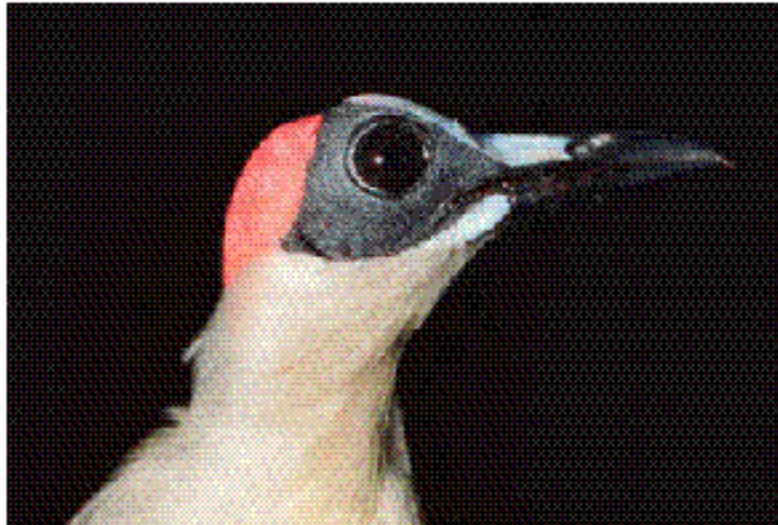


Biotic Surveys of Bioko and Rio Muni, Equatorial Guinea



Date: 25 June 1999

Submitted to: Biodiversity Support Program

Submitted by: Brenda Larison¹, Thomas B. Smith³, Derek Girmañ², Donald Stauffer⁴, Borja Milá⁵, Robert C. Drewes⁶, Charles E. Griswold¹, Jens V. Vindum¹, Darrell Ubick¹, Kim O'Keefe¹, Jose Nguemá⁶, Lindsay Henwood¹

<p>¹Center for Tropical Research San Francisco State University San Francisco, CA 94132 USA (415) 338-1089 Tel (415) 338-0927 Fax tsmith@sfsu.edu email</p>	<p>²Department of Biology Sonoma State University Sonoma, CA 95476 USA</p>
<p>³Center for Population Biology University of California Davis, CA 95616 USA</p>	<p>⁴Department of Herpetology California Academy of Sciences San Francisco, CA 94118 USA</p>
<p>⁵Department of Entomology California Academy of Sciences San Francisco, CA 94118 USA</p>	<p>⁶C.U.R.E.F. APDO 207 Bata, Equatorial Guinea</p>

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 BOKO	
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 BOKO	114

PART III. BIOGEOGRAPHY

Chapter 4. Comparative avian phylogeography of Cameroon and Equatorial 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 Ecosistemas 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 Llande, 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 uniqueness 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, así 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 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 habían 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, así como en una sección especial (Parte IV) dedicada a recomendaciones específicas. 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 Ecuatorial (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 Científica 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 genética y los altos niveles de endemismo. La única especie endémica de la isla, *Speirops brunneus*, se encuentra exclusivamente en el Pico Basilé, y tres especies de escarabajos carábidos no voladores son probablemente endémicos. El área está amenazada por la caza y la extracción selectiva de madera. La Reserva Científica 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 está amenazado por considerables presiones humanas. La Caldera de Luba acoge a siete especies de primates, cuatro de las cuales son subespecies endémicas, y cuatro de ellas están listadas por la IUCN. Las densidades de primates en esta zona se encuentran entre las más altas registradas en todo África. 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 especies 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 único 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 Nzaz 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 país 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 Ecosistemas 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).

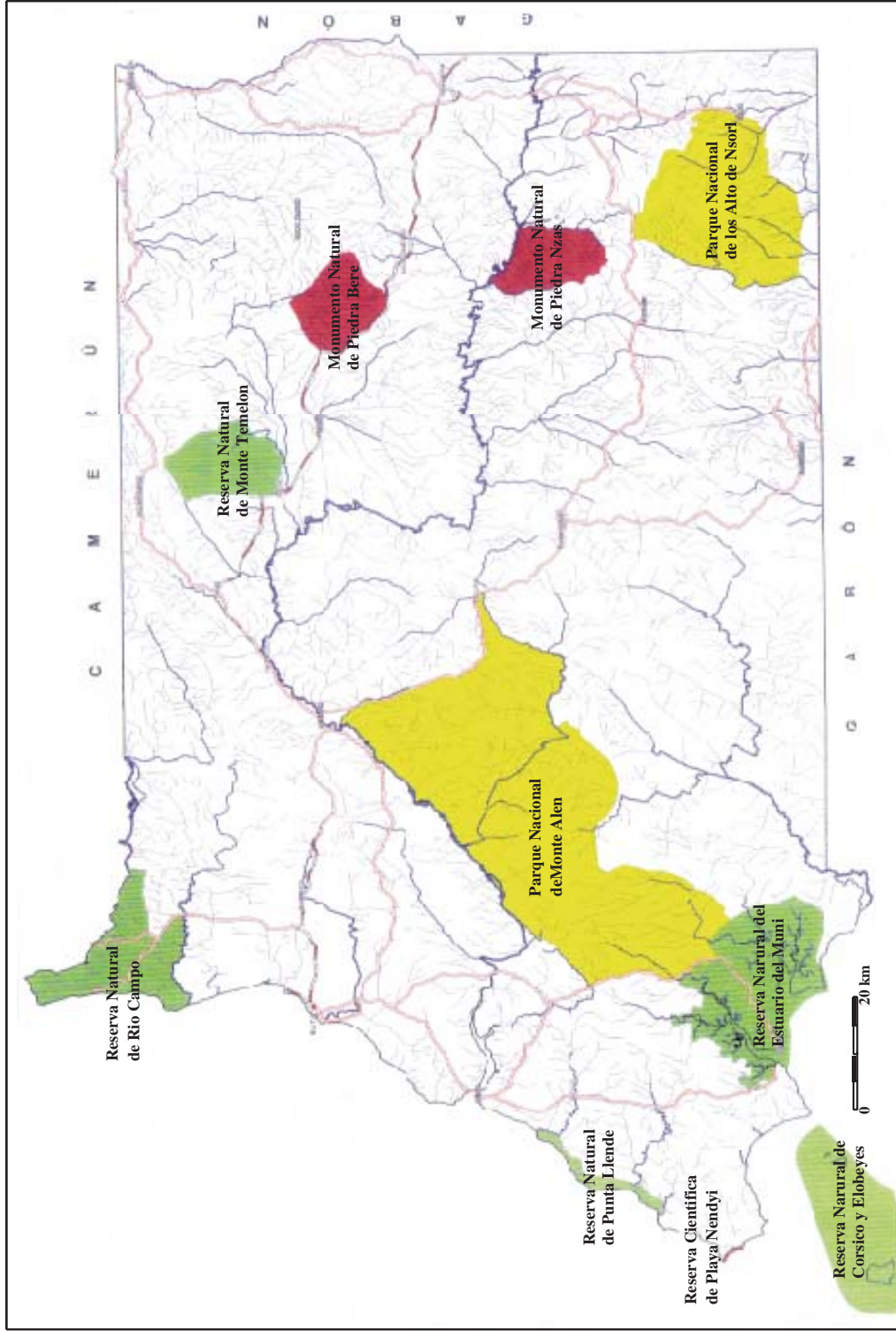


Figure I.1. Proposed reserve system for mainland Equatorial Guinea. Green, natural reserves; Yellow, national parks; Magenta, national monuments; Red, scientific reserves.

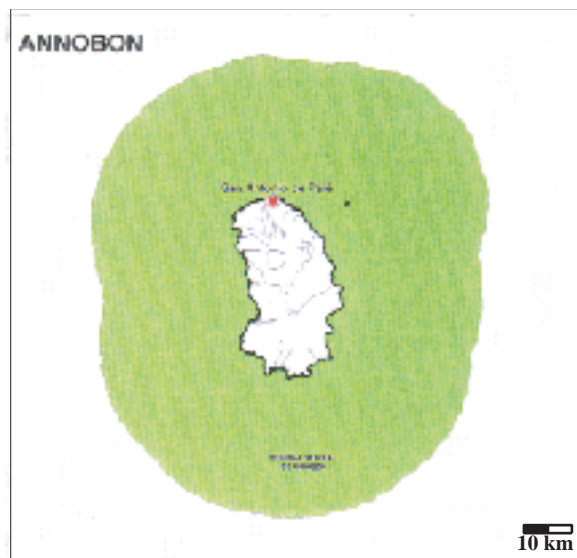
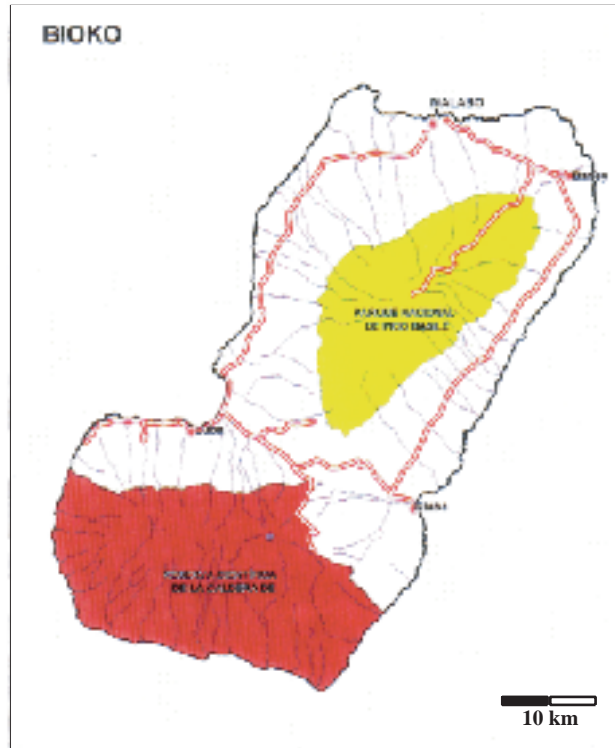


Figure I.2. Proposed reserves on Bioko and Annobon. Green, natural reserve; Yellow, national park; Red, scientific reserve.

ACKNOWLEDGEMENTS

For permission to carry out our work in Equatorial Guinea, we thank the Minister of Forests and the Environment, Teodoro Nguema Obiang, and the following members of his Ministry: Vice Minister Joaquin Mecheba Ivina, Secretary General Antonio Nculu Oye Nsue, and Director General Carlos Eyi Obama.

This research was funded by a grant from the Biodiversity Support Program of CARPE and the Endowment Fund of the Department of Herpetology, California Academy of Sciences. We are grateful to Jim Graham and Laurent Somé for their assistance.

We are grateful to the Provincial Governor of Southern Province of Bioko, Miguel Olomo Abia Ndjeng, for facilitating our work there. We extend our gratitude to two fellow scientists, Dr. Jose Mba Avoro of UNFAO and Santiago Engonga Osono, Biological Authority CITES, and two friends who provided help when it was most needed: Alfonso Ramos of the European Union and Dr. Ramon Castelo Alvarez of Doñana.

Our work on the mainland was greatly facilitated by the assistance of Luis Arranz (Director) of ECOFAC, and Frank Stenmanns (Asistente Técnico Principal) and Jaime Oko (Director Nacional) of CUREF, as well be the authorities at the Ministerio de Bosques y Medio Ambiente; Joaquín Mecheba Ivina (Vice Ministro), Antonio Nculu Oyé (Secretario General) and Francisco Abeso Owono (Director General).

The work on avian phylogeography was supported through grants and support from the USAID-CARPE program, National Geographic Society, Wildlife Conservation Society, WWF-Cameroon, a GAANN fellowship to KO and grants NSF-DEB9726425 and NIH Office of Research on Minority Health #5 P20 RR11805 grant to TBS. We thank the Cameroon government for permission to conduct the research in Cameroon. We thank Bob Wayne and Karen Holder for discussion and helpful comments and A. French, M. Kimura, R. Fotso, D. McNiven for assistance in the field.

We gratefully acknowledge Sierra Designs, Patagonia, and Alpine Aire Foods, whose donations of equipment and supplies have greatly aided our work.

LITERATURE CITED

- Fa, J. E. 1991. Guinea Ecuatorial: Conservacion de los Ecosistemas Forestales de Guinea Ecuatorial. IUCN, Gland, Switzerland.
- Fa, J. E. 1992. Conservation in Equatorial guinea. *Oryx* 26: 87-95.
- Jones, P. J. 1994. Biodiversity in the Gulf of Guinea: an overview. *Biodiversity and Conservation* 3: 772-784.
- Juste, J. B. and J. E. Fa 1994. 1994. Biodiversity conservation in the Gulf of Guinea islands: taking stock and preparing action. *Biodiversity and Conservation* 3: 757-758.

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 (Eisenraut 1968, 1973, Butynski and Koster 1994, Pérez del Val et al. 1994, Butynski and Koster 1994, Butynski et al. 1995, Eisenraut 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

<i>Site</i>	<i>Location</i>	<i>Elev.</i>	<i>Date</i>	<i>Activity</i>
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. 1.1) 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. 1.1). 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.

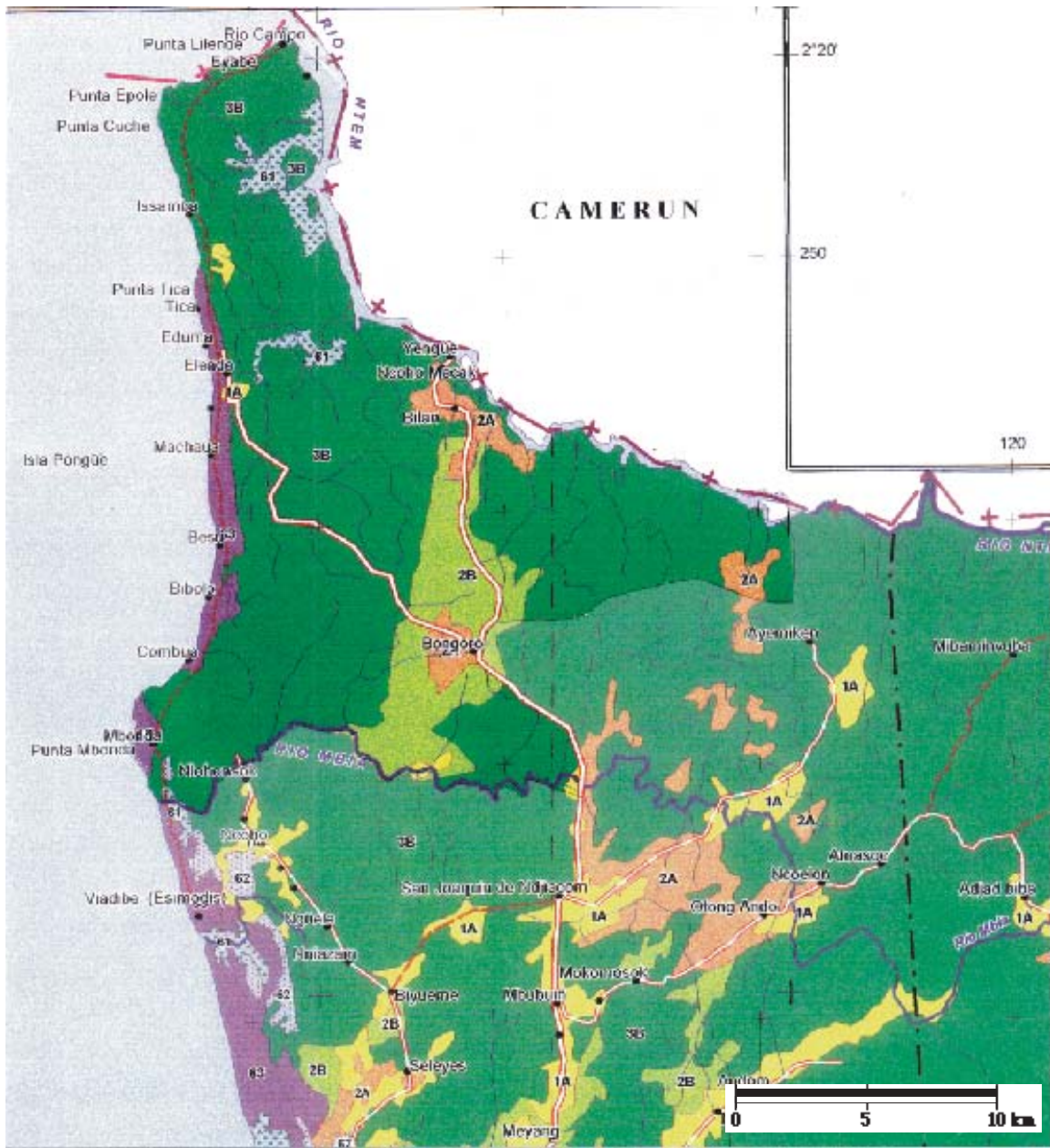


Figure 1.1a. Map of Reserva Natural de Rio Campo, in darker print, with surroundings lightened (C.U.R.E.F. 1998). See legend page 14 for vegetation types. Vegetation classifications do not indicate whether logging has occurred. Survey sites are indicated by X.

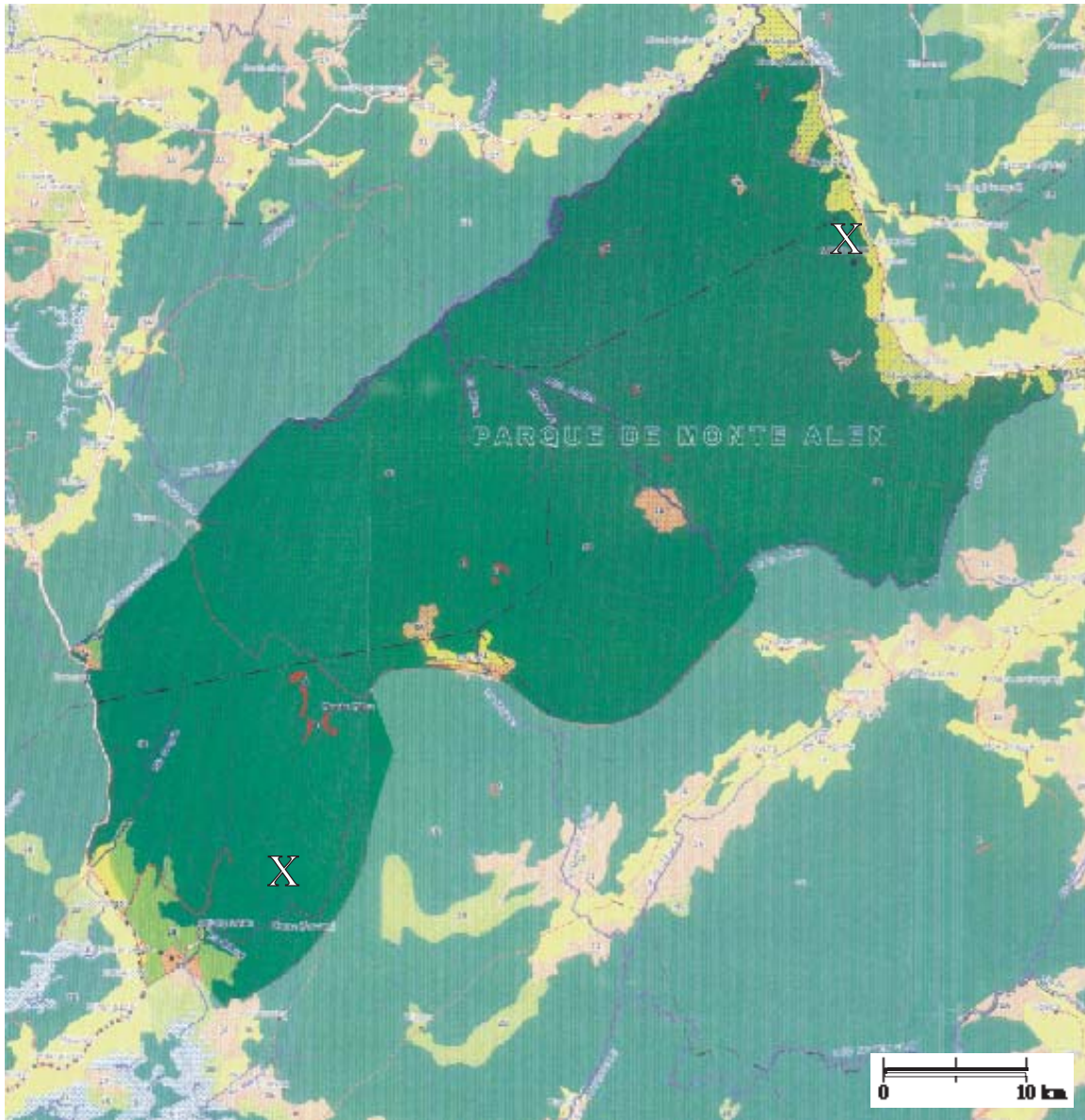














Figure 1.1c. Map of Parque Nacional de Monte ALEN (with proposed extension to include Montes Mitra shown) in darker print, with surroundings lightened (C.U.R.E.F. 1998). See legend page 14 for vegetation types. Vegetation classifications do not indicate whether logging has occurred. Survey sites are 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-Wallis tests (Sokal and Rohlf 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 Rohlf 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 km² (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*, which 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).

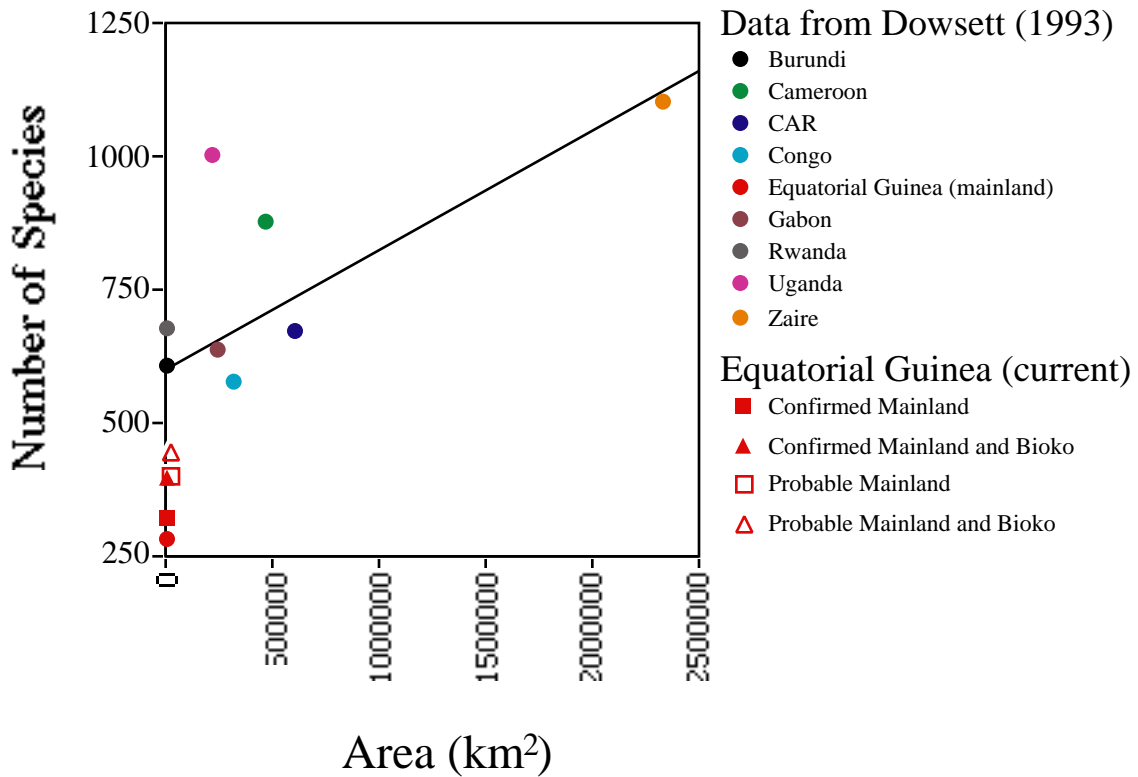


Figure 1.2. Comparison of number of avian species reported for Equatorial Guinea and other countries in the Congo Basin. Filled circles represent data on total number of species (including migrants) from Dowsett (1993). Data for Equatorial Guinea include that from Dowsett (filled circle) and additional 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
<i>Calonectris diomedea</i>								•		V
Cory's shearwater										
<i>Puffinus griseus</i>								•		V
Sooty shearwater										
<i>Hydrobates pelagicus</i>								•		V
British storm-petrel										
<i>Tachybaptus ruficollis</i>					• ³			•		R
Little grebe										
<i>Phaethon lepturus</i>								•		V
White-tailed tropicbird										
<i>Sula capensis</i>								•	• ⁶	V
Cape gannet										
<i>Sula leucogaster</i>								•		V
Brown booby										
<i>Phalacrocorax africanus</i>		• ¹						•	• ⁶	R
Reed cormorant										
<i>Anhinga melanogaster</i>								•	• ⁶	R
Darter										
<i>Pelecanus rufescens</i>									• ⁶	R
Pink-backed pelican										
<i>Ixobrychus minutus</i>									• ⁴	R
Little bittern										
<i>Ixobrychus sturmii</i>									• ⁵	R
Dwarf bittern										
<i>Tigriornis leucolophus</i>					• ^{3,4}					F
White-crested tiger heron										
<i>Nycticorax nycticorax</i>									• ⁶	R
Black-crowned night heron										
<i>Ardeola ralloides</i>								•	• ⁶	R
Squacco heron										
<i>Bubulcus ibis</i>					• ^{3,4}			•		V
Cattle egret										
<i>Butorides striatus</i>						• ¹		•	• ⁴	R
Green heron										

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Species Vernacular	Campo	Nsork	Mitra	Alen	Cogo	Savanna	Bioko	Other	Status
<i>Estrilda atricapilla</i> Black-headed waxbill				• ^{1,3}				• ⁴	F
<i>Estrilda nonnula</i> Black-crowned waxbill				• ¹			•	• ⁵	R
<i>Nesocharis ansorgei</i> Fernando Po olive-back *							•		M
<i>Vidua macroura</i> Pin-tailed whydah	• ¹						•	• ⁴	R
<i>Serinus burtoni</i> Thick-billed seed-eater							•		M
<i>Linurgus olivaceus</i> Oriole finch							•		M
<i>Emberiza cabanisi</i> 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	
<i>Turtur brehmeri</i> Blue-headed wood-dove	0.86	—	—	—	F
<i>Turtur tympanistria</i> Tambourine dove	0.43	—	—	—	R
<i>Halcyon malimbica</i> Blue-breasted kingfisher	1.29	—	—	—	R
<i>Ceyx lecontei</i> Dwarf kingfisher	—	0.39	—	0.43	F
<i>Corythornis leucogaster</i> White-bellied kingfisher	—	0.39	1.52	—	F
<i>Alcedo quadibrachys</i> Shining-blue kingfisher	—	—	0.38	—	F
<i>Pogoniulus atroflavus</i> Red-rumped tinkerbird	0.86	—	—	—	F
<i>Pogoniulus subsulphureus</i> Yellow-throated tinkerbird	—	—	—	0.43	F
<i>Sasia africana</i> African piculet	—	—	—	0.43	CB
<i>Campethera caroli</i> Brown-eared woodpecker	—	0.39	—	—	R
<i>Motacilla clara</i> Mountain wagtail	—	—	0.38	—	R
<i>Andropadus virens</i> Little greenbul	9.47	—	1.90	—	R

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

Species	Site				Status
	Rio Campo	Nsork	Montes Mitra	Monte Alen	
<i>Illadopsis rufipennis</i> Pale-breasted illadopsis	—	1.97	1.14	0.43	F
<i>Nicator chloris</i> Nicator	0.86	—	—	—	R
<i>Picathartes oreas</i> Grey-necked picathartes	—	—	—	0.43	CB
<i>Nectarinia olivacea</i> Olive sunbird	1.72	4.34	3.04	1.30	R
<i>Nectarinia seimundi</i> Little green sunbird	—	—	—	0.43	F
<i>Nigrita bicolor</i> Chestnut-breasted negrofinch	0.43	—	—	—	F
<i>Spermophaga haematina</i> Bluebill	—	—	0.38	—	F
<i>Pyrenestes ostrinus</i> 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).

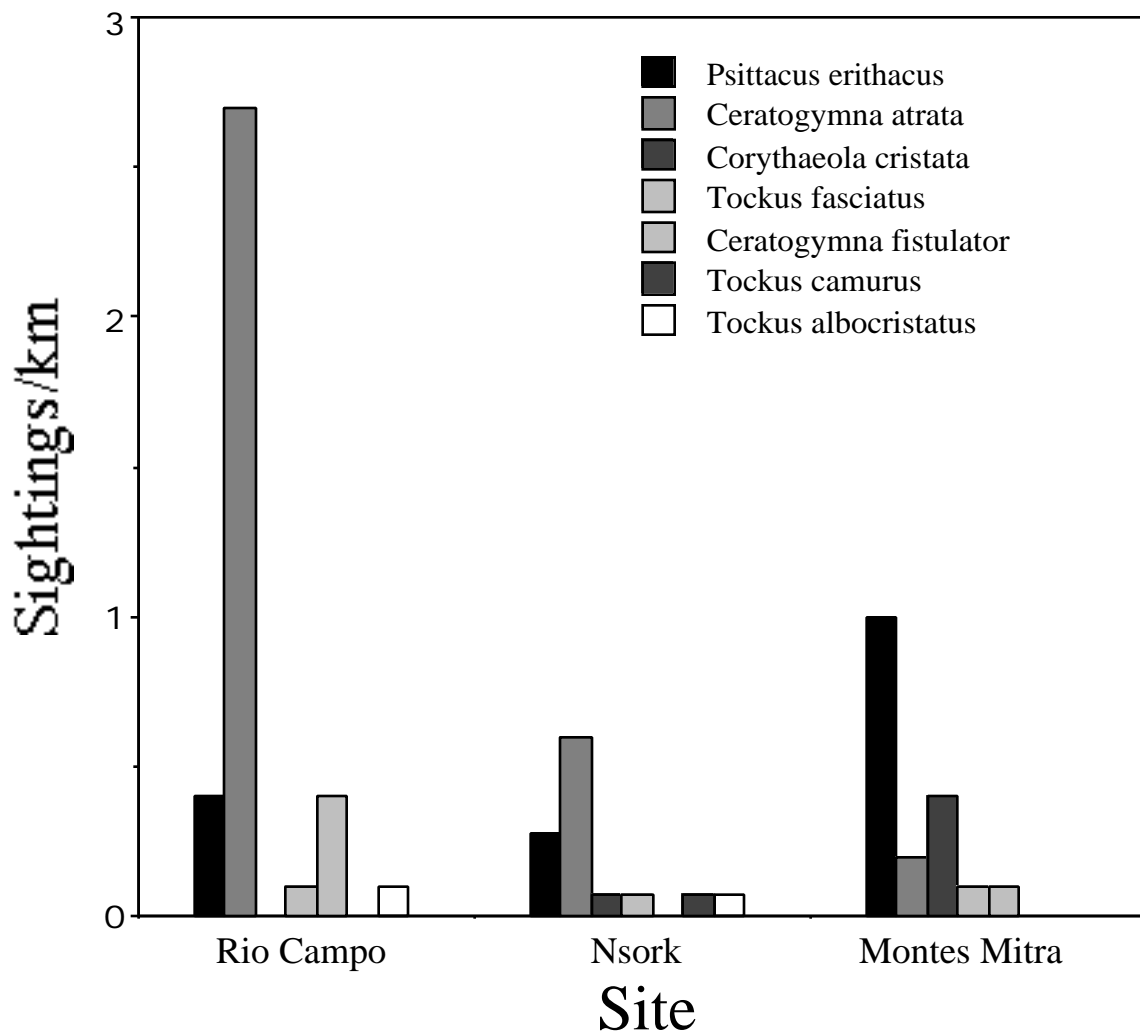


Figure 1.3. Relative abundance of large, frugivorous birds observed along transects at three sites in Rio Muni, Equatorial Guinea.

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 et 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).

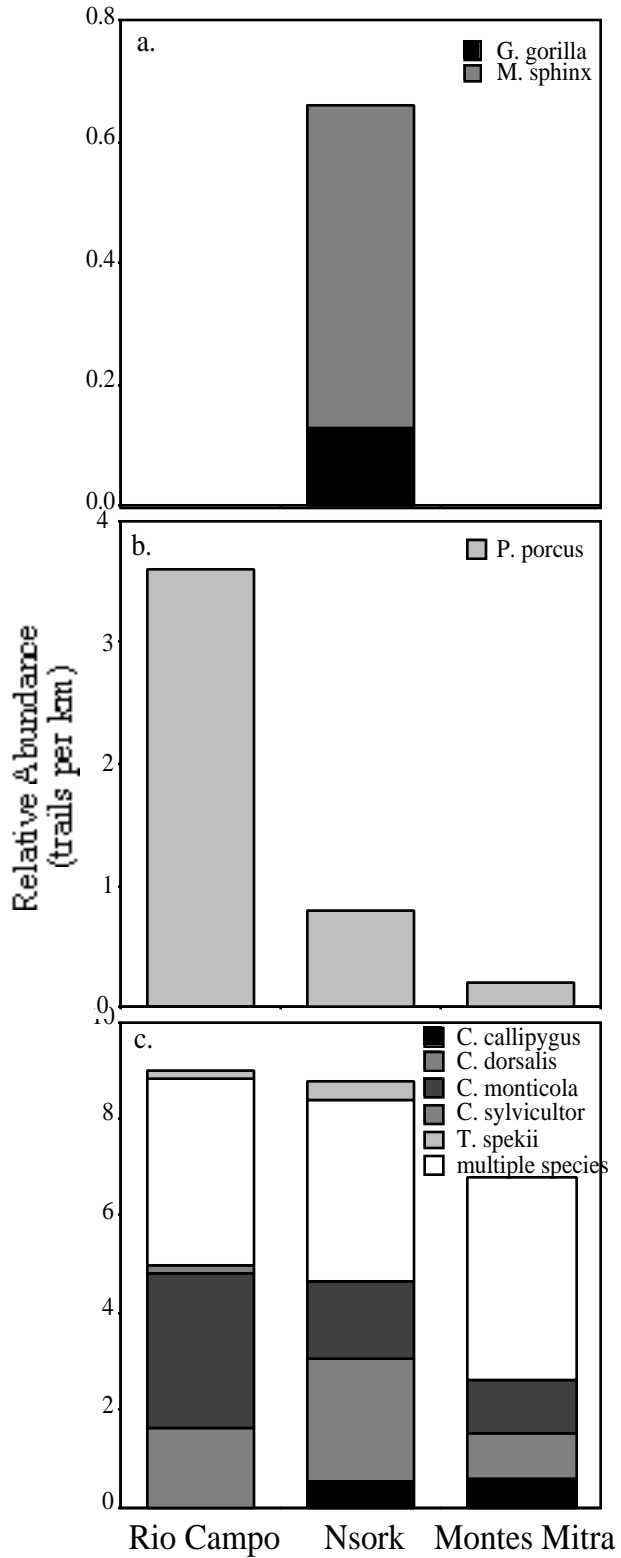


Figure 1.4. Relative abundance of mammals at three sites in Equatorial Guinea, estimated from sign along transects: a) primates, b) Suidae, c) Bovidae.

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 artiodactyls), 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 <i>Pan troglodytes</i> ⁴	Ngoro	C 1,2	B1,2	C1,2	E
Gorilla <i>Gorilla gorilla</i> ^{4,5}	Ngui	C1,2,6	A1,2,6	C1,2,6	CB
Black colobus <i>Colobus satanus</i> ^{4,5}	Nvam	1,2	2	A1,2	W
Mandrill <i>Mandrillus sphinx</i> ^{4,5}	Esegue	C1,2	B1,2	C1,2	W
Red-capped mangabey <i>Cercocebus torquatus</i> ^{4,5}	Kacfung	1,2	2	1,2	W
Grey-cheeked mangabey <i>Lophocebus albigena</i> ^{4,5}	Kak	1,2	2	1,2	CB
Talapoin <i>Miopithecus talapoin</i> ^{4,5}	Onsem	1,2	1,2	C1,2	W
De Brazza's monkey <i>Cercopithecus neglectus</i> ⁵	Fung	1,2	1,2	1,2	CB
Mona monkey <i>Cercopithecus mona</i> ⁵		1	—	—	E
Crowned monkey <i>Cercopithecus pogonias</i> ^{4,5}	Essuma	A	A	A	CB
Putty-nosed monkey <i>Cercopithecus nictitans</i> ^{4,5}	Avem	A1,2	A1,2	A1,2	E
Moustached monkey <i>Cercopithecus cephus</i> ^{4,5}	Nguemechog	A1,2	A1,2	A1,2	W
Rodentia					
Fire-footed rope squirrel <i>Funisciurus pyrropus</i> ⁴	Edon	—	—	A	E
African pigmy squirrel <i>Myosciurus pumilio</i> ⁴	Nvok-sen	—	—	A	W
Brush-tailed porcupine <i>Atherurus africanus</i> ^{4,5}	Ngom	B2	B2	A2	E
Giant pouched rat <i>Cricetomys emini</i> ^{4,5}	Kuiñ	B	B	B	E
Felidae					
Leopard <i>Panthera pardus</i> ⁴	Nze	C2	C2	C2	E

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

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

1) Sabater Pi and Jones (1967); 2) Fa (1991); 3) Castroviejo, Blom, and Alers (1990); 4) Alcalá (1995), García 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 km² 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, García 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, sugarcane, 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 utilisation rationnelle des ecosystemes forestiers en Afrique Centrale) and C.U.R.E.F. (Proyecto Conservacion y Utilizacion Racional de los Ecosistemas 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., Asociación 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, Estuario del Muni, Monte Temelon, Punta Llande 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 known 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 dorsalis* 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 substantial oil reserves and projected revenues from oil, the country could become, if it choose to do so, a leader in preserving biodiversity.

LITERATURE CITED

- Barnes, R. F. W. and K. L. Jensen. 1987. How to Count Elephants in Forests. African Elephant and Rhino Specialist Group.
- Barnes, R. F. W., M. Agnagna, M. P. T. Alers, A. Blom, G. DOUNGOUBE, M. Fay, T. Masuda, J. C. Nkoumou, C. Sikubwabo Kiyengo, and M. Tchamba. 1993. Elephants and ivory poaching in the forests of equatorial Africa. *Oryx* 27: 27-34.
- Bermelo, M. 1998. Estudio de viabilidad de un Programa de Ecoturismo de vision Gorilas en el Parque de Monte Alen, Equatorial Guinea. AGRECO-CTFT, for ECOFAC, Guinea Equatorial.
- Bibby, C. J., N. J. Collar, M. J. Crosby, M. F. Heath, Ch. Imboden, T. H. Johnson, A. J. Long, A. L. Slattersfield, and S. J. Thirgood. 1992. Putting Biodiversity on the Map: Priority Areas for Conservation. Cambridge, ICBP.
- Brown, L. H., E. K. Urban, and K. Newman. 1982-1997. The Birds of Africa. Volumes 1-5. New York, Academic Press.
- Butynski, T. M., D. Schaaf, and G. Hearn. 1995. Status and conservation of duikers on Bioko island. *Gnusletter* (IUCN Species Survival Commission, Antelope Specialists Group) 14: 23-28.
- Butynski, T. M. and S. H. Koster. 1994. Distribution and conservation status of primates in Bioko island, Equatorial Guinea. *Biodiversity and Conservation* 3: 893-909.
- Castroviejo, J. B., A. Blom, and M. P. T. Alers. 1990. Equatorial Guinea In: East, R. (compiler) *Antelopes: Global Survey and Regional Action Plans, Part 3: West and Central Africa*, pp 167-171. IUCN, Gland, Switzerland.
- Colell, M., C. Maté, and J. E. Fa. 1994. Hunting among Moka Bubis in Bioko: dynamics of faunal exploitation at the village level. *Biodiversity and Conservation* 3: 939-950.
- Collar, N. J. and S. N. Stuart. 1985. Threatened Birds of Africa and Related Islands. The ICBP/IUCN Red Data Book, Part 1. Cambridge/Gland, ICBP/IUCN.
- Dowsett, R. J. 1993. Afrotropical avifaunas: annotated country checklists. Pp 1-322 In: A contribution to the Distribution and Taxonomy of Afrotropical and Malagasy birds. R. J. Dowsett and F. Dowsett-Lemaire, eds. Tauraco Research Report No. 5.
- Dowsett-Lemaire F. and R. J. Dowsett. 1998. Birds of the Parque Nacional de Monte Alen, Equatorial Guinea. Preliminary report submitted to ECOFAC, Equatorial Guinea.
- Eisenraut, M. 1968. Beitrag zur vogelfauna von Fernando Poo und Westkamerun. *Bonner. Zool. Beitrag.* 19: 49-68.
- Eisenraut, M. 1973. Die Wirbeltierfauna von Fernando Poo und Westkamerun. *Bonner Zoologische Monographien* 3.
- Fa, J. E. 1991. Guinea Ecuatorial: Conservacion de los Ecosistemas Forestales de Guinea Ecuatorial. IUCN, Gland, Switzerland.
- Fa, J. E. 1992. Conservation in Equatorial Guinea. *Oryx* 26: 87-95.
- Fa, J. E., J. Juste, J. Pérez del Val, and J. Castroviejo. 1995. Impact of market hunting on mammal species in Equatorial Guinea. *Conservation Biology* 9: 1107-1115.
- Fay, M. 1988. Forest monkey populations in the Central African Republic: the northern limits. A census in Manovo-Gounda-St. Floris National Park. *Mammalia* 52: 57-74.
- Garcia, J. E., and J. Mba. 1997. Distribution, status and conservation of primates in Monte Alen National Park, Equatorial Guinea. *Oryx* 31: 67-76.
- Gonzalez-Kirchner, J. P. 1997. Census of western lowland Gorilla population in Rio Muni Region, Equatorial Guinea. *Folia Zoologica* 46: 15-22.
- Hall, B. P., and R. E. Moreau. 1962. A study of the rare birds of Africa. *Bull. Brit. Mus. Nat. Hist. (Zoology)* 8: 315-377.
- Hall, B. P. and Moreau, R. E. 1970. An Atlas of Speciation in African Passerine Birds. London, British Museum (National History).
- Inskipp, Tim. 1993. World checklist of threatened mammals. 2nd ed. World Conservation Monitoring Centre. Joint Nature Conservation Committee, Peterborough, U.K.

- Juste, J. B. and C. Ibañez. 1994b. Bats of the Gulf of Guinea islands: faunal composition and origins. *Biodiversity and Conservation* 3: 837-850.
- Juste, J. B. and J. E. Fa 1994. 1994. Biodiversity conservation in the Gulf of Guinea islands: taking stock and preparing action. *Biodiversity and Conservation* 3: 757-758.
- Juste, J., J. E. Fa, J. Pérez del Val, and J. Castroviejo. 1995. Market dynamics of bushmeat species in Equatorial Guinea. *Journal of Applied Ecology* 32: 454-467
- Kingdon, J. 1997. *The Kingdon Field Guide to African Mammals*. San Diego, Academic Press.
- Lasso, C. A. 1995. Biodiversidad Animal del Parque Nacional de Monte Alen. AGRECO-CTFT. for ECOFAC, Guinea Equatorial.
- Lasso, C., R. Hutterer, and A. Rial. Records of shrews (Soricidae) from Equatorial Guinea, especially from Monte Alen National Park. *Mammalia* 60: 69-76.
- Lee, P., E. Bennett, and J. Thornback. 1988. *Threatened primates of Africa*. Cambridge IUCN Monitoring Center.
- LeJoly, J. 1994. La Biodiversité végétale dans le Parc National de Monte Alen. Groupement AGRECO-CTFT, for Projet ECOFAC, Guinée Équatoriale.
- LeJoly, J., Y. Issembe, et M. Ayichedemou. 1998. Biodiversité végétale des ligneux sur le transect de Monte Chocolate dans la Parc National de Monte Alen. Groupement AGRECO-CTFT, for Projet ECOFAC, Guinée Équatoriale.
- Levey, D. J. 1988. Spatial and temporal variation in Costa Rican fruit and fruit-eating bird abundance. *Ecological Monographs* 58: 251-269.
- Loiselle, B. A., and J. G. Blake. 1991. Temporal variation in birds and fruits along an elevational gradient in Costa Rica. *Ecology* 72: 180-193.
- Louette, M. 1981. *The birds of Cameroon: An annotated checklist*. Verhandelingen van de Koninklijke Academie voor Wetenschappen, Letterer Schone Kunsten van Belgie. Klasse de Wetenschappen 43:1-295.
- Louette, M., L. Bijmens, D. Upoki Agenong'a, and R. C. Fotso. 1995. The utility of birds as bioindicators: case studies in equatorial Africa. *Belgian Journal of Zoology* 125: 157-165.
- Machado, A. 1998. Componente "Sistema Nacional de Unidades de Conservación. Anexo 4. Borrador de Anteproyecto de ley de áreas Protegidas de Guinea Ecuatorial. Documento Técnico No. 14. C.U.R.E.F.
- Macworth-Praed, C. W., and C. H. B. Grant. 1970. *Birds of West Central and Western Africa*. London, Longmans.
- N.R.C. 1981. *Techniques for the Study of Primate Population Ecology*. Washington, D.C., National Academy Press.
- Pérez Del Val, J. 1996. *Las Aves de Bioko*. Edilesa, Leon, Spain.
- Pérez del Val, J. 1998. Informe tecnico de la mision ornitológica de apoyo a la componente "unidades de conservación" (CUREF).
- Pérez del Val, J., J. E. Fa, J. Castroviejo, and F. Purroy. 1994. Species richness and endemism in the birds of Bioko. *Biodiversity and Conservation* 3: 868-892.
- Reichenow, A. 1910. *Über eine vogelsammlung vom Rio Benito im Spanischen Guinea*. Mitt. Zool. Mus. Berlin 5: 71-87.
- Ripley, S. D. and B. M. Beehler. 1985. A revision of the babbler genus *Trichastoma* and its allies (Aves: Timaliinae). *Ibis* 127: 495-509.
- Sabater-Pi, J. and C. Jones. 1967. Notes on the distribution and ecology of the higher primates of Rio Muni, West Africa. *Tulane Stud. Zool.* 14: 101-109.
- Smith, T. B. 1990. Natural selection on bill characters in two bill morphs of the African finch *Pyrenestes ostrinus*. *Evolution* 44: 832-842.
- Snow, D. W. 1978. *An atlas of speciation in African non-passerine Birds*. London : British Museum (Natural History).
- Sokal, R. R. and F. J. Rolph. 1995. *Biometry*. Third Edition. W. H. Freeman and Company, New York.

- Stuart, S. N., ed. 1986. Conservation of Cameroon Montane Forests. Cambridge, International Council for Bird Preservation.
- Whitney, K. D. and T. B. Smith. 1998. Habitat use and resource tracking by African Ceratogymna hornbills: implications for seed dispersal and forest conservation. *Animal Conservation* 1: 107-117.
- Whitney, K. D., M. K. Fogiel, A. M. Lamperti, K. M. Holbrook, D. M. Stauffer, B. D. Hardesty, V. T. Parker, and T. B. Smith. 1998. Seed dispersal by Ceratogymna hornbills in the Dja Reserve, Cameroon. *Journal of Tropical Ecology* 14:351-371.
- Wilson, D. E., F. R. Cole, J. D. Nichols, R. Rudran, and M. S. Foster, (eds.). 1997. *Measuring and Monitoring Biological Diversity: Standard Methods for Mammals*. Washington, D.C. Smithsonian Institution Press.

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

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

BIBLIOGRAPHY

- Lawson, D. P.
1993. The reptiles and amphibians of the Korup National Park Project, Cameroon. *Herp. Nat. Hist.* 1(2): 27-90.
- Mertens, R. 1941. Zur Kenntnis der Herpetofauna von Fernando-Poo. *Zool. Anz.* 135:275-281.
- _____ 1964. Die Reptilien von Fernando Poo. *Bonn. zool. Beitr.* 15:211-238.
- _____ 1965. Die Amphibien von Fernando Poo. *Bonn. zool. Beitr.* 16:14-29.

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 BOKO

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
<i>Abacetus</i>	sp. 1		2
pterostichine	sp. 2		1
pterostichine	sp. 3		1
<i>Euplynes</i>	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
<i>Pentagonica</i>	sp. 1		7
dromiine	sp. 1		4
<i>Calleida</i>	sp. 1		1
pericaline	sp. 1		1
<i>Lebia</i>	sp. 1		1
<i>Lebia</i>	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* nov. 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 *Hysteroocrates* 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'Île 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'Île 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, *Cangodermes 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 where 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. *Publicacoes 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 anophtalmes 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 espèces (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'Île 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 anophtalmes 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.
 Benoit, P.L.G., 1963. Araneidae-Nephilinae africains du Zoologisches Staatsinstitut und Zoologisches Museum Hamburg. Ent. Mitt. zool. Stinst. zool. Mus. Hamburg 2: 367-372.
 Benoit, P.L.G., 1964. La distribution géographique des Araneidae-Nephilinae africano-malgaches des genres *Nephila* et *Nephilengys*. Rev. Zool. Bot. Afr. (Belgium) 69: 311-326.
 Benoit, P.L.G., 1978. Contributions à l'étude de la faune terrestre des îles granitiques de l'archipel des Séchelles (Mission P.L.G. Benoit, J.J. Van Mol, 1972). Tetragnathidae et Araneidae-Nephilinae; Araneae-Cribellatae; Araneae-Sparassidae; Oxyopidae, Zodariidae et Selenopidae. Revue Zool. Afr. (Belgium) 92: 663-699.
 Canard, A, 1973. Contribution à la connaissance de la taxonomie, du cycle de développement et de la croissance de la Néphile de Madagascar (Araneida, Argiopidae). report, Thèse, Univ. Paris VI, 1-206.
 Canard, A, 1975. Stations africaines d'araignées des genres *Nephila* Leach et *Nephilengys* Koch (Araneae, Argiopidae) d'après les collections du Muséum national d'Histoire naturelle. Bull. Mus. Hist. nat. Paris (ser. 3), 306 (Zool. 216): 775-782.
 Canard, A, & Dresco, E, 1975. A propos de deux espèces de Néphiles (Araneae, Argiopidae) de la région éthiopienne. Bull. Mus. Hist. nat. Paris (ser. 3), 306(Zool. 216): 789-794.
 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.
 Hormiga, G., Eberhard, B. and Coddington, 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 - (*Polys*), 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:

- Benoit, P.L.G., 1962. Monographie des Araneidae-Gasteracanthinae africains. Ann. Mus. roy. Afr. Centr. (Zool.) 112: 7-70.
Benoit, P.L.G., 1962. Addenda à la révision des Araneidae Gasteracanthinae africains. Rev. Zool. Bot. Afr. (Belgium) 66: 370-374.
Benoit, P.L.G., 1964. Nouvelle contribution á la connaissance des Araneidae Gasteracanthinae d'Afrique et de Madagascar. Publçoes cult. Co. Diam. Angola 69: 41-52.

- Emerit, M, 1968. Contribution à l'étude de la biologie et du développement de l'araignée tropicale *Gasteracantha versicolor* (Walck.) (Argiopidae). Note préliminaire. Bull. Soc. Zool. Fr. 93: 49-68.
- Emerit, M, 1969. Contribution à l'étude des Gastéacanthes (Araneides, Argiopides) de Madagascar et des îles voisines. report, Thèse, Fac. Sci. Montpellier\ No. AO 2888, 1-434.
- Emerit, M, 1969-1970. Contribution à l'étude de la répartition biogéographique des Gastéacanthes de Madagascar. Bull. Mus. Hist. nat. Paris (ser. 2), 41(suppl. 1): 196-200.
- Emerit, M, 1973. Contribution à la connaissance des Araneidae Gasteracanthinae du sud-est africain: les Gastéacanthes du Natal Museum. Ann. Natal Mus. 21: 675-695.
- Emerit, M, 1974. Arachnides, Araignées, Araneidae Gasteracanthinae. Faune de Madagascar (Orstom CNRS Paris) 38: 1-215.
- Grasshoff, M, 1968. Morphologische Kriterien als Ausdruck von Artgrenzen bei Radnetzspinnen der Subfamilie Araneinae (Arachnida, Araneae, Araneidae). Abh. Senck. Naturf. Ges. 516: 1-100.
- Grasshoff, M, 1980. Contributions à l'étude de la fauna terrestre des îles granitiques de l'archipel des Sechelles (Mission, P. L. G. Benoit - J. J. van Mol 1972). Araneidae - Argiopinae, Araneidae - Araneinae (Araneae). Revue Zool. Afr. (Belgium) 94: 387-409.
- Grasshoff, M, 1986. Die Radnetzspinnen-Gattung *Neoscona* in Afrika (Arachnida: Araneae). Ann. Mus. roy. Afr. Centr. (Zool.) 250: 1-123.
- Grasshoff, M, & Edmunds, J, 1979. *Araneus legonensis* n. sp. (Araneidae: Araneae) from Ghana, West Africa, and its free sector web. Bull. Brit. Arachnol. Soc. 4: 303-309.
- 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.
- Scharff, N., & Coddington, J. 1997. A phylogenetic analysis of the orb-weaving spider family Araneidae (Arachnida, Araneae). Zoological Journal of the Linnean Society 120: 355-434.

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:

- Brignoli, P.M., 1979. Un nuovo Theridiosoma del Kenya. Revue Suisse Zool. 86: 485-489.
- Coddington, J.A., 1986. The genera of the spider family Theridiosomatidae. Smithson. Contrib. Zool. 422: 1-96.

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.

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:

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.

Baert, L., 1986. Mysmenidae from the Comoro Islands, Mozambique Channel (Araneae). *Revue Zool. Afr. (Belgium)* 100: 264-268.

Baert, L., & Murphy, J.A., 1987. *Kilifia inquilina*, a new mysmenid spider from Kenya (Araneae, Mysmenidae). *Bull. Brit. Arachnol. Soc.* 7: 194-196.

Forster, R.R., 1974. Symphytognathid spiders from central Africa. *Revue Zool. Afr. (Belgium)* 88: 115-126.

Griswold, C. 1985. *Isela okuncana*, a new genus and species of kleptoparasitic spider from southern Africa (Araneae: Mysmenidae). *Annals of the Natal Museum* 27: 207-217.

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.

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.
- Forster, R.R., 1977. La faune terrestre de l'Île de Sainte-Hélène, quatrième partie, 3. Arachnida: 3. Araneae, 16. Fam. Symphytognathidae. *Ann. Mus. roy. Afr. Centr. (Zool.)* 220: 129-131.
- Forster, R.R., & Platnick, N.I., 1977. A review of the spider family Symphytognathidae (Arachnida: Araneae). *Amer. Mus. Novitates* 2619: 1-29.
- Griswold, C. 1987. The spider genus *Symphytognatha* Hickman (Araneae: Symphytognathidae) newly described from Africa. *Annals of the Natal Museum* 28: 133-136.
- 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.

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.

- 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.
- Hubert, M, 1970. Description de deux espèces nouvelles d'araignées africaines appartenant au genre *Nesticus* (Araneae, Nesticidae). *Rev. Zool. Bot. Afr. (Belgium)*, 81(3-4): 361-368.
- Hubert, M, 1971. Sur un *Nesticus* nouveau d'Angola: *Nesticus machadoi* n. sp. (Araneae, Nesticidae). *Publ. cult. Co. Diam. Angola (Lisboa)*, 84: 73-78.
- 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 - (*Achaearana*), Pico Basilé (700m), Moca (1300-1400m), 5 km W Luba (0-50m), 3.5 km W Luba (0-50m)
 Species 26 - (*Achaearana*), Moca (1300-1400m), Moca (1500m)
 Species 27 - (*Achaearana*), 3.5 km W Luba (0-50m), Punta Becrof (0-50m)
 Species 28 - (*Achaearana*), Moca (1300-1400m), Moca (1500m)
 Species 29 - (*Achaearana*), Pico Basilé (700m)
 Species 30 - (*Achaearana*), Moca (1300-1400m), Moca (1500m)
 Species 31 - (*Achaearana*), 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.
- Forster, R., Platnick, N. & Coddington, J. 1990. A proosal and review of the spider family Synotaxidae (Araneae, Araneoidea) with notes on theridiid interrelationships. *Bulletin of the American Museum of Natural History* 193: 1-116.
- 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.
- Levi H.W., & Levi L.R. 1962. The genera of the spider family Theridiidae. *Bulletin of the Museum of Comparative Zoology* 127: 1-71.
- Lotz, L. 1994. Revision of the genus *Latrodectus* (Araneae, Theridiidae) in Africa. *Navorsing 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 Afrontane 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-weaving 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 - (?*Lepthyphantes*), 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 espèces 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'île 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 représentants 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 *Thoriosia* 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 *Peucezia* (Araneae, Oxyopidae). Entomology memoir, Department of Agriculture South Africa: 89: 1-50.

Clubionidae

This family has been delimited 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 cosmopolitan 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 (*Achaeearanea*)
 *Theridiidae sp. 29 (*Achaeearanea*)
 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 (*Achaeearanea*)
 Theridiidae sp. 26 (*Achaeearanea*)
 Theridiidae sp. 28 (*Achaeearanea*)
 Theridiidae sp. 30 (*Achaeearanea*)
 *Theridiidae sp. 31 (*Achaeearanea*)
 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
 *Agelidae 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 (*Achaearana*)
 Theridiidae sp. 28 (*Achaearana*)
 Theridiidae sp. 30 (*Achaearana*)
 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 (*Achaearana*)
 Theridiidae sp. 27 (*Achaearana*)
 *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 (*Achaeearanea*)
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							
<i>Moggridgea anaectenidia</i>			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 (<i>Nephila</i>)			3	4					
sp 2 -"-						6			
sp 3 (<i>Nephilengys</i>)				4	5	6			
sp 4 (<i>Tetragnatha</i>)			3			6			9
sp 5 -"-						6	7	8	
sp 6 -"-		2	3	4		6	7		
sp 7	1	2	3	4	5				
sp 8 (<i>Dolichognatha</i>)			3		5	6			9
sp 9	1	2		4					
sp 10				4					
sp 11 (<i>Landana</i>)									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 (<i>Cyrtophora</i>)				4	5				
sp 2 (<i>Argiope</i>)				4					
sp 3 (<i>Gasteracantha</i>)				4		6			9
sp 4 (<i>Aranaethra</i>)			3						
sp 5 (<i>Polrys</i>)				4					
sp 6 (<i>Cyrtarachne</i>)						6			
sp 7 -"-				4					
sp 8 -"-							7		
sp 9									
sp 10 (\pm <i>Neoscona</i>)				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 (<i>Neoscona</i>)	1	2	3	4	5		7		
sp 21 (<i>Caerostris</i>)				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 (<i>Cyclosa</i>)			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 (<i>Argyrodes</i>)				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 (<i>Hadrotarsinae</i>)			3			6	7	8
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 (\pm Achaearana)			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(<i>Thwaitesia</i>)	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						
<i>Buibui kankamelos</i> , n. sp.	2					
<i>Wanzia fako</i>			5			
Linyphiidae						
sp 1 (<i>Microlinyphia</i>)	1		4			
sp 2			4			
sp 3			4	5		
sp 4 (? <i>Lepthyphanthes</i>)	1		4	5		
sp 5 (? <i>Neriene</i>)	1	2	4	5		
sp 6 (<i>Mecynidis</i>)			4	5		
sp 7 (<i>Afroneta</i>)	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							
<i>Raecius zoropsides</i>	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 (<i>Hortipes</i>)							
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 (\pm 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 Afrotropical 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 afro-montane 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 BIKO - 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 BOKO

Insofar as can be estimated at this time, the arthropod fauna of Bioko is as rich and diverse as 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 Científica de Caldera de Luba). Only Mount Cameroon is comparable, and both population pressure and volcanic activity threaten this gradient. The Reserva Científica de Caldera de Luba is a biodiversity treasure that deserves top conservation priority.

REFERENCES

- Coddington, J. in press. Progress in spider systematics. *Systematic Biology*.
- Coddington, J. & Levi, H. 1991, Systematics and evolution of spiders (Araneae). *Annual Review of Ecology and Systematics* 22: 565--592.
- Dippenaar-Schoeman, A., & Jocqué, R. 1997. African spiders: an identification manual. *Plant Protection Research Institute Handbook* 9: 1--392.
- Griswold, C. 1991. Cladistic Biogeography of Afromontane Spiders. *Australian Systematic Botany* 4: 73-89.
- Roth, V, 1992a. Preliminary list of spiders recorded from Madagascar with synonymies, present placement of species, and a partial bibliography. Unpublished Technical Report for Parc Nacional Ranomafana, pp.1--18.
- Roth, V, 1992b. Spiders of Ranomafana National Park and immediate area. Unpublished Technical Report for Parc Nacional Ranomafana, pp.1--13.
- 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.

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 (Avice 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 (Avice 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 km² 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 km² 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').

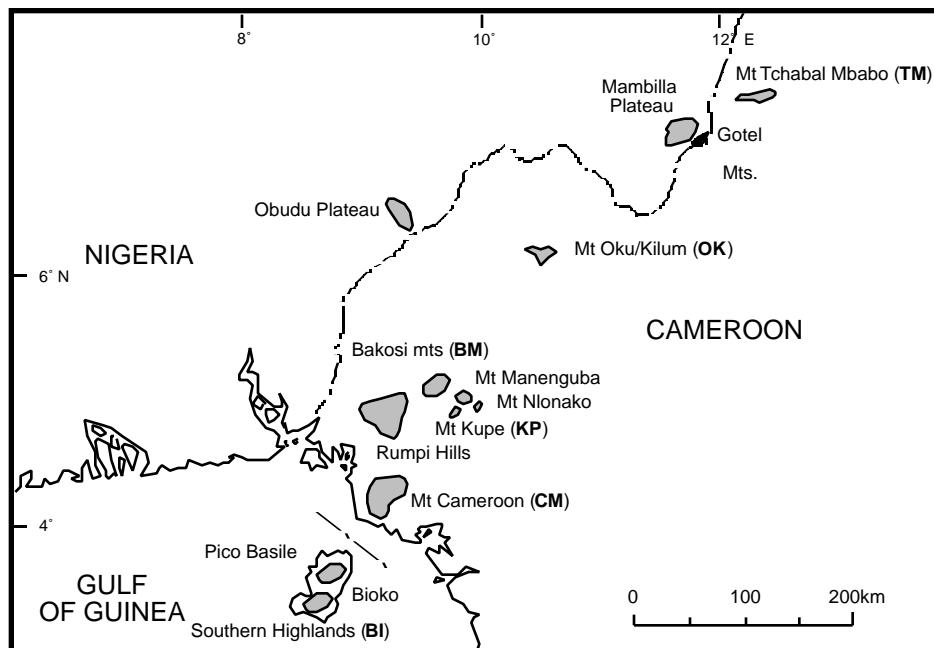


Fig. 4.1. Map showing the Afrotropical region of Cameroon and Equatorial Guinea. Mountains on which birds were sampled are shown with abbreviations in bold.

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° 09'E, 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 dendrogram 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).

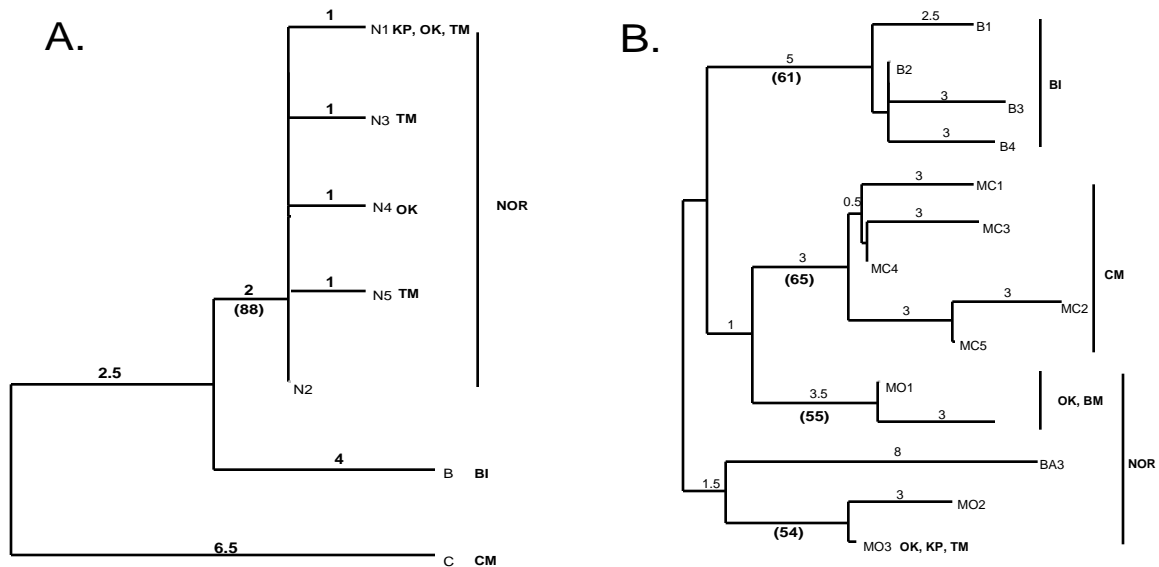


Fig. 4.2. Intraspecific phylogeographies for (A) mountain greenbul *Andropadus tephrolaemus* and (B) the Cameroon blue-headed sunbird *Nectarinia oritis* sampled from 6 mountains (BI, CM, KP, BM, OK, TM, abbreviations as in Fig. 1). Northern mountains, NOR, include, OK, KP, BM, TM. Each tree was estimated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

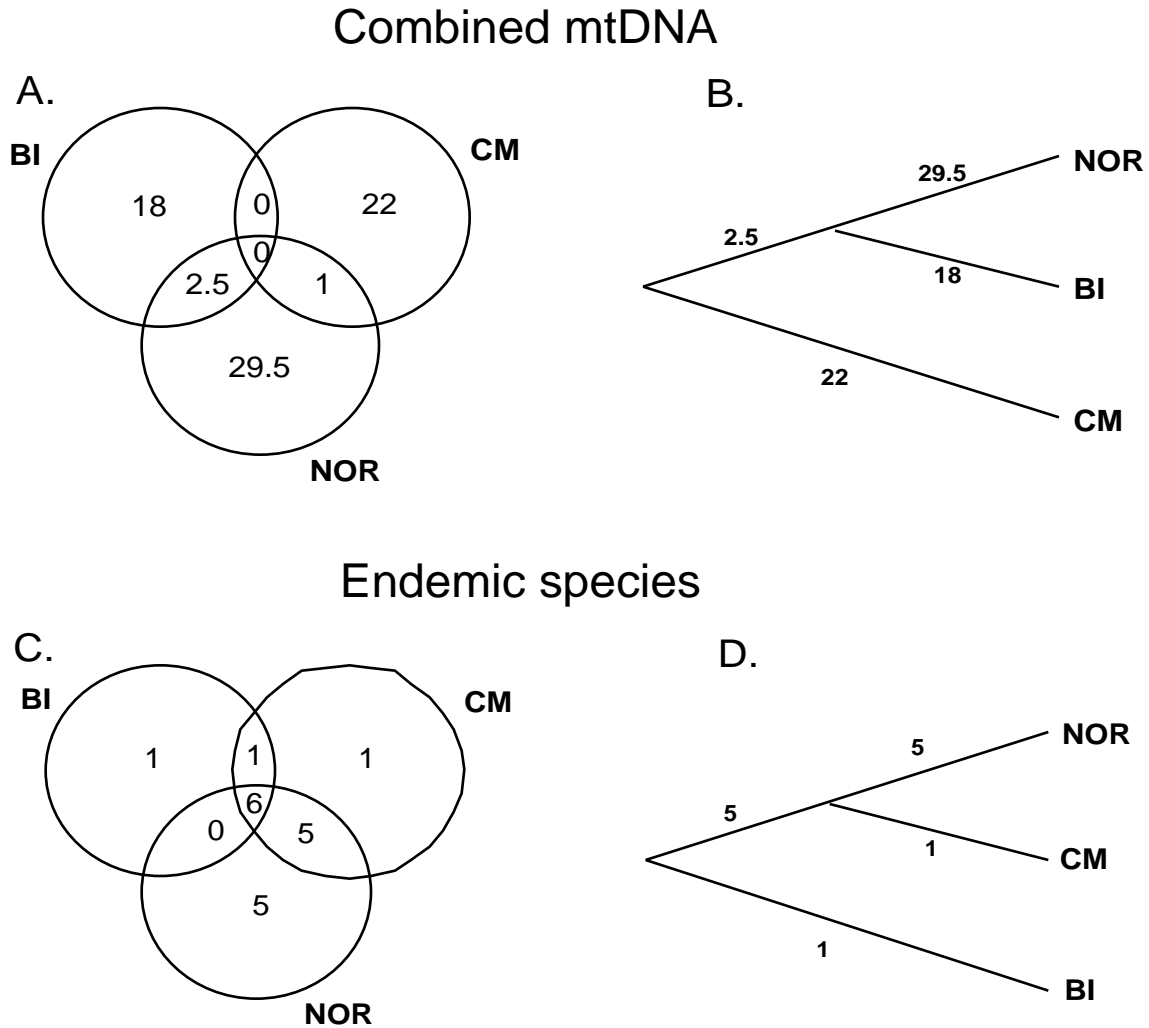


Fig. 4.3. Venn diagrams showing components (A) of mtDNA PD and counts for corresponding regions of endemic species (C) across mountains, and the corresponding area cladograms for mt DNA data (B) and endemics (D). See Moritz and Faith 1998 for more details on methods.

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

* 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).

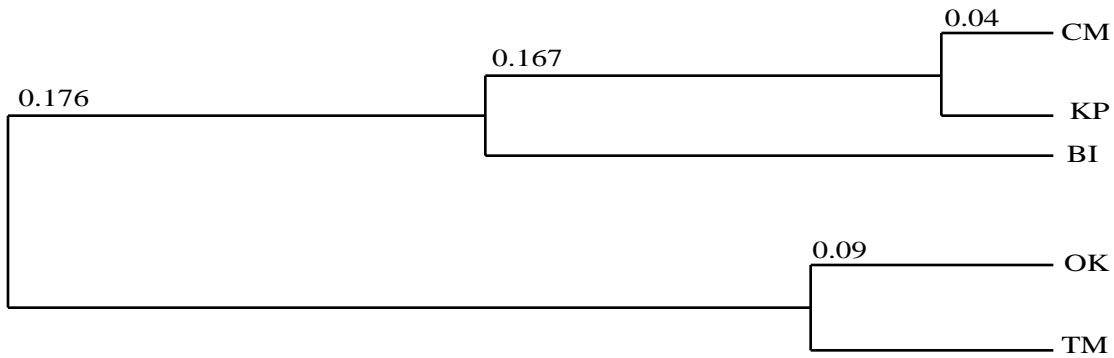


Fig. 4.4. Relationships among five mountains from Cameroon and Equatorial Guinea as inferred from the distributions of endemic species from Table 2 by UPGMA clustering of Bray-Curtis distances.

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).

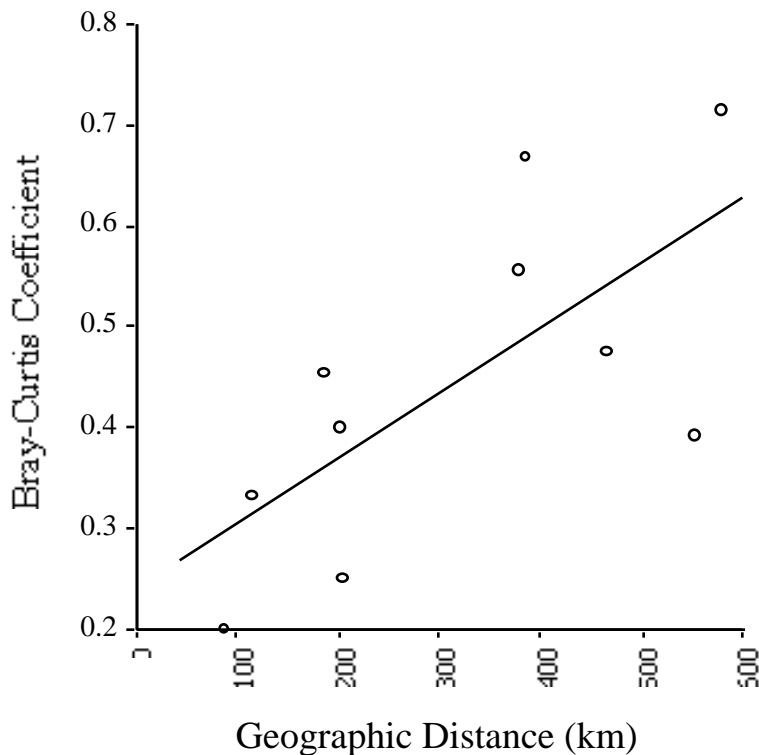


Fig. 4.5. Relationship between the similarity of endemics as index by Bray-Curtis distance coefficient and geographic distance ($y = 0.001x + 0.239$, $r = 0.7$, Mantel's test $P < 0.01$).

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 Afrotropical 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 surrounded 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 phenotypic 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. In 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 phenotypic 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).

LITERATURE CITED

- Avice JC (1992) Molecular population structure and the biogeographic history of a regional fauna: a case history with lessons for conservation biology. *Oikos*, 63, 62-76.
- Avice JC (1994) *Molecular markers*. New York: Chapman and Hall.
- Balmford A, Mace GM, and Ginsberg JR (1999) The challenges to conservation in a changing world: putting processes on the map. In GM Mace, Balmford A and Ginsberg JR Eds. *Conservation in a changing world*, Cambridge Univ. Press, Cambridge.
- Brown LH, Urban EK, and Newman K Eds (1982) *Birds of Africa*. (Vol. 1). London: Academic Press.
- Collar NJ, and Stuart SN (1985) *Threatened Birds of Africa and Related Islands*. Cambridge: ICBP/IUCN.
- Crozier RH, and Kusmierski RM (1994) Genetic distances and the setting of conservation priorities. In V Loeschke, Tomiuk J and Jain SK Eds. *Conservation Genetics*, (pp. 227-237). Birkhäuser Verlag Basel, Switzerland.
- Endler JA (1977) *Geographic variation, speciation, and clines*. Princeton, N.J.: Princeton University Press.
- Erwin TL (1991) An evolutionary basis for conservation strategies. *Science*, 253, 750-752.
- Faith D (1994) Phylogenetic pattern and the quantification of organismal biodiversity. *Phil Trans R Soc Lond B*, 345, 45-58.

- Faith D, and Walker P (1996) How do indicator groups provide information about the relative biodiversity of different sets of areas: on hotspots, complementarity and pattern-based approaches. *Biodiversity Letters*, 3, 18-25.
- Faith DP (1992) Conservation evaluation and phylogenetic diversity. *Biological Conservation*, 61, 1-10.
- Fjeldsa J (1994) Geographical patterns for relict and young birds in Africa and South America and implications for conservation priorities. *Biodiversity and Conservation*, 3, 107-226.
- Fry CH, Keith S, and Urban EK Eds (1988) *The Birds of Africa*. (Vol. III): Academic Press.
- Gene-Codes-Corporation (1995) *Sequencher 3.0 for the Apple Macintosh*. Ann Arbor.
- Guinea E (1951) Esquema de la vegetación de Fernando Poo. *Confer. Inter Afric Occid. Circular*, 4, 41-45.
- Humphries CJ, Williams PH, and Vane-Wright RI (1995) Measuring biodiversity value for conservation. *ARES*, 26, 93-111.
- Jones PJ (1994) Biodiversity in the Gulf of Guinea: an overview. *Biodiversity and Conservation*, 3, 772-784.
- Keith S, Urban EK, and Fry CH (1992) *The birds of Africa*. (Vol. 4). New York: Academic Press.
- Kocker TD, and White TJ (1989) Evolutionary analysis via PCR. In HA Erlich Ed. *PCR Technology - Principles And Applications For DNA Amplification.*, (pp. 137-147). Stockton Press., New York.
- Larison B, Smith TB, Fotso R, and McNiven D (in press) Comparative avian biodiversity of five mountains in northern Cameroon and Bioko. *Ostrich*, .
- Linder HP (1995) Setting conservation priorities: the importance of endemism and phylogeny in the southern African orchid genus *Herschelia*. *Conservation Biology*, 9, 585-595.
- Louette M (1981) The birds of Cameroon. An annotated checklist. *Verhandelingen van de Koninklijke Academie voor Wetenschappen, Letteren Schone Kunsten van België. Klasse de Wetenschappen*, 43, 1-295.
- Ludwig JA, and Reynolds JF (1988) *Statistical Ecology*. New York: John Wiley & sons.
- Mace G, and Lande R (1991) Assessing extinction threats: toward a reevaluation of IUCN threatened species categories. *Conservation Biology*, 5, 148-157.
- Mackworth-Præd CW, and Grant CHB (1973) *Birds of west and west-central Africa*. (Vol. 2). London: Longman.
- Maley J (1996) The African rain forest - main characteristics of changes in vegetation and climate from the Upper Cretaceous to the Quaternary. *Proc. Royal Soc. Edinburgh*, 104B, 31-73.
- Moritz C (1994) Defining evolutionarily significant units for conservation. *Trends in Ecology and Evolution*, 9, 373-375.
- Moritz C, and Faith DP (1998) Comparative phylogeography and the identification of genetically divergent areas for conservation. *Molecular Ecology*, 7, 419-429.
- Moritz C, and McDonald KR (1999) Evolutionary approaches to the conservation of tropical rainforest vertebrates. In C Moritz and Bermingham E Eds. *Rainforests Past and Future*, . University of Chicago Press, Chicago.
- Orr MR, and Smith TB (1998) Ecology and speciation. *Trends in Ecology and Evolution*, 13, 502-506.
- Page R (1994) Maps between trees and cladistic analysis of historical associations among genes, organisms, and areas. *Syst Biol*, 43, 58-77.
- Pérez del Val J, Fa JE, Catroviejo FJ, and Purroy FJ (1994) Species richness and endemism of birds on Bioko. *Biodiversity and Conservation*, 3, 868-892.
- Pressey RL, Humphries CR, Margules CR, Vane-Wright RI, and Williams PH (1993) Beyond opportunism: key principles for systematic reserve selection. *Trends in Ecology and Evolution*, 8, 124-128.

- Rohlf RJ (1993) *NTSYS-pc, Numerical taxonomy and multivariate analysis system*. Setauket, New York: Exeter software.
- Roy M (1997) Recent diversification in African greenbuls (Pycnonotidae: *Andropadus*) supports a montane speciation model. *Proc. R. Soc. Lond.*, 264, 1337-1344.
- Saiki RK, Gelfand DH, Stoffel S, Scharf SJ, Higuchi R, Horn GT, Mullis KB, and Erlich HA (1988) Primer directed enzymatic amplification of DNA with a thermostable DNA polymerase. *Science*, 239, 487-491.
- Schluter, D (1998). Ecological causes of speciation. In D. J. Howard & S. H. Berlocher Eds. *Endless forms: species and speciation*, . Oxford: Oxford University Press.
- Schneider CJ, and Moritz C (1998) Refugial isolation and evolution in Australia's wet tropics rainforest. *Proc. Roy. Soc. Lond.*, .
- Schneider, C, Smith T B, Larison B, and Moritz C. (in press). Divergence with gene flow and implications for speciation in the Australian rainforest lizard (*Carlia*). *Proc. Nat. Acad. Sci.*
- Smith TB (1990) Resource use by bill morphs of an African finch: Evidence for intraspecific competition. *Ecology*, 71, 1246-1257.
- Smith TB, Bruford MW, and Wayne RK (1993) The preservation of process: the missing element of conservation programs. *Biodiversity Letters*, 1, 164-167.
- Smith TB, and McNiven D (1993) Preliminary survey of the avifauna of Mt Tchabal Mbabo, west-central Cameroon. *Bird Conservation International*, 3, 13-19.
- Smith TB, Wayne RK, Girman DJ, and Bruford MW (1997) A role for ecotones in generating rainforest biodiversity. *Science*, 276, 1855-1857.
- Smith TB, Wayne RK, Girman DJ, and Bruford MW (1999) Evaluating the Divergence-with-Gene-Flow Model in Natural Populations: The Importance of Ecotones in Rainforests Speciation. In C Moritz and Bermingham E Eds. *Rainforests Past and Future*, . University of Chicago Press, Chicago.
- Sneath PH, and Sokal R (1973) *Numerical Taxonomy*: W.H. Freeman & Co.: San Francisco.
- Stuart SN Ed. (1986) *Conservation of Cameroon Montane Forests*. Cambridge: International Council for Bird Preservation.
- Swofford DL (1998) *PAUP 4.0 beta version for the Macintosh powerPC - Phylogenetic Analysis Using Parsimony (and Other Methods)*. (3.0s ed.). New York: Sinaur Associates.
- Taberlet P, and Bouvet J (1991) A single plucked feather as a source of DNA for bird genetic studies. *Auk*, 108, 959-960.
- Thomas DW, and Thomas J (1996) Tchabal Mbabo botanical field survey : WWF-Cameroon.
- Urban EK, Fry CH, and Keith S Eds (1986) *The Birds of Africa*. (Vol. 2). London: Academic Press.
- Vogler AP, and DeSalle R (1994) Diagnosing units of conservation management. *Conservation Biology*, 8, 354-363.
- Wright JB, Hastings DA, Jones WB, and Williams HR (1985) *Geology and mineral resources of West Africa*. London: George Allen & Unwin Publishers.

PART IV

ANNOTATED BIBLIOGRAPHY

Literature on Biodiversity in the Congo Basin/Gulf of Guinea Regions

GENERAL

Jones, P. J. 1994. Biodiversity in the Gulf of Guinea: an overview. *Biodiversity and Conservation*. 3:772-784.

An overview of the biogeographic history of the island and patterns of species richness and endemism. Includes discussions of the flora, terrestrial and freshwater vertebrates, terrestrial invertebrates, and marine organisms. Discusses conservation importance of the Gulf of Guinea islands.

Kingdon, J. 1989. *Island Africa: The Evolution of Africa's Rare Animals and Plants*. Princeton University Press, Princeton.

FLORA

ALGAE

Romo, S., E. Becares, and P. Compere. 1995. Algae from Bioko Island (Equatorial Guinea, West Africa). *Archiv fuer Hydrobiologie Supplementband* 106:79-95.
The first study of the algal flora of Equatorial Guinea.

PLANTS

Alston, A. H. G. 1959. *The Ferns and Fern Allies of West Tropical Africa*.
Keys to and descriptions of the ferns and related taxa. Includes Bioko.

Atkins, S. 1992. *Verbenaceae Guineae Aequatorialis Nonnullae*. . *Fontqueria* 33: 83-85.

Presents results of recent collections of Verbenacea from Bioko, including brief descriptions and locations collected.

Association pour l'étude taxonomique de la flore d'Afrique tropicale. Réunion plénière 1985 : (Missouri Botanical Garden). *Modern systematic studies in African botany: proceedings of the Eleventh Plenary Meeting of the Association for the Taxonomic Study of the Flora of Tropical Africa*, Missouri Botanical Garden, St. Louis, June 10-14. Peter Goldblatt and Porter P. Lowry II. (eds.) *Monographs in systematic botany from the Missouri Botanical Garden* 25: 0161-1542.

Benl, G. 1978. *The Pteridophyta of Fernando Po (Contribution to a flora of the island)*. I. *Acta Bot. Barcin.* 31:1-31.

Benl, G. 1980. *The Pteridophyta of Fernando Po (Contribution to a flora of the island)*. II. *Acta Bot. Barcin.* 32:1-34.

Benl, G. 1982. *The Pteridophyta of Fernando Po (Contribution to a flora of the island)*. III. *Acta Bot. Barcin.* 33:1-46.

- Benl, G. 1988. The Pteridophyta of Fernando Po (Contribution to a flora of the island). IV. Acta Bot. Barcin. 38:1-69.**
- Benl, G. 1991. The Pteridophyta of Fernando Po (Contribution to a flora of the island). V. Acta Bot. Barcin. 40:1-106.**
- Boss, J. J. 1984. The Dracaena in West Africa. Agric. Univ. Wageningen Papers 84:1-126.**
- Burkill, H. M. 1985. The useful plants of west tropical Kew (London, England): Royal Botanic Gardens.**
- Cebolla, and Rivas Ponce. 1994. Poaceae Guinea Aequatorialis Nonnullae. Fontqueria 39: 17-30.**
Presents species accounts and locations from recent collections of Poaceae from Bioko and Annobón (Pagalú).
- Dupont, L. M. 1996. Podocarpus in West Africa during the late Pleistocene. Pp. 85-101In: Heine, K. (ed.). Palaeoecology of Africa and the Surrounding Islands, Vol. 24. Rotterdam, Netherlands: A. A. Balkema**
- Enroth, J. 1996. The Neckeraceae (Musci) Collected By Mr Muller, Frank In Bioko (Equatorial Guinea) In 1994. Journal Of Bryology 19:189-191.**
Identification of 5 species of mosses found on Bioko, collected primarily from Caldera de Luba.
- Enroth, J. 1993. Notes on the Neckeraceae Musci 17. A Taxonomic Study on the Genus Neckeropsis in Africa Journal of the Hattori Botanical Laboratory 73:159-173.**
A taxonomic study of the seven species of this moss genus found in Africa and adjacent islands. Includes illustrations, and SEM micrographs of the peristome of some species.
- Escarré, A. 1968. Aportaciones al conocimiento de la flora de Fernando Poo. 1 - Araliaceae, Umbelliferai. Acta Phytotax. Barcinonensia 2:1-15.**
A key to species of the families Araliaceae and Umbelliferai on Bioko.
- Escarré, A. 1969. Aportaciones al conocimiento de la flora de Fernando Poo. 2 - Piperaceae, Urticaceae. Acta Phytotax. Barcinonensia 3:1-23.**
A key to species of the families Piperaceae and Urticaceae on Bioko.
- Escarré, A., and T. Reinales. 1970. Aportaciones al conocimiento de la flora de Fernando Poo. 3 - Familia Compuestas. Acta Phytotax. Barcinonensia 5:1-32.**
A key to species of the family Compositae (Asteraceae) on Bioko.
- Exell, A. W. 1944. Catalogue of the vascular plants of Sao Tome (with Principe and Annobon). London, British Museum (Natural History).**
- Exell, A. W. 1956. Supplement to the catalog of the vascular plants of Sao Tome (with Principe and Annobon). London, British Museum (Natural History).; Bull Inst Franc. Afrique Noire series A. 21(2):439-476. 1959.; Bull Brit. Mus. (Nat. Hist), Bot. 4:327-411.**
- Exell, A. W. 1952. The vegetation of the islands of the Gulf of Guinea. Lejuinia 16:57-66.**
Classification of vegetation types with lists of common plant species and endemics in each type.

- Exell, A. W. 1958. Progress accomplished in the study of the flora of the islands of the Gulf of Guinea. Mem. Soc. Broter. 13:19-21.**
A brief discussion of collections and descriptions/discoveries made on the flora of the Islands of the Gulf of Guinea.
- Exell, A. W. 1968. Príncipe, Sao Tome and Annobon. In: Conservation of Vegetation in Africa South of the Sahara. (I. Hedberg and O. Hedberg, eds.) Acta Phytogeographica Suecica 54:132-136.**
Summary of the vegetation types of the three oceanic islands of the Gulf of Guinea, including Annobon. Proposes areas for conservation.
- Exell, A. W. 1973. Angiosperms of the Islands of the Gulf of Guinea (Fernando Po, Principe, Sao Tome and Annobon). Bull Brit. Mus. (Nat. Hist.) Bot. 4:327-411.**
An annotated systematic list of the species then known from the islands, analysis of affinities of each flora with the mainland, and degree of endemism in each flora. Includes an annotated bibliography of works on the flora between 1944 and 1973.
- Exell, A. W. 1963. Angiosperms of the Cambridge Annobon Island Expedition. Bull. Brit. Mus. (Nat. Hist.) Bot. 3:93-118.**
List of species collected, locations collected, and their general distribution. Includes some plates.
- Fernández Casas, J., Morales, and R. Valverde, R. 1995. Survey of the flora of Bioko Island (Equatorial Guinea). Anales del Jardin Botanico de Madrid 52:230-240. Language: Spanish.**
A catalog of monographs published in the journal Fontqueria covering plant taxa found on Bioko.
- Fernández Casas. 1994. Fontqueria 39:31-44.**
- Fernández Casas. 1992. Ad Guineae Aequatorialis floram texendam inventa varia. Fontqueria 33:33-82.**
Identification of vascular plants collected during the previous few years in Equatorial Guinea (many new species and locations of their collection from Bioko, Pagalu).
- Figueiredo, E. 1994. Diversity and endemism of angiosperms in the Gulf of Guinea islands. Biodiversity and Conservation 3:785-793.**
Examines the diversity and endemism of the angiosperms of the Gulf of Guinea. Bioko has the highest diversity of the island, but low endemism. Shows a high similarity of floras among the islands by analyzing the number of shared genera. Discusses importance of and need for study of afro-montane elements and paleoendemism.
- Figueiredo, E. 1994. Fontqueria 39:1-8.**
A botanic bibliography of the Gulf of Guinea Islands, including 266 references
- Figueiredo, E. 1998. The Pteridophytes of Sao Tome and Principe (Gulf of Guinea). Bulletin of the Natural History Museum, London (Bot.) 28:41-66.**
Fern catalog covering 156 species, 12 of which are endemics.
- Gomez Moreno, M. L. 1942. Aracaceas de Fernando Poo. Estudio de las especies indigenas cultivadas in dicha isla. Anuario agrícola de los territorios españoles del golfo de Guinea 6: 7-37.**
Monograph on the Araceae of Bioko.
- Goyder, D. J. 1994. Asclepiadaceae Guinea Aequatorialis Nonnullae. Fontqueria 39:9-12.**
Presents species accounts and locations from recent collections of Asclepiadaceae from Bioko and Annobón (Pagalú).

- Guinea, E. 1948. Anuario agrícola de los territorios españoles del golfo de Guinea 13:95-164.**
- Guinea, E. 1950. Juncaceae, Cyperaceaeque Fernandopoinae. Anales Jard. Bot. Madrid 9: 335-360.**
- Guinea, E. 1951. Melastomaceae Fernandopoanae. Bol. R. Soc. Esp. Hist. Nat. 49(3): 175-187.**
- Guinea, E. 1951. Asteraceae (Compositae) Fernandopoanae. Anals Inst. Bot. Cavanilles 10(1): 301-340.**
- Guinea, E. 1946. Ensayo Geobotánico de la Guinea Continental Española. Madrid.**
- Guinea, E. 1949. En el país de los bubis. Instituto de Estudios Africanos. Madrid.**
- Guinea, E. 1946 Ensayo Geobotánico de la Guinea Continental Española. Madrid. Dirección de Agricultura de los Territorios Españoles del Golfo de Guinea.**
Includes discussion of climatic factors, synopsis of vegetation types. Maps various plant distributions relative to vegetation types. Provides catalog of the flora of mainland Equatorial Guinea.
- Guinea, E. 1951. Esquema de la vegetation de Fernando Póo. Confer. Inter. Afric. Occid. Circular Paper: 41-77.**
Includes lists of plants collected by Guinea on Bioko. In four languages.
- Guinea, E. 1968. Fernando Po. In: Conservation of Vegetation in Africa South of the Sahara, I. Hedberg and O. Hedberg, (eds.) Acta Phytogeog. Suecica 54:130-132.**
Brief summary of the vegetation types found on Bioko and botanical species in each.
- Hepper, F. N. 1992. Fontqueria 33: 29-32. Scrophulariaceae Solanaceaeque Guineae Aequatorialis Nonnullae.**
Presents results of recent collections of Apocynaceae from Bioko, Rio Muni and Annobón (Pagalú), including brief descriptions and locations collected on Bioko and Annobon.
- Hutchinson, J., and J. M. Dalziel. 1954. Flora of west tropical Africa, the British West African colonies, British Cameroons, the French and Portuguese colonies south of the Tropic of Cancer to Lake Chad, and Fernando Po. In 2 Volumes. Royal Botanic Gardens, Kew.**
Keys and descriptions to the flora of tropical west africa. Includes Bioko.
- Lawson, G. W. 1996. The Guinea-Congo lowland rain forest: an overview. Proc. Roy. Soc. Edinburgh Section B 104:5-14.** Provides a brief overview of the geographical and climatic setting, floristic and vegetation patterns, and productivity of the region, with a brief discussion of conservation issues.
- Leeuwenberg, A. J. M. 1994. Apocynaceae Guineae Aequatorialis Nonnullae. Fontqueria 40:1-6.**
Presents results of recent collections of Apocynaceae from Bioko and Annobón (Pagalú), including brief descriptions and locations collected.
- LeJoly, J. 1994. La Biodiversité végétale dans le Parc National de Monte Alen. Groupement AGRECO-CTFT, for Projet ECOFAC, Guinée Équatoriale.**
Botanic survey (trees) in Monte Alen. Lists Latin and Fang names of trees.

- LeJoly, J., Y. Issembe, and M. Ayichedemou. 1998. Biodiversité végétale des ligneux sur le transect de Monte Chocolate dans la Parc National de Monte Alen. Groupement AGRECO-CTFT, for Projet ECOFAC, Guinée Équatoriale.**
Botanic inventory along a 4.5 km transect in Monte Alen. Noting the presence of all species with individuals >10 cm dbh within a 5m wide swath, and all species with individuals > 70 cm dbh within a 50 m wide swath.
- Leuschner, C. 1996. Timberline and alpine vegetation on the tropical and warm-temperate oceanic islands of the world: Elevation, structure and floristics. Vegetatio 123:193-206.**
This review seeks to identify common physiognomic patterns in the high elevation vegetation that exist among islands belonging to different floristic regions of the world. Based on the existing literature as well as personal observation, an overview of the elevation, physiognomy and floristics of the forest (and tree) line and the alpine vegetation on 15 island peaks (including Bioko) is given.
- Lisowski, S. 1998. Etude de la Biodiversité Vegetale dans la Region Continentale de Guinée Equatoriale. Documento Technico 16, Anexo 3, Componente Sistema Nacional de Unidades de Conservacion. CUREF, Equatorial Guinea.**
A very general, broad survey of plant diversity and habitat types in Rio Muni.
- Lock, J. M. 1993. Costaceae Zingiberaceaeque Guineaae Aequatorialis Nonnullae. Fontqueria 36: 293-294.**
Presents results of recent collections of Verbenaceae from Bioko, including brief descriptions and locations collected.
- Maley, J. 1991. The African rainforest vegetation and paleoenvironments during late Quaternary. Clim. Changes. 19:79-98.**
- Maley, J. 1996. The Africa rain forest-main characteristics of changes in vegetation and climate from the Upper Cretaceous to the Quaternary. Proceedings of the Royal Society of Edinburgh Section B (Biological Sciences 104:37-73.**
This chapter sets out to give a historical overview of the changes in vegetation of the African rain forest from its origins, towards the end of the Cretaceous period. Climatic conditions and rainforest expansions and contractions are documented. The impacts of these changes on the evolution of flora and fauna are discussed.
- Mildbraed, J. 1922. Fernando Po in Wissenschaftliche Ergebnisse der Zweiten Deutschen Zentral-Africa-Expedition, 1910-1911. Botanik, Leipzig 2:164-195.**
- Morales, R. Micromeria-Punctata New-Record Bentham for Equatorial Guinea on Bioko Island. Anales del Jardin Botanico de Madrid 48:90-91.**
- Morales 1993. Fontqueria 36: 287-291.**
Presumably something on some angiosperm taxa on Bioko.
- Morales. 1994. Fontqueria 39:13-16.**
Presumably something on some angiosperm taxa on Bioko.
- Morales, R. 1994. Melastomataceae Guinea Aequatorialis Nonnullae. Fontqueria 40:13-18.**
Presents species accounts from recent and old collections of Convolvulaceae from Bioko and Annobón (Pagalú), locations for recent collections.
- Moreno, M. D. 1990. El bosque de Guinea Ecuatorial. Malabo: Cooperacion Espanola in Guinea Equatorial.**

- Nguema, N. S. 1997. Estudio del bosque secundario del area protegida de Rio Campo. Documento Technico 3, Anexo 3, Componente Sistema Nacional de Unidades de Conservacion. CUREF, Equatorial Guinea.**
Examination of secondary forest structure and tree species diversity using 40 x 40 plots near Ayamiken
- Perold, S. M. 1997. A new species of the liverwort genus *Riccia* from Bioko Island, *R. biokoensis* Perold. *Nova Hedwigia* 64:243-248.**
A new *Riccia* species, *R. biokoensis*, is described and illustrated.
- Raynaud-Farrera, I., J. Maley, and D. Wirmann. 1996. Vegetation and climate in the forest of South-West Cameroon since 4,770 years BP: Pollen analysis of sediments from Lake Ossa. *Comptes Rendus de l'Academie des Sciences Serie II A Sciences de la Terre et des Planetes* 322:749. Language: English, French.**
A detailed palynological analysis of a core recovered from Lake Ossa, situated in the wet rain forests of South West Cameroon, provides new information on the vegetational and climatic history of this region during the last 4,770 years BP. Pollen counts, showing a rich and well-diversified microflora, indicate the persistence of forest environment throughout this period.
- Rial, A. 1994. Resultados del Inventario de Biodiversidad Vegetal en la Transecta de Monte Chocolate. Report for ECOFAC, Guinea Equatorial.**
Report on tree diversity along a transect in Monte Alen, following the methods of LeJoly.
- Richards, P. W. 1963a. Ecological notes on West African vegetation. II. Lowland forest of the Southern Bakundu Forest Reserve. *Journal of Ecology* 51:123-149.**
Covers topography, human influences, climate, soils, structure and physiognomy and floristic composition.
- Richards, P. W. 1963b. Ecological Notes on West African vegetation. III. The upland forests of Cameroons Mountain. *Journal of Ecology* 51:529-554.**
Covers topography, climate, soils, structure, floristic composition, and altitudinal zonation.
- Sanford, W. W. 1971. The orchid flora of Equatorial Guinea in relation to that of West Africa. *Mitt. Bot. St.Samml. Münch.* 10:287-298.**
- Vollesen, K. 1992. Acanthaceae Guineaae Aequatorialis Nonnullae. *Fontqueria* 33:23-27.**
Presents results of recent collections of Acanthaceae from Bioko and Annobón (Pagalú), including brief descriptions and locations collected.
- White, F. 1981. The history of the Afromontane archipelago and the scientific need for its conservation. *Afr. J. Ecol.* 19:33-54.**
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. Zoologicheskyy 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 is 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 (Ploceidae) 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 Afrotropical Spiders. Australian Systematic Botany 4: 73-89.**
- Griswold, C. 1997. Occurrence and significance of the Afrotropical spider families Cyatholipidae and Phyxelididae at Bwindi-Impenetrable Forest National Park. Report to BINP, Uganda, March 1997, 3 pp.**
- Herbulot, C. 1998. Lepidopteres Geometrides recoltés par le Dr. J.-G. Canu dans l'île 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 Bioko Island (Equatorial Guinea) (Neuropteroidea, Planipennia: Coniopterygidae). Revue de Zoologie Africaine 102:493-502. 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. Bremen 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.

Watt, A. D., N. E. Stork, C. McBeath, and G. L. Lawson. 1997. Impact of forest management on insect abundance and damage in a lowland tropical forest in southern Cameroon. *Journal of Applied Ecology* 34:985-998.

The rate of deforestation in West Africa was around 2% (12 000 km²) 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

Basilio, A. 1962. La vida animal in la Guinea espanola. Madrid: I.E. A. (CSIC).

De la Riva, I. 1994. Informe Sobre la Diversidad Faunistica del Parque Nacional de Monte Alen, Guinea Ecuatorial. Report to ECOFAC, Composante Guinea Ecuatorial.

Provides lists of birds, mammals, reptiles, amphibians and fish encountered in various habitats in Monte Alen.

Eidmann, H. 1941. La vida animal en la selva virgen. Investigaciones en la isla de Fernando Póo. Traducción de don Jaime Nosti, "Anuario agricola de los territorios espanoles del Golfo de Guinea, pp. 51-92, Madrid.

Eisentraut, M. 1973. Die Wirbeltierfauna von Fernando Poo und Westkamerun. Bonner Zoologische Monographien 3.

Lasso, C. A. 1995. Biodiversidad Animal del Parque Nacional de Monte Alen. AGRECO-CTFT. for ECOFAC, Guinea Equatorial.

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.

Fernandez Peralta, L., and A. Ramos Martos. 1993. Distribution and biological aspects of *Pagellus bellottii bellottii* Steindachner, 1882 (Sparidae), in the Guinean Gulf. *Boletin del Instituto Espanol de Oceanografia* 9:157-170. Language: Spanish.

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.

- Lasso, C. A., R. Castelo, and A. Rial. Peces del Parque Nacional de Monte Alen, Cuencas del Rio Uoro (Rio Muni), Guinea Ecuatorial. Report to Proyecto ECOFAC, Guinea Ecuatorial.**
Report on the fish fauna of Monte Alen. 58 species, 36 genera, 16 families. Distribution and habitat relationships discussed. Authors suggest that Uoro River is an important region for many of these species.
- McAllister, D. E., F. W. Scheuler, C. M. Roberts, and J. P. Hawkins. 1994.**
Mapping and GIS analysis of the global distribution of coral reef fishes on an equal-area grid. Pp. 155-175. In Mapping the Diversity of Nature. R. Miller (ed.). London: Chapman and Hall.
GIS study of 950 species of coral reef fishes in eight families, to identify hotspots (high species density) and centers of endemism. Though it has low species diversity, the Gulf of Guinea was the richest area for endemics (28 out of 42 species, 67%).
- McEachran, J. D., B. Seret, and T. Miyake. 1989. Morphological variation within Raja miraletus and status of Raja ocellifera (Chondrichthyes, Rajoidei). Copeia 1989:629-641.**
Includes samples from the Gulf of Guinea.
- Miller, P. J. 1998. The West African species of Eleotris and their systematic affinities (Teleostei: Gobiodei). Journal of Natural History 32:273-296.**
Fish include *Eleotris vittata* (found on Bioko as well as the mainland), *Eleotris feae* (endemic to Annobon and Bioko), and *Eleotris annobonensis* (endemic to Bioko and Annobon).
- Reid, G. M. 1996. Ichthyogeography of the Guinea-Congo rain forest, West Africa. Proceedings of the Royal Society of Edinburgh Section B (Biological Sciences) 104:285-312.**
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.
- Thys van den Audenaerde, D. F. E. 1967. The freshwater fishes of Fernando Póo. Vlaamse Academie Voor Wetenschappen, Lett. Schone Kunsten Belg. 29:1-167.**

Herpetofauna

- Blanc, C. P. Mission Reptiles et Amphibians - Reserve de Faune de la Lope March-April 1995. AGRECO-CTFT for ECOFAC - Composante Gabon.**
A brief report on herps identified from 30 inventory stations in Lope Reserve.
- Boehme, W. 1994. A record of *Dimorphognathus africanus* from Bioko, Equatorial Guinea, and deletion of *Phrynodon sandersoni* from the faunal list of this island (Anura: Ranidae: Petropedetinae). Bonner Zoologische Beitrage 45:125-128.**
The record of *Phrynodon sandersoni* from Fernando Póo (= Bioko), Equatorial Guinea, by Mertens (1968, see also Amiet 1981) was based on misidentified specimens of *Dimorphognathus africanus*, which were not recorded before from that island.
- Bauer, A. M., J. V. Vindum and R. C. Drewes. 1993. A summary of African holdings and African research of the Department of Herpetology, California Academy of Sciences. J. Herp. Assoc. Afr. 41: 10-13.**
- Blaustein, A. R. 1994. Chicken little or Nero's fiddle? A perspective on declining amphibian populations. Herpetologica 50: 85-97.**

- Blaustein, A. R. and D. B. Wake. 1990. Declining amphibian populations: A global phenomena? Trends in Ecology and Evolution 5: 203-204.**
- Butynski, T. M. 1996 Marine turtles on Bioko Island, Equatorial Guinea. Oryx 30: 143-149.**
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.**
- Castroviejo, J., J. Juste, J. Pérez del Val, R. Castelo, and R. Gil. 1994. Diversity and status of sea turtle species in the Gulf of Guinea Islands. Biodiversity and Conservation 3:828-836.**
Provides location and descriptions of nesting beaches, species accounts, and timing of reproduction. Discusses human impacts.
- Drewes, R. C. 1984. A phylogenetic analysis of the Hyperoliidae (Anura): treefrogs of Africa, Madagascar, and the Seychelles Islands. Occ. Pap. Calif. Acad. Sci. 139: 1-70.**
- Drewes, R. C. and J. V. Vindum. 1994. Amphibians of the Impenetrable Forest, Southwest Uganda. J. Afr. Zool. 108: 55-70.**
- Lawson, D. P. 1993. The reptiles and amphibians of the Korup National Park Project, Cameroon. Herpetol. Nat. Hist. 1: 27-90.**
- Mba, J., J. Nguema, and J. E. Garcia. 1998. Estudio y Conservación de las Tortugas Marinas en el Litoral de la Región Continental de Guinea Ecuatorial. Documento Técnico 12, Anexo 3, Componente Sistema Nacional de Unidades de Conservación. CUREF, Equatorial Guinea.**
- Hutchinson, J., and M. Simmonds. 1992. Escalation of threats to marine turtles. Oryx 26:95-102.**
Overview of threats to marine turtles world wide, particularly threats from disease and pollution.

Birds

- Alexander, B. 1903. On the birds of Fernando Po. Ibis 3:330-403.**
Report on approximately 500 specimens of 103 species collected on Bioko in 1902, including localities, descriptions and measurements.
- Amadon, D. 1953. Avian systematics and evolution in the Gulf of Guinea. Bull. Am. Mus. Nat. Hist. 100:395-451.**
Examination and measurement of museum specimens from Bioko with comparisons made to type specimens or other specimens from other regions. Presents a bird list for the four Gulf of Guinea Islands. Presents discussions of zoogeography, endemism, and size and color variation.
- Amadon, D. and A. Basilio. 1957. Notes on the birds of Fernando Póo island, Spanish Equatorial Africa. Am. Mus. Novitates. 1846:1-8.**
- Bannerman, D. A. 1953. The Birds of West and Equatorial Africa. London.**
- Basilio, A. 1963. Aves de la isla de Fernando Póo. Madrid: Colculsa.**
Lists and describes characteristics and habitat affinities of 182 bird species from Bioko.

- Bibby, C. J., N. J. Collar, M. J. Crosby, M. F. Heath, C. Imboden, T. H. Johnson, A. J. Long, A. J. Slattersfield and S. J. Thirgood. 1992. Putting Biodiversity on the Map: Priority areas for Global Conservation. Cambridge: ICBP.**
Identifies areas of concentrated endemism by mapping distributions of species with an estimated range of <50,000km². (a la Terbourgh and Winter 1983 for Columbian and Ecuadorian bird species). (excludes seabirds).
- Brosset, A. and C. Erard. 1986. Les Oiseaux des Régions Forestières du Nord-est du Gabon. Vol 1. Écologie et Comportement des Espèces.**
- Brown, L. H., E. K. Urban, and K. Newman. 1982-1997. The Birds of Africa. Volumes 1-5. New York, Academic Press.**
Five volume guide (with more planned) covering all of Africa, with thorough species accounts, maps of distribution, and references.
- Butynski, T.M., and S. H. Koster. 1989. Gray-necked rockfowl (*Picathartes oreas*) found on Bioko Island (Fernando Póo). *Tauraco* 1, 186-189.**
- Collar N. J., and S. N. Stuart. 1985. Key forests for threatened birds of Africa. Cambridge ICBP Monograph 3.**
Identifies and describes 75 important areas for bird conservation based on presence or probable presence more than one threatened species, or of a threatened species that occurs no-where else.
- Collar, N. J., and S. N. Stuart. 1985. Threatened birds of Africa and related islands. Cambridge: ICBP/IUCN.**
- Collar, N. J., M. J. Crosby, and A. J. Slattersfield. 1994. Birds to Watch 2: The World List of Threatened Birds. Bird Life International.**
Replaces Birds to Watch. Presents new evaluations using new criteria (more quantitative, less subjective, reflecting step-wise increases in the risk of extinction, based on measured or reasoned rates of decline, pop levels, and range sizes), greater standardization across accounts and some data overview analysis.
- Diamond, A. W., and A. C. Hamilton. 1980. The distribution of forest passerine birds and Quaternary climatic changes in tropical Africa. *J. Zool. Lond.* 191:379-402.**
Cluster analysis of the distribution patterns of forest passerine birds (290 species) in tropical Africa. Found three main distribution types: restricted distributions (144 species), disjunct distributions (65 species), and wide distributions (81 species).
- Dowsett, R. J. 1993. Afrotropical avifaunas: annotated country checklists. Pp 1-322 In: A contribution to the Distribution and Taxonomy of Afrotropical and Malagasy birds. R. J. Dowsett and F. Dowsett-Lemaire, eds. *Tauraco Research Report No. 5.***
Presents bird lists by country for tropical Africa. Includes lists for Equatorial Guinea and Islands of the Gulf of Guinea.
- Dowsett, R.J. in preparation/press. Corrections to the list of birds of Equatorial Guinea and Bioko (Fernando Po). *Tauraco.***
- Dowsett-Lemaire, F. and R. J. Dowsett. 1998. Birds of the Parque Nacional de Monte Alen, Equatorial Guinea. Preliminary report submitted to ECOFAC, Equatorial Guinea.**
Bird list from a nine month survey of Monte Alen.
- Eisentraut, M. 1968. Beitrag zur vogelfauna von Fernando Poo und Westkamerun. *Bonner. Zool. Beitrag.* 19:49-68.**

- Eisentraut, M. 1973. Die Wirbeltierfauna von Fernando Poo und Westkamerun. Bonner Zoologische Monographien 3.**
- Esono, F. J. 1998 Caracterización de la comunidad de aves de mediana y gran envergadura en Iduma (Ndote). Documento Técnico 11, Anexo 3, Componente Sistema Nacional de Unidades de Conservación. CUREF, Equatorial Guinea.**
- Feiler, A, and T. Nadler. 1992. Evolutionary Relationships Between White-Eyes of the Genus *Speirops* Aves Zosteropidae from Western Cameroon and the Islands in the Gulf of Guinea. Bonner Zoologische Beiträge 43:423-432. Language: German.**
Evolutionary relationships of 4 species the Genus *Speirops* were studied using morphological, biological and ecological characters. Results that all four *Speirops* species form a monophyletic group and may be regarded as members of a superspecies.
- Fry, C. H. 1961. Notes on the birds of Annobon and other islands in the Gulf of Guinea. Ibis 103:267-276.**
Two month Visit by author to Annobon, Sao Tome and Bioko in 1959. As part of a joint expedition of Cambridge and Madrid Universities. Provides a systematic list of species, with some life history notations, and a brief description of the climate and environment.
- Gonzalez-Kirchner, J. P. 1996. Polyspecific associations between birds and primates in Equatorial Guinea. Real Sociedad Espanola De Historia Natural (Ed.). Real Sociedad Espanola de Historia Natural: Tomo extraordinario publicado con motivo del 125 aniversario de su fundacion; (The Royal Spanish Society of Natural History: A special edition published on the occasion of the 125th anniversary of its founding); 12th Biennial Meeting of the Royal Spanish Society of Natural History, Madrid, Spain, March 11-15,1996. 572p. Real Sociedad Espanola de Historia Natural: Madrid, Spain. p. 211-213. Language: Spanish.**
- Hall, B. P. and Moreau, R. E. 1962. A study of the rare birds of Africa. Bull. Brit. Mus. Nat. Hist. 8:313-378.**
Identifies 96 rare species of resident African birds by defining them as those with ranges <250 miles in all directions. Provides brief accounts of the range, ecology and status of each individual species.
- Hall, B. P. and Moreau, R. E. 1970. An Atlas of Speciation in African Passerine Birds. London, British Museum (National History).**
- Harrison, M. J. S. 1990. A recent survey of the birds of Pagalu (Annobon). Malimbus 11:135-143.**
- Inskipp, T. 1993. World checklist of threatened birds. 3rd ed. World Conservation Monitoring Centre. Joint Nature Conservation Committee, Peterborough, Eng.**
- Koster, S. H. and T. M. Butynski. In press. Status of the avifauna on Bioko Island (Fernando Po), Equatorial Guinea. Tauraco 2:**
- Koster, S. H., and T. M. Butynski. 1989. Status of the avifauna on Bioko Island (Fernando Póo) Equatorial Guinea. Washington, DC: WWF unpublished report.**
- Lambert, K. 1988. Nocturnal migration activity of seabirds in the Gulf of Guinea. Beitrage zur Vogelkunde 34:29-35. Language: German.**
The authors studied the nocturnal migration activity of seabird-species by attracting them to strong ships lights. The most frequently observed species were *Sterna paradisaea*, *Phalaropus fulicarius* and *Xema sabini*,

- Larison, B. and T. Smith. 1996. A survey of montane and lowland birds from three sites on the island of Bioko, Equatorial Guinea. Unpubl. Report to the Government of Equatorial Guinea.**
List of species observed or captured in mist-nets in a lowland plantation, lowland secondary forest, and montane forest.
- Larison, B., T. B. Smith, R. Fotso, and D. McNiven. 1999. Comparative avian biodiversity from five mountains in Northern Cameroon and Bioko, Equatorial Guinea. Ostrich 70:in press.**
Compares species richness and relative abundance of birds observed or mist-netted on the five mountains. Includes habitat descriptions and discussion of human impacts and conservation potential.
- Louette, M. 1981. The birds of Cameroon. An annotated checklist. Verhandelingen van de Koninklijke Academie voor Wetenschappen, Letterer Schone Kunsten van Belgie. Klasse de Wetenschappen 43:1-295.**
List of the birds of Cameroon, with distributions and habitat affinities.
- Macworth-Praed, C. W., and C. H. B. Grant. 1970. Birds of West Central and Western Africa. London: Longmans.**
Two volume field guide. Includes descriptions, distributions and notes on ecology.
- Moreau, R. E. 1966. The Bird Faunas of Africa and it's Islands. Academic Press, London.**
- Pérez del Val, J., J. E. Fa, J. Castroviejo, and F. Purroy. 1994. Species richness and endemism in the birds of Bioko. Biodiversity and Conservation 3:868-892.**
Provides species list for the island, as well as distributions and species accounts for endemic species and subspecies and restricted range species.
- Pérez del Val, J. Aportacion a la historia natural de la avifauna de Bioko. PhD. Dissertation University of Leon, Spain.**
- Pérez del Val, J. 1998. Informe Technico de la Mision Ornitológica de Apoyo a la Componente "Unidades de Conservación" Documento Technico 15, Anexo 3, Componente Sistema Nacional de Unidades de Conservacion. CUREF, Equatorial Guinea.**
Report on mist-net surveys conducted in a variety of habitats in the Montes Mitra region.
- Pérez Del Val, J. 1996. Las Aves de Bioko. Edileasa, Leon, Spain.**
- Rand, A. I., H. Friedmann, and M. A. Traylor. 1959. Birds from Gabon and Moyon Congo. Fieldiana, Zoology 41:219-411.**
Report on specimens collected by C. R. Aschemeier (1917-1919) and H. A.Beatty (1951-1952) in Gabon and Congo.
- Reichenow, A. 1910. Uber eine vogelsammlung vom Rio Benito im Spanischen Guinea. Mitt. Zool. Mus. Berlin 5:71-87.**
List of bird species encountered at various sites in Equatorial Guinea.
- Smith, T. B., K. K. Rasmussen, K. D. Whitney, and M. K. Fogiel. 1996. A preliminary survey of birds from the Lac Lobeke Reserve, south-eastern Cameroon. Bird Conservation International 6:167-174.**
List of birds mist-netted and observed during a brief visit to Lac Lobeke in 1993.
- Snow, D. W. 1978. An atlas of speciation in African non-passerine Birds. London : British Museum (Natural History).**

Strickland, H. E. 1851. Notes on some birds from the River Gaboon in west Africa (Pp131-135) and Further notes on birds from the River Gaboon in west Africa (Pp161-163) in Jardine, W. Contributions to Ornithology, 1848-1852. London.

Wells, D. R. 1968. Zonation of bird communities on Fernando Póo. Bull. Nigerian Ornithol Soc. 5:71-87.

Whitney, K. D. and T. B. Smith. 1998. Habitat use and resource tracking by African *Ceratogymna* hornbills: implications for seed dispersal and forest conservation. *Animal Conservation* 1:107-117. Authors results suggest that hornbills are important dispersers in both primary and secondary forest, and will likely play larger roles in forest regeneration as more vulnerable seed dispersers are removed from hunting.

Whitney, K. D., M. K. Fogiel, A. M. Lamperti, K. M. Holbrook, D. M. Stauffer, B. D. Hardesty, V. T. Parker, and T. B. Smith. 1998. Seed dispersal by *Ceratogymna* hornbills in the Dja Reserve, Cameroon. *Journal of Tropical Ecology* 14:351-371.

Wolff-Metternich, G. F., and E. Stresemann. 1956. Biologischen Notizen über Vögel von Fernando Po, "Journal für Ornithologie 97, Hft 3", pp. 273-290.

Mammals

Alers, M. P. T. and A. Blom. 1988. Elephants and Apes of Rio Muni: Report of a First Mission to Rio Muni (Equatorial Guinea). Unpubl. Manuscript. Wildlife Conservation International.

Anon. 1969. Threat to monkeys on Fernando Po. *Oryx* 10:146-147.
One paragraph note on five monkey species considered threatened by hunting on Bioko.

Barnes, R. F. W., M. Agnagna, M. P. T. Alers, A. Blom, G. Doungoube, M. Fay, T. Masunda, J. C. Ndo Nkoumou, C. Sikubwabo Kiyengo, and M. Tchamba. 1993. Elephants and ivory poaching in the forest of equatorial Africa. *Oryx* 27:27-34. A reconnaissance of four central African countries is combined with previous information from others (including Equatorial Guinea) to describe the status of the elephant in central African forest, and the impacts of poaching.

Butynski, T. M., C. D. Schaaf, and G. W. Hearn. 1995. Status and conservation of duikers on Bioko Island. IUCN Species Survival Commission, Antelope Specialists Group, *Gnusletter* 14:23-28.
Findings on the status and distribution of the two subspecies of duiker on Bioko, from surveys in 1986, 1990, and 1992. Includes discussion of natural predators and competitors as well as hunting.

Butynski, T. M., C. D. Schaaf, and G. W. Hearn. 1997. African buffalo *Syncerus caffer* extirpated on Bioko Island, Equatorial Guinea. *Journal of African Zoology* 111:57-61. Language: French.
Authors report on lack of forest buffalo on Bioko, where they were apparently widespread previously.

Butynski, T. M., and S. H. Koster. 1989. The status and conservation of forests and primates Bioko Island (Fernando Póo), Equatorial Guinea. WWF unpubl. report, Washington D.C.

- Butynski, T.M., and S. H. Koster. 1994. Distribution and conservation status of primates in Bioko Island, Equatorial Guinea. *Biodiversity and Conservation* 3:893-909.**
 Reports on the distribution, habitat associations, and status of primates on Bioko, from a ten-week survey in 1986. Found that the encounter rates of primates was comparable to those from Kibale Forest in Uganda which has the highest known primate density in the world. Discusses conservation concerns.
- Castroviejo, J. B., A. Blom, and M. P. T. Alers. 1990. Equatorial Guinea. Pp. 110-113 In: East, R. (compiler) *Antelopes: Global Survey and Regional Action Plans, Part 3: West and Central Africa*. Gland, Switzerland: IUCN.**
 An account of the distribution and status of Equatorial Guinea antelopes based on data from Castroviejo et al. 1986, and Alers and Blom 1988.
- Disotell, T.R., R.L. Honeycutt and M. Rivolo. 1992. Mitochondrial DNA phylogeny of the old world monkey tribe Papionini. *Molecular Biology and Evolution* 9:1-13.**
- Dorst, J., and P. Dandelot. 1993. *Larger Mammals of Africa*. London, Harper Collins.**
 A field guide to the larger mammals of Africa. Includes plates, species accounts and distribution maps.
- East, R. 1990. Antelopes currently or potentially at risk in West and Central Africa. Pp 167-171 In: East, R. (compiler) *Antelopes: Global Survey and Regional Action Plans, Part 3: West and Central Africa*. Gland, Switzerland: IUCN.**
- East, R. 1990. Summary of regional status of antelopes in West and Central Africa. Pp 139-143 In: East, R. (compiler) *Antelopes: Global Survey and Regional Action Plans, Part 3: West and Central Africa*. Gland, Switzerland: IUCN.**
 Provides a regional overview of the status of antelopes and identifies key subspecies currently or potentially at risk.
- Eisentraut, M. 1964. La faune de chiroptera de Fernando Po. *Mammalia* 28:529-552. Language: French**
 Comparative study of the bat fauna of Bioko and the continent (West Cameroon). Includes a discussion of taxonomy, habitat, abundance, behavior, food, and reproduction for each species.
- Esono, R. 1998. Inventario de Pequeños Primates y Otras Especies de la Fauna de la reserva de Ndoté. Documento Técnico 10, Anexo 3, Componente Sistema Nacional de Unidades de Conservación. CUREF, Equatorial Guinea.**
- Estes, R. D. 1992. *The Behavior Guide to African Mammals*. Berkeley, University of California Press.**
- Feiler, A. 1988. The mammals of the islands in the Gulf of Guinea and their relatives on the African continent. *Zoologische Abhandlungen* 44:83-88. Language: German.**
 Based on a literature survey and a short visit to Sao Tome. Reasons for the occurrence of the different species on the islands are discussed.
- Garcia, J. E., and J. Mba. 1997. Distribution, status and conservation of primates in Monte Alen National Park, Equatorial Guinea. *Oryx* 31:67-76.**
 Reports on densities and distributions of primates in Monte Alen National Park, from surveys conducted over 7 months in 1994. Human impacts are discussed and management suggestions made.

- Garcia, J. E. 1995. Inventario y cense de las Poblaciones de Primates del Parque Nacional Moneto Alen. Agreco CTFT and Asociacion Amigos del Cota de Donana. Report to ECOFAC Componente Guinea Ecuatorial.**
- Gartlan, J. S. 1970. Preliminary notes on the ecology and behavior of the drill *Mandrillus leucophaeus*, Ritgen, 1824. Pp 445-480 In: Old World Monkeys: Evolution Systematics and Behavior. Napier, J. R. and P. H. Napier, (eds.). New York: Academic Press.**
- Gonzalez-Kirchner, J. P. 1992. Los Cercopithecoidea de la isla de Bioco. PhD Dissertation, University of Grenada, Spain.**
- Gonzalez-Kirchner, J.P. 1994. Ecologia y Conservacion de los Primates en Guinea Ecuatorial. Ceiba Ediciones, Cantabria.**
- Gonzalez-Kirchner, J. P. 1995. The diet of sympatric prosimians in equatorial Guinea. *Folia Zoologica* 44:13-18.**
The diets of *Galago alleni* in the Rio Muni region and those of Bioko Island are compared. Food preferences of sympatric prosimians in Equatorial Guinea are similar to those found in Gabon. Feeding adaptations appear to reduce interspecific competition between sympatric Lorisidae in this West African lowland tropical rain forest.
- Gonzalez-Kirchner, J. P. 1996. Habitat preference of two lowland sympatric Guenons on Bioko Island, Equatorial Guinea. *Folia Zoologica* 45:201-208.**
Macro and micro habitat preferences of two guenons, *Cercopithecus nictitans* C. pogonias are analyzed on Bioko. Discussion of ecological niche separation as a mechanism to reduce interspecific competition between species of similar body size that share the same habitat. Discussion of threats to the survival of these primates on Bioko, especially habitat destruction and isolation.
- Gonzalez-Kirchner, J. P. 1996. Notes on habitat use by the Russet-eared guenon (*Cercopithecus erythrotis* Waterhouse 1838) on Bioko Island, Equatorial Guinea. *Tropical Zoology* 9:297-304.**
Habitat preference of the Russet-eared guenon (*Cercopithecus erythrotis*) on Bioko is analyzed. Almost all the island is inhabited by this primate, that is able to live near human settlements. Russet-eared guenons were found at lower altitudes than any other guenon in the forest of Bioko island, and most of their activity took place on the lower levels of the canopy. Ecological plasticity and adaptability are shown to be the main characters of this guenon on Bioko.
- Gonzalez-Kirchner, J. P. 1996. Polyspecific associations between birds and primates in Equatorial Guinea. Real Sociedad Espanola De Historia Natural (Ed.). Real Sociedad Espanola de Historia Natural: Tomo extraordinario publicado con motivo del 125 aniversario de su fundacion; (The Royal Spanish Society of Natural History: A special edition published on the occasion of the 125th anniversary of its founding); 12th Biennial Meeting of the Royal Spanish Society of Natural History, Madrid, Spain, March 11-15,1996. 572p. Real Sociedad Espanola de Historia Natural: Madrid, Spain. p. 211-213. Language: Spanish.**
- Gonzalez-Kirchner, J. P. 1997. Behavioural ecology of two sympatric colobines on Bioko Island, Equatorial Guinea. *Folia Zoologica* 46:97-104.**
The habitat preferences and niche separation of the black (*Colobus satanas*) and red colobus (*Procolobus badius*) on Bioko are analyzed. The red colobus shows a clear preference for montane forest while Black colobus is more widely distributed. The red colobus uses preferentially the middle and upper part of the forest, and the black colobus can be observed in a wider range of strata inside the canopy.

Gonzalez-Kirchner, J. P. 1997. Census of western lowland gorilla population in Rio Muni Region, Equatorial Guinea. *Folia Zoologica* 46:15-22.

A census was made of gorilla populations throughout the Rio Muni region in Equatorial Guinea between July 1989 and December 1990, based on nest counts along strip transects. A total of 385 km of transects was sampled in areas inhabited by gorillas. The average densities of the gorilla population found in Rio Muni were similar to those found in neighboring Gabon and Congo. The estimated size of the gorilla population in Rio Muni stands between 1000 and 2000 individuals.

Gonzalez-Kirchner, J. P., and M. S. De la Maza. 1992. Sticks Used by Wild Chimpanzees A New Locality in Rio Muni. *Folia Primatologica* 58:99-102.

Gonzalez-Kirchner, J. P., and M. S. De La Maza. 1996. Preliminary notes on the ecology of the drill (*Mandrillus leucophaeus*) on Bioko island, Rep. Equatorial Guinea. *Garcia De Orta Serie de Zoologia* 21:1-5.

A two year study of the biology of the Drill (*Mandrillus leucophaeus poensis*) on Bioko. Defines the status and distribution of Drill on Bioko. Finds that the intensity of hunting and forestry exploitation may threaten populations on Bioko. Note: Gonzalez-Kirchner states in this paper that Drill are not found above the elevation of 1,000, which is incorrect. They were detected at 1500 m by Smith and Larison in 1996.

Holden, T., and Diller, H. 1980. Mammals of Africa including Madagascar. HarperCollins, Hong Kong.

Happold, D. C. D. 1996. Mammals of the Guinea-Congo rain forest. *Proc. Roy. Soc. Edinburgh Section B* 104:5-14.

Discusses the variation in species composition, and number of species of mammals, among different regions of the Guinea-Congo rain forests, and possible causes thereof. The highest species richness (up to 130 species) is found in parts of the West Central and East Central rain forest regions, and the lowest richness occurs in the Western Region and on the periphery of the rain forest zone.

Hearn, G. W., and R. W. Berghalier. 1996. Census of diurnal primate groups in the Gran Caldera Volcanica de Luba, Bioko Island, Equatorial Guinea. Unpubl. Report to the Government of Equatorial Guinea.

A repeat of a 1990 survey by Zoo-Atlanta (Schaaf, Butynski and Hearn 1990) using the same trails, guides and methods. Found a 40% decline in the number of primate groups. Discusses other recent primate studies on the island, and the pros and cons of developing ecotourism as a strategy to fund the protection of natural areas.

Hearn, G. W. et al. 1998. Census of the Diurnal Primates in the Gran Caldera de Luba, January, 1998. Brief Preliminary Report to the Government of Equatorial Guinea.

A lengthier survey than above, covering 205 km, confirmed the reduction in primate densities found in the 1996 survey, and implicates hunting as a primary causal factor.

Heim de Balsac, H. 1968. Contribution a l'etude des Soricidae de Fernando Poo et du Cameroun. *Bonner Zoologische Beitrag* 21:15-42.

Inskipp, T. 1995. Checklist of mammals listed in the CITES appendices. 3rd Ed. World Conservation Monitoring Centre. Joint Nature Conservation Committee report no. 235. 0963-8091 Peterborough, U.K.

Inskipp, Tim. 1993. World checklist of threatened mammals. 2nd ed. World Conservation Monitoring Centre. Joint Nature Conservation Committee, Peterborough, U.K.

- Juste, B. J., and C. Ibanez. 1994. Bats of the Gulf of Guinea islands: faunal composition and origins. *Biodiversity and Conservation* 3:837-850.**
Comparison of the bat faunas of the Gulf of Guinea islands: species composition, endemism and hypothetical origins. All bats found on the mainland region are found on Bioko.
- Juste, B. J., and J. Pérez Del Val. 1995. Altitudinal variation in the subcanopy fruit bat guild in Bioko Island, Equatorial Guinea, Central Africa. *Journal of Tropical Ecology* 11:141-146.**
Using mistnet captures, estimated fruit bat diversity among the vegetation types from lowland forest through, montane and mossy forest, and alpine scrub. Found the highest diversity in lowland forest.
- Juste, J., and C. Ibanez. 1993. Geographic Variation and Taxonomy of *Rousettus- Aegyptiacus* Mammalia Megachiroptera in the Islands of the Gulf of Guinea. *Zoological Journal of the Linnean Society* 107:117-129.**
The systematic status of the *Rousettus aegyptiacus* populations of the oceanic islands of Principe and Sao Tome in the Gulf of Guinea (West Africa) is examined. These populations present noticeable phenetic differences between themselves as well as among the *R. a. unicolor* populations of Gulf of Guinea continental coast and those of Bioko island. The differences found justify the description of new subspecies on the two islands.
- Juste, J., and J. Castroviejo. 1992. Unusual Record Of The Spotted Hyena (*Crocuta- Crocuta*) In Rio Muni, Equatorial Guinea (Central Africa) *Zeitschrift Fur Säugetierkunde-International Journal Of Mammalian Biology* 57:380-381.**
Record of a spotted hyena, a savanna species, near Nsork, S.E. Rio Muni, in closed lowland forest. Likely a dispersal event.
- Juste, J., C. Ibanez, and A. Machordom. 1997. Evolutionary relationships among the African fruit bats: *Rousettus aegyptiacus*, *R. angolensis*, and *Myonycteris*. *Journal of Mammology* 78:766-744.**
Affinities of *Rousettus (Lissonycteris) angolensis* are closer to *Myonycteris torquata* and *M. brachycephala* (Sao Tome endemic) than to *R. aegyptiacus* (mainland, Bioko, Sao Tome, Principe).
- Juste, B. J., A. Machordom, and C. Ibanez. 1996. Allozyme variation of the Egyptian rousette (*Rousettus aegyptiacus*; Chiroptera, Pteropodidae) in the Gulf of Guinea (West-Central Africa). *Biochemical Systematics and Ecology* 24:499-508.**
Genetic variation among the populations of *Rousettus aegyptiacus* from the islands of the Gulf of Guinea (Bioko, Principe and Sao Tome) and two other continental populations of *R. aegyptiacus*, (Rio Muni and Guinea Conakry) was studied in order to evaluate their systematic and evolutionary relationships.
- Juste, B. J.; Ibanez, C; Machordom, A. 1977. Evolutionary relationships among the African fruit bats: *Rousettus aegyptiacus*, *R. angolensis*, and *Myonycteris*. *Journal of Mammalogy* 78:766-774.**
Genetic relationships among *Rousettus aegyptiacus*, *R. angolensis*, *Myonycteris torquata*, and *M. brachycephala* were studied using both phenetic and phylogenetic procedures, considering both allele and loci as characters. All of the analyses (both quantitative and qualitative) showed a high level of concordance in establishing *R. (Lissonycteris) angolensis*, *M. torquata*, and *M. brachycephala* as a monophyletic group. Nevertheless, none of the analyses was clearly able to identify sister groups among these taxa. Based on the evidence generated here and from previous independent datasets, the maintenance of *Lissonycteris* within the genus *Rousettus* is not sustainable.
- Juste, B. J., and C. Ibanez. 1994. Contribution to the knowledge of the bat fauna of Bioko Island, Equatorial Guinea (central Africa). *Zeitschrift fuer Säugetierkunde* 59:274-281.**
First report on Bioko of *Hipposideros commersoni*, *Glauconycteris beatrix*, *Pipistrellus (P.) kublii*, *P. (N.) tenuipinnis*, and *P. (N.) cf. capensis*. Other species previously reported as doubtful, are confirmed on Bioko.

- Kingdon, J. 1997. The Kingdon Field Guide to African Mammals. San Diego, Academic Press.**
Covers all known species of African mammals, their ecology, distribution, status, and behavior.
- Lasso, C., R. Hutterer, and A. Rial. 1996. Records of shrews (Soricidae) from Equatorial Guinea, especially from Monte Alen National Park. Mammalia 60:69-76.**
Study using pitfall traps in Monte Alen National Park. Eight species of shrews of the genera *Crocidura* (5 sp.), *Paracrocidura* (1 sp.) and *Sylvisorex* (2 sp.) were recorded, four of which are new for the country. Shrew abundance was found to be related to seasonal rainfall. *Sylvisorex johnstoni* was the dominant species (60% of all captures while most other species were uncommon or rare).
- Lee, P., E. Bennett, and J. Thornback. 1988. Threatened primates of Africa. Cambridge: IUCN Monitoring Center.**
Summarizes the status, distribution, ecology of each species, as well as threats and conservation measures (by country).
- Mate, C. and M. Colell. 1995. Relative abundance of forest cercopithecines in Ariha, Bioko Island, Republic of Equatorial Guinea. Folia Primatologica 64: 49-54.**
- Mate, C., M. Collel, and M. Escobar. 1996. Preliminary observations on the ecology of forest Cercopithecidae in the Lokofe-Ikomaloki Region (Ikela, Zaire). Folia Primatol. 64:196-200.**
- Michelmore, F. K. Beardsley, R. F. W. Barnes, and I. Douglas-Hamilton. 1989. Elephant population estimates for the central African forests. In: The Ivory Trade and the Future of the African Elephant. S. Cobb (ed.). Internatinal Development Centre, Oxford.**
- Michelmore, F. 1994. Keeping Elephants on the Map: Case studies of the application of GIS for conservation. Pp 107-125. In Mapping the Diversity of Nature. R. Miller (ed.). London: Chapman and Hall.**
Uses regional examples to examine the use of GIS to estimate elephant populations, and factors influencing them.
- Napier, J. R., & Napier, P. H. 1994. The Natural History of the Primates. Cambridge, MA, MIT Press.**
- Nosti, J. 1950. Bufalos fernandinos. Agricultura No. 220, p.116.**
- Oates J. F. 1986. Action Plan for African primate conservation: 1986-1990. New York: IUCN/SSC Primate Specialist Group.**
- Oates, J. F. 1994. Africa's Primates in 1992: Conservation Issues and Options. American Journal of Primatology 34:61-71.**
Outlines the threats to conservation of African Primates, characteristics of those that tend to become threatened, and hindrances to effective conservation. Discusses solutions to these problems including reserves and management
- Oates, J. F. 1988. The distribution of Cercopithecus monkeys in West African forests. In: A Primate Radiation. (A. Gautier-Hion, F. Bourliere, J.-P. Gautier, and J. Kingdon, eds) pp79-103. Cambridge University Press.**
- Oates, J.F. (compiler) 1996. African Primates: Status Survey and Conservation Action Plan. Revised Edition. IUCN/SSC Primate Specialist Group, New York.**

- Oates, J.F. 1988. The distribution of Cercopithecus monkeys in West African forests. In: *A Primate Radiation*. A. Gautier-Hion, F. Bourliere, J.-P. Gautier and J. Kingdon, eds. Cambridge University Press, Cambridge. pp.79-103.**
- Pérez del Val, J., J. Juste, and J. A. Castroviejo. 1995. Review Of Zenkerella insignis Matschie, 1898 (Rodentia, Anomaluridae) First Records In Bioko Island (Equatorial Guinea) *Mammalia* 59:441-443.** First records of Zenkerella insignis in Bioko, captured near Ureca. Authors review what is known about this poorly known species.
- Sabater-Pi, J. 1973. Contribution to the ecology of Colobus polykomos satanas (Waterhouse, 1838) of Rio Muni (Republic of Equatorial Guinea). *Folia Primatol.* 19:193-207.**
- Sabater-Pi, J. and C. Groves. 1972. The importance of higher primates in the diet of the Fang of Rio Muni. *Man* 7:239-243.**
- Sabater-Pi, J., and C. Jones. 1967. Notes on the distribution and ecology of the higher primates of Rio Muni, West Africa. *Tulane Stud. Zool.* 14:101-109.** Observations taken during a 50 day survey in Rio Muni. Distributions and habitat affinities.
- Sabater-Pi, J. 1984. Gorilas y Champancés del Africa Occidental: Estudio Comparativo de su conducta y ecología en libertad. Fondo do Cultura Economica, Mexico.**
- Schaaf, C. D., T. M. Butynski, and G. W. Hearn. 1990. The drill, Mandrillus leucophaeus and other primates in the Gran Caldera de Luba: Results of a survey conducted March 7-22, 1990. Zoo Atlanta Unpublished Report to the Government of Equatorial Guinea.**
Fifteen day survey of monkey populations in the Gran Caldera de Luba. The primary goal of the survey was to find a good long term study site for drill. Drill was encountered at a rate of 0.1 groups/km, making it the best known study site at the time.
- Schaaf, C. D., T. T. Struhsaker, and G. W. Hearn. 1992. Recommendations for biological conservation areas on the island of Bioko, Equatorial Guinea. Zoo Atlanta Unpublished Report to the Government of Equatorial Guinea.**
A survey of primate populations on the southwestern coast of the island.
- Struhsaker, T.T. 1969. Correlates of ecology and social behavior among African cercopithecines. *Folia Primatologica* 11:80-118.**
- Smith, T. B. and D. McNiven. 1993. Preliminary survey of the avifauna of Mt. Tchabal Mbabo, west-central Cameroon. *Bird Conservation International* 3: 13-19.**
- Stuart, S. N., ed. 1986. Conservation of Cameroon Montane Forests. Cambridge, International Council for Bird Preservation..**
- Struhsaker, T. T. 1980. Correlates of ecology and social organization among African cercopithecines. *Folia Primatol.* 11:80-118.**

Tutin, C. E. G., L. J. T. White, and A. Mackangaq-Missandzou. 1997. The use of by rain forest mammals of natural forest fragments in an equatorial African savanna. *Conservation Biology* 11:1190-1203.

Forty-five species of large mammals (> 2kg) were censused monthly for two years in forest fragments outside the main body of rainforest in Gabon. The authors assert that how forest mammals use the forest fragments has broad implications for conservation and management of tropical ecosystems because the natural landscape at Lope mimics the fragmentation of forests produced increasingly by human action. They compare the forest fragment data with previously collected data from contiguous forest.

Tutin, C. E. G., R. M. Ham, L. J. T. White, and M. J. S. Harrison. 1997. The primate community of the Lope Reserve, Gabon: Diets, responses to fruit scarcity, and effects on biomass. *American Journal of Primatology* 42:1-24.

The diets of all diurnal primates (*Gorilla g. gorilla*, *Pan t. troglodytes*, *Mandrillus sphinx*, *Colobus satanas*, *Cercocebus albigena*, *Cercopithecus nictitans*, *C. pogonias*, *C. cephus*) in the Lope Reserve, central Gabon, are described from qualitative and quantitative data collected over 10 years. A total of 397 foods were recorded, of which 91% were from plants.

Verheyen, W. N., M. Colyn, and J. Hulselmans. 1996. Re-evaluation of the *Lophuromys nudicaudus* HELLER, 1911 species-complex with a description of a new species from Zaire (Muridae - Rodentia). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique Biologie* 66:241-273.

A revision of the systematics of the related *Lophuromys nudicaudus* was conducted in order to define precisely a new murid species from the Zaire lowland rainforest. There are indications that specimens from the region between the Cross and Sanaga rivers differ sufficiently from typical *nudicaudus* to warrant taxonomical recognition under the subspecific name *tullbergi*. The Bioko-population, described under the subspecific name *parvulus*, is very close to its mainland counterpart and should therefore be put into synonymy with *tullbergi*.

White, J. T. 1994. Biomass of rain forest mammals in the Lope Reserve, Gabon. *J. Anim. Ecol.* 63:499-512.

Calculated using densities estimated using standard line-transect methods, and weights taken from the literature. Total biomass was high due to high elephant densities. Primate and duiker biomasses were lower than figures reported for some African rain forests.

Wilson, V. J.. 1987. Pan African Decade of Duiker Research (1985-1994) and Action Plan for Duiker conservation. Bulawayo, Chipangali Wildlife Trust.

CONSERVATION ISSUES

Akendengue, B. 1992. Medicinal Plants Used by the Fang Traditional Healers in Equatorial Guinea. *Journal of Ethnopharmacology* 37:165-173.

Ethnobotanical study of some medicinal plants used by the Fang traditional healers of two regions of Equatorial Guinea in Central Africa: Malabo and Bata. The pharmacological and therapeutical properties are given.

Barnes, R. F. W., and S. A. Lahm. 1997. An ecological perspective on human densities in the central African forests. *Journal of Applied Ecology* 34:245-260.

The factors determining human densities in the central African forests are examined and compared with the predictions from an agronomic model by the Food and Agriculture Organization, United Nations Fund for Population Activities and International Institute for Applied Systems Analysis (FAO/UNFPA/IIASA). An important general finding is that the illusion of rain forest fertility, propagated by the FAO/UNFPA/IIASA model, will result in inappropriate land use policies for the forest zone.

- Bermelo, M. 1998. Estudio de Viabilidad de un Programa de Ecoturismo de vision Gorilas en el Parque de Monte Alen, Equatorial Guinea. AGRECO-CTFT, for ECOFAC, Guinea Equatorial.**
Study of the viability of ecotourism at Monte Alen based on gorilla sighting.
- Binet, D. The Large Marine Ecosystem of Shelf Areas in the Gulf of Guinea Long-Term Variability Induced by Climatic Changes. 1990. Pp 104-118 In: Sherman, K., L. M. Alexander and B. D. Gold (ed.). Large Marine Ecosystems: Stress, Mitigation, And Sustainability; First International Conference On Large Marine Ecosystems. Washington, DC: American Association For The Advancement Of Science (AAAS).** Discusses the seasonal, regional, and year to year variation in oceanographic and meteorological conditions in the Gulf of Guinea and its impact on fisheries. Discusses implications for fisheries management. Data focus on the coast between Liberia and Benin.
- Castroviejo, J. J. 1993. Estudio sobre la zonificación y uso multiple de las áreas protegidas de Bioko. Unpubl. Report Forindeco, 85 pp.**
- Castroviejo, J., J. Juste, and R. Castelo. 1986. Proyecto de investigacion y conservacion de la naturaleza en Guinea Ecuatorial. Madrid: Secretaria General Technica.**
- Castroviejo, J., J. Juste, R. Castelo, and J. Pérez del Val. 1994. The Spanish cooperation programme in Equatorial Guinea: a ten year review of research and nature conservation in Bioko. Biodiversity and Conservation 3:951-961.**
An overview of the objectives and actions of the Spanish cooperation program on Bioko.
- Colell, M., C. Mate, and J. E. Fa. 1994. Hunting among Moke Bubis in Bioko: Dynamics of faunal exploitation at the village level. Biodiversity and Conservation 3:939-950.**
Reports on the findings of a study involving interviews of hunters and observation of hunting trips. Authors report on species hunted and methods, and discuss likely impacts.
- Esono Mba, F. 1997. Area protegida del Sur de la Isla de Bioko: Zonificacion ecologica y delimitacion. Unpublished thesis. Escuela Universitaria de Estudios Agropecuarios y Forestal "Obiang Nguema Mbasogo" Malabo, Equatorial Guinea.**
- Fa, J. E. 1988. Equatorial Guinea: wildlife conservation and rational use of natural resources. Mexico, Universidad Nacional Autonoma de Mexico.**
- Fa, J. E. 1991. Guinea Ecuatorial: Conservacion de los Ecosistemas Forestales de Guinea Ecuatorial. Gland, Switzerland: IUCN.**
Description of proposed protected areas for Equatorial Guinea, including habitat types, birds and mammal species lists (from interviews and literature). General overview of the climate, habitats and economy of Equatorial Guinea.
- Fa, J. E. 1992. Conservation in Equatorial Guinea. Oryx 26:87-94.**
Brief overview of the types of habitats represented in Equatorial Guinea, protected areas proposed, and threats to conservation.
- Fa, J. E., J. Juste, J. Pérez del Val, and J. Castroviejo. 1995. Impact of market hunting on mammal species in equatorial guinea. Conservation Biology 9:1107-1115.**
A study of bushmeat in two major market sites in Equatorial Guinea: Malabo (Bioko Island) and Bata (Rio Muni). Two species, *Cephalophus monticola* and *Cricetomys emini*, in Bioko and *C. monticola* and *Atherurus africanus* in Rio Muni accounted for more than half of all carcasses brought into markets. Authors found that bushmeat demand in the large towns in Equatorial Guinea appeared to exceed supply at the time of study.

Fischer, G., and G. K. Heilig. 1997. Population momentum and the demand on land and water resources. *Philosophical Transactions of the Royal Society of London B Biological Sciences* 352:869-889.

This paper investigates, by major world regions and countries, what is known about population growth, what can be projected with reasonable certainty, and what is pure speculation. Sets a frame for analyzing demographic driving forces that are expected to increase human demand and pressures on land and water resources.

Garcia, J. E. 1996. Uso tradicional y comercial de los recursos naturales y su impacto medio-ambiental. Ponencia preparado para un seminario del Banco Africano de Desarrollo (BAD) en Malabo, 13 December 1996. Documento Technico 1, Anexo 3, Componente Sistema Nacional de Unidades de Conservacion. CUREF, Equatorial Guinea.

Garcia, J. E. and F. Eneme. 1997. Diagnostico de las áreas criticas para la conservation. Documento Technico 2, Anexo 3, Componente Sistema Nacional de Unidades de Conservacion. CUREF, Equatorial Guinea.

Happold, D. C. D. 1995. The interactions between humans and mammals in Africa in relation to conservation: a review. *Biodiversity and Conservation* 4:395-414.

Discusses the impacts of humans on mammal populations and the need to bring local people into the conservation process through education and taking their needs into consideration.

Johnson, T.H. 1988. *ICBP Database: Equatorial Guinea*. ICBP, Cambridge

Juste, J., and J. E. Fa. 1994. Biodiversity conservation in the Gulf of Guinea islands: taking stock and preparing action. *Biodiversity and Conservation* 3:759-771.

Introduces a 24 point Action Statement on biodiversity in the Gulf of Guinea islands framed during a workshop sponsored by the Jersey Wildlife Preservation Trust in Jersey in 1993.

Juste, J., J. E. Fa, J. Pérez del Val, and J. Castroviejo. 1995. Market Dynamics Of Bushmeat Species In Equatorial Guinea. *Journal Of Applied Ecology* 32:454-467.

Investigation into the impact of commercial hunting on forest mammals in Equatorial Guinea. Comparison of actual (from counts in markets) and potential harvests indicated that some species being hunted unsustainably.

Keukelaar, F. 1997. Mapping of primate census trails in the Caldera of Luba, Island of Bioko, Equatorial Guinea (Central Africa). Unpublished report, Beaver College, 72 pp.

Machado, A. 1998. Componente "Sistema Nacional de Unidades de Conservación. Anexo 4. Borrador de Anteproyecto de ley de áreas Protegidas de Guinea Ecuatorial. Documento Técnico No. 14. C.U.R.E.F.

Pérez del Val, J. 1994. El bosque de altura en Bioco. *Africa* 2000 8:9-13.

Richards, P. 1996. Forest indigenous peoples: concept, critique and cases. *Proc. Roy. Soc. Edinburgh Section B* 104:349-365.

Schaff, C. D. 1994. The role of zoological parks in biodiversity conservation in the Gulf of Guinea islands. *Biodiversity and Conservation* 3:962-968.

Suggests several initiatives for the involvement of zoos in conservation in the Gulf of Guinea including training and equipment for field staff, and biological inventories.

Smith, T. B., R. K. Wayne, D. J. Girman, and M. W. Bruford. 1997. A role for ecotones in generating rainforest biodiversity. *Science* 276: 1855-1857.

Struhsaker, T. T. 1997. Ecology of an African Rainforest. University Press of Florida, Gainesville, Florida.

Stuart, S. N., ed. 1986. Conservation of Cameroon Montane Forests. Cambridge: ICBP.

Sunderland, T. 1998. Preliminary Market Survey of the Non-Wood Forest Products (NWFP's) of Rio Muni, Equatorial Guinea. Documento Technico 18, Anexo 3, Componente Sistema Nacional de Unidades de Conservacion. CUREF, Equatorial Guinea.

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 spite 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 as 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 Nzaz, 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 dorsalis* 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 could 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 of which contains a compound used in the treatment of prostate 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 Llande - 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 its 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).

LITERATURE CITED

- Castroviejo, J. 1993. Estudio sobre la zonificación y uso múltiple de las áreas protegidas de la isla de Bioco. Unpublished report.
- 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.
- Collar, N. J. and S. N. Stuart. 1985. Threatened Birds of Africa and Related Islands. The ICBP/IUCN Red Data Book, Part 1. Cambridge/Gland, ICBP/IUCN.
- Fa, J. E., J. Juste, J. Pérez del Val, and J. Castroviejo. 1995. Impact of market hunting on mammal species in Equatorial Guinea. *Conservation Biology* 9: 1107-1115.
- Garcia, J.E. and F Eneme. 1997. Diagnóstico de las áreas críticas para la conservación. Componente Unidades de Conservación. Proyecto C.U.R.E.F., Bata, Ecuatorial Guinea.
- Jones, P. J. 1994. Biodiversity in the Gulf of Guinea: an overview. *Biodiversity and Conservation* 3: 772-784.
- Juste, J. J., and J. E. Fa. 1994. Biodiversity conservation in the Gulf of Guinea islands: taking stock and preparing action. *Biodiversity and Conservation* 3: 759-771.
- Levey, D. J. 1988. Spatial and temporal variation in Costa Rican fruit and fruit-eating bird abundance. *Ecological Monographs* 58: 251-269.
- Loiselle, B. A., and J. G. Blake. 1991. Temporal variation in birds and fruits along an elevational gradient in Costa Rica. *Ecology* 72: 180-193.
- Machado, A. 1998. Borrador de anteproyecto de ley de áreas protegidas de Guinea Ecuatorial. Documento Técnico No. 14. Proyecto C.U.R.E.F., Bata, Guinea Ecuatorial.
- Orr, M.R., and T. B. Smith. 1998. Ecology and speciation. *Trends in Ecology and Evolution* 13: 502-506.
- Pérez del Val, J., J. E. Fa, J. Castroviejo, and F. Purroy. 1994. Species richness and endemism in the birds of Bioko. *Biodiversity and Conservation* 3: 868-892.
- Schluter, D. 1998. Ecological causes of speciation. In D. J. Howard & S. H. Berlocher Eds. *Endless forms: species and speciation*, . Oxford: Oxford University Press.
- Schneider, C., T. B. Smith, B. Larison, and C. Moritz. in press. Divergence with gene flow and implications for speciation in the Australian rainforest lizard (*Carlia*). *Proc. Nat. Acad. Sci.*
- Smith, T. B., R. K. Wayne, D. J. Girman, and M. W. Bruford. 1997. A role for ecotones in generating rainforest biodiversity. *Science* 276: 1855-1857.
- Smith, T. B., R. K. Wayne, D. J. Girman, and M. W. Bruford 1999. Evaluating the Divergence-with-Gene-Flow Model in Natural Populations: The Importance of

- Ecotones in Rainforests Speciation. In C. Mortiz and E. Bermingham (Eds.)
Rainforests Past and Future. University of Chicago Press, Chicago.
- Stuart, S. N., ed. 1986. Conservation of Cameroon Montane Forests. Cambridge,
International Council for Bird Preservation.
- Sunderland, T. C. H. 1998. Preliminary Market Survey of the Non-wood Forest Products
(NWFP's) of Rion Muni, Equatorial Guinea. A report to the Central African Regional
Programme for the Environment (CARPE) and the Proyecto Conservacion y
Utilizacion Forestales de Guinea Ecuatorial (CUREF).
- Whitney, K. D. and T. B. Smith.1998. Habitat use and resource tracking by African
Ceratogymna hornbills: implications for seed dispersal and forest conservation.
Animal Conservation 1: 107-117.