraphosidae). Koedoe 34: 69-75.

Smith, A. M. 1990. A revision of the Theraphosidae family from Africa and the Middle East. England, Fitzgerald Publishing, 142 pp.

Pholcidae

These long legged spiders, which may be known as 'daddy long legs' in English speaking countries, occur in dark habitats such as caves, under stones and fallen logs, road cuts and embankments, and abandoned buildings. They construct irregular space webs, which incorporate sticky silk. The eggs are carried in a thin silken bag held in the chelicerae. Individuals often vibrate rapidly if the web is touched. The phylogenetic placement of the family was recently established (Platnick *et al* 1991). Thirteen genera with 88 species are recorded from the Afrotropical Region, but there is no comprehensive treatment of the African fauna.

Ten species of Pholcidae were collected on Bioko:

Species 1 - Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 2 - Pico Basilé (2300m), Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m)
Species 3 - Pico Basilé (700m)
Species 4 - Moca (1300-1400m), Moca (1500m), 5 km W Luba (0-50m)
Species 5 - 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 6 - 5 km W Luba (0-50m), (+Malabo)
Species 7 - Pico Basilé (700m), 3.5 km W Luba (0-50m)
Species 8 - Pico Basilé (1750m)
Species 9 - Pico Basilé (1750m)
Species 10 - Arena Blanca (0-50m)

Selected References on the Afrotropical Pholcid Fauna:

Benoit, P.L.G., 1977. La faune terrestre de l'Ile de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 5. Fam. Pholcidae. Ann. Mus. roy. Afr. Centr. (Zool.), 220: 48-49.

Brignoli, P.M., 1980. Recherches en Afrique de l'Institut de Zoologie de l'Aquila (Italie), 3. Sur le genre *Leptopholcus* Simon, 1893 (Araneae, Pholcidae). Revue Zool. Afr. (Belgium), 94(3): 649-655.

Platnick, N. I., J. A. Coddington, R. F. Forster, and C. E. Griswold. 1991. Spinneret evidence and the higher classification of the haplogyne spiders (Araneae, Araneomorphae). American Museum Novitates, 3016: 1-73.

Scytodidae

Commonly referred to as 'spitting spiders,' these squirt glue from a highly modified venom gland to immobilize prey. They may be free running or make irregular webs. The phylogenetic placement of the family was recently established (Platnick *et al* 1990) There is one genus (*Scytodes*) worldwide: 56 species have been recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published, though there are several regional treatments.

Three species of *Scytodes* were collected on Bioko:

Species 1 - Pico Basilé (1750m)
Species 2 - Pico Basilé (700m), Arena Blanca (0-50m)
Species 3 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)

Selected References on the Afrotropical Scytodid Fauna:

Benoit, P.L.G., 1977. La faune terrestre de l'Ile de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 4. Fam. Scytodidae. Ann. Mus. Roy. Afr. Centr. (Zool.) 220: 46-48.

Platnick, N. I., J. A. Coddington, R. F. Forster, and C. E. Griswold. 1991. Spinneret evidence and the higher classification of the haplogyne spiders (Araneae, Araneomorphae). American Museum Novitates 3016: 1-73.

Telemidae

These small to minute spiders occur in caves and leaf litter. Little is known of their biology, though some are known to weave spacewebs. The phylogenetic placement of the family was recently established (Platnick *et al* 1991). Three genera and 7 species are recorded from the Afrotropical Region but the family remains poorly known. No comprehensive treatment of the Afrotropical species has been published.

Four recognizable species were collected on Bioko as well as several unplaced females:

Species 1 - Moca (1300-1400m), Moca (1500m)
Species 2 - Pico Basilé (1750m), Pico Basilé (700m)
Species 3 - 5 km W Luba (0-50m)
Species 4 - 5 km W Luba (0-50m)
Unsorted females Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), and 5 km W Luba (0-50m).

Selected References on the Afrotropical Telmid Fauna:

Baert, L, 1985. Telemidae, Mysmenidae, and Ochyroceratidae from Cameroon (Araneae). Scientific report of the Belgian Mount Cameroon expeditions, 1981 and 1983, no. 13. Biol. Jaarb. Dodonaea 53: 44-57.

Brignoli, P.M., 1978. A few notes on a remarkable South African troglobitic spider, *Cangoderces lewisi* Harington, 1951 (Araneae, Telemidae). Revue Suisse Zool. 85(: 111-114.

Brignoli, P.M., 1980. Contributions à l'étude de la faune terrestre des îles granitiques de l'archipel des Sechelles (Mission P. L. G. Benoit - J. J. van Mol 1972). Araneae Telemidae et Ochyroceratidae. Revue Zool. Afr. (Belgium), 94(2): 380-386.
Harington, J.S. 1951. A new leptonetid spider, Cangoderces lewisi n. g. n. sp. Ann. Natal Mus. 12: 81-90.
Machado, A. de B. 1956. Captures d'araignees Telemidae au Congo Belge et paleogeographie de cette famille. Folia Scientifique Afrique Centrale 2: 26-27.
Platnick, N. I., J. A. Coddington, R. F. Forster, and C. E. Griswold. 1991. Spinneret evidence and the higher classification of the haplogyne spiders (Araneae, Araneomorphae). American Museum Novitates 3016: 1-73.
Saaristo, M.I., 1978. Spiders (Arachnida, Araneae) from Seychelles Islands, with notes on taxonomy. Ann. Zool. Fennici 15: 99-126.

Ochyroceratidae

These small to minute spiders occur in leaf litter were they construct spacewebs. The phylogenetic placement of the family was recently established (Platnick *et al* 1991). Four genera and 16 species are recorded from the Afrotropical Region but the family remains poorly known. No comprehensive treatment of the Afrotropical species has been published.

Two recognizable species were collected on Bioko as well as several unplaced females:
Species 1 - Moca (1300-1400m), Moca (1500m)
Species 2 - 5 km W Luba (0-50m)
Miscellaneous females from Moca (1500m), 5 km W Luba (0-50m), and 3.5 km W Luba (0-50m).

Selected References on the Afrotropical Ochyroceratid Fauna:
Machado, A. de B. 1951. Ochyroceratidae de l'Angola. Publicacios culturais da Companhia de diamantes de Angola 8: 5-88.
Machado, A. de B. 1964. Ochyroceratidae nouveaux d'Afrique. Annals of the Natal Museum 16: 215-230.
Platnick, N. I., J. A. Coddington, R. F. Forster, and C. E. Griswold. 1991. Spinneret evidence and the higher classification of the haplogyne spiders (Araneae, Araneomorphae). American Museum Novitates 3016: 1-73.

Segestriidae

These spiders are highly adapted to their life in tubewebs, which are made in holes in tree trunks and walls, and crevices on rockfaces. They have the first three pairs of legs pointing forward to facilitate rapid movement. Signal threads radiate from the opening of the tubes. Two genera and 31 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published.
Several female individuals of one species were collected at Pico Basilé (700m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m), and Punta Becrof (0-50m).

Selected References on the Afrotropical Segestriidae Fauna: none.

Oonopidae

These small to minute spiders are widely distributed in the tropics. They are nocturnal, ground and litter-dwelling predators that actively pursue prey without building webs. They are often armor-plated. Twenty-six genera with 75 species are recorded from the Afrotropical Region. The family is poorly known and no comprehensive treatment of the Afrotropical species has been published, though a generic key is available (Benoit 1977b).

Eight species were collected on Bioko:
Species 1 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m), 5 km W Luba (0-50m)
Species 2 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 3 - Moca (1500m), 3.5 km W Luba (0-50m)
Species 4 - Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m)
Species 5 - Pico Basilé (1750m), Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 6 - Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m)
Species 7 - 5 km W Luba (0-50m)
Species 8 - Moca (1300-1400m)

Selected References on the Afrotropical Oonopid Fauna:

Benoit, P.L.G., 1964. La découverte d'Oonopidae anophthalmes dans les termitières africaines. Rev. Zool. Bot. Afr. (Belgium) 70: 174-197.
Benoit, P.L.G., 1975. Deux nouvelles araignées aveugles du genre *Termitoonops* Benoit avec une clé des espéces (Araneae, Oonopidae). Rev. Zool. Bot. Afr. (Belgium), 89(4): 940-948.
Benoit, P.L.G., 1976. Un nouveau genre d'Oonopidae, termobie et aveugle, en Afrique centrale. Rev. Zool. Bot. Afr. (Belgium) 90: 177-180.
Benoit, P.L.G., 1977a. La faune terrestre de l'Ile de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 2. Fam. Oonopidae et Tetrablemmidae. Ann. Mus. roy. Afr. Centr. (Zool.) 220: 31-44.
Benoit, P.L.G., 1977b. Oonopidae anophthalmes africains nouveaux avec une clé des genres (Araneae). Revue Zool. Afr. (Belgium) 91: 243-249.

Hersiliidae

These fast moving spiders typically live on tree trunks, walls, or rock faces where their flattened bodies allow them to hide in narrow cracks or lie adpressed to the substrate without casting a shadow. The extremely long lateral spinnerets spin sheets of silk used in prey capture: the spider circles rapidly around the prey tying it down with silk. Three genera with 28 species are recorded from the Afrotropical Region. Benoit (1967) revised the Afrotropical species.

Three species were collected on Bioko:
Species 1 - Moca (1300-1400m)
Species 2 - 5 km W Luba (0-50m)
Species 3 - 3.5 km W Luba (0-50m)

Selected References on the Afrotropical Hersiliid Fauna:

Benoit, P.L.G., 1967. Révision des espèces africaines du genre *Hersilia* Sav. et Aud. Rev. Zool. Bot. Afr. (Belgium) 76: 1-36.

Zodariidae

This large, worldwide family comprises mostly fast-moving terrestrial predators that make no web for prey capture. Many are specialized ant predators. Twenty-four genera with 163 species are recorded from the Afrotropical Region.

Three species were collected on Bioko:
Species 1 - Pico Basilé (700m), Moca (1300-1400m), Moca (1500m)
Species 2 - Moca (1300-1400m), Moca (1500m)
Species 3 - 3.5 km W Luba (0-50m), Arena Blanca (0-50m), Punta Becrof (0-50m)

Selected References on the Afrotropical Zodariid Fauna:

Bosmans, R, & van Hove, M, 1986. A revision of the afrotropical representatives of the genus *Langbiana* Hogg (Araneae: Zodariidae). Bull. Brit. Arachnol. Soc. 7: 17-28.

Bosmans, R, & van Hove, M, 1986. New species and new records of spiders of the genus *Langbiana* (Araneae; Zodariidae). Scientific report of the Belgian Cameroon expeditions 1981 and 1983 XVI. Revue Suisse Zool. 93: 373-392.
Bosmans, R, & van Hove, M, 1986. A revision of the African species of the genus *Suffucioides* Jézéquel (Araneae, Zodariidae). Bull. Brit. Arachnol. Soc., 7: 17-28.
Jocqué, R, 1986. A revision of the genus *Hermippus* (Araneae: Zodariidae). J. Nat. Hist. (G. B.) 20: 7-22.
Jocqué, R, 1987. Descriptions of new genera and species of African Zodariinae with a revision of the genus *Heradida* (Araneae, Zodariidae). Revue Zool. Afr. (Belgium) 101: 143-163.
Jocqué, R, 1987. An updating of the genus *Leprolochus* (Araneae, Zodariidae). Stud. Neotrop. Fauna Environ. 23: 77-87.
Jocqué, R, 1991. A generic revision of the spider family Zodariidae (Araneae). Bulletin of the American Museum of natural History 201: 1-160.

Mimetidae

Often called 'pirate spiders,' these are vagrant predators on other spiders. They build no webs but may enter the webs of other spiders by mimicking courtship behavior. The first legs have diagonal rows of spines that grip the prey. The family was recently placed in the superfamily Palpimanoidea (Forster & Platnick 1984). Four genera and 10 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published.

Four species were collected on Bioko:

Species 1 - Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 2 - 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 3 - Pico Basilé (700m), Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 4 - Punta Becrof (0-50m)

Selected References on the Afrotropical Mimetid Fauna:

Forster, R.R., & Platnick, N.I., 1984. A review of the archaeid spiders and their relatives, with notes on the limits of the superfamily Palpimanoidea (Arachnida, Araneae). Bull. Amer. Mus. Nat. Hist. 178: 1-106.

Palpimanidae

These terrestrial and arboreal predators build no webs. Like other members of the Palpimanoidea (Forster & Platnick 1984) they appear to be predators on other spiders. The first legs have modified setae on the inner surface that may aid in holding the prey. Eleven genera with 50 species have been recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published.

Two species were collected on Bioko.

Species 1 - Arena Blanca (0-50m)
Species 2 - 5 km W Luba (0-50m), Arena Blanca (0-50m)

Selected References on the Afrotropical Palpimanid Fauna:

Forster, R.R., Platnick, N.I., 1984. A review of the archaeid spiders and their relatives, with notes on the limits of the superfamily Palpimanoidea (Arachnida, Araneae). Bull. Amer. Mus. Nat. Hist. 178: 1-106.

Deinopidae

These large spiders live on vegetation and hide during the day with their legs stretched fore and aft to resemble sticks. Those with large eyes (*Deinopis*) are called 'ogre faced spiders' and those with hump-backed abdomens (*Menneus*) are sometimes called 'camel spiders.' At night they construct highly modified cribellate orb webs that comprise a small, expandable square that is held in the front 4 legs. The web is cast or pulled over prey. Three genera and 14 species are recorded from the Afrotropical Region. The family is undergoing revision (Opell & Coddington, in prep.). No comprehensive treatment of the Afrotropical species has been published.

One species was collected at Moca (1300-1400m) and Arena Blanca (0-50m).

Selected References on the Afrotropical Deinopid Fauna:
Coddington, J.A., 1986. Orb webs in non-orb-weaving ogre-faced spiders (Araneae: Dinopidae): a question of genealogy. Cladistics, 2(1): 53-67.

Uloboridae

This family build cribellate orb webs, some of which are highly modified. Modified webs are often tensed or tugged with the first legs. Uniquely in the spiders, uloborids lack venom glands and rely on wrap attack to subdue prey. Five genera and 20 species are recorded from the Afrotropical Region. A world generic revision is available but no comprehensive treatment of the Afrotropical species has been published.

Seven species were collected on Bioko.

Species 1 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 2 - Pico Basilé (700m), 5 km W Luba (0-50m)
Species 3 - 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 4 - Pico Basilé (1750m), Moca (1300-1400m)
Species 5 - Arena Blanca (0-50m), Punta Becrof (0-50m)
Species 6 - 3.5 km W Luba (0-50m)
Species 7 - Pico Basilé (700m)

Selected References on the Afrotropical Uloborid Fauna:
Opell, B.D., 1979. Revision of the genera and tropical American species of the spider family Uloboridae. Bull. Mus. Comp. Zool. 148: 443-549.

Tetragnathidae

This large, worldwide family contains some of the largest and most conspicuous spiders of the tropics. Most construct orb webs with glue-sticky silk. *Nephila* and *Nephilengys* build huge orb webs: those of *Nephila* are made of yellow or golden silk and are built in vegetation, whereas those of *Nephilengys* are built against tree trunks, rock faces, and walls. *Tetragnatha* are common along streams. Tetragnathids may be among the commonest orb builders in forest understory. Twenty-two genera with 162 species are recorded from the Afrotropical Region. A phylogenetic study of the family has been recently completed (Hormiga *et al* 1995), its conclusions were corroborated (Griswold *et al* 1998), and several descriptive studies of Afrotropical tetragnathids have been published.

Eighteen species were collected on Bioko:

Species 1 - (*Nephila*), Pico Basilé (700m), Moca (1300-1400m)
Species 2 - (*Nephila*) 5 km W Luba (0-50m)
Species 3 - (*Nephilengys*), Moca (1300-1400m), Moca (1500m), 5 km W Luba (0-50m)
Species 4 - (*Tetragnatha*), Pico Basilé (700m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 5 - (*Tetragnatha*) 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 6 - (*Tetragnatha*) Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 7 - Pico Basilé (2300m), Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m)
Species 8 - (*Dolichognatha*), Pico Basilé (700m), Moca (1500m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 9 - Pico Basilé (2300m), Pico Basilé (1750m), Moca (1300-1400m)

Species 10 - Moca (1300-1400m)
Species 11 - (*Landana*), Punta Becrof (0-50m)
Species 12 - Moca (1300-1400m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 13 - Pico Basilé (1750m), Pico Basilé (700m), Moca (1500m)
Species 14 - Moca (1300-1400m), Moca (1500m)
Species 15 - Moca (1300-1400m), Moca (1500m)
Species 16 - Moca (1300-1400m)
Species 17 - 5 km W Luba (0-50m)
Species 18--20 or 22 - Pico Basilé (2300m), Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m)

Selected References on the Afrotropical Tetragnathid Fauna:

Benoit, P.L.G., 1962. Les Araneidae-Nephilinae africains. Rev. Zool. Bot. Afr. (Belgium) 65: 217-231.
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Hormiga, G., Eberhard, B. and Coddingtob, J. 1995. Web-construction behavior in *Phonognatha* and phylogeny of the nephiline and tetragnathine spiders (Araneae: Tetragnathidae). Australian Journal of Zoology 43: 313-364.

Araneidae

This large, worldwide family contains some of the largest and most conspicuous spiders of the tropics. Most construct orb webs with glue sticky silk. Some have highly modified webs, including some reduced to a single line with a sticky droplet (i.e., the 'bolas spiders'). The Gasteracanthinae are heavily armored spiders with spiny bodies that hang in the web during the daytime. *Cyrtophora* make non-sticky orbs and are often colonial. Most araneids are nocturnal, hiding during the day, building their webs at night, and eating the web before dawn. Sixty-five genera with 269 species are recorded from the Afrotropical Region. The phylogenetic position of the family (Griswold *et al* 1998) and intrafamilial phylogeny have recently been examined (Scharff & Coddington 1997). Several revisionary studies of the Afrotropical fauna have been published.

At least 37 species were collected on Bioko:

Species 1 - (*Cyrtophora*), Moca (1300-1400m), Moca (1500m)
Species 2 - (*Argiope*), Moca (1300-1400m)
Species 3 - (*Gasteracantha*), Moca (1300-1400m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 4 - (*Aranaethra*), Pico Basilé (700m)
Species 5 - (*Poltys*), Moca (1300-1400m)
Species 6 - (*Cyrtarachne*), 5 km W Luba (0-50m)
Species 7 - (*Cyrtarachne*) Moca (1300-1400m)
Species 8 - (*Cyrtarachne*) 3.5 km W Luba (0-50m)
Species 9 - Moca (1300-1400m)
Species 10 - (*Neoscona*), Moca (1300-1400m), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 11 - (*Neoscona*) Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m)
Species 12 - Moca (1300-1400m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 13 - 5 km W Luba (0-50m)
Species 14 - 3.5 km W Luba (0-50m)
Species 15 - Pico Basilé (2300m), Pico Basilé (1750 m)
Species 16 - Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Punta Becrof (0-50m)
Species 17 - Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500 m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 18 - 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 19 - Moca (1300-1400m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 20 - (*Neoscona*), Pico Basilé (2300m), Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m)
Species 21 - (Caerostris), Moca (1300-1400m)
Species 22 - Moca (1300-1400m)
Species 23 - Moca (1300-1400m)
Species 24 - Pico Basilé (700m)
Species 25 - Moca (1300-1400m)
Species 26 - 3.5 km W Luba (0-50m)
Species 27 - Pico Basilé (700m)
Species 28 - Arena Blanca (0-50m)
Species 29 - Moca (1300-1400m)
Species 30 - Pico Basilé (700m)
Species 31 - Moca (1300-1400m)
Species 32 - Pico Basilé (1750m)
Species 33 - Pico Basilé (700m)
Species 34 - Moca (1300-1400m)
Species 35 - 5 km W Luba (0-50m)
Species 36 - 5 km W Luba (0-50m)
Species 37--39 - (*Cyclosa*), Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m)

Selected References on the Afrotropical Araneid Fauna:

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Griswold, C., J. Coddington, G. Hormiga, and N. Scharff. 1998. Phylogeny of the orb-web building spiders (Araneae, Orbiculariae: Deinopoidea, Araneoidea). Zoological Journal of the Linnean Society 122: 1-99.
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Theridiosomatidae

These small to minute spiders build modified glue-sticky silk orb webs in dark, moist places. The phylogenetic position of the family has been recently established (Griswold *et al* 1998) and a phylogeny of the world genera is available (Coddington 1986). Seven species in five genera are recorded from the Afrotropical Region but no comprehensive treatment of the Afrotropical species has been published. There are probably many new species.

Seven species were collected on Bioko:

Species 1 - Pico Basilé (2300m), Pico Basilé (700m), Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 2 - 3.5 km W Luba (0-50m)
Species 3 - Moca (1500m)
Species 4 - Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 5 - Moca (1500m)
Species 6 - 5 km W Luba (0-50m)
Species 7 - 3.5 km W Luba (0-50m)

Selected References on the Afrotropical Theridiosomatid Fauna:

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Coddington, J.A., 1986. The genera of the spider family Theridiosomatidae. Smithson. Contrib. Zool. 422: 1-96.

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Mysmenidae

These minute spiders build highly modified glue-sticky silk orb webs. Some webs comprise 3-dimensional orbs. Most live in dark, moist places and are only collected by spoon-dropping after corn-starch dusting of their webs. At least two Afrotropical genera are kleptoparasites in the webs of other spiders: these are so highly modified that they have lost the capacity to produce glue-sticky silk (Griswold *et al* 1998). The phylogenetic position of the family has been recently established (Griswold *et al* 1998). Seven genera with 9 species have been recorded from the Afrotropical Region, but there are certainly many new species.

Eight to ten species were collected on Bioko.

Species 1 - Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 2 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 3 - Pico Basilé (1750m)
Species 4 - Moca (1300-1400m)
Species 5 - Moca (1300-1400m)
Species 6 - Moca (1500m)
Species 7 - Moca (1500m)
Species 8--9 or 10 - Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m)

Selected References on the Afrotropical Mysmenid Fauna:

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Anapidae

These minute, usually armor plated spiders build modified glue-sticky silk orb webs. Most live in dark, moist places and are only collected by spoon-dropping after corn-starch dusting of their webs. The phylogenetic position of the family has been recently established (Griswold *et al* 1998). The faunas of South America and the Australasian regions have been recently studied (Platnick & Forster 1989), but the Afrotropical fauna remains poorly known. Five genera and 11 species are recorded from the Afrotropical Region, but many new species remain to be described.

Two species were collected on Bioko.

Species 1 - Pico Basilé (2300m), Moca (1300-1400m), Moca (1500m)
Species 2 - Moca (1500m)

Selected References on the Afrotropical Anapid Fauna:
Brignoli, P.M., 1981. New or interesting Anapidae (Arachnida, Araneae). Revue Suisse Zool. 88: 109-134.
Griswold, C., J. Coddington, G. Hormiga, and N. Scharff. 1998. Phylogeny of the orb-web building spiders (Araneae, Orbiculariae: Deinopoidea, Araneoidea). Zoological Journal of the Linnean Society 122: 1-99.
Platnick, N.I., & Forster, R.R., 1989. A revision of the temperate South American and Australasian spiders of the family Anapidae (Araneae, Araneoidea). Bull. Am. Mus. Nat. Hist. 190: 1-139.

Symphytognathidae

These minute spiders build horizontal, finely woven glue-sticky silk orb webs. Most live in dark, moist places and are only collected by spoon-dropping after corn-starch dusting of their webs. They include the smallest of spiders, with adults sometimes being less than 0.5 mm in total length. The phylogenetic position of the family has been recently established (Griswold *et al* 1998). A world review is available (Forster & Platnick 1977) but the Afrotropical fauna remains poorly known. Three genera and 5 species are recorded from the Afrotropical Region, but many new species remain to be described.

One species was collected at Pico Basilé (700m)

Selected References on the Afrotropical Symphytognathid Fauna:
Forster, R.R., 1974. Symphytognathid spiders from central Africa. Revue Zool. Afr. (Belgium) 88: 115-126.
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Nesticidae

These are small, poorly known spiders that occur in dark places, especially caves. They differ from the Theridiidae in retaining a paracymbium on the male palp. Like theridiids they construct a “gumfoot” web consisting of an irregular retreat suspended beneath a covering object, with few to several glue-sticky lines affixed under higher tension between the retreat and lower substrate (there are many exceptions to this rule). Nesticids and theridiids can subdue prey by flinging large globs of sticky silk with the comb on the fourth tarsus. PLS aggregate spigots are modified to enable this behavioral synapomorphy (Coddington, 1989). The phylogenetic position of the family has been recently established (Griswold *et al* 1998). Two genera and 7 species are recorded from the Afrotropical Region and many more species remain to be described.

At least one species was collected at Pico Basilé (1750m), Moca (1500m), and 5 km W Luba (0-50m).

Selected References on the Afrotropical Nesticid Fauna:
Coddington, J.A., 1989. Spinneret silk spigot morphology. Evidence for the monophyly of orb-weaving spiders, Cyrtophorinae (Araneidae), and the group Theridiidae-Nesticidae. J. Arachnology, 17(1): 71-95.

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Hubert, M, 1977. La faune terrestre de l'Ile de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 18. Fam. Nesticidae. Ann. Mus. roy. Afr. Centr. (Zool.), 220: 153-158.

Theridiidae

This cosmopolitan family is one of the largest, with over 2000 species in 55 genera. The last comprehensive treatment of the family was by Levi and Levi (1962), in which familial relimitation and generic synonymy reduced the number of genera from 140 to fewer than 50. In this work genera were diagnosed, and a sketch of theridiid classification was presented. Recently, Forster, *et al.* (1990) presented a brief discussion of theridiid interrelationships, separating out *Synotaxus* as the basonym of the Synotaxidae, and arguing for an enlarged Hadrotarsidae as a theridiid subfamily. Theridiids range from minute to large, and typically construct a "gumfoot" web consisting of an irregular retreat suspended beneath a covering object, with few to several glue-sticky lines affixed under higher tension between the retreat and lower substrate (there are many exceptions to this rule). Nesticids and theridiids can subdue prey by flinging large globs of sticky silk with the comb on the fourth tarsus. PLS aggregate gland spigots are modified to enable this behavioral synapomorphy (Coddington, 1989). Some are of medical importance (*Latrodectus*, the "widow spiders"). The genus *Argyrodes* includes predators on other spiders and kleptoparasites in the webs of other spiders. Members of the Hadrotarsinae appear to be specialized predators on ants. The phylogenetic position of the family has been recently established (Griswold *et al* 1998). This family is very rich in species and may be the largest family of spiders. Typically, in collections of tropical spiders, theridiids are the richest fauna. Twenty seven genera and 251 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published, and most species cannot even be identified to genus.

Eighty one species were collected on Bioko.

Species 1 - (*Argyrodes*), Moca (1300-1400m), Moca (1500m)
Species 2 - (*Argyrodes*) 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 3 - (*Argyrodes*) 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 4 - (*Argyrodes*) Moca (1300-1400m), Moca (1500m), Punta Becrof (0-50m)
Species 5 - (*Argyrodes*) Pico Basilé (700m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 6 - (*Argyrodes*) Pico Basilé (700m)
Species 7 - (*Argyrodes*) Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 8 - (*Argyrodes*) Moca (1300-1400m), 5 km W Luba (0-50m)
Species 9 - (*Argyrodes*) Moca (1300-1400m)
Species 10 - (*Argyrodes*) Moca (1300-1400m)
Species 11 - (*Argyrodes*) 5 km W Luba (0-50m)
Species 12 - (*Argyrodes*) Punta Becrof (0-50m)
Species 13 - (*Argyrodes*) Punta Becrof (0-50m)
Species 14 - (Hadrotarsinae), Pico Basilé (700m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m), Punta Becrof (0-50m)
Species 15 - (Hadrotarsinae) Moca (1300-1400m), Moca (1500m), Arena Blanca (0-50m)
Species 16 - (Hadrotarsinae) Moca (1300-1400m)
Species 17 - (Hadrotarsinae) Moca (1300-1400m), Moca (1500m)

Species 18 - (Hadrotarsinae) 3.5 km W Luba (0-50m)
Species 19 - (Hadrotarsinae) Pico Basilé (700m), Punta Becrof (0-50m)
Species 20 - (Hadrotarsinae) Moca (1300-1400m)
Species 21 - (Hadrotarsinae) Moca (1300-1400m)
Species 22 - (Hadrotarsinae) Moca (1500m)
Species 23 - (Hadrotarsinae) 3.5 km W Luba (0-50m)
Species 24 - (Hadrotarsinae) Arena Blanca (0-50m)
Species 25 - (*Achaearanea*), Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 26 - (*Achaearanea*), Moca (1300-1400m), Moca (1500m)
Species 27 - (*Achaearanea*), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 28 - (*Achaearanea*), Moca (1300-1400m), Moca (1500m)
Species 29 - (*Achaearanea*), Pico Basilé (700m)
Species 30 - (*Achaearanea*), Moca (1300-1400m), Moca (1500m)
Species 31 - (*Achaearanea*), Moca (1300-1400m)
Species 32 - (Phoroncidia), 3.5 km W Luba (0-50m)
Species 33 - Pico Basilé (1750m), Moca (1300-1400m)
Species 34--35 or 36 - (*Thwaitesia*), Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 37 - Pico Basilé (700m), 3.5 km W Luba (0-50m)
Species 38 - 5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 39--41 - Pico Basilé (2300m), Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), Moca (1500m)
Species 42 - 3.5 km W Luba (0-50m)
Species 43 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 44 - Moca (1300-1400m)
Species 45 - Pico Basilé (2300m), Pico Basilé (1750m), Pico Basilé (700m), Punta Becrof (0-50m)
Species 46 - Pico Basilé (2300m), Moca (1300-1400m)
Species 47 - Pico Basilé (2300m), Moca (1300-1400m)
Species 48 - 3.5 km W Luba (0-50m)
Species 49 - 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 50 - Pico Basilé (1750m), Moca (1300-1400m)
Species 51 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m)
Species 52 - Moca (1500m)
Species 53 - 3.5 km W Luba (0-50m)
Species 54 - Pico Basilé (2300m)
Species 55 - Pico Basilé (1750m)
Species 56 - Pico Basilé (700m)
Species 57 - Pico Basilé (700m)
Species 58 - Pico Basilé (700m)
Species 59 - Pico Basilé (700m)
Species 60 - Pico Basilé (700m)
Species 61 - Moca (1300-1400m)
Species 62 - Moca (1300-1400m)
Species 63 - Moca (1300-1400m)
Species 64 - Moca (1300-1400m)
Species 65 - Moca (1300-1400m)
Species 66 - Moca (1500m)
Species 67 - 5 km W Luba (0-50m)
Species 68 - 5 km W Luba (0-50m)
Species 69 - 5 km W Luba (0-50m)
Species 70 - 3.5 km W Luba (0-50m)

Species 71 - 3.5 km W Luba (0-50m)
Species 72 - 3.5 km W Luba (0-50m)
Species 73 - 3.5 km W Luba (0-50m)
Species 74 - 3.5 km W Luba (0-50m)
Species 75 - 3.5 km W Luba (0-50m)
Species 76 - 3.5 km W Luba (0-50m)
Species 77 - 3.5 km W Luba (0-50m)
Species 78 - Arena Blanca (0-50m)
Species 79 - Arena Blanca (0-50m)
Species 80 - Arena Blanca (0-50m)
Species 81 - Punta Becrof (0-50m)

Selected References on the Afrotropical Theridiid Fauna:

Coddington, J.A., 1989. Spinneret silk spigot morphology. Evidence for the monophyly of orb-weaving spiders, Cyrtophorinae (Araneidae), and the group Theridiidae-Nesticidae. J. Arachnology 17: 71-95.

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Lotz, L. 1994. Revision of the genus *Latrodectus* (Araneae, Theridiidae) in Africa. Navorsinge van die Nasionale Museum, Bloemfontein 10: 1-60.

Cyatholipidae

This small family is today restricted to the southern hemisphere (Griswold 1987, 1997a, 1997b, 1998; Forster, 1988), occurring in Africa, Australia, Madagascar, and New Zealand. Wunderlich (1994) has recently described some spiders attributed to this family from Baltic amber. They are small in stature and, where known, hang beneath glue-sticky silk sheet webs. The phylogenetic position of the family has been recently established (Griswold *et al* 1998). Within Africa the distribution of the eight described genera and 26 described species is ‘afromontane’ (Griswold 1991). Additional species to be described also fit this biogeographic pattern (Griswold in prep).

Two species were collected on Bioko, each of which also occurs on nearby Mt. Cameroon:

Buibui kankamelos, n. sp. - Pico Basilé (1750 m)
Wanzia fako Griswold 1998 - Moca (1500 m)

Selected References on the Afrotropical Cyatholipid Fauna:

Forster R.R.. 1988. The Spiders of New Zealand, part VI. Otago Musuem Bulletin, **6**: 1-124.

Griswold, C. 1987. A review of the southern African spiders of the family Cyatholipidae Simon, 1894 (Araneae: Araneomorphae). Annals of the Natal Museum 28: 499-542.

Griswold, C. 1991. Cladistic Biogeography of Afromontane Spiders. Australian Systematic Botany 4: 73-89.

Griswold, C. 1997a. The spider family Cyatholipidae in Madagascar (Araneae: Araneoidea). Journal of Arachnology 25: 53-83.

Griswold, C. 1997b. *Scharffia*, a remarkable new genus of spiders from East African Mountains (Araneae, Cyatholipidae). Journal of Arachnology 25: 269-287.

Griswold, C. 1998. *Wanzia fako*, a new genus and species of spider from Cameroon (Araneae, Cyatholipidae). Entomologica scandinavica 29: 121-130.

Griswold, C. (in prep) A monograph of the world genera and Afrotropical species of the spider family Cyatholipidae.
Griswold, C., J. Coddington, G. Hormiga, and N. Scharff. 1998. Phylogeny of the orb-web building spiders (Araneae, Orbiculariae: Deinopoidea, Araneoidea). Zoological Journal of the Linnean Society 122: 1-99.
Wunderlich J. 1994. Die ersten fossilen Becherspinnen (Fam. Cyatholipidae) in Baltischem und Bitterfelder Bernstein (Arachnida: Araneae). Mitteilungen des Geologischen-Paläontologischen Instituts der Universität Hamburg 75: 231-241.

Linyphiidae

The Linyphiidae are one of the most diverse spider families, containing more than 440 described genera and over 3600 described species, and are worldwide in distribution. They range from minute to medium sized and are long-legged spiders with at least femoral spines, lateral striae on the chelicerae, patella-tibia autospasy, and generally hang beneath glue-sticky silk sheet webs. The phylogenetic placement of the family was recently established (Griswold *et al* 1998) and Hormiga (1993, 1994) provided a phylogenetic study of the family. Seventy six genera with 373 species are recorded from the Afrotropical Region. There is a catalogue of Afrotropical species (Scharff 1990a), and many species have been described, but no comprehensive treatment of the Afrotropical species has been published.

At least 32 species were collected on Bioko. These specimens have been lent to the staff of the Zoological Museum in Copenhagen, where studies of Afrotropical Linyphiidae are being conducted. Of particular interest is the presence of *Afroneta* above 1700 m on Pico Basilé: this ‘afroalpine’ genus is otherwise known from Mt. Cameroon and Mt. Oku in Cameroon and the high mountains of east Africa (e.g., Kilimanjaro).

Species 1 - (*Microlinyphia*), Pico Basilé (2300m), Moca (1300-1400m)
Species 2 - Moca (1300-1400m)
Species 3 - Moca (1300-1400m), Moca (1500m)
Species 4 - (?*Lepthyphanthes*), Pico Basilé (2300m), Moca (1300-1400m), Moca (1500m)
Species 5 - (?*Neriene*), Pico Basilé (2300m), Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m)
Species 6 - (*Mecynidis*), Moca (1300-1400m), Moca (1500m)
Species 7 - (*Afroneta*), Pico Basilé (2300m), Pico Basilé (1750m)
Species 8 - Moca (1300-1400m)
Species 9 - Pico Basilé (2300m), Pico Basilé (1750m), Moca (1300-1400m)
Species 10 - Pico Basilé (1750m), Moca (1300-1400m)
Species 11 - Pico Basilé (2300m), Pico Basilé (1750m)
Species 12 -- 13 Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m)
Species 14 - Pico Basilé (2300m)
Species 15 - Pico Basilé (1750m)
Species 16 - Pico Basilé (1750m)
Species 17 - Pico Basilé (1750m)
Species 18 - Pico Basilé (700m)
Species 19 - Moca (1300-1400m)
Species 20 - Moca (1300-1400m)
Species 21 - Moca (1300-1400m)
Species 22 - Moca (1300-1400m)
Species 23 - Moca (1300-1400m)
Species 24 - Moca (1300-1400m)
Species 25 - Moca (1500m)
Species 26 - Moca (1500m)
Species 27 - 5 km W Luba (0-50m)
Species 28 - 5 km W Luba (0-50m)

Species 29 - 5 km W Luba (0-50m)
Species 30 - 3.5 km W Luba (0-50m)
Species 31 - 3.5 km W Luba (0-50m)
Species 32 - Punta Becrof (0-50m)

Selected references on the Afrotropical linyphiid fauna:

Bosmans, R, 1977. Scientific report of the Belgian Mt. Kenya Bio-Expedition II. Spiders of the subfamily Erigoninae from Mt. Kenya. Revue Zool. Afr. (Belgium) 91: 449-472.

Bosmans, R, 1978. Description of four new *Lepthyphantes* species from Africa, with a redescription of L. biseriatus Simon & Fage and L. tropicalis Tullgren. Bull. Brit. Arachnol. Soc. 4: 258-274.

Bosmans, R, 1979. Spiders of the subfamily Linyphiinae from Mount Kenya (Araneae, Linyphiidae). Scientific report of the Belgian Mt. Kenya bio-expedition 1975, No. 17. Revue Zool. Afr. (Belgium) 93: 53-100.

Bosmans, R, 1985. The genera *Troglohyphantes* (new record) and *Lepthyphantes* in North Africa (Araneae: Linyphiidae). Studies on North African Linyphiidae, 3. Revue Arachnol. 6: 135-178.

Bosmans, R, 1985. Études sur les Linyphiidae nord-africains II. Le genre *Oedothorax* Bertkau en afrique du nord, avec une révision des caractères diagnostiques des mâles espècies ouest-paléarctiques. Biol. Jaarb. Dodonaea 53: 58-75.

Bosmans, R, 1986.Études sur les Linyphiidae nord-africaines 4. le genre *Centromerus* Dahl (Araneae: Linyphiidae). Biol. Jaarb. Dodonaea 54: 85-103.

Bosmans, R, 1986. Scientific report of the Belgian Cameroon expeditions, 1981 and 1983: New species and new records of spiders of the family Linyphiidae: Araneae. Revue Zool. Afr. (Belgium) 100: 171-204.

Holm, A, 1962. The spider fauna of the east African mountains. Zool. Bidr. Uppsala 35: 19-204.

Holm, A, 1964. Descriptions of some Central African Erigonidae. Rev. Zool. Bot. Afr. (Belgium) 69: 103-112.

Holm, A, 1968. Spiders of the families Erigonidae and Linyphiidae from East and Central Africa. Ann. Mus. roy. Afr. Centr. (Zool.) 171: 1-49.

Holm, A, 1977. La faune terrestre de l'Ile de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 20. Fam. Erigonidae. Ann. Mus. roy. Afr. Centr. (Zool.) 220: 163-168.

Holm, A, 1984. The spider fauna of the East African mountains, part 2. The genus *Walckenaeria* Blackwall (Araneae, Linyphiidae). Zoologica Scripta 13: 135-153.

Hormiga G. 1993. Implications of the phylogeny of Pimoidae for the systematics of linyphiid spiders (Araneae, Araneoidea, Linyphiidae). Memoirs of the Queensland Museum 33: 533-542.

Hormiga G. 1994. Cladistics and the comparative morphology of linyphiid spiders and their relatives (Araneae, Araneoidea, Linyphiidae). Zoological Journal of the Linnean Society 111: 1-71.

Jocqué, R, 1977. *Pelecopsis malawiensis* n. sp. from Central Africa (Araneida: Erigonidae). Revue Zool. Afr. (Belgium) 91: 131-136.

Jocqué, R, 1981. Notes on African Linyphiidae (Araneida) 1. A new genus from the Cape Verde Islands. Revue Zool. Afr. (Belgium) 95: 829-832.

Jocqué, R, 1981. Some linyphiids from Kenya with the description of *Locketidium* n. gen. (Araneida, Linyphiidae). Revue Zool. Afr. (Belgium) 95: 557-569.

Jocqué, R, 1981. Erigonid spiders from Malawi (Araneida, Linyphiidae). Revue Zool. Afr. (Belgium) 95: 470-492.

Jocqué, R, 1983. Notes sur les Linyphiidae (Araneae) d'Afrique. 2. Sur quelques representants du Gabon. Bull. Mus. Natn. Hist. Nat. Paris (Zool. Biol. Ecol. Anim.) 5: 619-631.

Jocqué, R, 1983. Linyphiidae (Araneae) from Ivory Coast, with description of three new genera. Zool. Meded. (Leiden) 57: 1-18.
Jocqué, R, 1984. Notes on African Linyphiidae (Araneae) 3. the genus *Tybaertiella*, with the description of a new species of *Pelecopsis*. Bull. Brit. Arachnol. Soc. 6: 217-228.
Jocqué, R, 1984. Linyphiidae (Araneae) from South Africa, part 1: the collection of the Plant Protection Research Institute, Pretoria. J. Ent. Soc. S. Afr. 47: 121—146.
Jocqué, R, 1985. Linyphiidae (Araneae) from the Comoro islands. Revue Zool. Afr. (Belgium) 99: 197-230.
Jocqué, R, & Bosmans, R, 1983. Linyphiidae (Araneae) from Ivory Coast, with the description of three new genera. Zool. Meded. (Leiden) 57: 11-18.
Jocqué, R, & Scharff, N, 1986. Spiders of the family Linyphiidae (Araneae) from the Tanzanian mountain areas Usambara, Uluguru and Rungwe. Ann. Mus. roy. Afr. Centr. (Zool.) 248: 1-61.
Scharff, N, 1990a. A catalogue of African Linyphiidae (Araneae). Steenstrupia 16: 117-152.
Scharff, N, 1990b. Spiders of the family Linyphiidae from the Uzungwa mountains, Tanzania (Araneae). Ent. Scandinavica; Suppl. 36: 1-95.
Scharff, N. 1992. The linyphiid fauna of eastern Africa (Araneae: Linyphiidae) - distribution patterns, diversity, and endemism. Biological Journal of the Linnean Society 45: 117-154.

Agelenidae

These fast moving spiders run on top of non sticky sheet webs that have a funnel retreat at one end. The elongate lateral spinnerets facilitate sheet spinning. Agelenids are most common as solitary ambushers in savannas, but in the lowland forests of the African mainland there are social species (Darchen 1965). The phylogenetic placement of the family was recently established (Griswold *et al*, in press). No comprehensive treatment of the Afrotropical species has been published since Roewer (1954), whose work is nearly useless. Eleven genera and 47 species are recorded from the Afrotropical Region.

One species was collected at Moca (1300-1400m).

Selected references on the Afrotropical agelenid fauna:

Benoit, P.L.G., 1977. Fam. Agelenidae. La faune terrestre de l'île de Sainte-Hélène. IV. Ann. Mus. roy. Afr. Centr. (Zool.) 220: 126-127.
Darchen, R.J., 1965. Ethologie d'une araignée sociale, *Agelena consociata*. Biol. Gabonica 1: 117-146.
Griswold, C., J. Coddington, N. Platnick, and R. Forster. (in press) Towards a phylogeny of entelegyne spiders (Araneae, Entelegynae). Journal of Arachnology.
Roewer, C.F., 1954. Araneae Lycosaeformia, I. (Agelenidae, Hahniidae, Pisauridae). Explor. Parc natn. Upemba Miss. G. F. de Witte 30: 3-420.

Dictynidae

These small spiders build cribellate ladder or funnel webs. Most occur on vegetation, though at least one species is kleptoparasitic in the webs of social spiders (Griswold & Meikle-Griswold 1987). The phylogenetic placement of the family was recently established (Griswold *et al*, in press). Ten genera with 17 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published.

Four species of solitary, web-building species were collected on Bioko.

Species 1 - Moca (1300-1400m), Moca (1500m)
Species 2 - Moca (1300-1400m)
Species 3 - Moca (1300-1400m)
Species 4 - Moca (1500m)

Selected references on the Afrotropical dictynid fauna:

Griswold, C., J. Coddington, N. Platnick, and R. Forster. (in press) Towards a phylogeny of entelegyne spiders (Araneae, Entelegynae). Journal of Arachnology.

Griswold, C. & T. Meikle Griswold. 1987. *Archaeodictyna ulova* new species, (Araneae: Dictynidae), a remarkable kleptoparasite of group-living eresid spiders (Stegodyphus spp., Araneae: Eresidae). American Museum Novitates 2897: 1-11.

Hahniidae

These small spiders construct delicate sheetwebs near the soil surface and are commonly found in forested areas. Their broad arrangement of spinnerets facilitates sheet spinning. Two genera with 30 species are recorded from the Afrotropical Region and, despite many recent descriptive papers, no comprehensive treatment of the Afrotropical species has been published. Many new species probably exist.

Two species of *Hahnia* were collected on Bioko.

Species 1 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m)

Species 2 - Pico Basilé (1750m), Moca (1300-1400m)

Selected references on the Afrotropical hahniid fauna:

Benoit, P.L.G., 1978. Hahniidae du mont Kenya (Araneae). Scientific report of the Belgian Mt. Kenya bio-expedition, 1975, no. 16. Revue Zool. Afr. (Belgium), 92(3): 609-621.

Bosmans, R, 1980. Studies on African Hahniidae, 1. The taxonomic status of *Hahniops* Roewer 1942, with redescription of its type species (Arachnida: Araneae). Senckenbergiana Biol. 61: 93-96.

Bosmans, R, 1981. Étude sur les Hahniidae (Araneae) africains 2. Les espèces du genre *Hahnia* de la collection Simon. Bull. Mus. Natn. Hist. Nat. Paris (Zool. Biol. Ecol. Anim.) 3: 203-211.

Bosmans, R, 1982. Two new species of *Hahnia* from Malawi (Araneae: Hahniidae). Revue Zool. Afr. (Belgium) 96: 174-178.

Bosmans, R, 1982. Scientific report of the Belgian Mount Cameroun expedition 1981, 1. Situation of the collecting sites on the altitudinal gradient. description of *Hahnia leopoldi* n. sp. (Araneae: Hahniidae). Revue Zool. Afr. (Belgium) 96: 670-682.

Zorocratidae

This family has recently been characterized (Griswold 1993) and its phylogenetic placement established (Griswold *et al*, in press). These are large spiders that run freely or make silk lined burrows with cribellate capture threads radiating from the entrance. Their distribution may be ‘afromontane’ (Griswold 1991). Three genera and 8 described species are recorded from the Afrotropical Region (many new species are yet to be described).

The one species collected on Bioko is also found on Mt. Cameroon. *Raecius zoropsides* was collected at Pico Basilé (1750m), Moca (1300-1400m), and Moca (1500m).

Selected references on the Afrotropical zorocratid fauna:

Griswold, C. E. 1991. Cladistic Biogeography of Afromontane Spiders. Australian Systematic Botany 4: 73-89.

Griswold, C. E. 1993. Investigations into the phylogeny of the Lycosoid spiders and their kin (Arachnida, Araneae, Lycosoidea). Smithsonian Contributions to Zoology 539: 1-39.

Griswold, C., J. Coddington, N. Platnick, and R. Forster. (in press) Towards a phylogeny of entelegyne spiders (Araneae, Entelegynae). Journal of Arachnology.

Ctenidae

These fast moving terrestrial and arboreal hunters are commonly called 'tropical wolf spiders'. Most are nocturnal, make no web, and rely on speed and strength to subdue prey. They include some of the largest spiders in Africa. The phylogenetic placement of the family was recently examined (Griswold 1993). Nine genera and 104 species are recorded from the Afrotropical Region. In spite of many papers describing Afrotropical ctenids there has been no comprehensive treatment of the Afrotropical species and identification remains difficult.

Four species were collected on Bioko: these will be lent to the American Museum of Natural History where studies of Ctenidae are underway.

Species 1 - Pico Basilé (700m), Moca (1300-1400m)
Species 2 - 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
Species 3 - Pico Basilé (1750m), Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m)
Species 4 - 5 km W Luba (0-50m)

Selected references on the Afrotropical ctenid fauna:

Benoit, P.L.G., 1974. Contribution à l'étude du genre Africactenus avec une clé des espèces (Aran., Ctenidae). Revue Zool. Afr. (Belgium) 88: 131-142.

Benoit, P.L.G., 1976. Études sur les Ctenidae africains (Araneae). II. Les genres *Thoriosa* Simon et *Trogloctenus* Lessert. Rev. Zool. Bot. Afr. (Belgium) 90: 221-227.

Benoit, P.L.G., 1977. Études sur les Ctenidae africains. III. Le remembrement du genre *Anahita* Karsch. Revue Zool. Afr. (Belgium) 91: 368-380.

Benoit, P.L.G., 1977. Études sur les Ctenidae africains. IV. Espèces nouvelles du genre *Anahita* Karsch. Revue Zool. Afr. (Belgium) 91: 713-720.

Benoit, P.L.G., 1977. Études sur les Ctenidae africains. V. Gen. *Ctenus*, groupe erythrochelis. Revue Zool. Afr. (Belgium) 91: 697-703.

Benoit, P.L.G., 1977. Études sur les Ctenidae africains (Araneae). VI. Gen. *Ctenus* Walck. groupe caligineus. Revue Zool. Afr. (Belgium) 91(4): 1025-1031.

Benoit, P.L.G., 1978. Études sur les Ctenidae africains (Araneae), 7. Gen. *Ctenus* Walck.-groupe *kingsleyi*. Revue Zool. Afr. (Belgium) 92: 219-223.

Griswold, C. E. 1993. Investigations into the phylogeny of the Lycosoid spiders and their kin (Arachnida, Araneae, Lycosoidea). Smithsonian Contributions to Zoology 539: 1-39.

Miturgidae

The limits of this family of running or burrowing spiders are still unclear, and most African genera attributed to the Miturgidae may ultimately be moved elsewhere (Griswold 1993). Currently eight genera and about 80 Afrotropical species are placed in this family.

Two species were collected on Bioko:

Species 1 - Moca (1300-1400m)
Species 2 - Moca (1300-1400m), 3.5 km W Luba (0-50m)

Selected references on the Afrotropical fauna:

Griswold, C. E. 1993. Investigations into the phylogeny of the Lycosoid spiders and their kin (Arachnida, Araneae, Lycosoidea). Smithsonian Contributions to Zoology, 539: 1-39.

Pisauridae

These are known as 'nursery web spiders' because of the large sheet or dome webs in which the young of some species hide. Some pisaurids run on sheet webs whereas others run on foliage. The large *Dolomedes* live near water and are known as 'fishing spiders.' The phylogenetic placement of the family was recently examined (Griswold 1993; Sierwald 1990). Thirty two genera comprising 153 species are recorded from the

Afrotropical Region. Roewer (1954) and Sierwald (1987, 1990, in press) have treated the family.

Six species were collected on Bioko.

Species 1 - Pico Basilé (700m)
Species 2 - Moca (1300-1400m)
Species 3 - Moca (1300-1400m)
Species 4 - 3.5 km W Luba (0-50m)
Species 5 - Arena Blanca (0-50m)
Species 6 - Arena Blanca (0-50m)

Selected references on the Afrotropical pisaurid fauna:

Griswold, C. E. 1993. Investigations into the phylogeny of the Lycosoid spiders and their kin (Arachnida, Araneae, Lycosoidea). Smithsonian Contributions to Zoology 539: 1-39.

Roewer, C.F., 1954. Araneae Lycosaeformia, I. (Agelenidae, Hahniidae, Pisauridae). Explor. Parc natn. Upemba Miss. G. F. de Witte 30: 3-420.

Sierwald, P. 1987. Revision der Gattung *Thalassius* (Arachnida: Araneae: Pisauridae). Verhandlungen der naturwissenschaftlichen Verein zu Hamburg 29: 51-142.

Sierwald, P. 1990. Morphology and homologous features in the male palpal organ in Pisauridae and other spider families, with notes on the taxonomy of Pisauridae (Arachnida, Araneae). Nemouria 35: 1-59.

Sierwald, P. (In press). Phylogenetic analysis of pisaurine nursery web spiders, with revisions of *Tetragonophthalma* and *Perenethis* (Araneae, Lycosoidea, Pisauridae). Journal of Arachnology.

Lycosidae

The true 'wolf spiders,' most of these are free running predators. They have good eyesight and vision plays an important role of prey capture and mating behavior. The Hippasinae make non sticky sheet webs with a funnel retreat at one side, similar to the webs of Agelenidae. The egg sac is carried on the spinnerets and, after hatching, the young ride on the mother's back. The phylogenetic placement of the family was recently examined (Griswold 1993). Fifty one genera with 469 species have been recorded from the Afrotropical Region. In spite of a large descriptive literature the classification of this family is poorly understood and most tropical African specimens are unidentifiable, even to genus.

Six species were collected on Bioko.

Species 1 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 2 - Moca (1300-1400m)
Species 3 - Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 4 - Pico Basilé (1750m)
Species 5 - Moca (1300-1400m), Moca (1500m)
Species 6 - Moca (1300-1400m), Moca (1500m)

Selected references on the Afrotropical lycosid fauna:

Griswold, C. E. 1993. Investigations into the phylogeny of the Lycosoid spiders and their kin (Arachnida, Araneae, Lycosoidea). Smithsonian Contributions to Zoology 539: 1-39.

Roewer, C.F., 1959. Araneae Lycosaeformia II (Lycosidae). Explor. Parc natn. Upemba Miss. G. F. de Witte 55: 3-518.

Roewer, C.F., 1960. Araneae Lycosaeformia II (Lycosidae, Fortsetzung und Schluss). Explor. Parc natn. Upemba Miss. G. F. de Witte 55: 519-1040.

Oxyopidae

The ‘lynx spiders’ are fast moving hunters with good vision that hunt both day and night. The legs catch prey, often after a short jump. No Afrotropical species is known to make a web, though there are web building species in the American tropics (Griswold 1983). The phylogenetic placement of the family was recently examined and placement within Lycosoidea corroborated (Griswold 1993). Four genera and 107 species are recorded from the Afrotropical Region, but no comprehensive treatment of the Afrotropical species has been published.

Two species were collected on Bioko.

Species 1 - Arena Blanca (0-50m)
Species 2 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)

Selected references on the Afrotropical oxyopid fauna:

Benoit, P.L.G., 1977. Fam. Oxyopidae. La faune terrestre de l’île Sainte-Hélène. IV. Ann. Mus. Roy. Afr. Centr. (Zool.) 220: 104.

Griswold, C. E. 1983. *Tapinillus longipes* Taczanowski, a web-building lynx spider from the American tropics (Araneae: Oxyopidae). Journal of Natural History 17: 979-985.

Griswold, C. E. 1993. Investigations into the phylogeny of the Lycosoid spiders and their kin (Arachnida, Araneae, Lycosoidea). Smithsonian Contributions to Zoology 539: 1-39.

Van Niekerk, P. & Dippenaar-Schoeman, A. 1994. A revision of the Afrotropical species of *Peucetia* (Araneae, Oxyopidae). Entomology memoir, Department of Agriculture South Africa: 89: 1-50.

Clubionidae

This family has been relimited to exclude taxa grouped by clear synapomorphies (e.g. Corinnidae, Miturgidae, Liocranidae) and the monophyly of the remaining taxa is unclear. They are two clawed running spiders, none of which are known to build webs. Five genera with 58 species are recorded from the Afrotropical Region. They remain poorly understood and no comprehensive treatment of the Afrotropical species has been published.

Seven species were collected on Bioko.

Species 1 - Moca (1300-1400m), Moca (1500m)
Species 2 - Pico Basilé (2300m), Pico Basilé (1750m)
Species 3 - Pico Basilé (2300m)
Species 4 - Moca (1300-1400m)
Species 5 - Moca (1300-1400m)
Species 6 - Moca (1300-1400m)
Species 7 - 3.5 km W Luba (0-50m)

Selected references on the Afrotropical clubionid fauna: none.

Liocranidae

This family of two-clawed running spiders has recently been separated from the Clubionidae. Twelve genera and about 30 described species have been recorded from the Afrotropical Region. The Afrotropical fauna is not well characterized: except for the recent description of *Hortipes* by Bosselaers and Ledoux (1998) no treatment of the Afrotropical species has been published. More than 50 additional new species of *Hortipes* remain to be described.

Five species, including 4 *Hortipes*, were collected on Bioko. The *Hortipes* are on loan to Bosselaers: all are shared with Mt. Cameroon.

Species 1 - 3.5 km W Luba (0-50m)
Species 2 - (*Hortipes*) on loan

Species 3 - (*Hortipes*) on loan
Species 4 - (*Hortipes*) on loan
Species 5 - (*Hortipes*) on loan

Selected references on the Afrotropical liocranid fauna:

Bosselaers, J. & J.-C. Ledoux. 1998. Description of a new African genus, *Hortipes* (Araneae, Liocranidae). Revue Arachnologique 12: 147-152.

Corinnidae

This family of two-clawed running spiders has recently been separated from the Clubionidae. They are wandering spiders that are common in leaf litter in forested areas. Many mimic ants or mutillid wasps. Twenty two genera with 110 species are recorded from the Afrotropical Region, but no comprehensive treatment of the Afrotropical species has been published. There is little modern literature on this family in Africa.

Eleven species were collected on Bioko.

Species 1 - Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 2 - Moca (1300-1400m), Moca (1500m)
Species 3 - Moca (1300-1400m), 3.5 km W Luba (0-50m)
Species 4 - 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 5 - (*Castianeira*), Pico Basilé (1750m), Moca (1500m)
Species 6 - (*Castianeira*) 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 7 - (Trachelinae), Pico Basilé (2300m), Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m)
Species 8 - Moca (1300-1400m)
Species 9 - 5 km W Luba (0-50m)
Species 10 - 3.5 km W Luba (0-50m)
Species 11 - Punta Becrof (0-50m)

Selected references on the Afrotropical corinnid fauna: none.

Gnaphosidae

These are free living, mainly nocturnal spiders that live on the soil surface or leaf litter. They are abundant in arid regions but uncommon in wet areas. The lateral spinnerets are long and cylindrical with elongate spigots crowning the tip: these spigots produce a swathing band that restrains prey. The American fauna is relatively well known but little recent attention has been focussed on the Afrotropical fauna. Forty one genera with 319 species are recorded from the Afrotropical Region.

Three species were collected on Bioko.

Species 1 - Moca (1300-1400m)
Species 2 - Moca (1500m)
Species 3 - 3.5 km W Luba (0-50m)

Selected references on the Afrotropical gnaphosid fauna:

Fitzpatrick, M. 1994. A new species of *Eilica* Keyserling, 1891 from Zimbabwe (Araneae: Gnaphosidae). Arnoldia Zimbabwe 10: 19-21.

Platnick, N.I., & Murphy, J.A., 1984. A revision of the spider genera *Trachyzelotes* and *Urozelotes* (Araneae, Gnaphosidae). Amer. Mus. Novitates 2792: 1-30.

Platnick, N.I., & Murphy, J.A., 1987. Studies of Malagasy spiders. 3. The Zelotine Gnaphosidae (Araneae: Gnaphosoidea) with a review of the genus *Camillina*. Amer. Mus. Novitates 2874: 1-33.

Heteropodidae

These are large to huge wandering spiders, mostly nocturnal, that occur on the soil surface, vegetation, on tree trunks and in buildings. Commonly called 'huntsman spiders' or 'giant crab spiders,' they are fast moving predators that build no webs but rely on speed and strength to subdue prey. *Heteropoda venatoria* is a cosmotropical synanthropic species that feeds on cockroaches and other household vermin. Thirty four genera with 198 species are recorded from the Afrotropical Region. The family is poorly known and no comprehensive treatment of the Afrotropical species has been published. The only modern monograph of a Afrotropical heteropodid group is that of Croeser (1996).

Four species were collected on Bioko.

Species 1 - Moca (1300-1400m), Moca (1500m)
Species 2 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 3 - Pico Basilé (700m)
Species 4 - Malabo

Selected references on the Afrotropical heteropodid fauna:

Croeser, P. M. C. 1996. A revision of the African huntsman spider genus *Palystes* L. Koch, 1875 (Araneae, Heteropodidae). Annals of the Natal Museum 37: 1-122.

Philodromidae

These medium sized, vagrant spiders were formerly classified among the crab spiders (see below). They make no webs and run down their prey on vegetation or on the soil surface. They are most common in the semiarid regions of Africa. Eight genera with 87 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published.

One species was collected from Moca (1300-1400m).

Selected references on the Afrotropical philodromid fauna: none.

Thomisidae

These 'crab spiders' comprise classic 'sit and wait' predators that rely on camouflage to ambush prey. Their common name reflects the fact that many walk sidewise. Many resemble bark, flowers or other substrates. Some mimic ants or bird droppings. They spin no webs. This is one of the largest families of spiders: sixty nine genera with 356 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published, but several genera have been monographed for the southern Afrotropical region.

Seventeen species were collected on Bioko.

Species 1 - 3.5 km W Luba (0-50m)
Species 2 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m)
Species 3 - Pico Basilé (1750m)
Species 4 - Pico Basilé (700m)
Species 5 - Moca (1300-1400m)
Species 6 - Moca (1300-1400m)
Species 7 - Moca (1300-1400m), Arena Blanca (0-50m)
Species 8 - Pico Basilé (700m), 3.5 km W Luba (0-50m)
Species 9 - Pico Basilé (1750m)
Species 10 - Pico Basilé (700m)
Species 11 - Moca (1300-1400m)
Species 12 - Moca (1300-1400m)
Species 13 - Moca (1300-1400m)
Species 14 - Moca (1300-1400m)
Species 15 - Moca (1300-1400m)

Species 16 - 3.5 km W Luba (0-50m)
Species 17 - Moca (1300-1400m)

Selected references on the Afrotropical thomisid fauna:

Dippenaar-Schoeman, A.S., 1980. The crab-spiders of southern Africa (Araneae: Thomisidae), 1. the genus *Runcinia* Simon, 1875. J. Ent. Soc. S. Afr. 43: 303-326.

Dippenaar-Schoeman, A.S., 1980. The crab spiders of the southern Africa (Araneae: Thomisidae), 2. The genera *Pherecydes* Pickard-Cambridge, 1883 and *Smodicinus* Simon, 1895. J. Ent. Soc. S. Afr. 43: 327-340.

Dippenaar-Schoeman, A.S., 1983. The spider genera *Misumena*, *Misumenops*, *Runcinia* and *Thomisus* (Araneae: Thomisidae) of southern Africa. Entomology Mem. Dep. Agric. Tech. Serv. Repub. S. Afr. 55: 1-66.

Dippenaar-Schoeman, A.S., 1984. The crab-spiders of southern Africa (Araneae: Thomisidae). 4. The genus *Monaeses* Thorell, 1869. Phytophylactica 16: 101-116.

Dippenaar-Schoeman, A.S., 1985. The crab spiders of Southern Africa (Araneae: Thomisidae), 5. the genus *Tmarus*. Phytophylactica 17: 115-128.

Dippenaar-Schoeman, A.S., 1986. The crab spiders of southern Africa (Araneae: Thomisidae). 7. The genus *Holopelus* Simon 1886. Phytophylactica 18: 187-190.

Dippenaar-Schoeman, A.S., 1986. The crab spiders of southern Africa (Araneae, Thomisidae) 6. The genus *Avelis* Simon, 1895. Phytophylactica 18: 131-132.

Dippenaar-Schoeman, A.S., 1989. The crab spiders of southern Africa (Araneae: Thomisidae), 8. The genus *Thomisops* Karsch, 1879. Phytophylactica 21: 319-330.

Salticidae

This is the largest family of spiders. These are called ‘jumping spiders’ because most move by making short jumps. They have excellent eyesight: 6 lateral eyes perceive movement, and the spider swivels to bring objects of interest into the field of view of the anterior median eyes. Most can see a clear, color image at a distance of several times their body length. Eyesight plays a crucial role in feeding, with the spiders stalking the prey from a distance then capturing it after a quick leap. Males display ornamentation in a courtship dance performed before the female. Most use silk only for retreats, but the subfamily Spartaeinae includes web building and web invading species (Jackson 1985). Many species mimic ants. One hundred eleven genera and 622 species are recorded from the Afrotropical Region. No comprehensive treatment of the Afrotropical species has been published, though many ant mimic and spartaeine genera have been monographed.

Forty five species were collected on Bioko.

Species 1 - Pico Basilé (1750m), Moca (1500m), Punta Becrof (0-50m)
Species 2 - Pico Basilé (700m), 3.5 km W Luba (0-50m)
Species 3 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
Species 4 - Pico Basilé (700m), 3.5 km W Luba (0-50m), (Malabo)
Species 5 - Moca (1300-1400m)
Species 6 - 5 km W Luba (0-50m), Arena Blanca (0-50m), Punta Becrof (0-50m)
Species 7 - Pico Basilé (700m), Moca (1300-1400m), Moca (1500m)
Species 8 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m)
Species 9 - 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 10 - Moca (1300-1400m)
Species 11 - 3.5 km W Luba (0-50m)
Species 12 - 3.5 km W Luba (0-50m)
Species 13 - 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 14 - Pico Basilé (2300m), Moca (1300-1400m)
Species 15 - Pico Basilé (1750m), Moca (1300-1400m)
Species 16 - Moca (1300-1400m), Arena Blanca (0-50m)
Species 17 - 5 km W Luba (0-50m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m), Punta Becrof (0-50m)

Species 18 - 5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 19 - Moca (1300-1400m), Moca (1500m), Arena Blanca (0-50m)
Species 20 - 5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 21--23 - Pico Basilé (1750m), Moca (1300-1400m), Moca (1500m), 3.5 km W Luba (0-50m), Arena Blanca (0-50m)
Species 24 - Pico Basilé (2300m)
Species 25 - Pico Basilé (1750m)
Species 26 - Pico Basilé (1750m)
Species 27 - Pico Basilé (1750m)
Species 28 - Pico Basilé (700m)
Species 29 - Pico Basilé (700m)
Species 30 - Moca (1300-1400m)
Species 31 - Moca (1300-1400m)
Species 32 - Moca (1300-1400m)
Species 33 - Moca (1300-1400m)
Species 34 - Moca (1500m)
Species 35 - 5 km W Luba (0-50m)
Species 36 - 5 km W Luba (0-50m)
Species 37 - 3.5 km W Luba (0-50m)
Species 38 - 3.5 km W Luba (0-50m)
Species 39 - 3.5 km W Luba (0-50m)
Species 40 - 3.5 km W Luba (0-50m)
Species 41 - 3.5 km W Luba (0-50m)
Species 42 - 3.5 km W Luba (0-50m)
Species 43 - Arena Blanca (0-50m)
Species 44 - Arena Blanca (0-50m)
Species 45 - 5 km W Luba (0-50m)

Selected references on the Afrotropical salticid fauna:

Jackson, R.R., 1985. A web building jumping spider *Portia fimbriata*. Scientific Amer. 253: 102-115.

Wanless, F.R., 1978. A revision of the spider genus *Portia* (Araneae: Salticidae). Bull. Br. Mus. Nat. Hist. (Zool.) 34: 83-124.

Wanless, F.R., 1978. A revision of the spider genera *Belippo* and *Myrmarachne* (Araneae, Salticidae) in the Ethiopian region. Bull. Br. Mus. Nat. Hist. (Zool.) 33: 1-139.

Wanless, F.R., 1979. A revision of the spider genus *Brettus* (Araneae: Salticidae). Bull. Br. Mus. Nat. Hist. (Zool.) 35: 183-190.

Wanless, F.R., 1980, A revision of the spider genus *Macopaeus* (Araneae: Salticidae). Bull. Br. Mus. Nat. Hist. (Zool.) 38: 219-223.

Wanless, F.R., 1980. A revision of the spider genus *Onomastus* (Araneae: Salticidae). Bull. Br. Mus. Nat. Hist. (Zool.) 39: 179-188.

Wanless, F.R., 1980. A revision of the spider genera *Asemonea* and *Pandisus* (Araneae: Salticidae). Bull. Br. Mus. Nat. Hist. (Zool.) 39: 213-257.

Wanless, F.R., 1984. A review of the spider subfamily Spartaeinae nom. n. (Araneae: Salticidae), with descriptions of six new genera. Bull. Br. Mus. Nat. Hist. (Zool.) 46: 135-205.

Wesolowska, W., 1986. A revision of the genus *Heliophanus* C. L. Koch, 1833 (Aranei: Salticidae). Ann. Zool. (Warsaw) 40: 1-254.

Wesolowska, W., 1989. Notes on the Salticidae (Aranei) of the Cape Verde Islands. Ann. Mus. Civ. Stor. Nat. Genova 87: 263-273.

Table 3.2. List of spiders collected at survey localities on Bioko. Species unique to a site are indicated with an asterisk (*).

Site 1 (25 spp., 1 unique) --Pico Basilé: 3°36’9”N, 8°46’38”E, ca.2300 m, 26--27 Sept.

Pholcidae sp. 2
Tetragnathidae sp. 7
Tetragnathidae sp. 9
Tetragnathidae sp. 18--20 or 22
Araneidae sp. 15
Araneidae sp. 20 (*Neoscona*)
Theridiosomatidae sp. 1
Anapidae sp. 1
Theridiidae sp. 39--41
Theridiidae sp. 45
Theridiidae sp. 46
Theridiidae sp. 47
*Theridiidae sp. 54
Linyphiidae sp. 1 (*Microlinyphia*)
Linyphiidae sp. 4 (?*Lepthyphanthes*)
Linyphiidae sp. 5 (?*Neriene*)
Linyphiidae sp. 7 (*Afroneta*)
Linyphiidae sp. 9
Linyphiidae sp. 14
Linyphiidae sp. 11
Clubionidae sp. 2
Clubionidae sp. 3
Corinnidae sp. 7 (Trachelinae)
Salticidae sp. 14
Salticidae sp. 24

Site 2 (61 spp., 18 unique)--Pico Basilé: 3°37’38”N, 8°48’15”E, ca.1750 m, 27--29 Sept.

*Dipuridae sp. 1
*Mygalomorphae sp. 1
Pholcidae sp. 2
*Pholcidae sp. 8
*Pholcidae sp. 9
*Scytodidae sp. 1
Scytodidae sp. 3
Telemidae sp. 2
Oonopidae sp. 1
Oonopidae sp. 5
Uloboridae sp. 4
Tetragnathidae sp. 6 (*Tetragnatha*)
Tetragnathidae sp. 7
Tetragnathidae sp. 9
Tetragnathidae sp. 13
Tetragnathidae sp. 18--20 or 22
Araneidae sp. 15
Araneidae sp. 16
Araneidae sp. 17
Araneidae sp. 20 (*Neoscona*)
*Araneidae sp. 32
Theridiosomatidae sp. 4
*Mysmenidae sp. 3

Mysmenidae sp. 8--9 or 10
Nesticidae sp.
Theridiidae sp. 33
Theridiidae sp. 34--35 or 36 (*Thwaitesia*)
Theridiidae sp. 39--41
Theridiidae sp. 45
Theridiidae sp. 50
Theridiidae sp. 51
*Theridiidae sp. 55
**Buibui kankamelos*, n. sp.
Linyphiidae sp. 5 (?*Neriene*)
Linyphiidae sp. 7 (*Afroneta*)
Linyphiidae sp. 9
Linyphiidae sp. 10
Linyphiidae sp. 11
Linyphiidae sp. 12--13
*Linyphiidae sp. 15
*Linyphiidae sp. 16
*Linyphiidae sp. 17
Hahniidae sp. 1
Hahniidae sp. 2
Raecius zoropsides
Ctenidae sp. 3
*Lycosidae sp. 4
Clubionidae sp. 2
Corinnidae sp. 5 (*Castianeira*)
Corinnidae sp. 7 (Trachelinae)
Thomisidae sp. 2
*Thomisidae sp. 3
*Thomisidae sp. 9
Salticidae sp. 1
Salticidae sp. 8
Salticidae sp. 15
Salticidae sp. 21--23
*Salticidae sp. 25
*Salticidae sp. 26
*Salticidae sp. 27

Site 3 (61 spp., 21 unique)--Pico Basilé: 3°41’44”N, 8°52’17”E, ca.700m, 17 Sept.

Pholcidae sp. 1
*Pholcidae sp. 3
Pholcidae sp. 7
Scytodidae sp. 2
Telemidae sp. 2
Segestriidae sp.
Zodariidae sp. 1
Mimetidae sp. 1
Mimetidae sp. 3
Uloboridae sp. 2
*Uloboridae sp. 7
Tetragnathidae sp. 1 (*Nephila*)
Tetragnathidae sp. 4 (*Tetragnatha*)
Tetragnathidae sp. 6 (*Tetragnatha*)

Tetragnathidae sp. 7
Tetragnathidae sp. 8 (*Dolichognatha*)
Tetragnathidae sp. 13
Tetragnathidae sp. 18--20 or 22
*Araneidae sp. 4 (*Aranaethra*)
Araneidae sp. 11 (*Neoscona*)
Araneidae sp. 16
Araneidae sp. 17
Araneidae sp. 20 (*Neoscona*)
*Araneidae sp. 24
*Araneidae sp. 27
*Araneidae sp. 30
*Araneidae sp. 33
Araneidae sp. 37--39 (*Cyclosa*)
Theridiosomatidae sp. 1
Theridiosomatidae sp. 4
Mysmenidae sp. 8--9 or 10
*Symphytognathidae sp.
Theridiidae sp. 5 (*Argyrodes*)
Theridiidae sp. 6 (*Argyrodes*)
Theridiidae sp. 7 (*Argyrodes*)
Theridiidae sp. 14 (Hadrotarsinae)
Theridiidae sp. 19 (Hadrotarsinae)
Theridiidae sp. 25 (*Achaearanea*)
*Theridiidae sp. 29 (*Achaearanea*)
Theridiidae sp. 34--35 or 36 (*Thwaitesia*)
Theridiidae sp. 37
Theridiidae sp. 39--41
Theridiidae sp. 45
*Theridiidae sp. 56
*Theridiidae sp. 57
*Theridiidae sp. 58
*Theridiidae sp. 59
*Theridiidae sp. 60
*Linyphiidae sp. 18
Ctenidae sp. 1
Ctenidae sp. 3
*Pisauridae sp. 1
*Heteropodidae sp. 3
*Thomisidae sp. 4
Thomisidae sp. 8
*Thomisidae sp. 10
Salticidae sp. 2
Salticidae sp. 4 (also from Malabo)
Salticidae sp. 7
*Salticidae sp. 28
*Salticidae sp. 29

Site 4 (155 spp., 63 unique)--Moca: 3°21’36”N, 8°39’49”E, ca.1300-1400 m, 1--11 Oct.

**Moggridgea anactenidia*
Barychelidae sp.
Pholcidae sp. 1
Pholcidae sp. 2

Pholcidae sp. 4
Scytodidae sp. 3
Telemidae sp. 1
Ochyroceratidae sp. 1
Oonopidae sp. 1
Oonopidae sp. 4
Oonopidae sp. 5
Oonopidae sp. 6
*Oonopidae sp. 8
*Hersiliidae sp. 1
Zodariidae sp. 1
Zodariidae sp. 2
Mimetidae sp. 1
Mimetidae sp. 3
Deinopidae sp.
Uloboridae sp. 4
Tetragnathidae sp. 1 (*Nephila*)
Tetragnathidae sp. 3 (*Nephilengys*)
Tetragnathidae sp. 6 (*Tetragnatha*)
Tetragnathidae sp. 7
Tetragnathidae sp. 9
*Tetragnathidae sp. 10
Tetragnathidae sp. 12
Tetragnathidae sp. 14
Tetragnathidae sp. 15
*Tetragnathidae sp. 16
Tetragnathidae sp. 18--20 or 22
Araneidae sp. 1 (*Cyrtophora*)
*Araneidae sp. 2 (*Argiope*)
Araneidae sp. 3 (*Gasteracantha*)
*Araneidae sp. 5 (*Poltys*)
*Araneidae sp. 7 (*Cyrtarachne*)
Araneidae sp. 10 (*Neoscona*)
Araneidae sp. 11 (*Neoscona*)
Araneidae sp. 12
Araneidae sp. 16
Araneidae sp. 17
Araneidae sp. 19
Araneidae sp. 20 (*Neoscona*)
Araneidae sp. 21 (Caerostris)
*Araneidae sp. 22
*Araneidae sp. 23
*Araneidae sp. 25
*Araneidae sp. 29
*Araneidae sp. 31
*Araneidae sp. 34
Araneidae sp. 37--39 (*Cyclosa*)
Theridiosomatidae sp. 1
Theridiosomatidae sp. 4
Mysmenidae sp. 1
*Mysmenidae sp. 4
*Mysmenidae sp. 5
Mysmenidae sp. 8--9 or 10
Anapidae sp. 1

Theridiidae sp. 1 (*Argyrodes*)
Theridiidae sp. 4 (*Argyrodes*)
Theridiidae sp. 7 (*Argyrodes*)
Theridiidae sp. 8 (*Argyrodes*)
*Theridiidae sp. 9 (*Argyrodes*)
*Theridiidae sp. 10 (*Argyrodes*)
Theridiidae sp. 15 (Hadrotarsinae)
*Theridiidae sp. 16 (Hadrotarsinae)
Theridiidae sp. 17 (Hadrotarsinae)
*Theridiidae sp. 20 (Hadrotarsinae)
*Theridiidae sp. 21 (Hadrotarsinae)
Theridiidae sp. 25 (*Achaearanea*)
Theridiidae sp. 26 (*Achaearanea*)
Theridiidae sp. 28 (*Achaearanea*)
Theridiidae sp. 30 (*Achaearanea*)
*Theridiidae sp. 31 (*Achaearanea*)
Theridiidae sp. 33
Theridiidae sp. 34--35 or 36 (*Thwaitesia*)
Theridiidae sp. 39--41
*Theridiidae sp. 44
Theridiidae sp. 46
Theridiidae sp. 47
Theridiidae sp. 50
Theridiidae sp. 51
*Theridiidae sp. 61
*Theridiidae sp. 62
*Theridiidae sp. 63
*Theridiidae sp. 64
*Theridiidae sp. 65
Linyphiidae sp. 1 (*Microlinyphia*)
*Linyphiidae sp. 2
Linyphiidae sp. 3
Linyphiidae sp. 4 (?*Lepthyphanthes*)
Linyphiidae sp. 5 (?*Neriene*)
Linyphiidae sp. 6 (*Mecynidis*)
*Linyphiidae sp. 8
Linyphiidae sp. 9
Linyphiidae sp. 10
Linyphiidae sp. 12--13
*Linyphiidae sp. 19
*Linyphiidae sp. 20
*Linyphiidae sp. 21
*Linyphiidae sp. 22
*Linyphiidae sp. 23
*Linyphiidae sp. 24
*Agelnidae sp.
Dictynidae sp. 1
*Dictynidae sp. 2
*Dictynidae sp. 3
Hahniidae sp. 1
Hahniidae sp. 2
Raecius zoropsides
Ctenidae sp. 1
Ctenidae sp. 3

*Miturgidae sp. 1
Miturgidae sp. 2
*Pisauridae sp. 2
*Pisauridae sp. 3
*Lycosidae sp. 2
Lycosidae sp. 3
Lycosidae sp. 5
Lycosidae sp. 6
Clubionidae sp. 1
*Clubionidae sp. 4
*Clubionidae sp. 5
*Clubionidae sp. 6
Corinnidae sp. 1
Corinnidae sp. 2
Corinnidae sp. 3
Corinnidae sp. 7 (Trachelinae)
*Corinnidae sp. 8
*Gnaphosidae sp. 1
Heteropodidae sp. 1
*Philodromidae sp.
Thomisidae sp. 2
*Thomisidae sp. 5
*Thomisidae sp. 6
Thomisidae sp. 7
*Thomisidae sp. 11
*Thomisidae sp. 12
*Thomisidae sp. 13
*Thomisidae sp. 14
*Thomisidae sp. 15
*Thomisidae sp. 17
*Salticidae sp. 5
Salticidae sp. 7
Salticidae sp. 8
*Salticidae sp. 10
Salticidae sp. 14
Salticidae sp. 15
Salticidae sp. 16
Salticidae sp. 19
Salticidae sp. 21--23
*Salticidae sp. 30
*Salticidae sp. 31
*Salticidae sp. 32
*Salticidae sp. 33

Site 5 (73 spp., 15 unique)--Moca: 3°22’0”N, 8°39’57”E, ca.1500 m, 5--10 Oct.

Barychelidae sp.
*Mygalomorphae sp. 2
Pholcidae sp. 2
Pholcidae sp. 4
Scytodidae sp. 3
Telemidae sp. 1
Ochyroceratidae sp. 1
Oonopidae sp. 1

Oonopidae sp. 3
Oonopidae sp. 4
Oonopidae sp. 6
Zodariidae sp. 1
Zodariidae sp. 2
Mimetidae sp. 1
Tetragnathidae sp. 3 (*Nephilengys*)
Tetragnathidae sp. 7
Tetragnathidae sp. 8 (*Dolichognatha*)
Tetragnathidae sp. 13
Tetragnathidae sp. 14
Tetragnathidae sp. 15
Tetragnathidae sp. 18--20 or 22
Araneidae sp. 1 (*Cyrtophora*)
Araneidae sp. 17
Araneidae sp. 20 (*Neoscona*)
*Theridiosomatidae sp. 3
Theridiosomatidae sp. 4
*Theridiosomatidae sp. 5
*Mysmenidae sp. 6
*Mysmenidae sp. 7
Mysmenidae sp. 8--9 or 10
Anapidae sp. 1
*Anapidae sp. 2
Nesticidae sp.
Theridiidae sp. 1 (*Argyrodes*)
Theridiidae sp. 4 (*Argyrodes*)
Theridiidae sp. 15 (Hadrotarsinae)
Theridiidae sp. 17 (Hadrotarsinae)
*Theridiidae sp. 22 (Hadrotarsinae)
Theridiidae sp. 26 (*Achaearanea*)
Theridiidae sp. 28 (*Achaearanea*)
Theridiidae sp. 30 (*Achaearanea*)
Theridiidae sp. 34--35 or 36 (*Thwaitesia*)
Theridiidae sp. 39--41
Theridiidae sp. 51
*Theridiidae sp. 52
*Theridiidae sp. 66
**Wanzia fako*
Linyphiidae sp. 3
Linyphiidae sp. 4 (?*Lepthyphanthes*)
Linyphiidae sp. 5 (?*Neriene*)
Linyphiidae sp. 6 (*Mecynidis*)
Linyphiidae sp. 12--13
*Linyphiidae sp. 25
*Linyphiidae sp. 26
Dictynidae sp. 1
*Dictynidae sp. 4
Hahniidae sp. 1
Raecius zoropsides
Lycosidae sp. 5
Lycosidae sp. 6
Clubionidae sp. 1
Corinnidae sp. 2

Corinnidae sp. 5 (*Castianeira*)
Corinnidae sp. 7 (Trachelinae)
*Gnaphosidae sp. 2
Heteropodidae sp. 1
Thomisidae sp. 2
Salticidae sp. 1
Salticidae sp. 7
Salticidae sp. 8
Salticidae sp. 19
Salticidae sp. 21--23
*Salticidae sp. 34

Site 6 (67 spp., 24 unique)--5 km W Luba: 3°27'54"N, 8°31'17"E, 12--14 Oct .

Barychelidae sp.
Pholcidae sp. 1
Pholcidae sp. 4
Pholcidae sp. 6 (also Malabo)
Scytodidae sp. 3
*Telemidae sp. 3
*Telemidae sp. 4
*Ochyroceratidae sp. 2
Oonopidae sp. 1
Oonopidae sp. 2
*Oonopidae sp. 7
*Hersiliidae sp. 2
Palpimanidae sp. 2
Uloboridae sp. 1
Uloboridae sp. 2
Uloboridae sp. 3
*Tetragnathidae sp. 2 (*Nephila*)
Tetragnathidae sp. 3 (*Nephilengys*)
Tetragnathidae sp. 4 (*Tetragnatha*)
Tetragnathidae sp. 5 (*Tetragnatha*)
Tetragnathidae sp. 6 (*Tetragnatha*)
Tetragnathidae sp. 8 (*Dolichognatha*)
Tetragnathidae sp. 12
*Tetragnathidae sp. 17
Araneidae sp. 3 (*Gasteracantha*)
*Araneidae sp. 6 (*Cyrtarachne*)
Araneidae sp. 11 (*Neoscona*)
Araneidae sp. 12
*Araneidae sp. 13
Araneidae sp. 17
Araneidae sp. 19
*Araneidae sp. 35
*Araneidae sp. 36
Theridiosomatidae sp. 4
*Theridiosomatidae sp. 6
Mysmenidae sp. 2
Nesticidae sp.
Theridiidae sp. 2 (*Argyrodes*)
Theridiidae sp. 3 (*Argyrodes*)
Theridiidae sp. 5 (*Argyrodes*)

Theridiidae sp. 7 (*Argyrodes*)
Theridiidae sp. 8 (*Argyrodes*)
*Theridiidae sp. 11 (*Argyrodes*)
Theridiidae sp. 14 (Hadrotarsinae)
Theridiidae sp. 25 (*Achaearanea*)
Theridiidae sp. 38
Theridiidae sp. 43
*Theridiidae sp. 67
*Theridiidae sp. 68
*Theridiidae sp. 69
*Linyphiidae sp. 27
*Linyphiidae sp. 28
*Linyphiidae sp. 29
Ctenidae sp. 3
*Ctenidae sp. 4
Lycosidae sp. 1
Oxyopidae sp. 2
*Corinnidae sp. 9
Heteropodidae sp. 2
Salticidae sp. 3
Salticidae sp. 6
Salticidae sp. 17
Salticidae sp. 18
Salticidae sp. 20
*Salticidae sp. 35
*Salticidae sp. 36
*Salticidae sp. 45

Site 7 (95 spp., 38 unique)--3.5 km W Luba: 3°28’54”N, 8°34’58”E, 13 Oct.

Barychelidae sp.
*Dipuridae sp. 2
Pholcidae sp. 5
Pholcidae sp. 7
Scytodidae sp. 3
Segestriidae sp.
Oonopidae sp. 2
Oonopidae sp. 3
Oonopidae sp. 4
Oonopidae sp. 5
Oonopidae sp. 6
*Hersiliidae sp. 3
Zodariidae sp. 3
Mimetidae sp. 1
Mimetidae sp. 2
Mimetidae sp. 3
Uloboridae sp. 1
*Uloboridae sp. 6
Tetragnathidae sp. 5 (*Tetragnatha*)
Tetragnathidae sp. 6 (*Tetragnatha*)
Tetragnathidae sp. 12
Tetragnathidae sp. 18--20 or 22
*Araneidae sp. 8 (*Cyrtarachne*)
Araneidae sp. 10 (*Neoscona*)

*Araneidae sp. 14
Araneidae sp. 18
Araneidae sp. 19
Araneidae sp. 20 (*Neoscona*)
*Araneidae sp. 26
Araneidae sp. 37--39 (*Cyclosa*)
Theridiosomatidae sp. 1
Theridiosomatidae sp. 2
Theridiosomatidae sp. 4
*Theridiosomatidae sp. 7
Mysmenidae sp. 1
Mysmenidae sp. 2
Mysmenidae sp. 8--9 or 10
Theridiidae sp. 14 (Hadrotarsinae)
*Theridiidae sp. 18 (Hadrotarsinae)
*Theridiidae sp. 23 (Hadrotarsinae)
Theridiidae sp. 25 (*Achaearanea*)
Theridiidae sp. 27 (*Achaearanea*)
*Theridiidae sp. 32 (Phoroncidia)
Theridiidae sp. 34--35 or 36 (*Thwaitesia*)
Theridiidae sp. 37
*Theridiidae sp. 42
Theridiidae sp. 43
*Theridiidae sp. 48
Theridiidae sp. 49
*Theridiidae sp. 53
*Theridiidae sp. 70
*Theridiidae sp. 71
*Theridiidae sp. 72
*Theridiidae sp. 73
*Theridiidae sp. 74
*Theridiidae sp. 75
*Theridiidae sp. 76
*Theridiidae sp. 77
Linyphiidae sp. 12--13
*Linyphiidae sp. 30
*Linyphiidae sp. 31
Ctenidae sp. 2
Miturgidae sp. 2
*Pisauridae sp. 4
Lycosidae sp. 1
Lycosidae sp. 3
Oxyopidae sp. 2
*Clubionidae sp. 7
*Liocranidae sp. 1
Corinnidae sp. 1
Corinnidae sp. 3
Corinnidae sp. 4
Corinnidae sp. 6 (*Castianeira*)
*Corinnidae sp. 10
*Gnaphosidae sp. 3
Heteropodidae sp. 2
*Thomisidae sp. 1
Thomisidae sp. 2

Thomisidae sp. 8
*Thomisidae sp. 16
Salticidae sp. 2
Salticidae sp. 3
Salticidae sp. 4 (also Malabo)
Salticidae sp. 9
*Salticidae sp. 11
*Salticidae sp. 12
Salticidae sp. 13
Salticidae sp. 17
Salticidae sp. 21--23
*Salticidae sp. 37
*Salticidae sp. 38
*Salticidae sp. 39
*Salticidae sp. 40
*Salticidae sp. 41
*Salticidae sp. 42

Site 8 (38 spp., 5 unique)--Arena Blanca: 3°31’21”N, 8°35’0”E, 14 Oct.

*Pholcidae sp. 10
Scytodidae sp. 2
Segestriidae sp.
Zodariidae sp. 3
Mimetidae sp. 1
*Palpimanidae sp. 1
Palpimanidae sp. 2
Deinopidae sp.
Uloboridae sp. 5
Tetragnathidae sp. 5 (*Tetragnatha*)
Tetragnathidae sp. 18--20 or 22
Araneidae sp. 18
*Araneidae sp. 28
Araneidae sp. 37- 39 (*Cyclosa*)
Theridiidae sp. 14 (Hadrotarsinae)
Theridiidae sp. 15 (Hadrotarsinae)
*Theridiidae sp. 24 (Hadrotarsinae)
Theridiidae sp. 38
*Theridiidae sp. 78
*Theridiidae sp. 79
*Theridiidae sp. 80
*Pisauridae sp. 5
*Pisauridae sp. 6
*Oxyopidae sp. 1
Corinnidae sp. 4
Corinnidae sp. 6 (*Castianeira*)
Thomisidae sp. 7
Salticidae sp. 6
Salticidae sp. 9
Salticidae sp. 13
Salticidae sp. 16
Salticidae sp. 17
Salticidae sp. 18
Salticidae sp. 19

Salticidae sp. 20
Salticidae sp. 21--23
*Salticidae sp. 43
*Salticidae sp. 44

Site 9 (39 spp., 5 unique)--Punta Becrof: 3°43’18”N, 8°39’41”E, 18 Oct.

Pholcidae sp. 1
Pholcidae sp. 5
Segestriidae sp.
Zodariidae sp. 3
Mimetidae sp. 2
*Mimetidae sp. 4
Uloboridae sp. 1
Uloboridae sp. 3
Uloboridae sp. 5
Tetragnathidae sp. 4 (*Tetragnatha*)
Tetragnathidae sp. 8 (*Dolichognatha*)
Tetragnathidae sp. 11 (*Landana*)
Tetragnathidae sp. 12
Araneidae sp. 3 (*Gasteracantha*)
Araneidae sp. 10 (*Neoscona*)
Araneidae sp. 12
Araneidae sp. 16
Araneidae sp. 17
Araneidae sp. 19
Theridiidae sp. 2 (*Argyrodes*)
Theridiidae sp. 3 (*Argyrodes*)
Theridiidae sp. 4 (*Argyrodes*)
Theridiidae sp. 5 (*Argyrodes*)
Theridiidae sp. 7 (*Argyrodes*)
*Theridiidae sp. 12 (*Argyrodes*)
*Theridiidae sp. 13 (*Argyrodes*)
Theridiidae sp. 14 (Hadrotarsinae)
Theridiidae sp. 19 (Hadrotarsinae)
Theridiidae sp. 27 (*Achaearanea*)
Theridiidae sp. 34--35 or 36 (*Thwaitesia*)
Theridiidae sp. 45
Theridiidae sp. 49
*Theridiidae sp. 81
*Linyphiidae sp. 32
Ctenidae sp. 2
*Corinnidae sp. 11
Salticidae sp. 1
Salticidae sp. 6
Salticidae sp. 17

Table 3.3. Taxonomic list of spiders collected on Bioko, Equatorial Guinea. Numbers represent site(s) at which each taxon was collected.

Sites:

1--3°36’9"N, 8°46’38"E, ca.2300 m, 26--27 Sept.
2--3°37’38"N, 8°48’15"E, ca.1750 m, 27--29 Sept.
3--3°41’44"N, 8°52’17"E, ca.700m , 17 Sept.
4--3°21’36"N, 8°39’49"E, ca.1300-1400 m, 1--11 Oct.
5--3°22’0"N, 8°39’57"E, ca.1500 m, 5--10 Oct.
6--3°27’54"N, 8°31’17"E, 12--14 Oct.
7--3°28’54"N, 8°34’58"E, 13 Oct.
8--3°31’21"N, 8°35'0"E, 14 Oct.
9--3°43’18"N, 8°39’41"E, 18 Oct.

Taxon	Site								
MYGALOMORPHAE									
Migidae									
Moggridgea anactenidia				4					
Barychelidae									
sp				4	5	6	7		
Dipluridae									
sp 1		2							
sp 2							7		
Family undetermined									
sp 1		2							
sp 2					5				
ARANEOMORPHAE									
Pholcidae									
sp 1			3	4		6			9
sp 2	1	2		4	5				
sp 3			3						
sp 4				4	5	6			
sp 5							7		9
sp 6						6 (+Malabo)			
sp 7			3				7		
sp 8		2							
sp 9		2							
sp 10								8	
Scytodidae									
sp 1		2							
sp 2			3					8	
sp 3		2		4	5	6	7		
Telemidae									
sp 1				4	5				
sp 2		2	3						
sp 3						6			

sp 4					6			
females	2	3	4	5	6			
Ochyroceratidae								
sp 1			4	5				
sp 2					6			
females				5	6	7		
Segestriidae (no males)								
sp		3				7	8	9
Oonopidae								
sp 1 (pbly 2 spp)	2		4	5	6			
sp 2					6	7		
sp 3				5		7		
sp 4			4	5		7		
sp 5	2		4			7		
sp 6			4	5		7		
sp 7					6			
sp 8			4					
Hersiliidae								
sp 1			4					
sp 2					6			
sp 3						7		
Zodariidae								
sp 1		3	4	5				
sp 2			4	5				
sp 3						7	8	9
Mimetidae								
sp 1		3	4	5		7	8	
sp 2						7		9
sp 3		3	4			7		
sp 4								9
Palpimanidae								
sp 1							8	
sp 2					6		8	
Deinopodae								
sp			4				8	
Uloboridae								
sp 1					6	7		9
sp 2		3			6			
sp 3					6			9
sp 4	2		4					
sp 5							8	9
sp 6						7		
sp 7		3						

Tetragnathidae									
sp 1 (*Nephila*)			3	4					
sp 2 -”-						6			
sp 3 (*Nephilengys*)				4	5	6			
sp 4 (*Tetragnatha*)			3			6			9
sp 5 -”-						6	7	8	
sp 6 -”-		2	3	4		6	7		
sp 7	1	2	3	4	5				
sp 8 (*Dolichognatha*)			3		5	6			9
sp 9	1	2		4					
sp 10				4					
sp 11 (*Landana*)									9
sp 12				4		6	7		9
sp 13		2	3		5				
sp 14				4	5				
sp 15				4	5				
sp 16				4					
sp 17						6			
sp 18 - 20 or 22	1	2	3	4	5		7	8	
Araneidae									
sp 1 (*Cyrtophora*)				4	5				
sp 2 (*Argiope*)				4					
sp 3 (*Gasteracantha*)				4		6			9
sp 4 (*Aranaethra*)			3						
sp 5 (*Poltys*)				4					
sp 6 (*Cyrtarachne*)						6			
sp 7 -”-				4					
sp 8 -”-							7		
sp 9									
sp 10 (±*Neoscona*)				4			7		9
sp 11 -”-			3	4		6			
sp 12				4		6			9
sp 13						6			
sp 14							7		
sp 15	1	2							
sp 16		2	3	4					9
sp 17		2	3	4	5	6			9
sp 18							7	8	
sp 19				4		6	7		9
sp 20 (*Neoscona*)	1	2	3	4	5		7		
sp 21 (Caerostris)				4					
sp 22				4					
sp 23				4					
sp 24			3						
sp 25				4					
sp 26							7		
sp 27			3						
sp 28								8	
sp 29				4					
sp 30			3						
sp 31				4					
sp 32		2							
sp 33			3						

sp 34				4					
sp 35						6			
sp 36						6			
sp 37- 39 (*Cyclosa*)			3	4		6	7	8	
Theridiosomatidae									
sp 1	1		3	4			7		
sp 2							7		
sp 3					5				
sp 4		2	3	4	5	6	7		
sp 5					5				
sp 6						6			
sp 7							7		
Mysmenidae									
sp 1				4			7		
sp 2						6	7		
sp 3		2							
sp 4				4					
sp 5				4					
sp 6					5				
sp 7					5				
sp 8 - 9 or 10		2	3	4	5		7		
Anapidae									
sp 1	1			4	5				
sp 2					5				
Symphytognathidae									
sp			3						
Nesticidae									
sp		2			5	6			
Theridiidae									
sp 1 (*Argyrodes*)				4	5				
sp 2 -”-						6			9
sp 3 -”-						6			9
sp 4 -”-				4	5				9
sp 5 -”-			3			6			9
sp 6 -”-			3						
sp 7 -”-			3	4		6			9
sp 8 -”-				4		6			
sp 9 -”-				4					
sp 10 -”-				4					
sp 11 -”-						6			
sp 12 -”-									9
sp 13 -”-									9
sp 14 (Hadrotarsinae)			3			6	7	8	9
sp 15 -”-				4	5			8	
sp 16 -”-				4					
sp 17 -”-				4	5				
sp 18 -”-							7		
sp 19 - “-			3						9

sp 20 -”-				4					
sp 21 -”-				4					
sp 22 -”-					5				
sp 23 -”-							7		
sp 24 -”-								8	
sp 25 (±Achaearanea)			3	4		6	7		
sp 26 -”-				4	5				
sp 27 -”-							7		9
sp 28 -”-				4	5				
sp 29 -”-			3						
sp 30 -”-				4	5				
sp 31 -”-				4					
sp 32 (Phoroncidia)							7		
sp 33		2		4					
sp 34 - 35 or 36(*Thwaitesia*)	2	3	4	5		7		9	
sp 37			3				7		
sp 38						6		8	
sp 39 - 41	1	2	3	4	5				
sp 42							7		
sp 43						6	7		
sp 44				4					
sp 45	1	2	3						9
sp 46	1			4					
sp 47	1			4					
sp 48							7		
sp 49							7		9
sp 50		2		4					
sp 51		2		4	5				
sp 52					5				
sp 53							7		
sp 54	1								
sp 55		2							
sp 56			3						
sp 57			3						
sp 58			3						
sp 59			3						
sp 60			3						
sp 61				4					
sp 62				4					
sp 63				4					
sp 64				4					
sp 65				4					
sp 66					5				
sp 67						6			
sp 68						6			
sp 69						6			
sp 70							7		
sp 71							7		
sp 72							7		
sp 73							7		
sp 74							7		
sp 75							7		
sp 76							7		
sp 77							7		

sp 78								8	
sp 79								8	
sp 80								8	
sp 81									9
Cyatholipidae									
Buibui kankamelos, n. sp.		2							
Wanzia fako					5				
Linyphiidae									
sp 1 (*Microlinyphia*)	1			4					
sp 2				4					
sp 3				4	5				
sp 4 (?*Lepthyphanthes*)	1			4	5				
sp 5 (?*Neriene*)	1	2		4	5				
sp 6 (*Mecynidis*)				4	5				
sp 7 (*Afroneta*)	1	2							
sp 8				4					
sp 9	1	2		4					
sp 10		2		4					
sp 11	1	2							
sp 12 - 13		2		4	5		7		
sp 14	1								
sp 15		2							
sp 16		2							
sp 17		2							
sp 18			3						
sp 19				4					
sp 20				4					
sp 21				4					
sp 22				4					
sp 23				4					
sp 24				4					
sp 25					5				
sp 26					5				
sp 27						6			
sp 28						6			
sp 29						6			
sp 30							7		
sp 31							7		
sp 32									9
Agelenidae									
sp				4					
Dictynidae									
sp 1				4	5				
sp 2				4					
sp 3				4					
sp 4					5				
Hahniidae									
sp 1		2		4	5				
sp 2		2		4					

Zorocratidae									
Raecius zoropsides		2		4	5				
Ctenidae									
sp 1			3	4					
sp 2							7		9
sp 3		2	3	4		6			
sp 4						6			
Miturgidae									
sp 1				4					
sp 2				4			7		
Pisauridae									
sp 1			3						
sp 2				4					
sp 3				4					
sp 4							7		
sp 5								8	
sp 6								8	
Lycosidae									
sp 1						6	7		
sp 2				4					
sp 3				4			7		
sp 4		2							
sp 5				4	5				
sp 6				4	5				
Oxyopidae									
sp 1							8		
sp 2						6	7		
Clubionidae									
sp 1				4	5				
sp 2	1	2							
sp 3	1								
sp 4				4					
sp 5				4					
sp 6				4					
sp 7							7		
Liocranidae									
sp 1							7		
sp 2 (*Hortipes*)									
sp 3 -”-									
sp 4 -”-									
sp 5 -”-									
Corinnidae									
sp 1				4			7		
sp 2				4	5				
sp 3				4			7		
sp 4							7	8	

sp 5 (±*Castianeira*)		2			5				
sp 6 -”-							7	8	
sp 7 (Trachelinae)	1	2		4	5				
sp 8				4					
sp 9						6			
sp 10							7		
sp 11									9
Gnaphosidae									
sp 1				4					
sp 2					5				
sp 3							7		
Heteropodidae									
sp 1				4	5				
sp 2						6	7		
sp 3			3						
sp 4	Malabo								
Philodromidae									
sp				4					
Thomisidae									
sp 1							7		
sp 2		2		4	5		7		
sp 3		2							
sp 4			3						
sp 5				4					
sp 6				4					
sp 7				4			8		
sp 8			3				7		
sp 9		2							
sp 10			3						
sp 11				4					
sp 12				4					
sp 13				4					
sp 14				4					
sp 15				4					
sp 16							7		
sp 17				4					
Salticidae									
sp 1		2			5				9
sp 2			3				7		
sp 3						6	7		
sp 4			3				7 (Malabo)		
sp 5				4					
sp 6						6		8	9
sp 7			3	4	5				
sp 8		2		4	5				
sp 9							7	8	
sp 10				4					
sp 11							7		
sp 12							7		

sp 13							7	8	
sp 14	1			4					
sp 15		2		4					
sp 16				4				8	
sp 17						6	7	8	9
sp 18						6		8	
sp 19				4	5			8	
sp 20						6		8	
sp 21 - 23		2		4	5		7	8	
sp 24	1								
sp 25		2							
sp 26		2							
sp 27		2							
sp 28			3						
sp 29			3						
sp 30				4					
sp 31				4					
sp 32				4					
sp 33				4					
sp 34					5				
sp 35						6			
sp 36						6			
sp 37							7		
sp 38							7		
sp 39							7		
sp 40							7		
sp 41							7		
sp 42							7		
sp 43								8	
sp 44								8	
sp 45						6			

DISCUSSION OF TARGET TAXA

CARABID BEETLES (Insecta: Coleoptera; Carabidae) - David H. Kavanaugh

Collections made during the Academy's expedition to Bioko, Equatorial Guinea, in September-October 1998, included 98 beetle specimens belonging to the Family Carabidae. This material has been preliminarily sorted to morphospecies and initial study suggests that a total of 28 species are represented. No comprehensive study of the carabid fauna of west Africa in general or of Bioko in particular has been published or even undertaken, and the literature to date for the fauna of the region includes only isolated descriptions of species. It is therefore not possible to accurately identify any of the material collected to species or, except in a few instances, even to genus except by comparison with type material, all of which is deposited in collections in Europe (mainly in Paris). I will not be able to make the necessary comparisons until at least a year from now, so the attached list represents the best determinations that can be made at present. However, even without more detailed identifications, it is possible to make certain generalizations about the carabid fauna of Bioko from the initial sampling effort.

Fully half of the species in the collections made are represented by single specimens only. This suggests that the carabid fauna of Bioko was only partially sampled, that many additional species will be found to occur there, and that the carabid fauna is certainly richer, more diverse, than is presently known.

An overview of the carabids collected suggests a fauna with a distinctly Pantropical appearance, with groups common to Africa, southeast Asia, the Indo-Australian region, and even South America represented. From a cursory review of the extensive holdings of African carabids in the Academy's collections, most of which, unfortunately, remain unidentified at present, it is clear that the carabids of Bioko have closest affinities with the fauna of the adjacent mainland of Africa, especially with the fauna of Cameroon. It is not yet possible to determine what percentage of the species sampled are in fact common to both Bioko and the mainland, but it is likely that a majority of species in the Bioko fauna will fall in this category. Several of the carabids examined are short-winged, flightless forms, and all of these were collected in montane habitats on Pico Basilé. Typically, and on a worldwide basis, flightless, montane carabid beetles occupy highly restricted geographical ranges, often being confined to single peaks or mountain ranges, with most closely related species found on adjacent peaks or ranges. It is therefore likely that at least three, and probably more, of the species sampled are endemic to the island of Bioko, more specifically to higher, undisturbed montane habitats on Pico Basilé, and will be found nowhere else. Certainly, the survival of such unique, endemic forms is a serious conservation concern. Different but related species most probably occupy montane habitats on the mainland, particularly in the highlands of Cameroon.

SPIDERS (ARANEAE) - Charles E. Griswold

Cyatholipidae

The cyatholipid spiders are today restricted to the southern hemisphere, occurring in Africa, Australia, Madagascar, and New Zealand. In the Afrotropical Region the family fits an Afromontane biogeographic pattern. Two species were collected on Bioko, each of which also occurs on nearby Mt. Cameroon. *Buibui kankamelos*, n. sp., was collected on Pico Basilé at 1750 m. This species is otherwise known from Mt. Cameroon. *Buibui*, the new genus to which it belongs, also occurs in the mountains of eastern Africa (Ethiopia, Tanzania, Kenya, and Congo Kinshasa). This species suggests affinities between Bioko plus Cameroon with the montane forests of East Africa. The other species collected was *Wanzia fako* Griswold 1998, which was taken at Moca at 1500 m. This species otherwise occurs on Mt. Cameroon, Mt. Kupe, and in the Bamenda highlands of Cameroon. *Wanzia* is sister group of genera that occur in the montane forests of East Africa (*Isicabu* and *Scharffia*) and Madagascar (*Alaranea*).

Migidae

Several individuals of *Moggridgea anactenidia* Griswold 1987, which also occurs in Cameroon, were collected on Bioko from one-door trap door nests in tree trunks at Moca at 1300-1400m. *Moggridgea anactenidia* is the sister species of *Moggridgea verruculata* Griswold 1987, which occurs in the highlands along the southern Congo basin. Sister species of these in turn is *Moggridgea microps* Hewitt 1915 that occurs along the Indian Ocean coast from South Africa to Kenya. The *microps* group of three species is sister group of the *quercina* group that occurs in the southern Cape region of South Africa. *Moggridgea* is unusual among afromontane arthropods in having been collected in the southern Congo Basin highlands. I think that this is an artifact of poor collecting in this area, and it is likely that the relationship between the western African and eastern African montane arthropod faunas includes a west Africa-southern Congo highland component.

Phyxelididae

This family is the dominant group of cribellate web-building spiders in cool-temperate forests of eastern and southern Africa and Madagascar, comprising 52 species in 11 genera (Griswold, C. 1990. A revision and phylogenetic analysis of the spider subfamily Phyxelidinae (Araneae, Amaurobiidae). *Bulletin of the American Museum of Natural History*, 196: 1-206.). Two additional species occur in Southeast Asia. Phyxelidids were not collected in Bioko although one of the field participants (Ubick) has experience collecting this family in Madagascar and Tanzania. Phyxelidids were also not collected on a previous expedition to Cameroon. Habitat in both localities seems ideal for phyxelidids. Therefore, phyxelidids appear absent from west Africa. This absence is inexplicable at this time.

Zorocratidae

This recently characterized family comprises three genera and 8 described species in the Afrotropical Region (many new species are to be described) and additional genera in South America and Sri Lanka.. The one species collected is also found on Mt. Cameroon. *Raecius zoropsides* (Strand 1915) was collected at Pico Basilé (1750m), Moca (1300-1400m), and Moca (1500m). Other *Raecius* species occur in Ivory Coast, Congo-Kinshasa, Ethiopia and Tanzania, and the sister genus, *Zorodictyna*, occurs in Madagascar. No cladistic analysis for this family has been completed.

THE SPIDERS OF BIOKO - SUMMARY

The spider fauna of Bioko is rich, well-balanced, and shows close affinities to the nearby mainland of Cameroon. All target groups studied (Cyatholipidae, Migidae, and Zorocratidae) are represented on Bioko by species that also occur in Cameroon. Bioko harbors an island biota only in that it is home to a typical montane rainforest arthropod fauna. Bioko's fauna is neither impoverished nor does it conspicuously lack groups present on the mainland. The richness and balance of Bioko's spider fauna is apparent in comparison to that of nearby Mt. Cameroon, which is similar in age and habitat diversity. In a 1992 study of Mt. Cameroon spiders (Coddington, J. Griswold, C., Wanzie, C., Hormiga, G. and Larcher, S. 1992. *Estimates of spider species richness on Mount Cameroon, West Africa.* Unpublished Technical Report to the Institute of Zootechnical Research, Ministry of Higher Education and Scientific Research, Yaoundé, Cameroon) two sites (Etinde, 500m, and Mann's Spring, 2200m) were sampled for 50 person-days. A total of 286 spider species were collected. By comparison, 42 person-days of sampling over a similar elevation range on Bioko netted 372 spider species. The Cameroon study was conducted in the dry season, while the Bioko study was conducted in the wet season, so the studies are not completely comparable, but the richness of the Bioko fauna is undeniable.

Although the data (spider specimens) were not collected in a way that allows statistical comparison of sites, some rough comparison of sites on Bioko is possible. When compared in terms of species collected by person-days of effort, sites 3 (Pico Basilé, ca.700m, 30.5 spp./pd), 7 (3.5 km W Luba, 0-50 m, 95 spp./pd) and (Arena Blanca: 0-50m, 38 spp./pd) stand out. Sites 7 and 8 are disturbed lowland forest sites, while site 3 is mid-elevation forest. A substantial number of species span low-high elevation range, e.g. several species of Araneidae and Tetragnathidae. There is also a rich fauna of species that are restricted to montane habitats (i.e., above 1300 m). Many Linyphiidae, Hahniidae, Dictynidae, and some Theridiidae and Corinnidae occur only at high elevation. All members of the afromontane target taxa (Cyatholipidae, Migidae, and Zorocratidae) are also restricted to elevations above 1300m. The spider fauna of Bioko is equivalent in richness and diversity to nearby mainland Cameroon.

CONSERVATION IMPORTANCE OF BIOKO

Insofar as can be estimated at this time, the arthropod fauna of Bioko is as rich and diverse at that of mainland Cameroon. The island shows no impoverishment associated with isolation. For those spider taxa that can be identified endemism is low (though an assessment of carabid beetles may show otherwise) and so Bioko cannot be considered a 'center of endemism.' Perhaps the most valuable aspect of Bioko is that it may harbor a rich and diverse biota, comparable to any on the mainland, for which a complete transect from low to high elevation (lowland forest through montane and mossy forest) is preserved on the south slopes of the southern highlands (Reserva Cientifica de Caldera de Luba). Only Mount Cameroon is comparable, and both population pressure and volcanic activity threaten this gradient. The Reserva Cientifica de Caldera de Luba is a biodiversity treasure that deserves top conservation priority.

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PART IV

BIOGEOGRAPHY

Chapter 4. Comparative avian phylogeography of Cameroon and Equatorial Guinea mountains: implications for conservation

Thomas B. Smith, Derek Girman, Kim O'Keefe and Brenda Larison

INTRODUCTION

Successfully prioritizing areas for conservation requires that data from many sources be integrated. Information on species richness, endemism, demography, genetic distinctiveness, and magnitudes of anthropogenic threats all provide important data for making informed conservation decisions (Balmford et al. 1999; Mace & Lande 1991; Moritz & McDonald 1999; Pressey et al. 1993). In particular, for conservation planning to be successful biologists should endeavor to preserve not only the pattern of biodiversity but also the evolutionary processes that generate and maintain it (Erwin 1991; Moritz & McDonald 1999; Smith et al. 1993). In this context, the use of genetic markers to formulate phylogenetic descriptions at the population or species level, and to prioritize areas for conservation is widely recognized (Avise 1994; Humphries et al. 1995; Moritz & Faith 1998; Smith et al. 1997). One useful approach is to contrast intraspecific phylogeographies of co-distributed species to identify important geographic areas that have undergone independent evolution (Avise 1992; Crozier & Kusmierski 1994; Faith 1992; Moritz & Faith 1998). If phylogenetic patterns are concordant across diverse taxa, extrapolating to multi-species communities may be possible. Thus, the application of comparative phylogeography has the potential to identify evolutionarily significant units (Moritz 1994; Vogler & DeSalle 1994) and to provide a means of identifying important geographic areas for subsequent conservation efforts.

According to Moritz and Faith (1998) there are three requirements for the use of comparative phylogeography for conservation purposes: 1) an appropriate geographic area must be defined, based on biogeographic data, geomorphology or other criteria; 2) a history of vicariance across regions to be compared must be shared among taxa, as indicated by congruence of phylogenetic division and biogeographic barriers; and 3) combinations of regions that maximize diversity must be identifiable. Quantitative methods for testing congruence have recently been developed (Page 1994). One such approach, summarizing genetic data across co-distributed taxa by incorporating branch length data, is the "Phylogenetic Diversity" (PD) measure (Faith 1994; Faith 1992; Moritz & Faith 1998). The PD method is useful in characterizing the spatial pattern of genetic diversity regardless of the taxonomic unit (Faith & Walker 1996; Moritz & Faith 1998). In this application, PD estimates the underlying pattern of genetic diversity by recording the total amount of the branching pattern that is spanned by a given mtDNA allele (Moritz & Faith 1998). When combined with other relevant evolutionary and ecological data the approach can help prioritize and focus conservation efforts.

In this study we used the expanded Phylogenetic Diversity measure approach of Moritz and Faith (1998), combining phylogenetic data from two co-distributed bird species with available distributional information on avian endemism to assess the conservation value of mountains in southwestern Cameroon and the Gulf of Guinea, Equatorial Guinea. Montane forests of western Cameroon and islands of the Gulf of Guinea are well known for their biogeographic significance, particularly with respect to the large numbers of endemic and threatened bird species (Collar & Stuart 1985; Louette 1981; Stuart 1986). Recently, considerable attention has focused on the conservation of these high elevational forests (Larison et al. in press; Pérez del Val et al. 1994; Smith & McNiven 1993; Stuart 1986). Conservation efforts are currently underway or being developed for many of the mountains, including Pico Basilé and the southern highlands of Bioko in Equatorial Guinea, and Mt. Cameroon, Mt. Kupe, Mt. Oku, and Tchabal Mbabo in Cameroon (Fig. 1). Despite intense conservation interest, comparative information on the genetic distinctiveness of the fauna present on each mountain is lacking.

The objective of this study was to develop a quantitative framework to assess avian biodiversity and evolutionary units across the Afromontane region of the Gulf of Guinea. Specifically we: 1) use concordance of intra-specific mtDNA phylogenies of two montane bird species to identify which mountains or mountain groups represent significant evolutionary units, 2) use quantitative methods to describe avian endemism across mountains, and 3) contrast avian endemism with mtDNA phylogenies among the mountain groupings defined by the mtDNA phylogenies. Finally, we discuss the utility of our results along with other types of information to help prioritize conservation efforts across the region.

METHODS

STUDY SITES

The geological history of the region is complex, with volcanic activity beginning in the Upper Cretaceous. The chain of highlands and mountains (Fig. 4.1), referred to as the Cameroon line, extends northeast from the islands in the Gulf of Guinea through Mt. Cameroon to Tchabal Mbabo (Wright et al. 1985). Most of the volcanic activity likely occurred during the Pliocene, with signs of recent volcanic activity in Mt. Cameroon persisting through the Quaternary. The island of Bioko is primarily Pliocene in age (Wright et al. 1985). Unlike the mountains of volcanic origin, Mt. Kupe, a massive horst of granite and syenite, was formed by blockfaulting (Stuart 1986). Six mountains, five in Cameroon and one in Equatorial Guinea, were examined in the study (Fig. 4.1). The five mountains in Cameroon were sampled, some repeatedly, as follows: Mt. Cameroon, 31 May-2 June 1993, 25 May-20 July 1995 and 30 March-3 April 1997; Tchabal Mbabo, 1-5 December 1990, 11-20 July 1995; Mt. Kupe, 26-29 May 1993, 26 February - 2 March 1997; Mt. Oku/Kilum 23 July 1995 and Bokosi Mts. 5-6 March 1997. On the island of Bioko, Equatorial Guinea, we surveyed birds on the northern slope of the Caldera de Luba in the southern highlands from 22-27 June 1996.

Mt. Cameroon - Located on the coast of southwestern Cameroon, this isolated, large (50x30 km) volcano is the highest mountain in West Africa at 4085 m. Its approximately 800 km^2 of forest ranges from lowland forest at sea-level to montane forest between 1400 and 2500 m. Because Mt. Cameroon is an active volcano, mature forest is interspersed with forest in various stages of regeneration due to periodic lava flows. The south and south-east portions of the mountain are well populated and vulnerable to deforestation from agriculture and logging. The only protected area is the 300 km^2 Bambuku Forest Reserve on the north-west side of the mountain (Collar & Stuart 1985; Stuart 1986). Sampling took place in montane forest at an elevation of approximately 1500 m, at a site (N4° 9' E9° 14') above the town of Buea on the southern slope in 1993 and up mountain (1100m) near the village of Mapanja in 1997.

Mt. Kupe - Mt. Kupe is the first major peak inland from Mt. Cameroon, though it is much smaller, at 2064 m. Montane rainforest begins at approximately 1600 m, and is estimated to cover only 0.21km2 (Collar & Stuart 1985; Stuart 1986). Sampling took place in montane forest at an elevation of 1600 m (N4° 47' E9° 43').

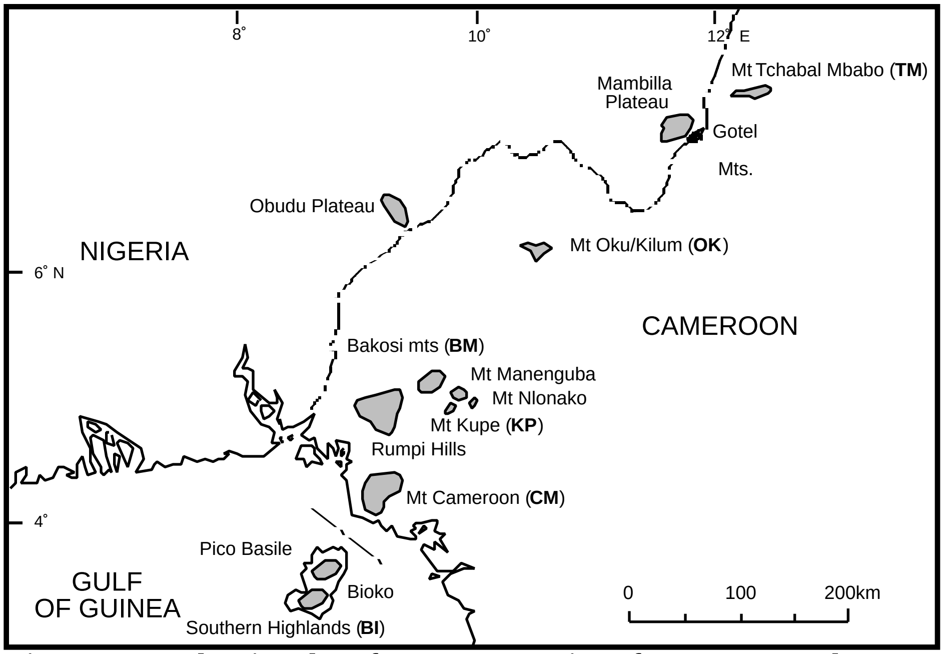

Fig. 4.1. Map showing the Afromontane region of Cameroon and Equatorial Guinea. Mountains on which birds were sampled are shown with abbreviations in bold.

Bokosi Mts. - These mountains lie to the northwest of Mt. Kupe exceeding 1500 m elevation in many areas, and support healthy montane forests. Sampling took place in montane forest at an elevation of 1600m near the village of Kodmin.

Mt. Oku (Kilum) – This mountain forms part of the Bamenda Highlands, and with an elevation of 3011 m is the second highest mountain in Cameroon. Due to pressures from high human population densities, agriculture and grazing, little forest exists on Oku below 2000 m (Stuart 1986). The remaining forest is montane and extends from 2000 m to the summit, but is threatened by grazing, wood harvesting, burning and over-exploitation of small mammals and *Pygaem* bark. Sampling took place in montane forest at an elevation of 2070 m (N6° 14' E10° 31').

Tchabal Mbabo – This plateau forms a 25-30 km crescent-shaped ridge. Montane forest extends from over 2,000 m down to approximately 1700 m, narrowing below this elevation into gallery forest and thickly wooded savanna. The north and west facing slopes harbor approximately 2,500 hectares of montane forest and montane scrub, while the large montane gallery forests on the plateau are still in need of quantification (Thomas & Thomas 1996). The steep north slopes where most of the montane forest occurs do not permit easy access, and are therefore relatively undisturbed. In contrast, the plateau is under heavy human pressure, including livestock grazing, crops, and wood gathering. We sampled the plateau at two localities: 1) the north slope about 5 km from Mayo Kélélé (07˚16'N 12˚09E, elev. 2456 m) in 1995 (Larison et al. in press), and 2) the western escarpment in 1990 (Smith & McNiven 1993). Sampling was conducted in a gallery on the plateau at 2000 m and in forest on the north slope between 1930 and 1945 m.

Southern highlands of Bioko – The region is thickly forested, with montane forest beginning as low as 800 m (Guinea 1951). Primary forest on the relatively uninhabited south slope of the island runs in a continuous gradient from lowland to montane forest (Jones 1994), representing one of the few intact gradients in West Africa. We sampled between 1600 and 1,650 m on the north slope of the Caldera de Luba (N3° 23 E8° 33’) above the village of Ruiché (Larison et al. in press).

SPECIES AND FIELD METHODS

At each site between 10 to 33 mist-nets (12 m, 30 x 30 mm mesh) were erected in forest along cleared net lanes (Larison et al. in press). Nets were opened at sunrise (06h00) and closed between 11h00 or 12h00. Individuals were banded with numbered aluminum bands, sexed, aged, measured, and a small sample of blood was taken from the brachial vein by venu-puncture (1 or 2 drops) (Smith 1990; Smith et al. 1997). Sampling for genetic analysis concentrated on two species, the mountain greenbul (*Andropadus tephrolaemus*) and the Cameroon blue-headed sunbird (*Nectarinia oritis*). The mountain greenbul is a medium sized greenbul restricted to montane forests above 1500 m, and has a wide geographic distribution in Africa, occurring throughout many mountains of East Africa (Keith et al. 1992; Roy 1997). Two subspecies are recognized in the region: *Andropadus t. tephrolaemus* occurring on Mt. Cameroon and Bioko and *Andropadus t. bamendae*, a darker race found from Mt. Kupe to Tchabal Mbabo (Louette 1981). Outside of Cameroon and Equatorial Guinea, numerous other subspecies have been identified, particularly in the East African mountains of Tanzania (Keith et al. 1992; Roy 1997). In contrast, the Cameroon blue-headed sunbird is endemic to Cameroon and Bioko, Equatorial Guinea. It is a shy, sedentary species found in the lower canopy of high montane forest (Mackworth-Praed & Grant 1973). There are three recognized subspecies, *Nectarinia oritis poensis* on Bioko, *Nectarinia o. oritis* on Mt. Cameroon and *Nectarinia oritis bansoensis* for the mountains in northern Cameroon.

Data on distributions of avian endemism among the different mountains were gathered from numerous sources (Brown et al. 1982; Fry et al. 1988; Keith et al. 1992; Larison et al. in press; Louette 1981; Mackworth-Praed & Grant 1973; Pérez del Val et al. 1994; Smith & McNiven 1993; Stuart 1986; Urban et al. 1986). As most of the montane forest species are endemic to the region, at least at the subspecific level, we limit our discussion to only those endemics recognized as full species.

DNA SEQUENCING

Blood samples collected from 31 *A. tephrolaemus* individuals from five mountains, and from 45 individuals of *N. oritis* on all six mountains, were stored in buffer (following Smith et al. 1997). Approximately 20 µl of blood/buffer mixture were digested in 450 µl of TNE (10 mM Tris -pH 8.0, 2 mM EDTA, and 10 mM NaCl) with 200 µg Proteinase K, and 35 µl 10% SDS for approximately 20 hours at 37° C. The DNA was then isolated using a phenol/chloroform/isoamyl alcohol method (Taberlet & Bouvet 1991).

The polymerase chain reaction (PCR) was used to amplify a portion of the cytochrome *b* region of the mitochondrial genome (Saiki et al. 1988) using primers MVZ-03' and MVZ-04' (Kocker & White 1989). Double-stranded PCR products were generated in 50 µl reactions consisting of buffer (100 mM Tris-HCl, pH 9.0, 500 mM KCl, 1% Triton X-100), 2.5mM MgCl2, 0.8 mM dNTPs, 0.1 mM of each primer, 1.25 units of Promega Taq DNA polymerase, and 20-60 ng of genomic DNA, in a Perkin Elmer Cetus model 2400 thermocycler. PCR products were purified using a Qiagen PCR product isolation kit. Double stranded cycle sequencing using dye-primer labeling was carried out in an ABI Robotic Catalyst. Sequenced products were run in a 6% acrylamide gel in an ABI Prism 377 automated sequencer (Applied Biosystems Inc.), and sequences were examined and aligned using the program Sequencher 3.0 (Gene-Codes-Corporation 1995).

DATA ANALYSIS

We used the Phylogenetic Diversity measure (PD) to estimate the underlying diversity among the montane sampling sites for each species (Faith 1994; Faith & Walker 1996;

Faith 1992; Moritz & Faith 1998). Neighbor-joining trees for each species were estimated from Kimura two-parameter distances among cytochrome *b* haplotypes using the software program PAUP© version 4.0 (Swofford 1998). The branch lengths among all nodes and haplotypes were calculated for each tree. PD values were calculated as the sum of branch lengths along the minimum spanning path connecting all alleles from any two regions and extending to the root of the tree (Faith 1992; Moritz & Faith 1998). Separate pair-wise PD values calculated for each species were then combined into total pair-wise PD values for each combination of montane sites. In addition, the four most northern mountains were also designated NOR, for some comparisons (see Table 1 for sample locality abbreviations). Following Moritz and Faith (1998), the highest pair-wise PD values between montane sampling sites were used to identify the largest sum of diversity (branch lengths) encompassed by two localities. The distribution of total PD to specific areas and combinations of areas were described using a Venn diagram (Faith and Walker, 1996b). Each unit count of mtDNA divergence derived from the branch lengths of the original neighbor-joining trees (depicted in the Venn diagram) provides a new character. We then conducted a parsimony analysis of a data set derived from the Venn diagram to produce an area cladogram using PAUP version 4.0 (Faith 1992; Moritz & Faith 1998).

Distributional information on endemics from published literature was examined using the methods of Moritz and Faith (1998). Based on the presence and absence of endemics on each mountain we first calculated Bray-Curtis distances (Ludwig & Reynolds 1988) to describe differences among mountains, then used the resulting data to cluster them and generate a dendogram using UPGMA (Sneath & Sokal 1973). Both analyses were run on NTSYS-pc 1.80 (Rohlf 1993). Following Moritz and Faith (1998) the data were also represented using a Venn diagram to examine patterns of shared and unique endemic species among the mountains and were further illustrated using a parsimony tree.

RESULTS

PHYLOGEOGRAPHIC PATTERNS

In *Andropadus tephrolaemus*, a total of 316 base pairs were sequenced from the cytochrome *b* gene (N = 31) revealing 7 haplotypes across five mountains (Fig. 4.2A). Analysis shows three distinct clades: the northern mountains (including Mt. Kupe, Mt. Oku, and Mt. Tchabal Mbabo), Mt. Cameroon, and Bioko. Sequencing of 316 bps of the mitochondrial cytochrome *b* gene in *Nectarinia oritis* (N=45) across all mountains revealed a total of 14 haplotypes. The resulting neighbor-joining tree showed the existence of distinct clades for Bioko and Mt. Cameroon (Fig. 4.2B). However, unlike *Andropadus tephrolaemus*, there is evidence of paraphyly within the northern mountains (NOR, including Kupe, Bakosi and Oku/Kilum).

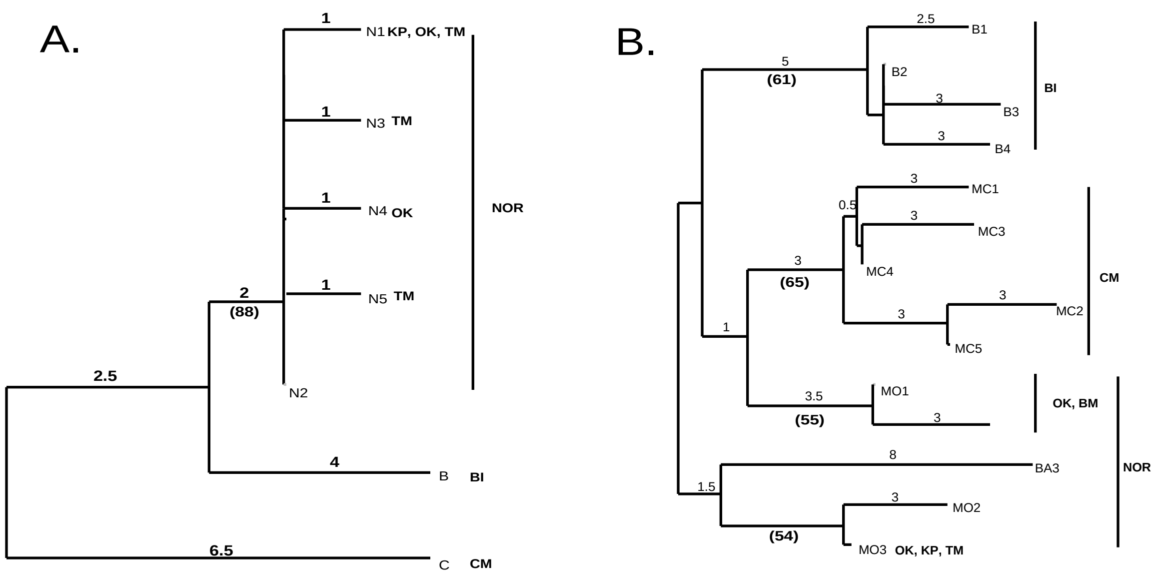

Fig. 4.2. Intraspecific phylogeographies for (A) mountain greenbul *Andropadus tephrolaemus* and (B) the Cameroon blue-headed sunbird *Nectarinia oritis* sampled from 6 mountains (BI, CM, KP, BM, OK, TM, abbreviations as in Fig. 1). Northern mountains, NOR, include, OK, KP, BM, TM. Each tree was estimated by neighbor-joining and numbers refer to Kimura sequence divergence estimates X 1000. Bootstrap values greater that 50% are indicated in parentheses.

PHYLOGENETIC DIVERSITY ANALYSIS

Combining phylogenies and branch lengths among mtDNA haplotypes across species provides an integrated picture of intraspecific genetic variation and distinctiveness across mountains (Faith 1994; Faith 1992; Moritz & Faith 1998). We assume that geologic history and ecological factors across regions, either through similar patterns of gene flow and/or effects of isolation, will result in a congruence of haplotype distributions in both species across geographic areas.

The outcome of the PD analyses are summarized in Table 4.1. PD values are compared within and between the biogeographic units of Bioko, Mt. Cameroon and the Northern Mountains and among specific mountains for both *N. oritis* and *A. tephrolaemus.* Comparisons among Bioko, Mt. Cameroon and northern mountains produced the highest PD values, although PD values within and among regions for *N. oritis* were higher than *A. tephrolaemus* suggesting that this small sunbird may be comparatively more sedentary.

Table 4.1. PD values for comparisons within and among three biogeographic units, Bioko (BI), Mt. Cameroon (CM) and the Northern Mountains (NOR) and among specific sampling localities (see Fig. 1). Locality abbreviations are as follows: Equatorial Guinea: BI – Southern Highlands of Bioko; Cameroon: CM - Mt. Cameroon; OK - Mt. Oku; KP - Mt. Kupe; BM – Bakossi mts; TM - Mt. Tchabal Mbabo; NOR - All Northern Mountains (including OK, KP, BM, TM).

Regions	*N. oritis*	*A. tephrolaemus*	Total
BI	14	4	18
CM	15.5	6.5	22
NOR	23.5	6	29.5
BI-CM	30.5	13	43.5
BI-OK	38.5	12.5	51
BI-KP	28	12.5	40.5
BI-BM	31.5	--	--
BI-TM	20	12.5	32.5
BI-NOR	38.5	12.5	51
CM-OK	40	14	54
CM-KP	30.5	14	44.5
CM-BM	33	--	--
CM-TM	22.5	14	36.5
CM-NOR	40	15	55
OK-KP	24.5	2	26.5
OK-BM	24.5	--	--
OK-TM	24.5	3	27.5
KP-BM	16.5	--	--
KP-TM	13.5	3	16.5
BM-TM	21.5	--	--

The distribution of total PD values across the mountain regions can be easily visualized using a Venn Diagram (Fig. 4.3A). The diagram clearly shows the northern mountains as having the highest PD value, followed by Mt. Cameroon and southern highlands of Bioko. The very small amount of overlap in PD values indicates that the phylogenies are highly structured and therefore informative. For example, the combined PD value for BI and NOR is 51 (Table 4.1), while individual PD values are 18 and 29.5 respectively, and overlap between BI and NOR is only 2.5 (An area cladogram using the same PD values is shown in Figure 4.2B).

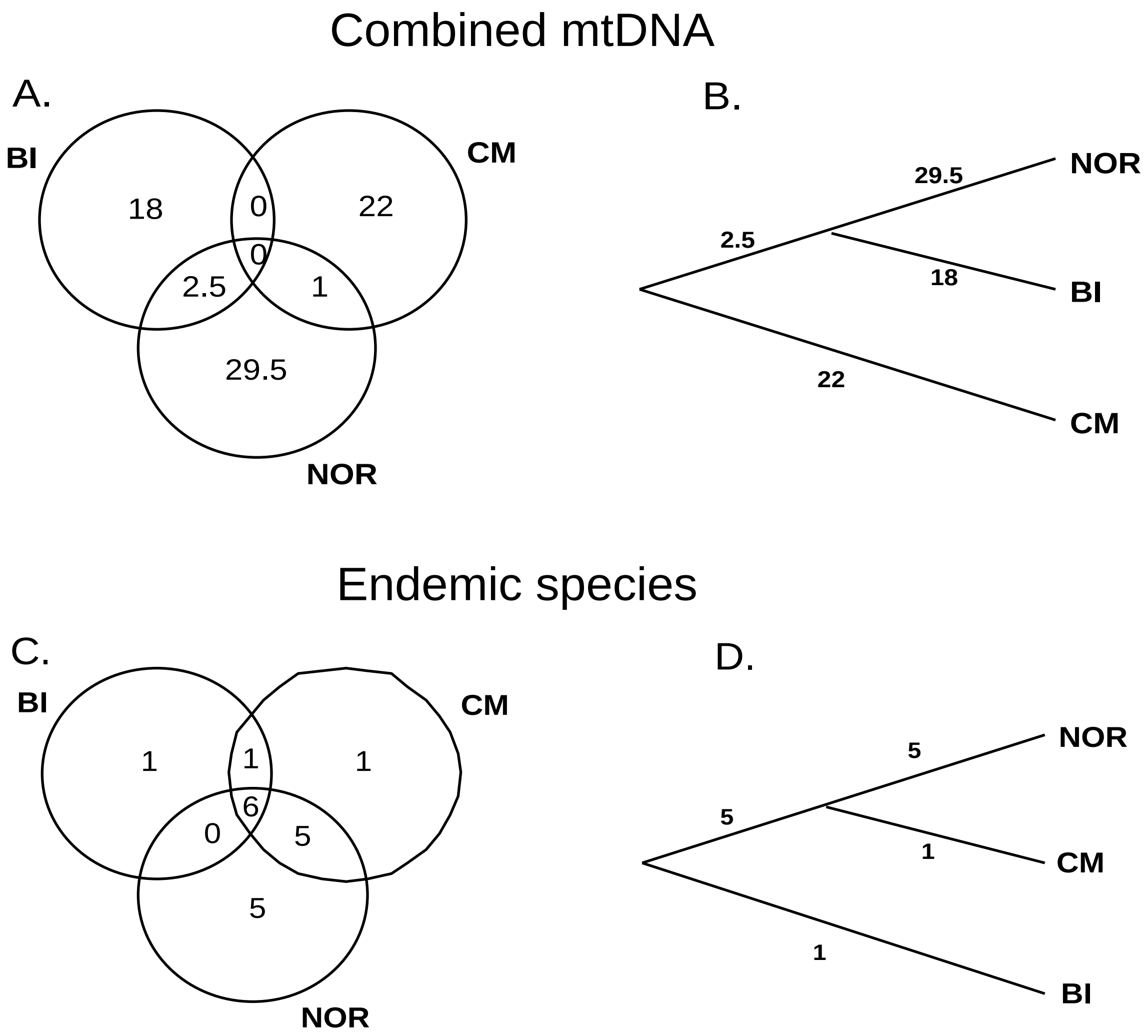

Fig. 4.3. Venn diagrams showing components (A) of mtDNA PD and counts for corresponding regions of endemic species (C) across mountains, and the corresponding area cladograms for mt DNA data (B) and endemics (D). See Moritz and Faith 1998 for more details on methods.

GEOGRAPHIC PATTERNS OF ENDEMISM

Based on published literature, 19 bird species are endemic to the Afromontane region of Cameroon and Equatorial Guinea (Table 4.2). Two of the species considered by Stuart (1984) to be endemic to this region were not included: Tullberg's woodpecker, *Campethera tullbergi*, which has recently been joined taxonomically with its eastern sister species (Fry et al. 1988), and Bamenda apalis, *Apalis bamenda* which is more widespread than previously thought (Larison et al. in press; Urban et al. 1986). We consider these distributions only approximate and not definitive. Further, mountains such as Tchabal Mbabo are under-surveyed for birds compared to others and are likely to reveal more endemics with additional surveys (Larison et al. in press; Smith & McNiven 1993; Urban et al. 1986). For this reason we exclude the Bokosi Mts. which have been poorly surveyed.

Distributions of endemics were not congruent with PD analysis across the mountain groupings defined by genetic data (see Fig. 4.3A for comparisons). This is further illustrated in Figures 4.3C and 4.3D when PD values based on endemism are constrained to the pattern described by the genetic data. The distributions of montane endemics analyzed using UPGMA analysis resulted in three main groupings: 1) the southern highlands of Bioko, 2) Mt. Cameroon and Mt. Kupe and 3) the two northernmost mountains Mt. Oku and Tchabal Mbabo (Fig. 4.4)**.**

Table 4.2. Species endemic to the Cameroon Montane Region* found on Mt. Cameroon (CM), Mt. Kupe (KP), Mt. Oku (OK), Tchabal Mbabo (TM), and Southern Highlands of Bioko (BI).

Species	CM	KP	OK	TM	BI
Cameroon Mountain Francolin *Francolinus camerunensis*	•				
Bannerman's Turaco *Tauraco bannermani*			•		
Cameroon Mountain Roughwing *Psalidoprocne fuliginosa*	•				•
Cameroon Mountain Greenbul *Andropadus montanus*	•	•	•	•	
Cameroon Olive Greenbul *Phyllastrephus poensis*	•	•	•	•	•
Grey-headed Greenbul *Phyllastrephus poliocephalus*	•	•			
Yellow-breasted Boubou *Laniarius atroflavus*	•		•	•	
Green-breasted Bush-shrike *Malaconotus gladiator*	•	•	•		
Mount Kupe Bush-shrike *Malaconotus kupeensis*		•			
Mountain Robin-chat *Cossypha isabellae*	•	•	•	•	
White-throated Mountain Babbler *Lioptilus gilberti*		•			
Black-capped Woodland-warbler *Phylloscopus herbeti*	•	•			•
Green Longtail *Urolais epiclora*	•	•	•		•
White-tailed Warbler *Poliolais lopesi*	•	•			•
Banded Wattle-eye *Platysteira laticincta*			•		
Cameroon Blue-headed sunbird *Nectarinia oritis*	•	•	•	•	•
Ursula's Mouse-colored Sunbird *Nectarinia ursulae*	•	•			•
Fernando Po White-eye *Speirops brunneus*					•
Bannerman's Weaver *Ploceus bannermani*			•	•	

* Distributions are taken from Stuart (1984), Fry et al. (1988), Smith and McNiven (1993), Pérez del Val et al. (1994), Urban et al. (1997), and Larison et al. (in press).

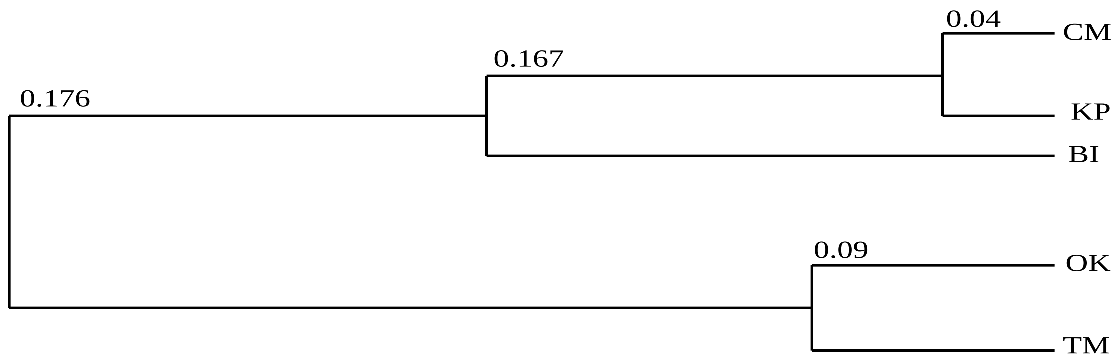

Fig. 4.4. Relationships among five mountains from Cameroon and Equatorial Guinea as inferred from the distributions of endemic species from Table 2 by UPGMA clustering of Bray-Curtis distances.

Thus in contrast to genetic data, Mt. Kupe groups with nearby Mt. Cameroon, rather than with the two northernmost mountains, Mt. Oku and Tchabal Mbabo. Furthermore, there is a positive relationship between the number of shared endemic species (Bray-Curtis distance) and geographic distance, with near mountains sharing more endemics than far mountains (Fig. 4.5). At the species level, Bioko and Mt. Cameroon, with only one unique endemic each, add little to the diversity of the montane region, although they exhibit a high degree of subspecific distinctiveness (Pérez del Val et al. 1994; Stuart 1986).

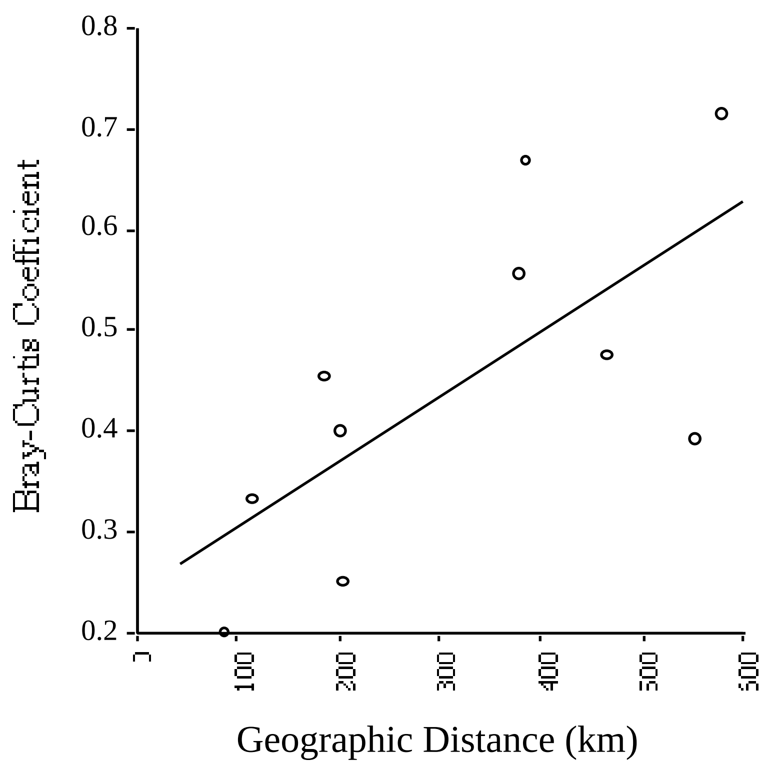

Fig. 4.5. Relationship between the similarity of endemics as index by Bray-Curtis distance coefficient and geographic distance (y = 0.001x + 0.239, r = 0.7, Mantel's test P<0.01).

DISCUSSION

INTERPRETING PHYLOGEOGRAPHIC PATTERNS

The montane greenbuls and the Cameroon blue-headed sunbird show concordant phylogenetic patterns. Based on PD analysis, the two species form three relevant biogeographic groups: Bioko, Mt. Cameroon and NOR (northern mountains, including all sampled mountains from Mt. Kupe to Tchabal Mbabo). Within this overall pattern, sunbirds show considerably more genetic structure than greenbuls. This suggests that sunbirds may have lower levels of dispersal than the greenbuls, or that they have been isolated for a longer period. The sunbird's sedentary behavior (Mackworth-Praed & Grant 1973) is consistent with this greater degree of genetic structure. Examining the phylogenetic patterns of *A. tephrolaemus* using cytochrome *b* and ND2 genes Roy (Roy 1997) postulated a complex history of interchange between Cameroon and the mountains of East Africa. The propensity to disperse**,** as asserted by Roy**,** is consistent with the relative lack of genetic structure in this species.

The complex geological history of the region makes inferring any simple pattern of isolation and divergence difficult. Paleoclimatic data suggests that many Afromontane vegetation types extended into the lowland 20,000 YBP (Maley 1996), providing a possible means of dispersal within suitable ecological habitats, especially for the northern mountains, which are connected by adjacent high ridges. Both species show distinctive clades for Bioko and Mt. Cameroon while the northern mountains are closely associated, a pattern consistent with the physical isolation of Bioko and Mt Cameroon compared to the northern mountains which show less physical isolation.

PHYLOGEOGRAPHY AND ENDEMISM

The pattern revealed by PD analysis contrasts sharply with the pattern based on endemism. The distribution of endemism is largely a function of geographic distance, with the closest mountains showing greater overlap of endemics than distant mountains. Thus as UPGMA analysis shows, Mt. Kupe groups with Mt. Cameroon, rather than the more distant two northern mountains. Why are the two measures different. One might expect the distribution of genetic variation and endemism to agree if they were shaped by similar vicariant events. However, the temporal and spatial scales required in each case may be quite different. For example, the association revealed by genetic diversity is consistent with the amount of geographic isolation. Bioko and Cameroon are both more isolated (by topography rather than distance) than any two of the northern mountains. Both stand alone and are surround by lowlands with no nearby ridges. In contrast, the mountains to the north are characterized by intervening highland and ridges, which could provide dispersal routes, albeit limited, between them. These geographic features could provide avenues for some present day gene flow among the northern mountains and hence reduced genetic divergence. However, the same geographic connectedness among northern mountains leading to genetic exchange between them might not necessarily lead to a similar association of endemics. This is because the probability of a dispersal event leading to the successful establishment of a new population is much less likely than a single individual dispersing and breeding with an already successfully established population. Because of demographic considerations, establishing a new population of a distinct species would likely require a large propagule of individuals.

ECOLOGICAL CONSIDERATIONS AND CONSERVATION IMPLICATIONS

The discrepancies between the distribution of recently derived lineages and concentrations of endemic species have been noted previously by several authors (e.g. (Fjeldsa 1994; Linder 1995). However, the discovery of different patterns should not be looked on despairingly by conservation planners since they likely do not represent conflicting data on identical processes. More likely they represent different measures of historical and demographic processes. Both sources of information are useful, and conservation practitioners should endeavor to maximize both types of information — as well as ecological information that may promote differences in selection regimes that create phynotypic diversity (Moritz & McDonald 1999) — in their conservation planning efforts. For example, substantial periods of isolation, even over many millions of years, may not lead to phenotypic evolution whereas selection along gradients in which populations exist in parapatry may (Endler 1977). For example, Schneider and Moritz (Schneider & Moritz 1998) found substantial genetic divergence in several lizard species among regions, but little or no detectable phenotypic evolution despite long-term isolation and major reductions in population size. In addition, Schneider et al. (in press) found significant morphology shifts in lizard populations across ecological distinct habitats (some separated by only 500 m), but little or no morphological differences across the major biogeographic barriers within the same habitats. These results mirror findings from northern Cameroon mountains which showed large shifts in morphological characters between rainforest and savanna, despite considerable gene flow (Smith et al. 1997; Smith et al. 1999). These studies suggest that greater emphasis should be placed on conserving the processes that promote divergence and speciation as well as the associated ecological habitats (Moritz & McDonald 1999; Orr & Smith 1998; Smith et al. 1997; Smith et al. 1999). In particular, elevational gradients between highland and lowland forest likely not only play roles as migration corridors but may also function as important gradients for natural selection (Smith et al. 1999). Increasing evidence suggests that divergent selection across such environmental gradients may promote divergence and possibly speciation (Smith et al. 1997, Orr and Smith 1998, Schluter 1998, Schneider et al. in press). Although additional ecological data needs to be gathered on the north slope of Tchabal Mbabo (Smith & McNiven 1993), northern slopes of Mt. Cameroon, and the slopes of Mt. Kupe, those found on Bioko represent intact elevational gradients which are rare in west Africa and should be priorities for conservation action. It this context it would also be important to determine if the distribution of endemics across mountains is largely a function of current ecological or historical factors. If the phynotypic characteristics that define endemics on particular mountains is due to natural selection, conserving them might also preserve important natural ecological processes that shape the montane community as a whole (Balmford et al. 1999; Smith et al. 1993).

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PART IV

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Illustrates the patterns of relationship among the afromontane flora, focusing on a variety of species that are illustrative of the complexities and varieties of relationships. Discusses hypothesis developed to explain the observed patterns.

Wilkin, P. 1994. Convolvulaceae Guinea Aequatorialis Nonnullae. Fontqueria 40:7-11.
Presents results of recent collections of Convolvulaceae from Bioko and Annobón (Pagalú), including brief descriptions and locations collected.

FAUNA

Gascoigne, A. 1993. A bibliography of the fauna of the islands of Sao Tome e Principe and the island of Annobon (Gulf of Guinea). Arquipelago Ciencias da Natureza 11:91-105.

A list of 317 works concerned with the fauna of the Democratic Republic of Sao Tome e Principe and the island of Annobon, Republic of Equatorial Guinea is presented. Most of the papers included refer directly to one of the islands or endemic species from the islands in their titles. However, other works that include significant sections on the islands are included, as well as unpublished papers that contribute useful information.

Groombridge, B., (ed). 1994. IUCN Red List of Threatened Animals. IUCN Monograph No. 5. Gland: IUCN.

Lists status of all threatened or extinct species, genera and subspecies, and commercially threatened species.

PROTISTS

Marret F. 1994. Distribution Of Dinoflagellate Cysts In Recent Marine Sediments From The East Equatorial Atlantic (Gulf Of Guinea) Review Of Palaeobotany And Palynology 84:1-22.

Forty-six sites throughout the Gulf of Guinea were sampled for dinoflagellates. Thirty-four species were identified. and their distributions documented relative to environmental parameters.

Schiebel, R., and S. Timm. 1996. Ammobaculites baculusalsus n. sp.: Taxonomy, ecology and distribution in the Gulf of Guinea (West Africa). Journal of Foraminiferal Research 26:97-102.

A new arenaceous benthic foraminiferal species was found among more than 100 abundant and well known benthic foraminiferal species in surface sediments of the upper continental slope from the Gulf of Guinea (West Africa). Ammobaculites baculusalsus n. sp. is taxonomically described and its ecology is discussed.

INVERTEBRATES

Bloemers, G. F., M. Hodda, P. J. D. Lambshead, J. H. Lawton, and F. R. Wanless. 1997. The effects of forest disturbance on diversity of tropical soil nematodes. Oecologia 111:575-582.

First account of the effects of forest disturbance on species richness of nematodes in tropical forest soils. From 24 in the Mbalmayo Forest Reserve, Cameroon.

Stop-Bowitz, C. 1991. Some New or Rare Species of Pelagic Polychaetes from the Gulf Of Guinea Atlantic Ocean. Pp. 261-270*In:* Petersen, M. E. and J. B. Kirkegaard (eds.). Systematics, Biology And Morphology Of World Polychaeta; 2nd International Polychaete Conference, Copenhagen, Denmark, August 18-23, 1986. Ophelia, Suppl. 5. Helsingor, Denmark: Ophelia Publications.

Gastropods

Arkhipkin A. I., and A. S. Shchetinnikov. 1989. Fauna and Distribution of the Young and Adult Pelagic Cephalopoda of Gulf of Guinea. Zoologichesky Zhurnal 68:26-32. Language: Russian.

Arkhipkin, A. I; N. Zheronkin Yu, A. Lotionov Yu, and A. S. Shchetinnikov. 1988. Fauna and distribution of pelagic cephalopods larvae in the Gulf of Guinea. Zoologicheskii Zhurnal 67:1459-1468. Language: Russian.
Reports on spatial distributions and vertical migrations of the pelagic larvae of 24 genera of cephalopods found while trawling in the Gulf of Guinea.

Gascoigne, A. 1994. The biogeography of land snails in the islands of the Gulf of Guinea. Biodiversity and Conservation 3:794-807.
Data on land snail diversity in the Gulf of Guinea islands in presented and the biogeography of the Gulf of Guinea fauna is discussed. The land snail faunas show high rates of endemism at species and generic levels (unlike many vertebrate fauna, this phenomenon is true of Bioko as well). Influence of island characteristics on the development of the land snail fauna is discussed. Current threats are discussed

Gascoigne, A. 1994. The dispersal of terrestrial gastropod species in the Gulf of Guinea. Journal of Conchology 35:1-7.
A discussion of modes of dispersal of terrestrial gastropod species in the Gulf of Guinea, focussing on the islands of Principe, Sao Tome and Annobon, is presented.

Van Bruggen, A C. 1994. The genus Truncatellina Lowe, 1852 (Mollusca, Gastropoda Pulmonata: Pupilloidea) in Malawi, Zambia, Angola, and Fernando Póo. Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen Biological Chemical Geological Physical and Medical Sciences 97:1-25.
Truncatellina adami is described as a new species from the island of Fernando Póo (Bioko). All species are figured and anatomical details are supplied for T. ninagongonis and T. pygmaeorum for the first time. Distributions of species in the genus are discussed and are found have a far wider distribution than thus far known. The species of this genus have minute shells (length 1.2-2.6 mm) and, in addition, belong to the cryptofauna of the forest floor, reasons why so little is known about their distribution.

Arthropods

Allard, V. 1988. Inventory of cetonians of the island of Bioko (formerly Fernando Póo) (Equatorial Guinea] with description of some new geographical races (Coleoptera, Cetoniidae). Bulletin de la Societe Sciences Nat. 59:26-28.
Nine new subspecies are proposed and described. Notes are provided on other cetonian taxa found on the island, with comparisons to the cetonian fauna of Cameroon.

Baz, A. 1990. Psocoptera from weaver bird nests (Aves: Ploceidae) in Equatorial Guinea (West-Africa). Annales de la Societe Entomologique de France 26:33-38. Language: Spanish.
Treats species of Psocoptera found in nests of weavers (Ploceiidae) in Equatorial Guinea. Includes description and illustration of a new species, *Rhyopsocus nidicola*.

Baz, A. 1990. Psocoptera of Bioko Island (Equatorial Guinea, West Africa). Journal of African Zoology 104:435-456.
Describes 28 species of Psocoptera representing 19 genera, collected from Bioko.

Bruehl, C A. 1997. Flightless insects: A test case for historical relationships of African mountains. Journal of Biogeography 24:233-250.
A study of species in 21 genera of flightless insects to elucidate former distribution of montane habitat in Africa, including the Cameroon Mountain region, and eastern mountains. Results contrast with the existing patterns of birds, grasses and butterflies.

Garrido, A. M., and J. L. Nieves Aldrey. 1996. Revision of the species of pteromalids described by R. Garcia Mercet (Hymenoptera, Chalcidoidea: Pteromalidae). Boletin de la Asociacion Espanola de Entomologia 20:221-235. Language: Spanish.
Includes one species from Bioko.

Griswold, C. 1987a. The African members of the trap-door spider family Migidae (Araneae: Mygalomorphae), I: The genus Moggridgea O. P. Cambridge, 1875. Annals of the Natal Museum 28: 1-118.

Griswold, C. 1987b. The African members of the trap-door spider family Migidae (Araneae: Mygalomorphae), 2: The genus Poecilomigas Simon. Annals of the Natal Museum 28: 475-497.

Griswold, C. 1991. Cladistic Biogeography of Afromontane Spiders. Australian Systematic Botany 4: 73-89.

Griswold, C. 1997. Occurrence and significance of the Afromontane spider families Cyatholipidae and Phyxelididae at Bwindi-Impenetrable Forest National Park. Report to BINP, Uganda, March 1997, 3 pp.

Herbulot, C. 1998. Lepidopteres Geometrides recoltes par le Dr. J.-G. Canu dans l'ile de Bioko (ex Fernando Póo) (Lepidoptera). Lambillionea 98:287-292.
List of 41 Geometridae species from Bioko collected by Dr. Jean-Guy Canu in 1997 including six new endemic species and one new endemic subspecies.

Monserrat, V J. 1988-1989. Contribution to the study of the Coniopterygidae of Rio Muni (Equatorial Guinea) (Neuropteroidea, Planipennia: Coniopterygidae). Annali del Museo Civico di Storia Naturale "Giacomo Doria" 87:157-182. Language: Italian.
Presents data on biology and distribution of 13 species of Coniopterygidae not previously recorded in Rio Muni. Two species are new for continental Africa. Eight new species are described.

Monserrat, V J, and L M. Diaz-Aranda. 1988. A contribution to the knowledge of the dustywings from Bioco Island (Equatorial Guinea) (Neuropteroidea, Planipennia: Conioptergidae). Revue de Zoologie Africaine 102493-502. Language: French .
Six new species of Coniopterygidae are recorded for Bioko. Two new species are described.

Roewer, C. F. 1942. Opiliones, Pedipalpi und Araneae von Fernando Poo. 21. Beitrag zu den wissenschaftlichen Ergebnissen der Westafrika-Expedition Eidmann 1939-40. Veröff. dtsch. Kolon.-Uebersee Mus. Breuen 3: 244--258

Simon, E. 1909. Arachnides recueillis par L. Fea sur la côte occidentale d'Afrique. 2e parti. Ann. Mus. civ. stor. nat. Genova 3: 335--449.

Soli, G E E. 1997. Afrotropical species of *Sciophila* Meigen (Diptera, Mycetophilidae). Journal of African Zoology 111:149-190.
Revision and phylogenetic analysis of the afrotropical species of *Sciophila* Meigen. Unidentified females are recorded from Ethiopia and Equatorial Guinea. A key to males of all known Afrotropical species is given.

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The rate of deforestation in West Africa was around 2% (12 000 km-2) per annum during the 1980s, and recent evidence from Cameroon suggests that the rate of deforestation there has increased during the 1990s. Recent research in the Mbalmayo Forest Reserve in southern Cameroon has examined. This paper describes a study of the impact of contrasting silvicultural techniques for regenerating degraded forest with West African tree species such as Terminalia ivorensis, on arthropod abundance and the damage caused to T. ivorensis by insect pests within the Mbalmayo Forest Reserve.

VERTEBRATES

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Species lists and distributions of the vertebrate taxa, produced from surveys over a 9 month period and the literature**.**

Fish

Castelo, R. 1994. Biogeographical considerations of fish diversity in Bioko. Biodiversity and Conservation 3:808-827.
Reports on fish collected from 34 sampling stations on Bioko, including 18 new species for the island. Describes main rivers, their water properties, and human pressure.

Castro J. A., and J. Mejuto. 1995. Reproductive Parameters Of Blue Shark, Prionace Glauca, And Other Sharks In The Gulf Of Guinea. Marine And Freshwater Research 46:967-973.
Reports on eight species of pelagic sharks caught in the Gulf of Guinea in June-August 1993.

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Distribution and biological aspects of *Pagellus bellottii bellottii* Steindachner, 1882 (Sparidae), in the Guinean Gulf. During the month of April 1990, the fishing survey "Guinea 90" on board the F/V Lagoapesca was carried out. The sampled area corresponds to shelf and slope waters off the coast of Sierra Leone, Liberia, Cote d'Ivoire and Ghana, from 20 to 700 m in depth.

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Examines the traditional ichthyogeographical accounts that highlight endemism and dispersal, and concludes that they are generally flawed. Paper argues that historical patterns of fish distribution can only be fully understood if phyletic data are taken into consideration. While Upper and Lower Guinea and the Zaire basin may be defined in part on the basis of endemism there is a lack of taxonomic and distributional evidence to show that Guinea-Congo is itself a cohesive ichthyogeographical unit.

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This paper reviews what is known about the marine turtles of Bioko, their nesting seasons, population trends, use by humans, conservation status and recent conservation efforts. Recommendations are made for additional research and conservation action.

Butynski, T.M., and S. H. Koster. 1989. Marine Turtles on Bioko Island (Fernando Póo), Equatorial Guinea: A call for research and conservation. WWF unpubl. report, Washington D.C.

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Undertaken to address the lack of knowledge about NWFP's in Equatorial Guinea by visiting markets to assess what NWFP's are being traded. One important finding is that forest use in Equatorial Guinea had diminished so much that many of the NWFP's being sold were imported from Cameroon, in spit of the fact that many of the species occur locally.

PART V

Conservation Recommendations

Due to its topography and periodic isolation from the mainland, Bioko harbors a highly diverse fauna that includes a number of endemic species and subspecies, and shows a high level of genetic uniqueness. While not herpetologically as diverse as the mainland, the species diversity of other vertebrates (particularly birds and fish) and invertebrates such as spiders is high (Jones 1994). While results are very preliminary, and many more surveys are needed, the arthropod fauna of Bioko was found to be as rich and diverse at that of the mainland, with comparable representation of families and species. The island shows no impoverishment associated with isolation. The number of spider species on Bioko may be even higher than that of Mt. Cameroon on the mainland. This survey identified 372 species of spiders in 42 person days, while in an earlier survey on Mt. Cameroon only 286 species were identified in 50 person days (Coddington et al. 1992). Among vertebrates, endemism at the specific level is low, only 1-3% of species (Jones 1994), though subspecific endemism is high (33% in birds). Endemism is higher among some invertebrates, most notably with 50% endemism in terrestrial mollusks. Among those spider taxa identified thus far, endemism is also low, and Bioko cannot be considered a 'center of endemism' for arthropods. However, one exception may be carabid beetles. It is likely that at least three of the carabid species found during this survey are endemic to higher, undisturbed montane habitats on Pico Basilé. The survival of such unique and very likely endemic species should be a conservation priority.

Elevational gradients between highland and lowland forest likely provide not only important migration corridors for some species altitudinally (Stuart 1986, Levey 1988, Loiselle and Blake 1991), but may also function as important gradients for natural selection (Smith et al. 1999). Recent studies suggest that divergent selection across such environmental gradients may promote divergence and speciation, thereby replenishing and maintaining biodiversity speciation (Smith et al. 1997, Orr and Smith 1998, Schluter 1998, Schneider et al. in press). A complete altitudinal gradient from low to high elevation (lowland forest through montane and mossy forest) is preserved on the south slopes of the southern highlands (Reserva Científica de Caldera de Luba). Only the gradient found on Mount Cameroon is comparable. The Reserva Científica de Caldera de Luba is a biodiversity treasure that deserves top conservation priority. Preserving the area on the mainland from Estuario del Rio Muni to Monte Alen would preserve another potentially important elevational gradient. While Monte Alen is comparatively low, generally less than 1200 m, and only a few montane species have been recorded, preservation of the Estuario-Monte Alen corridor is likely to be very important in supporting species that may undergo seasonal migrations or nomadic movements.

In addition to preserving elevational gradients, the creation of a network of preserves of contrasting habitat types will help ensure that species with specific habitat needs are protected. For example, *Picathartes oreas* requires areas with rocky outcrops in undisturbed forest for nesting. Such conditions are found at both Monte Alen and Nsork, and we found nests at both sites. Due to its restricted nesting requirements, *Picathartes* is classified as rare by IUCN (Collar and Stuart 1985). Efforts should be made to locate nesting colonies in these and other areas. Three small proposed reserves in the western part of the country, Reserva Natural de Monte Temelon, Monumento Natural de Piedra Bere, and Monumento Natural de Piedra Nzas, are dotted with inselbergs, and may harbor populations of *Picathartes*, but have yet to be investigated. Additionally, the creation of a network of reserves of different habitat types, and in different climatic zones is essential to ensuring that animal populations are able to track food sources, especially fruit (Whitney and Smith 1998) as they change across seasons and between years. Differences between coastal forest and inland forest in rainfall are likely to generate differences in fruiting phenology that may result in seasonal migrations of important frugivores (Whitney and Smith 1998).

Research suggests that hunting may be having a significant effect on the abundance of some species (Fa et al. 1995) in Equatorial Guinea. Unlike in other west African countries there are no closed hunting seasons in Equatorial Guinea, and at least two species, *Cercopithecus nictitans* and *Cephalophus dorsali*s may be over hunted on Rio Muni (Fa et al. 1995). Nsork is the only area in which we recorded all three large primates, Gorilla, Chimpanzee, and Mandrill. This may be because markets are relatively inaccessible from the area we visited, and the animals are less likely to be hunted. Setting aside conservation areas such as the currently proposed network of reserves will be very important for preserving core populations of animals, and regulation of hunting by imposing hunting seasons could also be one way to reduce take. It should be noted, however, that enforcement of hunting regulations may be very difficult, as such regulations are often flouted in neighboring countries. Local inhabitants are extremely poor, and other food sources are poorly developed in most areas. We found a dearth of agricultural products such as food crops and livestock throughout the country as compared to neighboring Cameroon. Thus ensuring that locals have alternatives to bushmeat hunting, to provide both subsistence and income will be critical to reducing dependence on bushmeat. Educating local inhabitants about methods of sustainable hunting (avoiding taking females and young, for instance), will be essential to successfully reducing hunting impacts. Additionally, a recent study of non-wood forest products in Rio Muni indicated that while a demand for such products exists in Rio Muni, most of these products are imported from Cameroon. This is not due to a lack of such products in Equatorial Guinea, but a loss of knowledge of forest use among Equato-Guineans (Sunderland 1998). It is possible that Guineans cound be re-educated, and a well thought out non-wood forest products industry developed. Guineans Given Equatorial Guinea's substantial oil reserves and projected revenues from oil, the country has the potential to become a leader in preserving biodiversity.

Thus, the preservation of biodiversity in Equatorial Guinea should focus on four key themes:

1) Maximize protection regions with high numbers of endemic species (Mountains /Bioko)
2) Preserve elevational gradients when ever possible
3) Creation of a network of preserves representing different habitat types and climatic zones, as proposed by C.U.R.E.F.
4) Increase conservation education and develop sustainable alternatives to hunting and logging.

The following priority areas for conservation have been recommended by C.U.R.E.F. We summarize their conservation value and limitations, and areas requiring further study:

1) Parque Nacional de Pico Basilé (33,000 ha) **-** Pico Basilé rises to an elevation of 3011 m, and covers a range of habitats including lowland rainforest, montane forest, mossy forest, and high elevation shrub formation, and subalpine meadows (Juste and Fa 1994). The island's one endemic bird, *Speirops brunneus*, is found only on Pico Basilé (Pérez del Val 1994), and in this survey, the three species of flightless Carabid beetles discovered are likely to be endemic. Examination of the specimens recorded indicates that the beetle fauna was only partially sampled with this survey, and additional arthropod surveys would be likely to turn up even more endemic beetles**.** This area has been set aside as a protected area since 1988, and there are virtually no human inhabitants. Unfortunately, there is no funding for this area so it remains

unprotected. Recently, a pharmaceutical company has begun building new roads on the slopes of Pico Basilé and is selectively logging the tree *Pygeum africanum,* the bark if which contains a compound used in the treatment of prostrate cancer (Hearn et al. 1998). These developments are likely to have further negative impacts on the primate fauna by creating easier access to the forest.

2) Reserva Científica de la Caldera de Luba (64,000 ha) **-** Would preserve a rainforest gradient from sea level to 2260m. In West Africa, the only equivalent gradient is found on Mt. Cameroon, which is threatened by considerable population pressure. The montane forest harbors numerous montane bird species of limited distribution, and the threatened species *Picathartes oreas.* There is also a very rich spider fauna, with many species represented that are restricted to montane habitats. Additionally, Caldera de Luba is home to seven primate species, four of which are endemic subspecies. Four of these species, Drill, *Mandrillus leucophaeus,* Black colobus, *Colobus satanus,* Pennant's red colobus, *Piliocolobus pennanti,* Russet-eared guenon, *Cercopithecus erythrotis,* and Preuss's guenon, *Cercopithecus preussi,* are listed as endangered by IUCN (Lee et al. 1988). Primate densities in this area are among the highest recorded anywhere in Africa (Butynski and Koster 1988). However, more recent surveys indicate significant declines in primate populations due to hunting (Hearn et al. 1998). This is the only place on the island where one can regularly observe Black-casqued hornbills, *Ceratogymna atrata,* African gray parrots, *Psittacus erithacus,* and the Red-headed malimbe, *Malimbus rubricollis* (Garcia and Eneme 1997). Four species of marine turtles nest on the beaches of southern Bioko. About 2200 people (mostly of the Bubi ethnic group) live in the area, with an additional 5000 using adjacent areas. Locals practice subsistence agriculture and some have small farms (mostly of banana, malanga and yuca). Locals practice primarily subsistence hunting, but hunters from the mainland run hunting camps in some areas. The area contains 78 of the 188 sacred places for the Bubi. Additional detailed information on the area's climate, soils, geology, vegetation, fauna, land tenure and land use can be found in Castroviejo (1994) and Garcia and Eneme (1997).

3) Parque Nacional de Monte Alen (including Montes Mitra) - In conjunction with Reserva Natural del Estuario del Muni this would preserve another elevational gradient. While Monte Alen is comparatively low, generally less than 1200 m, and only a few montane species have been recorded, preservation of the Estuario-Monte Alen corridor is likely to be very important in supporting species that may undergo seasonal migrations or nomadic movements. Monte Alen harbors fifteen species of primates (Garcia and Mba 1997), including several which are vulnerable (*Cercocebus torquatus, Pan troglodytes, Mandrillus sphinx,* and *Gorilla gorilla*) or endangered (*Colobus satanus*) (Lee 1988). Most of these species are found throughout the park, and do not appear to be threatened within the park. *Cercocebus torquatus,* however, has a restricted distribution in the park as elsewhere, and is vulnerable the river basins where it is found are in close proximity to human populations**.** There is no hunting or gathering allowed in the park (although some poaching still occurs), and ECOFAC has established a tourist lodge and some research facilities there. Thirteen of the bird species recorded for Monte Alen, including Picathartes oreas, are found only in the Congo Basin. *Picathartes oreas* is also a rare and threatened species (Collar and Stuart 1985). It is most well studied area on the mainland, with numerous bird, plant and mammal surveys, and some surveys of other vertebrates. Work aimed at improving the situation of *C. torquatus* in the park will be important, as will efforts to locate nesting colonies of Picathartes. To the best of our knowledge, the invertebrate fauna has not been examined in any detail. Logging concessions have been granted within the proposed conservation areas in Montes Mitra, which, together with the bushmeat industry, represent a primary threat to the conservation of the area (Garcia and Eneme 1997, Stenmanns, pers. comm.).

4) Reserva Natural de Rio Campo - This will likely be one of the more difficult areas to protect, given that it is bisected by roads and elephant and buffalo populations have

reportedly already suffered from government intervention to protect crops of the local population. Much of the area has been logged in past years, and the forest we surveyed was in a disturbed state. Nonetheless, there are some sound reasons for pursuing some level of conservation here. The area contains important mangroves along the northern coast and is the only site in the country where the Hippopotamus, *Hippopotamus amphibius*, can be found (Garcia and Eneme 1997). Elephants are known to enter the area from Cameroon but are kept at bay by hunters. Three species of marine turtle (Green turtle, *Chelonia mydas*, Hawksbill turtle, *Eretmochelys imbricata*, and Leatherback turtle, *Dermochelys coriacea*) nest in this area. Rio Campo was the one place in Equatorial Guinea where we found large concentrations of frugivorous birds such as hornbills. Other parts of the country (and the Dja Reserve in Cameroon where there is an ongoing hornbill study) had low numbers of hornbills during May 1998. These differences may be attributable to differences in fruit availability in different climatic zones, and suggest that preserving both coastal and inland forests, and forests at different elevations is essential to ensuring that frugivores are able to track food resources within and among years. Additionally, our studies in Cameroon suggest that the littoral zone in southern Cameroon is genetically distinct from other lowland rainforest areas. Further study will be necessary to determine whether the same is true of the area around Rio Campo. Interviews with local villagers indicate that chimpanzees are common in the area (and regularly raid their agricultural plots), and local hunters were familiar with drill (*Mandrillus sphinx*), gorilla (*Gorilla gorilla*) and leopard. This area is one of the main suppliers of bushmeat to the capital (Garcia and Eneme 1997). The possibility of connecting this area with Cameroon's Rio Campo Reserve, adds to its conservation value.

5) Parque Nacional de Los Altos de Nsork - Several factors make Nsork a likely area in which to undertake conservation. It is far from the primary bushmeat markets, and is abutted by roads along only a small part of its border (Figure 1.1b), with no roads in the interior. Nsork is the only area (among Nsork, Rio Campo, and Montes Mitra) where we encountered sign of all three of the large primates, Gorilla, mandrill and chimpanzee, and the lack of access to markets may, in part, account for this. We also recorded the threatened bird, *Picathartes oreas*, and discovered a nest. Efforts to locate nesting colonies of *Picathartes* here would be valuable. Additional work on birds and mammals as well as other taxa will be necessary. Human presence is sparse, with 2000 inhabitants estimated for this area of 70,000 ha (Machado 1998).
6) Reserva Natural del Estuario del Muni - This area of 70,000 ha contains the largest, best preserved expanse of mangroves in the country. The area is sparsely populated, with human settlements (small villages with associated subsistence-agriculture plots) concentrated along the two roads linking the Cogo area to Bata. The area has important fisheries (including crustaceans). Forest is continuous between the estuary and Montes Mitra/Monte Alen, and it would be a valuable component of the proposed altitudinal gradient. The area is rich in aquatic avifauna and contains prime habitat for the manatee (Machado 1998).
7) a) Reserva Natural de Monte Temelon, b) Monumento Natural de Piedra Bere, c) Monumento Natural de Piedra Nzas - These three areas are characterized by the presence of inselbergs surrounded by well-preserved forest. These spectacular rocky formations may host endemic arthropods and herpetofauna due to their high degree of isolation, and constitute a potential ecotourism destination. Monte Temelon in particular is one of the few remaining forested areas in the northeastern part of the country. Piedra Nzas contains large caves with important bat roosts (Machado 1998). Much more research on the flora, fauna, and local community is needed in these areas to fully assess their conservation potential.
8) Reserva Natural de Punta Llende - Coastal savanna/rainforest mosaic. We visited a similar area near Bata. Many of the same bird species will likely be found here as in similar habitat we visited near Bata, however, additional surveys will likely turn up

many more species, as we spent only one morning there. The savanna areas include birds species not found elsewhere in the country and further surveys and research are needed.

9) Reserva Científica de Playa Nendyi - This reserve would encompass 275 ha of isolated beach with an additional 225 ha of associated marine habitat. The primary importance of this area is it's importance as a nesting area for marine turtles (Machado 1998).

10) Reserva Natural de Corisco y Elobeyes -**.** This reserve includes the islands of Corisco, Elobey Grande, and Elobey Chico totaling 1795 ha with an additional 46205 ha of underwater marine habitat and feeding grounds for marine turtles. The islands also contain important marine bird colonies (Machado 1998).

11) Reserva Natural de Annobon – This island of 2088 ha (and associated 21022 ha of underwater habitat) is rich in animal and plant endemics and coral reefs (Machado 1998). Twenty-two % of Annobon's bird species, 29% of its reptile species, and 7% of its plant species are found nowhere else (Jones 1994).

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