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Keywords: 1GQ/African golden cat/Caracal aurata/density/distribution/habitat/hunting/leopard/occupancy/Panthera pardus/poaching/Profelis aurata/status/threat

Abstract: In order to determine the status, distribution and threats faced by felids and other medium to large-sized mammals on the continental region of Equatorial Guinea (referred to as Río Muni), an investigative survey was conducted covering all districts in which this territory is divided. Information was gathered between April and October 2010 through semi-structured interviews with key informants at 225, 5 x 5 km sampling units distributed evenly across this 26,000 km² territory. Interviews were designed to collect data on leopard, golden cat and fifteen other species selected by their importance as prey for both cats and humans or as a result of their high global conservation concern. Detection/non-detection data was analyzed along with country-wide Geographic Information System data via an occupancy modelling approach to describe the geographical ranges of targeted species and to identify the principal broad-scale factors explaining their distributional patterns. An attempt was made to estimate the density of both felid species across our sampling units. We then review the threats faced by cats and the site-specific threats to potential habitat corridors**.** In order to provide a framework for understanding the current status of felids in the area, a summary of the available information on where these species once occurred and on the principal threats that have driven their populations to decline over the last century is presented. Additionally, a rough assessment of the status of the hunting system was conducted at a district level spatial scale.

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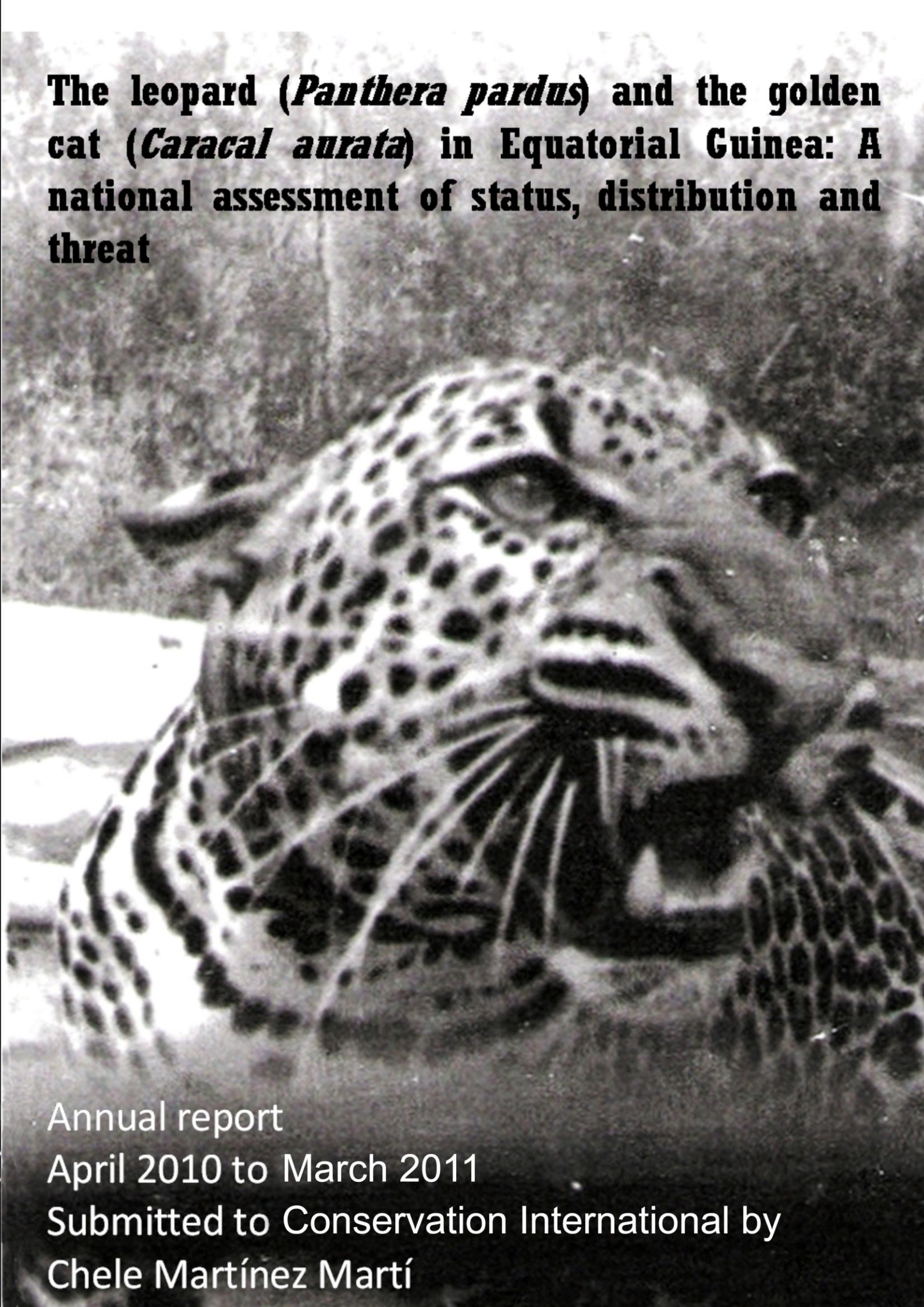
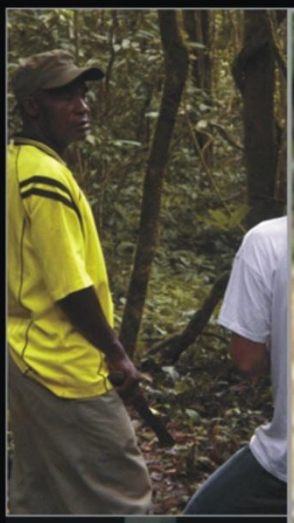


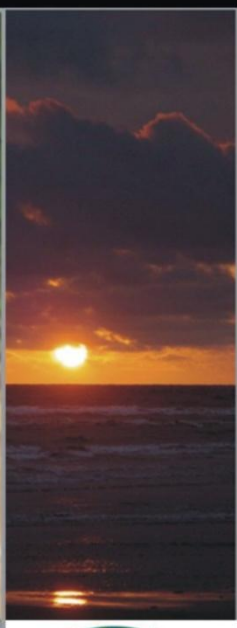
Annual report

April 2010 to March 2011

Submitted to Conservation International by

Chele Martínez Martí





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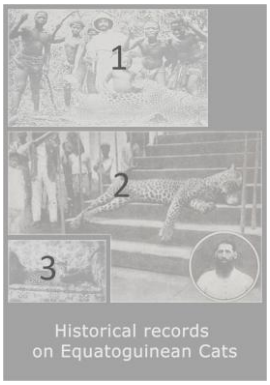
*Cover illustration***:** A prisoner of the war on wildlife in the former Spanish Guinea. E. La Chica

Back cover

Francisco Palomares Fernández (1, 5, 9), Heidi Ruffler (10), Alejandro Fallabrino (3, 4), Gabriel Ngua Ayecaba (8) and Chele Martínez Martí (2, 6, 7).



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CONTENTS

1. REPORT SUMMARY.

In order to determine the status, distribution and threats faced by felids and other medium to large-sized mammals on the continental region of Equatorial Guinea (referred to as Río Muni), an investigative survey was conducted covering all districts in which this territory is divided. Information was gathered between April and October 2010 through semi-structured interviews with key informants at 225, 5 x 5 km sampling units distributed evenly across this 26,000 km^2 territory. Interviews were designed to collect data on leopard, golden cat and fifteen other species selected by their importance as prey for both cats and humans or as a result of their high global conservation concern. Detection/non-detection data was analyzed along with country-wide Geographic Information System data via an occupancy modelling approach to describe the geographical ranges of targeted species and to identify the principal broad-scale factors explaining their distributional patterns. An attempt was made to estimate the density of both felid species across our sampling units. We then review the threats faced by cats and the site-specific threats to potential habitat corridors**.** In order to provide a framework for understanding the current status of felids in the area, a summary of the available information on where these species once occurred and on the principal threats that have driven their populations to decline over the last century is presented. Additionally, a rough assessment of the status of the hunting system was conducted at a district level spatial scale.

This survey represents the first nationwide assessment of cat species and other medium-to large sized mammals in Equatorial Guinea. The information rendered by this effort provides spatial data on wildlife distribution on Río Muni and its associated landscape characterization at 25 km^2 grids; providing a precursor for land use planning that incorporates conservation concerns and priorities. Results of this study have already been communicated to local counterparts to direct the development of additional activities as part of a national strategy for the conservation of cats and other threatened species in these high biodiversity forests of central Africa.

Summary line. A large-scale survey was conducted between April and October 2010 to gather information on the distribution of and threats faced by felids and other medium-to large sized mammals in Equatorial Guinea. Results of this study are currently being used to inform and direct the development of additional activities to assist in a national strategy and action plan for cats and other species of global conservation concern in the country.

1.1. Project staff & Collaborators/partners

Project Leader: Chele Martínez Martí. E-mail: truongsong@hotmail.com
Full time field technician: Ángeles Mang Eyene (ANDEGE).
Co-researchers: Dr. J. F. Calvo and Dr. J. A. Palazón (Department of Ecology and Hydrology, University of Murcia, Spain).

Figure 1. Ángeles and Chele examining a leopard´s skull in the village of Nsumu, Altos de Nsork National Park.

The *Ministry of Agriculture and Forest* (MdeAyB) provided a research permit to develop our work across the mainland territory of Equatorial Guinea. The *Instituto Nacional de Desarrollo Forestal y Manejo de Áreas Protegidas* (INDEFOR-AP) provided the maps and the Geographic Information System (GIS) data referring to the project area. *Amigos de la Naturaleza y del Desarrollo de Guinea Ecuatorial* (ANDEGE) is a national non-government organization (NGO) that is actively working on biodiversity conservation issues and directly involved in the management of some of the protected areas in mainland Equatorial Guinea. ANDEGE provided technical support for the implementation of the fieldwork and has also managed funds provided by *Panthera* and *Conservation International* (CI) for the completion of this study. CI also provided lodging and internet access while in Bata since the start of the field component of the project.

1.2. Project duration

Start and End Date of Award Performance Period: 4/9/2010-2/15/2011.
Start and End Date of Reporting Period: 4/9/2010-3/30/2011.

2. STUDY GOAL & OBJECTIVES

The aim of this project is to provide an assessment of the current status of the leopard and the golden cat in Equatorial Guinea, in order to provide baseline information for their conservation. Our main interest is to estimate the overall proportion of area occupied by felids across our study sites, and to identify the covariates having the highest influence in shaping the apparent felid land-use pattern detected by our interview survey. The specific objectives of this project are:

1. To provide information on distribution and abundance of cats in mainland Equatorial Guinea.
2. To estimate the availability of the main prey species.
3. To relate cat population state variables to a set of human activities, physical features and prey availability.

This final report is expected to provide practical information to a forthcoming National Action Plan for felids in Equatorial Guinea.

3. BACKGROUND INFORMATION.

3.1.Biafran Cats.

The dearth of research focused on felids in the Biafran sector of Central Africa (southern Nigeria, southwest Cameroon and Equatorial Guinea) has allowed the extent of their actual range collapse in this region to go unnoticed (Angelici et al., 1998; Willcox 2002; Matthews & Matthews 2006). The local extinction of these apex predators is of particular concern within this region, where landscapes are dominated by wildlife-dependent human populations and thus have extremely low potential for natural recolonization. The ever increasing anthropogenic pressure experienced by these species, coupled by a complete lack of information, heightens the urgency of conservation-oriented research and action to avert their looming regional extinction (Henschel 2009).

3.2 Study site.

Our study site lies between 1°01' and 2°21'N with its eastern border following the meridian of 11°20'E. It covers the 26,000 km^2 rectangular-shaped Río Muni region of Equatorial Guinea. Río Muni is characterized by a complex topography varying in form with distance from the Atlantic coast. The western littoral zone (less than 200 m a.s.l.) extends in a flat band 20-30 km from the coast, and is separated by the plains of the interior by the Niefang mountain range (1250 m a.s.l.) which itself runs parallel to the coast in a southwest-northeast direction. To the east of this range the hinterland pene-plain (300-650 m a.s.l.) characterised by smoother gradients of elevation and studded with granite inselbergs and bisected by the main Uoro river. The climate is hot and humid throughout the year. Rainfall varies from 4,000 mm on the highest parts of the mountains to 1,800 mm on the peneplains.

Forest cover is estimated at 78%, but given that timber was the main source of foreign exchange from the 1920s to the 1990s, virtually all the accesible areas have, at one time, been selectively logged at resulting in a mosaic matrix of secondary forest in different stages of regeneration. Despite this, significant areas of Rio Muni have maintained a very high level of species richness and endemics over geological time resulting in one of the *Highest Priority Area for conservation in Central Africa* (WWF 2006). Although hunters have near complete access to wildlife - less than 10% of these forests are classified as low-access (Minnemeyer et al., 2002) and the density of logging roads (0.09 km/km^2) is the highest for Central Africa (Laporte 2007) - Rio Muni contain most of the mammals typically found in the Lower Guinea Forest Block. Prominent examples include the forest

elephant *Loxodonta cyclotis*, the buffalo *Syncerus caffer*, six species of duiker, the gorilla *Gorilla gorilla*, the chimpanzee *Pan troglodytes*, the mandrill *Mandrillus sphinx*, the black colobus *Colobus satanas*, the leopard *Panthera pardus* and the golden cat *Caracal aurata*.

Existing legislation protects several species and prohibits hunting within the protected area system that roughly covers 16% of the region. In reality however, protected areas exist only on paper as the national agencies responsible for enforcing laws to control and prevent logging and hunting do not have the expertise, equipment or financial resources needed to carry out their mandate (CARPE 2008). Although average population density is 19 inhabitants/km^2, this figure is far lower (less than 5 inhabitants/km^2) in areas located away from the urban centres and main public roads along which most villages concentrate, and this is particularly evident in the southern half of the territory. About 62% of the population rely directly on subsistence agriculture, supplemented by fishing and hunting, as a means of providing the main sources of protein and regular income. Although the discovery in 1992 of large-scale oil reserves has caused a shift in attention away from logging, persistent threats to wildlife such as commercial bushmeat hunting and infrastructure development (in particularly road building and urban expansion), have increased considerably in the last few years.

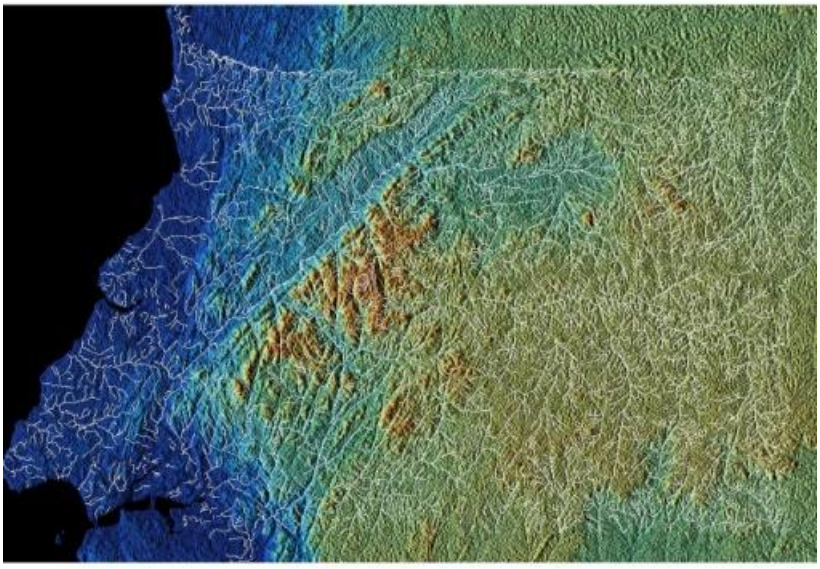


Figure 2. Study site.

3.3. Equatorial Guinea: A frontier of conservation and development.

Despite high anthropogenic pressures on wildlife populations, Equatorial Guinea arises as the country holding the most promise for targeting cat conservation efforts in the densely populated Biafran region. The following arguments are provided to support this assumption:

1. It holds a geographically strategic position in regards to climate change. Río Muni is included within one of the very few major 'Pleistocene Refuges' in Central Africa. The forest within these refuges could also be interpreted as climatically stable, with potential for particular resilience in the face of current global warming (Leal 2009). Conservation efforts targeted to forest-dependent species such as golden cats should be prioritized in this region over rainforest areas that may inevitably vanish and turn to savanna in the coming decades due to climate change.

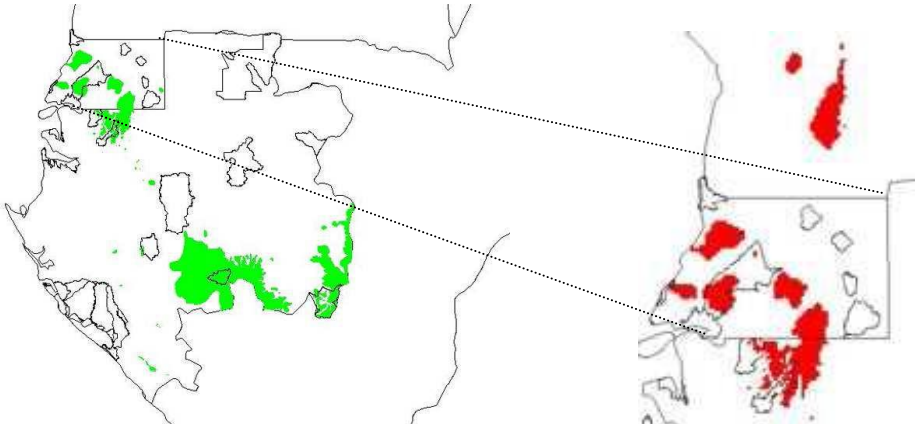


Figure 3. The West Central Africa showing the Pleistocene forest refuge landscape in green and the Northern Complex in more detail in red and the park system. Source: Leal 2005.

2. It holds a geographically strategic position in for stable cat populations. Given that corridors are critical elements in the long-term conservation of wide-ranging species including large cats, maintaining existing corridors between remnant populations should be integral to long-term conservation planning for these species. Río Muni is the only area within the Biafran region that is located adjacent to a large and stable population of leopards (Henschel 2009). Moreover, results from our survey indicate that populations in southern Rio Muni are still contiguous with those found in northern Gabon, providing potential for the development of a

trans-boundary cat conservation landscape (Wikramanayake et al., 2004) within this southern sector of the Biafran region.

Figure 4. Predicted distribution of leopard and location of protected areas in the Biafran region and Northern Gabon. Source: Henschel 2009.

3. New opportunity areas for cat conservation. Oil and gas driven economic growth has caused a strong and widespread movement of rural people to urban centres, leading to the abandonment of entire villages in some remote areas of felid conservation concern. Additionally, the oil sector revenues have eliminated the need for timber exports to generate foreign reserves. This has resulted in a 2007 decree banning log exports which had led to a steep drop in commercial timber harvests and associated forest disturbances in several cat priority sites. Moreover, the government of Equatorial Guinea (GoEG) has committed to converting 500,000 ha of timber concessions in the heavily forested southern half of Rio Muni into a sustainably managed national forest (CARPE 2006). This national forest (Bosque Nacional de Guinea Ecuatorial) currently spreads in an almost contiguous form interconnecting several protected areas in both Equatorial Guinea and Gabon.

Additionally, in 2002 the heads of states in the Central African sub-region committed to protect no less than 30% of the landmass of their states within a period of ten years (COMIFAC- Commission en charge des forets del´Afrique centrale, 2002). If the COMIFAC proposal is to be upheld, then the Equatoguinean National System of Protected Areas that currently covers 18.35% of the country's landmass territory should be expanded considerably over the next year.

Figure 5. The Northern sector of the Monte Alén-Monts de Cristal Landscape (red line), Protected Areas (green) and proposed Community Based Natural Resource Management areas (1 = Bosque Nacional de Guinea Ecuatorial ; 2 = Kougouleu-Medouneu-Mbe). Source: CARPE 2006.

4. Political-environmental will. In regards to both policy intent and signed agreements, Equatorial Guinea is unique in Central Africa. The GoEG has signed and ratified all major international and regional environmental and biodiversity treaties. It has also developed and promulgated a series of laws and decrees that have improved the legal and policy context of the environmental sector and have created implementing institutions for biodiversity conservation and sustainable natural resource use. These legal instruments include a National Forest Plan, a National Protected Areas System and a National Biodiversity Strategy. The GoEG is also collaborating with Conservation International in a project that aims to implement a National Biodiversity Institute and National Biodiversity Research

Program. Finally, the GoEG has committed to establish mechanisms to finance forest conservation and the National Protected Areas System.

5. Baseline socio-economic information from cat priority sites. A number of investigations carried out by the Zoological Society of London/ Imperial College (Keylock 2002, Kümpel 2006, Rist 2007, Allebone-Webb 2009, Gill 2010) have collected a huge amount of high-quality socio-economic data describing the economic role and environmental impacts of bushmeat hunting at several sites across Río Muni. These studies have followed the entire bushmeat commodity chain from forest camps through to traders and consumers in nearby villages and urban markets, and so provide crucial information to help guide the implementation of realistic cat conservation strategies that includes concerns on local livelihoods.

6. Information on Government development plans for the region. For a conservation effort to be effective in the long-term, it has to be coordinated with national plans for local economic development. The National Plan of Social and Economic Development of the country *Equatorial Guinea Horizon 2020*, provides key information on development plans for the area and allow us not to plan for the future, but to anticipate it.

7. Research interest. Río Muni provides a neat case study of the consequences (including opportunities) of economic changes on the conservation of biodiversity in general, and specifically of wide-ranging species such as felids, over a finer temporal and spatial scale than is usually possible. It also provides an opportunity to generate much needed information on the strategies used by cats to persist in human dominated landscapes experiencing intense commercial hunting of wildlife. This type of information can be applied not only to the conservation of Equatoguinean cats, but to other species, or to the ever-increasing number of tropical areas facing similar threats.

4.DESCRIPTION OF ACTIVITIES

Our stated project objectives involved the following general activities:

4.1. Literature review.

During and subsequent to project proposal preparation in July-August 2009, a compilation of all available reports on the distribution of cats in the country was undertaken in order to provide a framework for understanding the current situation for felids, information on past occurrence and the factors that have driven their decline over the last century.

4.2. Meeting with local collaborators.

Before initiating the field component of the project, a meeting was held at the ANDEGE headquarters in Bata on April 11, 2010. The project rationale, basic approach and methods were discussed. Based on the discussions of this initial meeting, the coordination of fieldwork activities and the itinerary were refined.

Project presentation. On April 12, I gave a PowerPoint presentation at INDEFOR-AP to outline the aims of the present study and introduce future steps. This presentation was attended by members of nearly all agencies and organizations involved in wildlife conservation in the country. Twenty-three participants, including INDEFOR-AP, MdeAyB, MdePyMA[1], ANDEGE, CARPE[2], ZSL[3] and CI staff attended the presentation (acronyms: 1 = Ministry of Fisheries and Environment. 2= Central African Regional Program for the Environment, 3 = Zoological Society of London).

4.3. Interview surveys.

Since information on medium to-large sized mammals status and distribution for the country was almost completely lacking, neither sign nor camera trap surveys were considered feasible or appropriate at this stage. An interview survey was therefore selected as a suitable initial step in gathering baseline quantitative and qualitative information on these species, and as a scoping study to identify areas for more intensive research in the future.

For a country-wide application we used the Pooling Local Expert Opinion method (van der Hoeven et al. 2004) as well as the recently developed occupancy approaches that address the issue of detection probability (Mackenzie et al. 2002) and variation in animal

abundance among sites (Royle and Nichols 2003) used in conjunction with presence/absence data derived from hunter interviews.

To estimate occupancy/use a plot-type sampling unit of 25 km^2 was defined within the village's hunting area. Six hunter's territories within the sample unit were used as spatial replicates to address the issue of detection probability (D. I. MacKenzie & J. A. Royle 2005). Therefore, the number of spatial replicates collecting information accounting for detectability numbered six per site.

In all villages surveyed, the first activity involved meeting the village chief to introduce ourselves and the study, plan activities and to consult him on the selection of hunters to be interviewed. Our interview requirements for a hunter were that he should still hunt, should have hunted regularly in the same area, and should be considered an expert by his peer group in the village. This resulted in the selection of people with intimate knowledge of the area and its wildlife and who were therefore able to list which species can be found, when (if applicable) and in which specific sites.

To clearly delineate each hunter's hunting zones we located on a georeferenced map specific areas characterised by recognisable features indicated by the interviewees. The respondents were asked to comment only on species occurring within these recently delineated zones. These areas were invariably small allowing for the repeatable recall of estimated presence/absence and perceived abundances from the hunter's memory.

During the interviews a species list was provided in Fang, the local dialect, alongside photographs of each animal. To assess the frequency of type II errors, our photographs included several species known to be entirely absent from the study site although morphologically similar to the target species. In all trials, interviewees never falsely identified a species known to exclusively occur outside of the region as present within their forest patches; giving us confidence that information provided on species identity was reliable. Also because our survey was focused on species preferred as a source of meat (large rodents, ungulates and mandrill) or memorable enough to be easily recalled (felids, apes and elephant), we found that the hunters had no problem identifying target species and even differentiating between related species of similar appearance, such as the several sympatric medium-sized duikers included elsewhere and within the red duiker group.

Our interview survey was conducted on a hunter-by-hunter basis and in two phases. Firstly, the hunter was asked about the current or recent presence or absence of each species within each of the six plots included in a site. Secondly, if a species had been reported to be present, the hunter was asked about an estimate of perceived abundance and group size (if applicable) based on his own field experience. Presence records for a given species were defined as plot-level occurrences when interviewees had no doubt as to whether the species was locally present at the time of interview or in the recent past and whether the species was thought to be a full-time resident or an occasional transient within the patch.

Spatial accuracy of hunter reporting was assessed by comparing distances and bearings reported from interviewees to neighboring villages against actual distances to the same villages previously measured from maps. In most cases we found a high degree of accuracy between perceived and map distances and bearings.

Interviewees were relaxed and open on the subject during all our conversations. As enforcement of official restrictions on bushmeat hunting and trade is non-existent in the country, regulations are seldom observed and thus interviewees talked openly about their hunting experiences providing us with comprehensive and unbiased responses. Reliability of hunter information on presence-absence of wildlife in a site was assessed by conducting additional interviews in neighbouring villages where hunters were known to be active in the same site.

4.4. Species list.

Species included in the study were Emin´s rat (Cricetomys emini), Cane rat (Thryonomys swinderianus), Brush-tailed porcupine (Atherurus africanus), Blue Duiker (Philantomba monticola), Bay Duiker (Cephalophus dorsalis), Peter´s Duiker (Cephalophus callipygus), Black fronted Duiker (Cephalophus nigrifrons), White bellied Duiker (Cephalophus leucogaster), Yellow backed Duiker (Cephalophus silvicultor), Ogilby´s duiker (Cephalophus ogilbyi), Red river Hog (Potamochoerus porcus), Buffalo (Syncerus caffer), Forest elephant (Loxodonta cyclotis), Mandrill (Mandrillus sphinx), Chimpanzee (Pan troglodytes), Gorilla (Gorilla gorilla), Golden cat (Caracal aurata) and Leopard (Panthera pardus). Although supposedly out of range, Ogilby´s duiker was included because it has been previously reported to occur in mainland Equatorial Guinea (Fa, J. E. & García Yuste, J. E. 2001, Nchanji et al. 2005, Rist 2007). However, in light of the interviews and anecdotal

reports provided by hunters in this study, we conclude that this is likely to be the result of misidentification.

Figure 6. The mythical Niefang range covered in mist at dawn.

5. SOME NOTES ON OCCUPANCY STUDIES AND RESULT INTERPRETATION

5.1. Occupancy theory.

Occupancy modelling (MacKenzie et al. 2002) is a likelihood-based method for estimating the probability of a species' presence at a site when its probability of detection is less than 1 (which it nearly always is). Occupancy represents the proportion of sampled area occupied by a species, or the probability of encountering an individual of a species at a survey location, given that it is in fact present. The 'naïve estimate' shows the proportion of all sampling units in which each species was recorded as present in the sample, while the occupancy values show the estimates corrected for imperfect detection. The species with the highest rates of detection have the smallest proportional correction. In other words their naïve estimates are more similar to the occupancy estimates than are those for species with lower rates of detection. When multiple sample sites are aggregated and occupancy estimates are averaged across these locations then occupancy can represent the proportion of a broader area occupied by the species. It tends to be closely correlated with abundance when the sampling unit area is comparable to species territory size (Mackenzie and Royle 2005).

5.2. Considerations regarding our study design.

Occupancy surveys that are described in MacKenzie et al. (2002) and Royle & Nichols (2003) use sampling units as "sites". Implicitly, it is assumed that each site is independent and no animal will move between sites during the survey period. Interview data recorded species detections over 1 year, during which considerable random fluxes in the occupancy of a site may have occurred. Unless the dispersal of the study species is very small compared to the selected cell size, setting up a grid system and using these models for adjacent cells would violate the assumption of independence between sites. Thus, using interview data in combination with these models for a wide-ranging species, such as leopards, will generate results that require an alternative interpretation of the occupancy parameter, psi, from true occupancy, or ''proportion of area occupied'' to ''proportion of area used'' (MacKenzie and Nichols, 2004; Zeller et al. 2010). As we were interested in the species' use of the site, not its occupation of it, the use of this method is deemed as sufficient to meet this goal.

Several species such as red river hog, bay duiker, blue duiker, brush-tailed porcupine and Emin´s rat were detected across nearly all sites, but use much smaller areas than our sampling unit size. Thus, a high probability of habitat occupancy by these species would be assumed even though they might have only used a section of a sampling unit. Given that such species were detected not only in a high number of sites, but in a high proportion of the spatial sub-samples within a site, the high naïve occupancy observed for them (Emin´s rat, brush-tailed porcupine and blue duiker = 100%; bay duiker = 99%; red river hog = 93%) is without doubt related to their widespread availability across our sampling units. Hunters´ perceived abundances for these species further support these results, indicating that these species are still common and abundant across the region.

Another consideration regarding sample design relates to the use of spatial replicates within a Royle & Nichols (2003) model context. Royle & Nichols (2003) only considered the case of having "true" replicates. i.e., a site is visited K times, and not that a site is divided into K sub-units as we are considering. However, Gopalaswamy (2006) made use of spatial replicates claiming that the spacing of sub-samples is small relative to the potential home-range of the species of interest and so total abundance (N), while perhaps not constant, should be generally consistent among the sub-samples. This argument was also made in our case for leopards, golden cats, gorillas, chimpanzees and forest elephants. Although we recognize the lack of information regarding home-range size for both the

leopard and the golden cat in central African rainforest environments and range-wide respectively, it is reasonable to assume that the spacing between sub-samples within a 5 x 5 km site will not exceed the potential home-range size for these species. Finally, by assuming that the size of each sampling unit (25 km^2) is likely to represent the potential home-range size for leopards and golden cats in the area, we have made use of the correlation between occupancy and abundance to estimate the average density of both felid species across our sampling units. By assuming that our entire sample is representative of the whole range of habitats and disturbance regimes found in Rio Muni (due both to the large sample size and to the care we took to ensure that the survey locations are evenly distributed) we were able to estimate total numbers for selected species by extrapolation of our average density estimates to the 26,000 km^2 study area.

5.3 Occupancy analysis.

In order to estimate the metric occupancy we used the program PRESENCE version 3.1 (Hines 2010) which provides a flexible framework to calculate overall and per-sample occupancy, as well as species detectability, while incorporating covariate information. We have kept the initial set of calculations very simple, using the presence or absence at each sampling unit location, and incorporating only elevation, ruggedness, density of rivers and density of human settlements as covariates in occupancy and detectability calculations. Roads and logging roads were not used as a covariate because of a lack of accurate information on historical and current levels of traffic (obscuring important differences in their effects on wildlife) and incomplete coverage, respectively.

We fitted occupancy models using the covariates listed above, and detectability was held constant across all sites. We summed occupancy estimates and developed predicted occurrence and distribution maps for both cat species.

6. RESULTS

6.1. Survey effort.

From April 13 to October 16 we recorded information on wildlife presence/absence and relative abundance from 1,350 plots (six per site in 225 sites of 25 km^2 each) encompassing an area of 5,625 km^2 or 21.6% of the mainland territory of the country. Total district surface area, sampled area per district and proportion (%) of each district sampled are shown in Table 1.

Table 1. Survey effort summary

District	Surface (km^2)	Sampled area	%
Aconibe	**1108**	**425**	**38.4**
Acurenam	**3254**	**350**	**10.8**
Añisok	**1718**	**575**	**33.5**
Bata	**1910**	**425**	**22.3**
Cogo	**2241**	**625**	**27.9**
Ebebiyin	**1095**	**225**	**20.5**
Evinayong	**4338**	**675**	**15.6**
Mbini	**2514**	**500**	**19.9**
Micomeseng	**2037**	**425**	**20.9**
Mongomo	**1415**	**225**	**15.9**
Niefang	**2339**	**600**	**25.7**
Nsoc Nsomo	**811**	**175**	**21.6**
Nsork	**1237**	**375**	**30.3**

6.2. Estimated area occupied by different mammals.

In the results and analysis, the following are the notations used: 'p' is detection probability, 'ψ' is Occupancy rate, or proportion of sites occupied (or 'used').

Table 2. Occupancy estimates for cats and other key species using the constant model.

Species	**ψ**	**SE**	**p**	**SE**
Caracal aurata	0,1614	0,0247	0,5461	0,0349
Panthera pardus	0,4545	0,0333	0,6324	0,0197
Gorilla gorilla	0,5557	0,0331	0,7438	0,0160
Pan troglodytes	0,9244	0,0176	0,8998	0,0085
Mandrillus sphynx	0,8400	0,0244	0,8827	0,0095
Loxodonta cyclotis	0,4444	0,0331	0,8567	0,0143
Potamochoerus porcus	0,9378	0,0161	0,9202	0,0076
Thryonomys swinderianus	0,8375	0,0252	0,5563	0,0152
Syncerus caffer	0,3516	0,0319	0,6700	0,0218
Cephalophus dorsalis	0,9956	0,0044	0,9739	0,0043
Cephalophus callipygus	0,4100	0,0329	0,6288	0,0208
Cephalophus leucogaster	0,1699	0,0251	0,5710	0,0335
Cephalophus nigrifrons	0,2690	0,0297	0,5481	0,0270
Cephalophus silvicultor	0,5913	0,0328	0,7454	0,0155

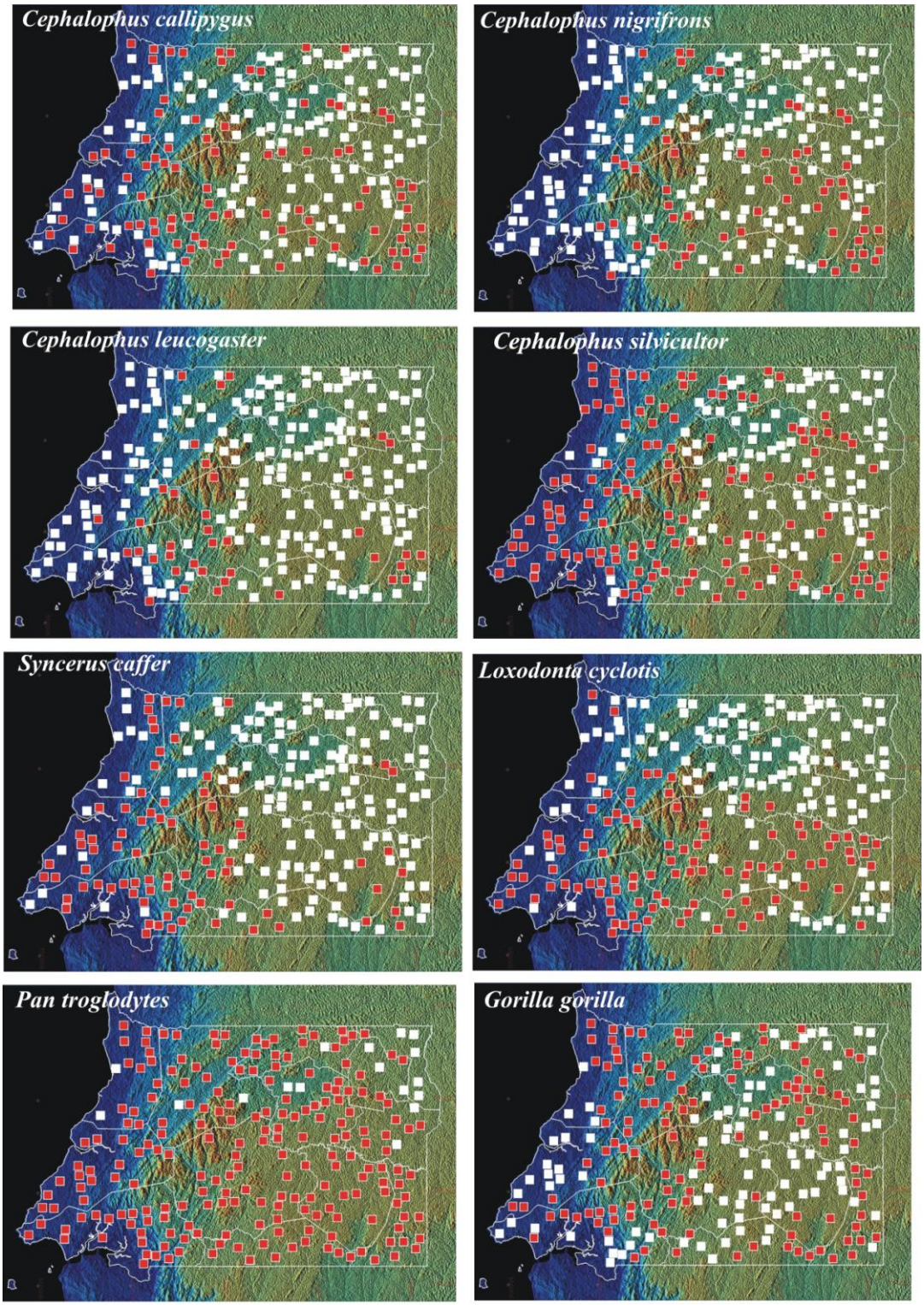


Figure 7. Naïve occupancy (detection-nondetection) maps for selected species. Sample sites are shown as 5x5 km^2 squares (red squares = species detected; white squares = species not detected)

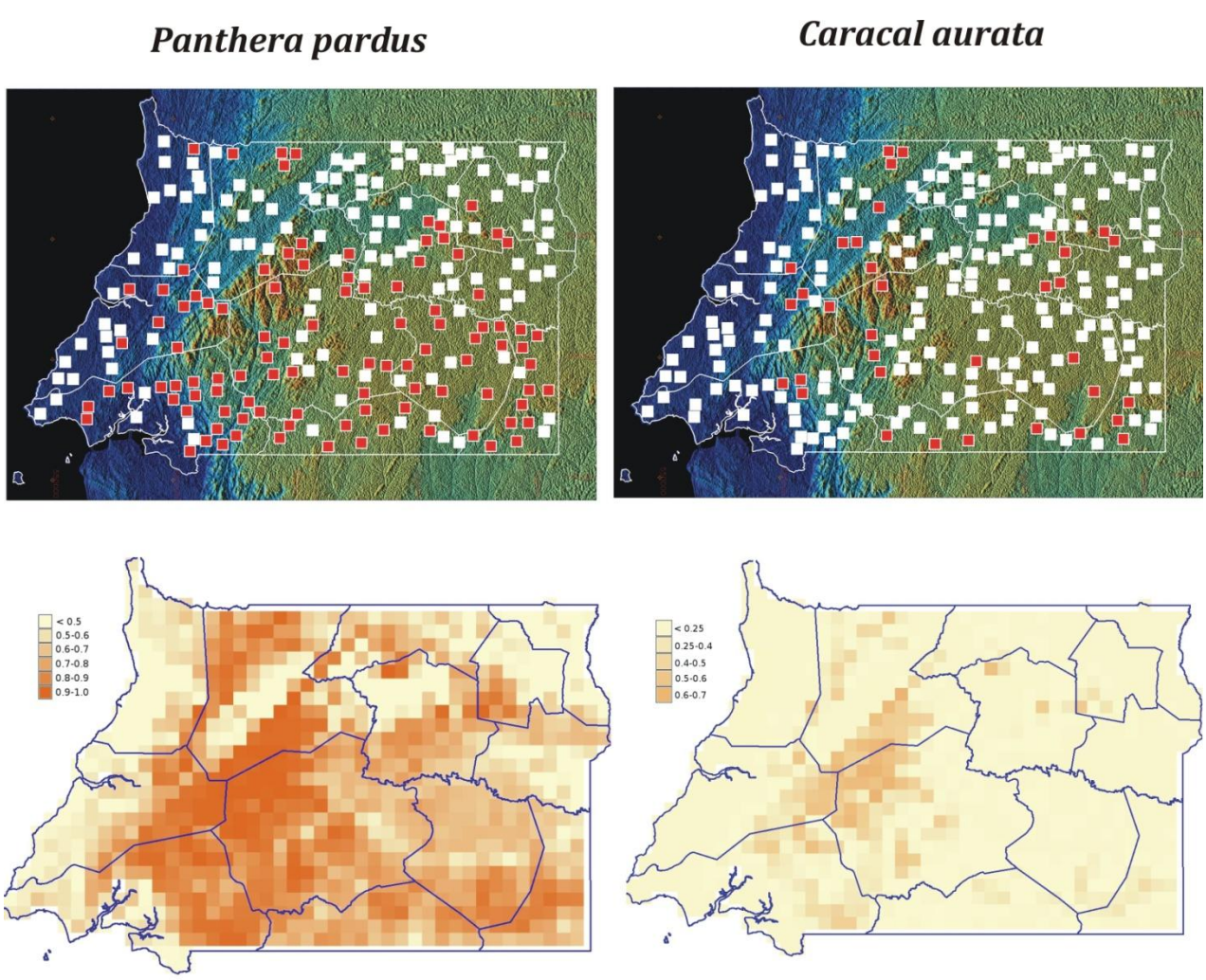


Figure 8. Naive occupancy (detection-nondetection) and estimated probabilities of occurrence for leopard *Panthera pardus* and golden cat *Caracal aurata* across Rio Muni. Sample sites are shown as 5x5 km² squares (red squares = species detected; white squares = species not detected).

6.3. Estimation of cat abundances.

By sampling a site repeatedly for the presence-absence of a species, Royle & Nichols (2003) constructed a model that may be used to determine the abundance of a species. In this section, we investigate the applicability of this model for presence-absence data of leopards and golden cats obtained from spatial replicates.

Abundance results derived from the analyses are presented below. In the results, the following are the notations used: 'λ' is the average cell-specific abundance interpreted as number of individuals per 25 km^2, 'd' is number of individuals per 100 km^2.

Table 3. Estimated densities for cats across our sampling units

Species	λ	95% conf. interval	d	95% conf. interval
Leopard	0.6767	0.5596 – 0.8183	2.7068	2.2384 – 3.2732
Golden cat	0.1885	0.1363 – 0.2605	0.7540	0.5452 – 1.0420

Our low leopard density estimates (2.23-3.27 individuals/100 km^2) appear to be reasonable for Rio Muni (where there are almost no areas left untouched by hunters and logging) and are strikingly similar to Henschel's (2009) calculation of 2.7 leopards/100 km^2, based on camera trap results from moderately hunted logging concessions in Gabon. Extrapolation of our felid average density estimates to the whole Rio Muni translates into a total population of 579-850 leopards and 140-270 golden cats.

Evaluation of this approach. Although animals are generally hard to detect in forest habitats, it is possible to obtain a reliable estimate of abundance if sampling methods are designed to increase animal-specific detection probability 'r'. Bearing in mind that our data is derived from the knowledge of local hunters, which has not developed out of academic interest, but from the very real and immediate demands of survival, detection probabilities obtained by hunter interviews are high and thus suitable for this type of analysis. Our approach of combining hunter interview data with the abundance-induced heterogeneity model allows for a rapid baseline quantitative assessment for species over large areas. From the perspective of the international conservation community, even accounting for data limitations for each component used in making cat density estimates,

these results are encouraging. For Equatoguinean conservation bodies, it represents major progress towards understanding the critical status of the country´s top predators, and a first step towards include them as a crucial component of the national plans for biodiversity conservation.

6.4. Factors determining probability of felid use across our sampling units.

In a human-dominated landscape, cat distribution and occurrence in different habitat types are much more likely to be determined by human activities than by actual habitat preferences. Within this context, it would make sense for Equatoguinean cats to prefer rugged, remoter terrain when more accessible areas are more frequently used by humans. Our results support this assumption and also appear to indicate that in relation to human disturbance, prey abundance plays a secondary role in shaping the apparent land-use pattern of these species.

Leopards preferentially prey upon species within a weight range of 10-40 kg (Hayward et al. 2006). In the following figures, probability of use of a site by leopards is plotted against abundance of different prey species within the leopard´s preferred weight range. We assumed that the higher the number of spatial replicates where a species was detected, the higher its relative abundance in a sampling unit.

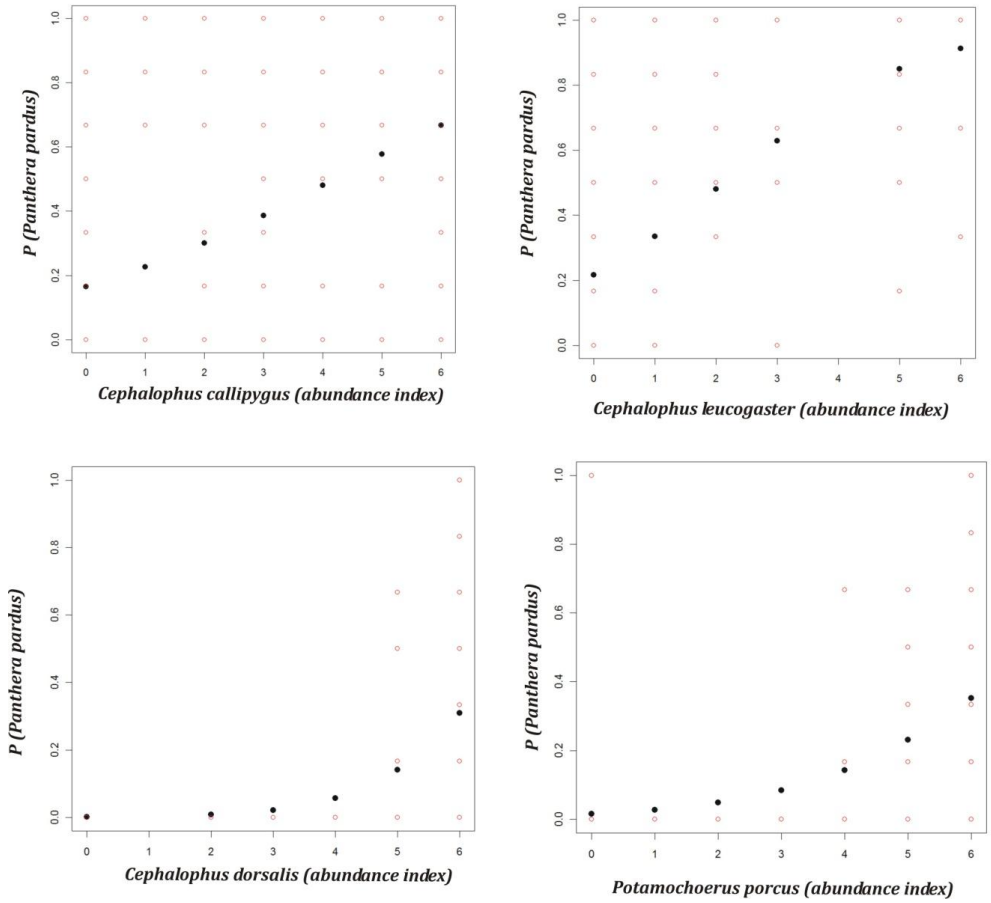


Figure 9. Relationship between leopard´s probability of use and the relative abundance of key prey species.

As expected, there is a clear relationship between the abundance of prey species and the probability of use of a site by leopards. However, this relationship is even stronger with prey species that are extremely sensitive to human disturbance and patchily distributed elsewhere, such as the White-bellied duiker. Although one could suggest that this may reflect that the areas inhabited by this rare duiker are in a nearly pristine condition and therefore prey abundance should be highest for these areas, this may not be necessarily the case in Rio Muni. In fact, despite heavy commercial hunting leading to changes in the prey profile present in a site, hunter reports suggested that abundance of key prey species for leopards in terms of biomass and wide distribution across Rio Muni such as the bay duiker and the red river hog, appeared frequently to be higher 6-7 km away from the villages than deeper into the forest. The increased abundance of red river hog at intermediate distances from the village is likely to be due to a habitat preference for agriculturally disturbed areas and a tendency to raid crops. On the other hand, perceived abundances for the bay duiker were also higher at intermediate distances from villages

than in more remote areas. This may be a reflection of its ability to benefit from a inter-specific competitive release, increasing in abundance in moderately hunted areas due to the reduced abundance of frugivorous competitors such as Peter´s duiker, that appear to be more sensitive to snare hunting.

Although considering red river hog and bay duiker abundance, biomass and occupancy, they may be the most important potential prey species in Rio Muni, our results suggest that the probability of use of a particular site by leopards may be more related to an avoidance of human dominated areas rather than to key prey abundance. At a landscape level, fear of humans may be impeding broad access to a resource that is otherwise widespread and abundant.

As expected for a landscape dominated by wildlife-dependent human populations, the explanatory covariates density of villages and terrain ruggedness were included in the top models for both cat species. The Beta parameters for density of villages for leopard (-0.114, SE 0.019) and golden cat (- 0.041, SE 0.019) were negatively correlated with ψ, suggesting that these cats have adapted their range to areas with little human contact, or, in other words, that felids are avoiding areas used by humans at the scale of our sampling units. The Beta parameters for terrain ruggedness, on the contrary, were positive for both leopards (0.271, SE 0.061) and golden cats (0.173, SE 0.055), indicating that variable topography is providing some protection against human-induced disturbance by restricting human movements to more accessible areas.

6.5. Great apes and forest elephant summary

Reviewing literature on western gorilla and central chimpanzee indicated that home range sizes were not much different than our 25 km^2 cell. Therefore, this cell size was used to estimate abundances using the model developed by Royle and Nichols (2003). In the case of the elephant, however, cell sizes were varied post data collection from 25 km^2 to 225 km^2. The home-range size of forest elephants in neighbouring Cameroon varies between 224 and 315 km^2 (Powell 1997), therefore this cell size is assumed to be reasonable to estimate elephant abundance.

Since all these species occur in groups, the estimated 'λ' was interpreted as average number of groups and not as individuals since Royle and Nichols (2003) implicitly assumes that all animals are independent, which is not true for these species. In order to

estimate the total number of individuals for Rio Muni mean group size values across the 225 sampling units were obtained from hunter interviews and multiplied by λ.

We conclude that gorilla, chimpanzee and elephant total numbers for Equatorial Guinea are consistent with previous estimates found in the literature. However, given the limitations of the estimates at the scale we are dealing with, these values should be used with the utmost care and conservation managers should always apply the "precautionary principle" and assume the lowest estimates for the sizes of ape and elephant populations when making conservation decisions.

6.5.1 Gorillas.

*6.5.1.a. Gorilla distribution***.**

Gorillas use a variety of habitats across Rio Muni ranging from secondary forest in different stages of regrowth to isolated swampy areas and forest/agriculture mosaics. Although patchy, populations appear to be present in 11 out of a total of 13 districts in which this territory is divided (they are most likely absent from Ebebiyin and Mongomo districts). The current geographic range of gorilla in Rio Muni as inferred from our survey is very similar to that described by González-Kirchner in the late 80s and early 90s.

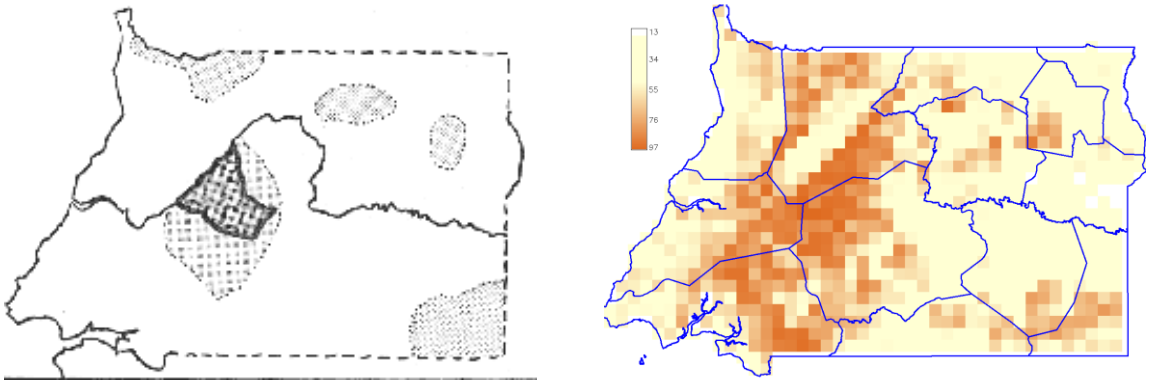


Figure 10. Gorilla distribution across Rio Muni based on González-Kirchner results (left) and probability of occurrence of gorilla as estimated in the present study (right).

Although gorillas are killed by locals from time to time despite governmental prohibition, they are not a preferred prey in rural Equatorial Guinea. In fact, during this study we have found that gorillas persist well and thrive in secondary forest located about 5-6 km away from villages, where other species theoretically more robust in the face of human hunting (e.g. Peter´s duiker) were extirpated a long time ago. Strikingly, we have found also that

gorillas are largely absent across extensive forested areas where historical and current human densities are very low (e.g. Eastern Evinayong district, northern half of Aconibe district, northern half of Nsork district, southeastern Añisok district), or where apes are benefited by some level of cultural protection (e.g. the coastal plain).

It is widely accepted that the main pressures and threats facing Equatoguinean gorillas are hunting and poaching for bushmeat, as well as habitat degradation and loss through agriculture and timber extraction. In the light of our findings, however, it appears that the observed broad distributional pattern of this species in Equatorial Guinea can not be attributed to human related activities at the scale we are dealing with. Our results on gorilla distribution in Rio Muni, linked to the palaeoenvironmental reconstruction for the region, suggest that the distributional pattern observed for gorillas, as observed at a continental scale, is mostly due to climatic variability and forest history and that anthropogenic action has had limited influence.

Gorilla inhabits pockets across the African tropical zone of what were Pleistocene forest refuge regions during the Ice Age period of rainforest contraction that took place approximately between 18,000-10,000 years ago (Tutin and White 1999; Stanley 1996). Periodic changes in climate during recent Pleistocene history led to the repeated retractions of vegetation cover into isolated refuge during glacial maxima (Maley 1996). Distributions of species dependent on closed canopy forest such as gorillas would have followed these changes, leading to population fragmentation within restricted forest refuge, from which expansion would later follow during climate warming. Such repeated isolation and expansion events have had profound effects on the genetic structure of gorillas, as demonstrated in a recent study (Wickings et al. 2009). González-Kirchner (1994) noted unusual frequencies of genetic anomalies and malformations in Equatoguinean gorillas likely to be linked to inbreeding, such as missing toe joints, that may result from such isolation.

Climatically stable areas in Rio Muni were identified at a coarse scale as areas with rainfall >2000 mm, altitude > 500 m and strong relief (Leal 2009). In between the areas in Rio Muni qualifying for the above requirements are the Niefang range, the Monte Mitra masiff, the Siete Montañas range and the Nsork and Nsok Nsomo highlands. All of the above areas are currently inhabited by gorillas. However, our results on gorilla distribution also include low-lying areas that do not qualify for the above requirements. In fact, although

gorillas have been reported to occur throughout Monte Alén National Park (García and Mba 1997) and thus inhabit areas up to 1200 m, our results suggest that gorilla occurrence is negatively correlated to altitude (Beta parameter value: - 0.0021, SE 0.0003).

The existence of fluvial refuges has been proposed in earlier studies (Colyn 1991) and support recent findings suggesting the presence of a late Pleistocene forest refuge in the lowland rain forest of Campo Ma´an National Park in southwest Cameroon. This newly described type of Pleistocene refuge are localized especially along the upper slopes of hills near the top, upper altitudinal zones in the lowland forests, or along riverbanks (Tchouto 2009) and explains the presence of gorilla in low-lying areas adjacent to Campo Ma´an such as Rio Campo Natural Reserve.

Both highland and lowland areas inhabited by gorillas share a common feature that appears to be critical for gorillas. Such a factor is the covariate terrain ruggedness, that, based on our results, was included in the top model for this species, with the Beta parameter (0.2475, SE 0.0561) positively correlated with ψ at the scale of our sampling units. Rugged topography must have provided a number of shady sites that remained forested across geological time and that may have been critical to the long-term persistence of gorillas during times of deforestation in more or less large areas with a gentle topography during the Ice Age, but also during the period of dryness of the Holocene, some 1300 years ago. The so-called Holocene Little Ice Age appears to have lead to major vegetation changes in the region (Ngomanda 2007) and postulated forest refuge areas for this period have been previously associated to steep and rugged terrain (Leal 2007). This explains why the extensive distributional gaps observed in Rio Muni are related to extensive areas of smooth relief that likely turned to savannah during past dry climatic events. These areas are mainly located in the Uoro river basin (Mongomo district, Eastern Evinayong district, northern half of Aconibe district, northern half of Nsork district, southeastern Añisok district), the coastal plain, the Abia river basin in Añisok district, the Ntem river basin (Ebebiyin district, northern Nsok Nsomo district, and eastern Micomeseng district) and in the high Mbe (Komo) river basin (in the south-central Acurenam district/Gabon limit).

6.5.1.b Gorilla numbers.

There were probably more than 5,000 gorillas on mainland Equatorial Guinea during the early 1960s (Sabater Pi 1966), but the population is believed to have dropped to about 1,000 by 1989 to 1990 (Gonzalez-Kirchner 1997). In this study we have found that group average density estimates across our 225 sampling units ranges from 0.031 – 0.044 (groups/km^2). Mean group size was estimated from hunter perceptions (3.4 ind/group). By assuming that our entire sample is representative of the whole range of habitats and disturbance regimes in Rio Muni (due to the care we took to ensure that the survey locations are evenly distributed), we extrapolated our average density values to the 26,000 km^2 of Rio Muni and estimated a total current population of 2740-3889 individuals. This is more than double the estimate obtained by González-Kirchner (1994) using nest counts along strip transects (800 – 1180 individuals), but similar to earlier estimates ranging from 2000 (Cousins 1978, Stuart and Stuart 1996) to 3000 individuals (Harcourt 1996).

6.5.1.c. Threats.

In evaluating direct threats to gorillas in Equatorial Guinea it is useful to think on two time scales. In the short term, by far the most serious threats are habitat fragmentation driven by widespread infrastructure development and poaching incidents in small and isolated populations. In the longer term, given that current gorilla distribution apparently matches that of postulated forest refuge, climate change is likely to become a serious threat if its consequences are not taken into account in gorilla conservation initiatives, especially in the design of corridors between populations.

6.5.2. Chimpanzee

6.5.2.a.Chimpanzee distribution.

Given that chimps were detected not only in a high number of sites, but in a high proportion of the spatial sub-samples within a site, models for this species provided a very high probability of habitat use across the whole area, suggesting they are still widespread in Rio Muni. Chimpanzees appear to occur throughout 12 out of 13 districts in which this area is divided (they are most likely absent from the heavily populated Ebibeyin district, located in the north-eastern corner of Rio Muni). Density of villages appeared as the main covariate explaining to some extend their probability of occurrence across our sampling units, with the Beta parameter (- 0.1039, SE 0.0199) negatively correlated with ψ and resulting in chimps being absent from the most densely populated areas. Gaps in

chimpanzee distribution roughly matches those areas with a long history of exploitation of commercial crops (northeaster corner of the country, south-central coastal Bata district and the immediate vicinity of the roads linking Bata and Micomeseng and Bata and Añisok cities).

*6.5.2.b. Chimpanzee numbers***.**

Jones and Sabater Pi (1971) estimated a density of 0.31-1.53 individual/km^2 in Rio Muni and a total population of 1000-2000 individuals. In the early 1980s, it was estimated that there were 600-1500 chimps, although a 1989-1990 census concluded that there could be between 990-2450 individuals (Caldecott et al. 2005). Our average group density estimate for Rio Muni ranges from 0.092 to 0.128 (groups/km^2). Mean group size was estimated from hunter reports in 4.2 ind/group, which results in a total population of 10,046-13,977 individuals for Rio Muni.

Our estimate on chimpanzee numbers may not reflect an actual increase in numbers from earlier studies, but the fact that much of their habitat had been unexplored previous to this survey and therefore obscured their occurrence from large areas of forest not previously known to harbour them.

Figure 11. At the right prize, this orphan chimpanzee from Nsoc Nsomo district is for sale without regard for the laws that protect him

6.5.2.c. Threats.

Forest fragmentation and large-scale disturbance driven by widespread infrastructure development appear to be the main direct threat to populations. Also poaching and capture of infants for sale may pose a significant threat in Rio Muni, especially in rural areas where human populations reach high densities.

6.5.3 Forest Elephant

6.5.3.a. Elephant distribution.

Elephants are almost completely absent from the territories located north of the Uoro river, where human population densities are higher than in the south. There are three exceptions to the above described distributional pattern: 1) the Río Campo Nature Reserve in the northwest, which is regularly used by a group of 3-4 elephants, 2) the section of the Uoro rift located between both the Uoro and mongo rivers, from Miyobo village (Niefang district) to Ngabe and Sendje I villages (Mbini district) and 3) the south-western corner of Añisok district, between the Uoro River and Nsemsoha village. However, none of the above areas appear to harbour resident individuals, being more likely to be used in a regular basis by groups moving in and out of Campo Ma´an National Park in Cameroon (1), Monte Alén National Park (2) and the forest of north-western Aconibe district (3).

Density of villages appeared as the main covariate explaining the probability of occurrence of elephants (Beta parameter -0.154317, SE 0.023898). However, the lack of GIS data on forest cover (size of forest patches may be the most plausible factor explaining their occurrence across Rio Muni) prevented us to model their distribution. Distributional patterns, however, can be easily inferred from the presence-absence maps shown in this report.

South of the Uoro River we found elephants to be present in all the districts, from the coastal plains to the hinterland, although not in a contiguous form. Main areas in terms of abundance and extent of elephant contiguous range are located in the forest that spread from Monte Alén National Park, via the western block of the National Forest (mid and low Mitemele river basin), to northern Gabon. Further east, the forest of the northern half of Aconibe district (including Piedra Nzas Natural monument) appear to be also permanently inhabited by elephants. Some elephants use the north-western sector of Altos de Nsork National Park (south-eastern Aconibe district), while small groups or solitary individuals appear to move in between these areas and the western block of the National forest via southern Evinayong and Acurenam districts.

Therefore, with the exception of the few individuals using Rio Campo Nature Reserve, elephants in Rio Muni appear to be part of a single population composed of two meta-populations (Monte Alén/western block of the National forest meta-population and Aconibe meta-population).

6.5.3.b. Elephant numbers.

It has been previously suggested that there may be around 600-700 elephants left in Rio Muni (African Elephant Status Report 2007). We estimated a group density ranging from 0.89 to 1.39 per 225 km^2 and a mean group size of 4.4 individuals, which translates in a total population of 452-706 individuals.

6.5.3.c. *Threats.*

The expansion and rehabilitation of road networks cutting off elephant routes between the two meta-populations and especially between Monte Alén National Park and northern Gabon is the main threat to the long-term persistence of this population. Human-elephant conflict also results in the killing of tens of individuals each year, mainly around Monte Alén National Park.

Figure 12: Elephant-human conflict is a result of habitat loss and fragmentation. When elephants and humans interact, there is conflict from crop raiding, injuries and deaths to humans caused by elephants, and elephants being killed by humans.

6.6. Impact of historical hunting.

In tropical forest regions, the problems associated with direct monitoring are greater, and the resources available for monitoring much smaller than in other regions, and it is therefore difficult to assess human impacts effectively over large spatial scales. Tools that allow the large-scale impacts of hunting in tropical regions to be assessed indirectly could therefore make a key contribution to the provision of information for management.

To determine the impact of historical hunting on contemporary bushmeat resources in mainland Equatorial Guinea we identified a set of bushmeat taxa that had a previously reported continuous distribution across the territory, have been reported to do well in secondary forest habitat (so they are not primary forest-obligate species) and their rate of capture is not biased by local preferences or hunting techniques (they are preferred meat elsewhere in the country and are usually caught by hunters using non-selective snares). Furthermore, species selected should show a clear gradation in vulnerability to hunting so we can assume that the emergence of distinctive species profiles and proportions in a district are related to sequences of overexploitation dependent on species' vulnerabilities to exploitation. Species finally qualifying for the above requirements were the blue duiker (*Philantomba monticola*), bay duiker (*Cephalophus dorsalis*) and Peter´s duiker (*Cephalophus callipygus*). The differences in vulnerability to hunting are related to species-specific factors such as reproductive rate and day range (the latter reflecting variation in the probability of encountering a snare). According to *Rowcliffe et al. 2003*, reproductive rate is highest for the blue duiker, medium for the bay duiker and lowest for the Peter´s duiker. Day range is highest for the Peter´s duiker, medium for the bay duiker and lowest for the blue duiker.

We usually have little understanding of historical baselines of population distributions and suffer 'shifting baseline syndrome': the phenomenon whereby each new generation redefines what is natural in terms of personal experience and is unaware of earlier declines in populations or conditions. Fortunately there is one historical account (Basilio 1948) that suggest that a typical primeval hunting system in the area, as it can be found today in several slightly hunted forest in Central Africa (East 1990), included the three selected species and that the blue duiker was the most abundant, followed by the Peter´s duiker and finally the bay duiker. Therefore, a rough assessment of the impact of historical hunting within a large-scale context could be inferred from the duiker community by pooling for each district the species composition and proportions at the site level.

We collected data on the presence/absence and perceived abundance of each taxa in all of the 225 sites sampled during the field phase of the study. Although we found some hunters reporting numbers that simply may not be possible, the proportional contribution of each species obtained from different hunters using the same area were always strikingly similar. The information gathered at each site was subsequently pooled for each district to obtain a broad picture of the state of the hunting system based on the species that are present or absent and on the proportional contribution of each species.

Table 4. Proportional contribution per district for three species of duikers.

	C. callipygus	***C. dorsalis***	***P. monticola***
Aconibe	0,80	37,07	62,13
Acurenam	0,88	40,34	58,78
Añisok	1,96	38,54	59,50
Bata	2,34	26,71	70,94
Cogo	4,01	34,31	61,68
Ebebiyin	0,00	27,30	72,70
Evinayong	3,04	37,44	59,52
Mbini	5,97	24,47	69,56
Micomeseng	0,29	34,78	64,93
Mongomo	0,68	32,17	67,16
Niefang	3,22	32,19	64,59
Nsoc Nsomo	0,00	27,57	72,43
Nsork	7,28	33,87	58,85

After collecting information from 225 sites we have not been able to find any site, much less an entire district, where the current species profile and proportions may qualify for a primeval hunting system as described in Basilio (1948). The broad picture observed for mainland Equatorial Guinea, consisting of proportionally few Peter´s duiker (if any) per district but a clear preponderance of higher productivity and typically low daily range species, suggests that the state of exploitation of bushmeat resources accross most of the country corresponds at best to a semisustainable, postdepletion hunting system as described in Kümpel et al. (2010). The following simple-informative figure summarizes information from Table 4 and shows the current status of duiker communities per district as a result of a historical period of overexploitation.

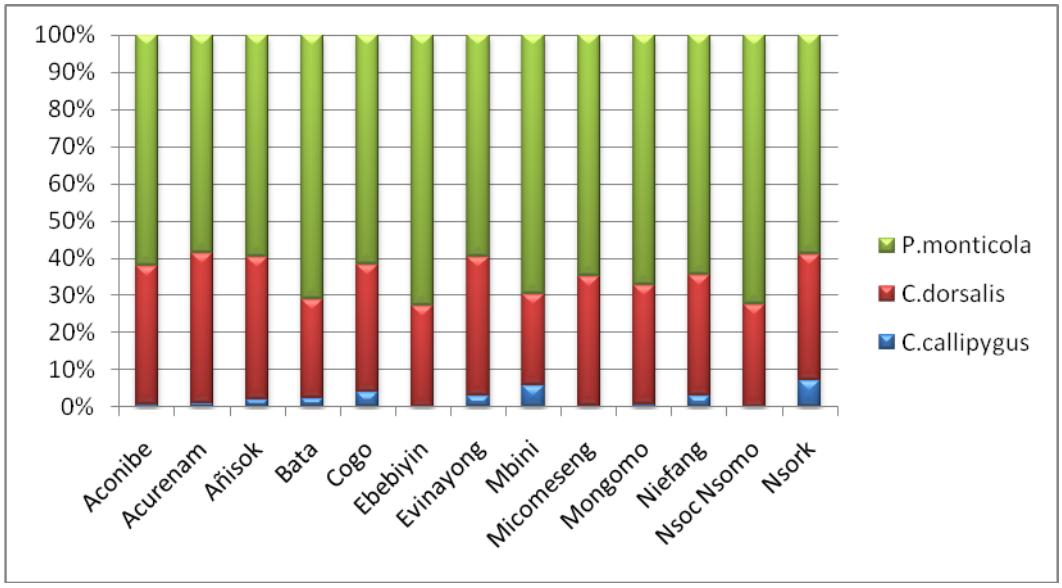
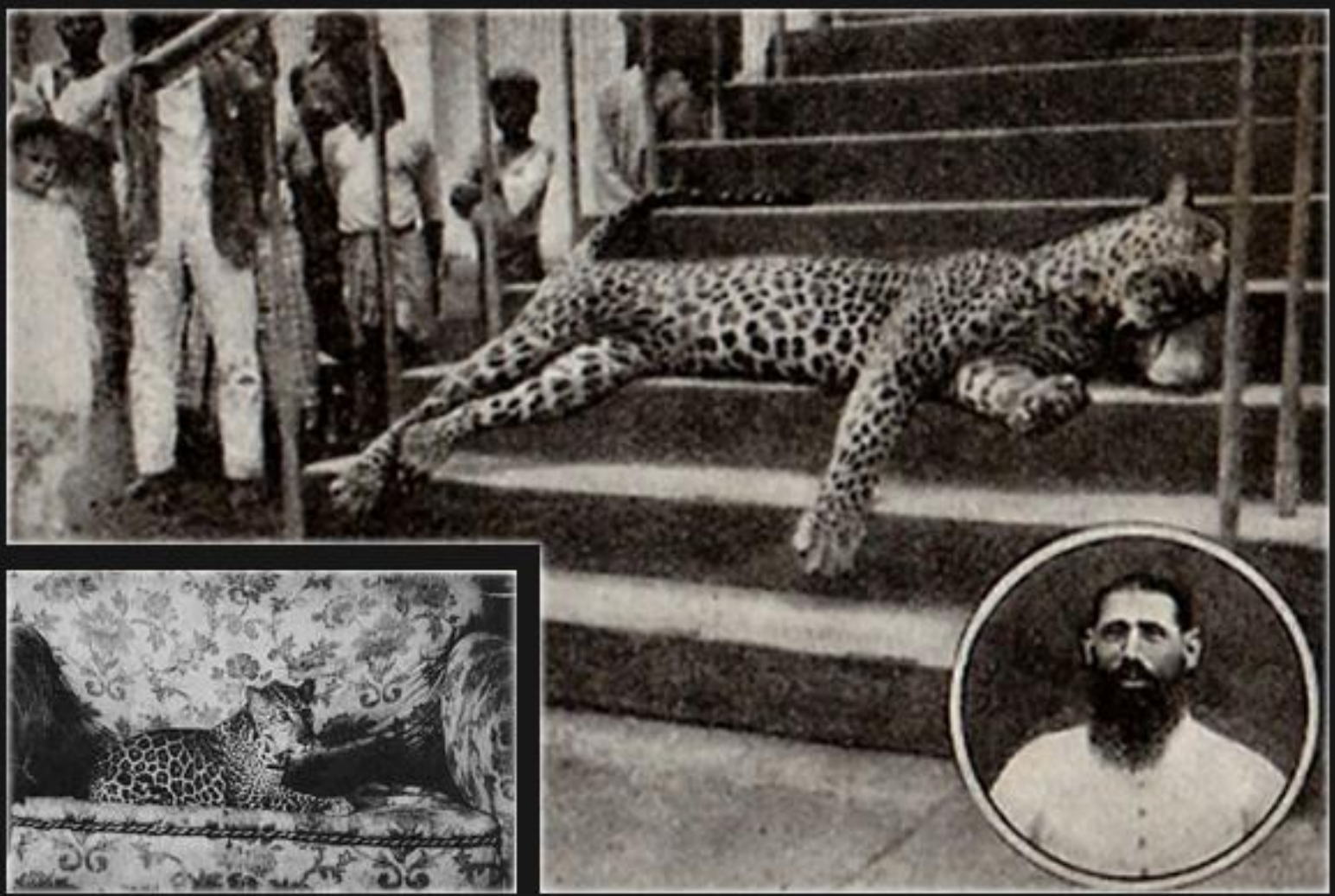


Figure 13. Proportional contribution per district for three species of duikers.

One of the possible applications of this methodology is to determine which areas have been heavily exploited and may be able to supply urban market(s) with robust bushmeat species in order to delineate landscapes into zones for more effective management and enforcement.



Historical records on Equatoguinean Cats

7. HISTORICAL RECORDS ON EQUATOGUINEAN CATS.

As a rainforest user and rainforest specialist respectively, it seems safe to assume that both the leopard and the golden cat once held an almost continuous distribution across the relatively small and heavily forested Rio Muni. Historical records and new evidence derived from this survey appear to support this assumption. In order to provide a framework for understanding the current status of felids in the area, I present a summary of the available information on where they once occurred and on the principal threats that have driven their populations to decline over the last century. This summary also provides a number of examples on human-leopard conflict in the area, an issue poorly known and documented in African rainforest environments. Additionally, as most information on the issue has been published in Spanish and in a variety of otherwise obscure sources (most notably colonial publications), this effort builds on the aim of making this available to a wider audience. Additionally, I present a reflexive analysis on the plausible issues driving to the apparent differences in resilience to human activities shown by leopards and golden cats in Rio Muni. The information presented here represents a first step towards the development of a national cat information database acting as a basis for designing cat conservation activities and decision-making. Published scientific papers, general wildlife survey reports, personal communications by informants with knowledge of the area gathered during this survey, and records published in colonial publications form the main framework of this dataset. For the purposes of this report, historical records were considered as those pre-2010, when this study began.

In colonial times leopards were traditionally considered pests, and its extermination was a management objective with bounties being offered by local administrations (Guinea Española 1923). Leopards were easily removed, especially through the use of cage-trapping but also by shooting, snaring and pursuing with dogs. Skins, whiskers, bones, canines and fangs were commonly available in local markets and valued for traditional rituals. There was a widespread trade in leopard parts, most of it local, though colonials too bought skins from these very markets that were subsequently smuggled to Spain. Live animals were also occasionally exported from Rio Muni to meet demand among Spanish zoos and private collections. Incidences of leopards taking livestock and dogs were quite common and, moreover, in certain circumstances leopards were also reported as man-eaters. No wonder reported records of the cat from this period are fairly common in colonial publications and attest to its former widespread occurrence in the area. On the contrary, information on the golden cat is virtually absent from these same sources,

probably reflecting the minor source of conflict encountered; permitting this species to play a secondary role in the minds of colonials. Consequently a lack of the information on the golden cat from these sources probably reflects a lack of reporting, rather than the rarity of the species from these areas. In fact, Basilio (1948) noted that the species could be found throughout Rio Muni, especially in riverine habitats, and that locals reported it to be more abundant than the leopard itself. In 1955, this Spanish misionnary and naturalist, based upon personal observations and anecdotal reports from indigenous and colonial game hunters, carried out the most comprehensive written account to date on leopards in Rio Muni, and provided insights into population trends and threats over the first half of the XX century. The following note was extracted from the 1948 archive of the local newspaper *Guinea Española*, where Basilio noted:

" ...When Spanish colonists first set foot in this territory (Rio Muni), it was possible to encounter leopards with ease across the region, from the north to the south, from the coast right into the very centre of the territory. Even in recent times both Bata and Rio Benito were frequently raided at night by leopards, which, in fearless attacks, would snatch domestic animal from the very same pens that belonged to the missionaries and colonists; though on occasion they were imprisoned in the traps that awaited them. Today the situation is changing. The increase of the human population around certain nuclei, the increased use of fire-arms, the extension of deforestation for agriculture and timber exploitation, the almost continuous drone of motors from both the roads and railroads, has made the leopard flee from wide areas of the coast and from large sections of the inland region. There still however remains in this colony sufficiently large sections of forest where they live comfortably and will continue to live, in our opinion, into the long-term ... one specimen that we recently observed had been hunted in the Bimbiles region ... We were offered fresh leopard skins many times in the villages that we passed through ... locals have great appreciation for the whiskers, as they remove them for, according to them, medicine ... and also for the very feat of capturing a specimen, providing a prized trophy, that ultimately communicates the strength and bravery associated with the leopard ... In relation to man, the leopard is both wary and distrusting ... though in general, the leopard would not be averse to human flesh through times of hunger. Some years ago, nearby Punta Mbonda, a leopard pounced on small child, who had been placed by its mother in a basket ... the leopard took advantage of these few moments where the child's mother had left to collect water from a spring.. More recently, nearby Evinayong, another leopard managed to penetrate one traditional hut to kill a man who lay ill in his bed. The leopard, startled by a few of the man's neighbours whilst dragging

the body from the house, released its prey and fled. The man's chest had been ripped open, whilst his entrails had in part been devoured ... In the same part of Evinayong, lived an indigenous man, who whilst working in his fields heard a harsh growl come from behind... fortunately he had by his side a thick branch which he grabbed in a flash and threw down upon the animal with all his force towards its head, knocking it unconscious to the ground, he then killed it with several further blows ... Long ago, when the distribution of indigenous communities was widely scattered across the forest landscape and leopards were far more numerous, these animals were known to prey on humans quite frequently ... some individuals even appeared to get accustomed to human flesh to such point that they did not want to eat anything else. It has been told that one particularly famous leopard bred great terror over a considerable period of time in the area between Kukumankok and Akurenam, causing the flight of entire populations ... It was eventually killed by one young man who had lost his father, mother and sister to the claws of this beast. (Translated from *La Guinea Española,* May 10, 1948).

In a note published in 1955 in the same colonial publication, Basilio noted the following:

"*At the beginning of the century* (XX) *the leopard was common in Guinea ... By the year 1945,it was sufficient to pass through the administration buildings and by the houses of the colonials to see a high number of skins from leopards hunted in the surroundings. Today, it's becoming increasingly difficult to see them. It was precisely the great value and esteem attached to these skins in the market that caused the considerable persecution of the leopard, leading to a regrettable decline in its numbers ... Intensive clearing of forested land to open up areas to agriculture, roads and timber exploitation lead to the leopard's retreat from former strongholds ... we've heard it repeatedly confirmed by various colonists that the leopards no longer exists in Guinea ... we contend such assertions with various leopard accounts registered in the last two years ... In September 1953, in the village of Abumeyen, in the district of Nsork, a leopard entered one of the village kitchens at dusk chasing a domestic cat. This provoked loud outcries from one woman sleeping on one of the beds commonly found in these traditional fang 'pamues' kitchens .... Consequently, the leopard, forgetting the cat, pounced towards her tearing at her with its claws ... the women's daughter answered her cries for help ... the leopard then left by the back door of the kitchen and into the forest ... this tale was later confirmed by a doctor, from the nearby city of Nsork, who attended to the women's injuries. In February 1954, in the forest of Bonbon, in the district of Kogo, one leopard was captured by the town catechist in a trap specially prepared for larger animals...*

the beast was ensnared by the very end of its front legs ... not having a shotgun, he (the catechist) took a stick to his hand and dealt deadly blows to the leopard ... Father Moisés del Rey, who retold this story to us, preserved the skin of this leopard ... In June of the same year, 1954, in Acurenam, on the town's peripheries ... a young leopard was hunted... the local administrator communicated this information to us and showed us photos of the recently killed cub ... later, the same administrator on two separate occasions came across a pair of leopards on the road between Akurenam and Evinayong. Between October and November in 1954 we had a stint of time in the village Eves Esandon ... we are certain that around there they (leopards) are frequently encountered ... in the year that we had been there the locals had hunted six specimens ... a colonial guard told us that one night, at dusk, on the banks of the Nkom river, he saw a leopard devouring a mvak (mongoose) ... after shooting the leopard it quickly disappeared into the forest ... on the following day he returned to the very same place accompanied by other men and found the leopard only a hundred metres from the spot it had been the night before, still alive, but immobilised due to its gun wounds and thus it wasn't difficult to finish it off. Latterly, the hunting of leopards with firearms became increasingly rare, only on occasions of great luck could this be achieved ... The majority of leopards hunted by locals were captured by wire snares, set throughout trails in the forest ... In March of the current year, 1955, we arrived at a Puerto Iradier, the capital of Kogo district. In the town hospital, they were attending to one local hunter who had recently received a series of injuries as a result of a bare fisted fight with a leopard ... In this case ... one afternoon he had been hunting in the forests surrounding the village of Madya, near the river Congue. He was imitating the call of a Mvin (Peter´s duiker), but the call received a far from peaceful response, rather it was greeted by an onrushing noise ... leading to the appearance of a leopard. Protecting himself under the roots of a large tree, the hunter dared to shoot at the leopard. Hurt by the shot, the leopard turned furiously and blindly turned around the tree without seeing the hunter. He fired another shot and hit the target. Finally the leopard saw him and pounced towards the hunter ... the leopard thrust its teeth into the hunter's hand and clawed around his head and face ... the hunter managed to hold the leopard down, weakening the animal by the neck and by giving repeatedly blows to its head off the trunk of a tree. More recently still, in May of this year, one leopard started to make forays into a palm-oil plantation in Nkolamvan, in Kogo district. In the space of a week it had, between goats and sheep, made 15 kills ... alarmed, the man in charge of the plantation entrusted two hunters with the task of capturing the animal ... they shortly placed half a goat in the forest. Thinking that the leopard wouldn't take long to return they settled down close to the carcass ... at nightfall an enormous leopard appeared which they duly shot at it twice ...

the leopard disappeared back inside the forest. Not long after, the leopard returned to making its regular visits to the plantations. All the above information suffice to convince us on the fact that the leopard is still a long way away from disappearing in Guinea. Today, due in part to appropriate resolutions that regulate hunting and the use of firearms in the colony, rather than being close to disappearing, leopard populations seem to be on the increase ..." (Translated from *La Guinea Española,* July 25, 1955).

Forty years after Basilio´s study the state of knowledge on equatoguinean felids had hardly improved. The departure of colonials in 1968 and the subsequent period of political unrest led to a sudden reduction in the number of observations reported. Given that past observed trends indicating a continued decline in leopard range were also coupled by the absence of any formal protection, this absence of information provided the impression that leopards had been extirpated from the region, excluding perhaps a small population in the rugged and sparsely populated Niefang range. It was impossible to verify this assumption until the late 1990s, when the advent of oil renewed international attention in the region and a series of wildlife assessments were undertaken in the context of evaluating a number of areas for potential protection (IUCN 1998; Larison et al. 1999). As a result of these surveys, felid presence was reported from the Monte Alén area of the Niefang range, in the Monte Mitra masiff and in the Piedra Nzás inselberg complex of the eastern pene-plain. Although these earlier surveys showed the potential for cat persistence in a handful of areas of Rio Muni, their populations were deemed to be small and extremely insecure.

The most recent historical reports on cats were provided by general wildlife surveys reporting indirect records (Nchanji et al. 2005) and of species offtake surveys undertaken in bushmeat related studies (Fa, J. E. & García Yuste, J. E. 2001; Kümpel 2006; Rist 2007). All of these records were obtained from the Monte Mitra masiff and its surroundings and thus information on cats from other areas in Rio Muni remained virtually non-existent. Despite this lack of information, the conservation status of the leopard in Equatorial Guinea was assessed as Critically Endangered, whereas the status of the golden cat still remained without assessment (Nchanji et al. 2005).

In the following list, I summarize all available location records for leopards in colonial times and include felid reports made subsequently. Aditionally, information on the dates and circumstances in which leopards were shot, trapped, snared or otherwise

encountered by humans is given when available (Refer to fig. 14 for localities of each record).

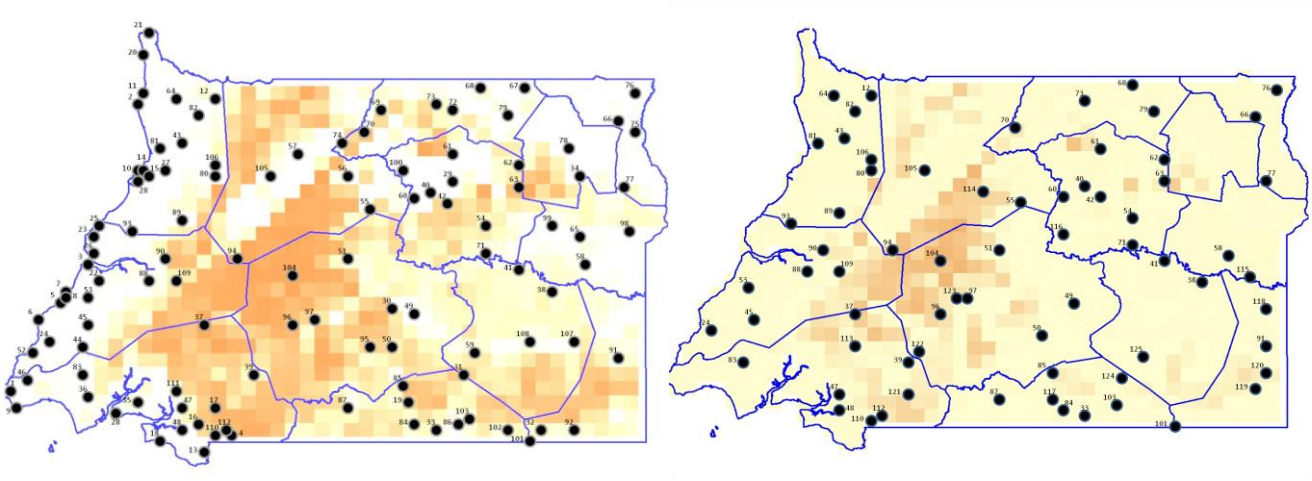


Figure 14. Map of historic and recent reports of leopards (left) and golden cats (right) in Rio Muni (locations are displayed on the occurrence maps developed in the results section).

Localities: 1:Cabo San Juan, 2: Punta Mbonda, 3: Rio Benito/Mbini, 4: Ngonekie, 5: Hanje, 6: Kubue, 7: Kumendje, 8: Ndote, 9: Calatrava, 10: Moganda/Lipon, 11: Evongo, 12: Ayamiken, 13: Asobla, 14: Bikui, 15: Limbe, 16: Akanabur, 17: Otoche, 18: Kangañe, 19: Ngon, 20: Tika, 21: Rio Campo, 22: Ncoesis, 23: Melongo, 24: Mondung, 25: Matondo, 26: Bolondo, 27: Mokoga, 28: Angolo, 29: Bimbiles, 30: Evinayong, 31: Kukumankok/akurenam, 32: Abumeyem, 33: Akurenam, 34: Eves Esandon, 35: Madya, 36: Nkolamvam/Ncolavam, 37: Monte Mitra, 38: Piedra Nzás, 39: Midyobo, 40: Ndjioveng, 41: Oveng Ndong, 42: Mfulayong Esatop, 43: Mbubuiñ, 44: Mboete-Mbini, 45: Engong-Mbini, 46: Ewonanam, 47: Amanening, 48: Magameñi, 49: Fegayong, 50: Mitemle, 51: Ayactanga, 52: Akanabot-Mbini, 53: Monguma, 54: Ondeng Nsomo, 55: Anvam, 56: Abenelang, 57: Ecoayop, 58: Nkum, 59: Kukumankok, 60: Tohalen, 61: Angonowañ, 62: Ncama, 63: Piedra Bere, 64: Bongoro, 65: Obee Okas, 66: Omonguen, 67: Afanegui, 68: Beayop, 69: Ncoenco, 70: Nkue, 71: Oyala, 72: Bisabat, 73: Mbe, 74: Olong Amvam, 75: Bife Eseng, 76: Ngocua, 77: Mocoga Yebiveñ, 78: Mengaha, 79: Niezam, 80: Mboete-Bata, 81: Seleyes, 82: Bidu, 83: Bonbon, 84: Mosogo, 85: Nguolosoc, 86: Basile, 87: Esong, 88: Binguru, 89: Ebian-Bata, 90: Abia, 91: Modjom I, 92: Nsumu, 93: Anguoc, 94: Mosumu, 95: Fimokua, 96: Teguete, 97: Nfaman, 98: Bilosi, 99: Acaasi, 100: Meseng, 101: Mbam Efac, 102: Acanabot, 103: Oveng-Acurenam, 104: Essamalán, 105: Mongo, 106: Akora, 107: Engong-Aconibe, 108: Afaanam, 109: Manyana-Uoro, 110: Mibonde Elón, 111: Mayang, 112: Mibonde San Miguel, 113: Ncoho-Motorá, 114: Corro, 115: Nsang Ayong, 116: Nsemsoha, 117: Ayaesong, 118: Epkuameyene, 119: Oveng-Nsork, 120: Mesee, 121: Ocuamcos, 122: Acurenam-Evinayong, 123: Nfua, 124: Ebian-Acurenam, 125: Engomgom.

1. Villagers reported a string of leopards attacks. One leopard killed a goat just outside the campsite. Cabo San Juan, Kogo district (Iradier, M. 1887).

2. A 1,20m long leopard was flushed out by two guard dogs and susbsequently climbed up to a tree. It was then shot and injured before being pulled to the ground. After five minutes of fighting it was killed by the dogs. Cabo San Juan, Kogo district (Guinea Española, Apr.1903).

3. A man-eater. No data on the number of victims, but this is reported to be high. Villagers scattered several poisoned goat carcasses across a wide area but the leopard left all intact. Late one evening, a woman and a boy were returning home from the beach when they came across a leopard on their path. As the leopard dissappeared in the vegetation they continued on course. As the woman arrived at the main door of her house, the leopard pounced upon her biting her neck and dragging her into the forest. From the same period and area a boy was also reported to have been killed by a leopard while playing in the beach. Punta Mbonda, Bata district (Guinea Española, Feb.1905).

4. A leopard killed numerous goats and chickens and injured a woman. Rio Benito, Mbini district (Guinea Española, Aug.1907).

5. One leopard was shot dead near the Otoche river. Ngonekie, Kogo district (Guinea Española, Dec. 1908).

6. A leopard killed 12 goats over the period of a month. Locals reported that, due to drought, animals left the forest to feed on crops, and as they came were followed by leopards into the vicinity of villages. One leopard was caught in a cage-trap and killed. Soon after a further leopard was spotted in the same area. Hanje, Mbini district (Guinea Española, Jun.1915).

7. After several years without reports on leopards in the area, reported attacks on rose to previous levels. A 1,60m long leopard killed more than 20 goats and a donkey. The animal was caught in a cage-trap but was able to dismantle the structure and escape. Finally, it was trapped in a snare and shot dead. Cabo San Juan, Kogo district (Guinea Española, Feb.1916).

8. A leopard that had been preying on goats escaped from a snare between the Naño and Ijono rivers. Locals reported that leopards had not been seen in the area for several years, and their recent comeback was due to a dramatic decrease in forestry activities in forest nearby that disturb both them and their natural prey.

Cabo San Juan, Kogo district (Guinea Española, May.1916).

9. During one night a leopard killed a guard dog near the Mision. The dog's head was found the day after in the nearby forest. Rio Benito, Mbini district (Guinea Española, Jan. 1917).

10. One leopard killed numerous dogs. Tracks were found on a daily basis near the Mision. A large antelope carcass was found in the surrounding forest. During the night a leopard was seen chasing several dogs within the village. The animal returned to the forest upon noticing several villagers sitting nearby. Soon after villagers offered a fresh leopard skin to one of the misionnaries working in the area. Rio Benito, Mbini district (Guinea Española, Jun. 1917).

11. Attacks on livestock and dogs reported as unusually high. A man returning home with his dog was attacked by a leopard that then carried the dog away. kubue, Mbini district (Guinea Española, Jun. 1917).

12. A 3m long leopard was caught in a cage-trap and shot dead. The skin and claws were sold. Kumendje, Mbini district (Guinea Española, Jun. 1917).

13. A leopard was caught in a cage-trap and killed. Ndote, Mbini district(Guinea Española, Jun. 1917).

14. A leopard was caught in a cage-trap and killed. Calatrava, Mbini district (Guinea Española, Jun. 1917).

15. A 2,30m long leopard was shot dead. Mision de Bata, Bata district (Guinea Española, Sept.1918).

16. One cub was shot dead. Punta Mbonda, Bata district (Guinea Española, Aug. 1919).

17. A leopard was caught in a cage-trap and killed with machete and spears in Evongo villaje, near Punta Mbonda, Bata district (Guinea Española, Aug. 1919).

18. One domestic pig killed by a leopard. Ayamiken, Bata district (Guinea Española, Aug.1919).

19. A leopard entered a military camp at nightime and killed a goat. The cat left its tracks all over the camp. Asobla, Kogo district (Guinea Española, Feb.1920).

20. A leopard that had been killing several goats over a month was caught in a cage-trap and killed with spears. Bikui, Bata district (Guinea Española, Mar.1920).

21. A leopard cub was found in a well and bought alive by a colonial. Limbe, Bata district (Guinea Española, Nov.1920).

22. A large leopard followed a dog into a hut and attacked an old lady found in its path. The woman suffered injuries to the head, chest, back and arms while the dog was killed. Family members arrived at the scene quickly to rescue the injured woman. However, as the leopard was aware of the presence of several villagers outside, it did not leave the hut. Instead, the

animal, while searching desperately for a way out, knocked down a torch setting the hut alight. The leopard died inside and locals preserved the cranium for rituals and medicine. Akanabur, Cogo district (Guinea Española, Oct. 1921).

23. A hunter wounded a leopard but was then killed by the animal. Otoche, Kogo district (Guinea Española, Oct. 1921).

24. A leopard killed a dog in a military camp. Kangañe, Kogo district (Guinea Española, Dec. 1921).

25. A 2.65m long leopard was caught in a cage-trap and killed with spears and a shotgun. This leopard had killed more than 30 goats in the village. Ngon, Akurenam district (Guinea Española, Jan. 1922).

26. Leopards were reported as very common in the area. However, tracks and sightings in broad day light were unusually common in such close vicinity to villages. A large antelope carcass was allegedly killed by a leopard was found in amongst some bushes. Tika, Bata district (Guinea Española, Sept.1922).

27. Leopard tracks were commonly encountered along the paths just outside the village. Rio Campo, Bata district (Guinea Española, Sept.1922).

28. A goat was killed by a leopard in broad day light. It was dragged 200 m away into the nearby forest. Ncoesis, Mbini district (Guinea Española, Sept.1922).

29. A leopard reported to have been killing numerous goats and chickens was driven off a partially devoured goat by villagers in the forests surrounding the village. They salvaged the leftovers for themselves. Numerous tracks were found along pathways. A leopard was seen patrolling amongst the huts at nightime. Melongo, Bata district (Guinea Española, Oct. 1922).

30. A leopard killed numerous goats and chickens. Numerous tracks were found along the paths surrounding the village. Mendung, Mbini district (Guinea Española, Oct. 1922).

31. Numerous goats and chickens reported to have been killed by a leopard. Tracks were found along the paths leading from the village. The leopard was trapped in a cage-trap baited with goat and a week later the animal was sent alive to Madrid, Spain. Matondo, Mbini district (Guinea Española, Oct. 1922).

32. Numerous tracks were found along the paths and one leopard was observed in early dawn hours. Upuanyo, Bata district (Guinea Española, Oct. 1922).

33. Numerous ducks and chickens reported to have been killed by a leopard. Bolondo, Bata district (Guinea Española, Oct. 1922).

34. A leopard that had killed ten goats in a week was finally caught in a cage-trap baited with goat meat and was then killed with spears. Mokoga, Bata district (Guinea Española, Jan.1923).

35. A villager killed a female leopard and her cub. Soon after this, another leopard started to kill domestic animals in the same area. Punta Mbonda, Bata district (Guinea Española, Jan.1923).

36. A leopard was seen during the night patrolling the streets of the capital city of Bata. The leopard killed a dog. Bata, Bata district (Guinea Española, Jun.1923).

37. A leopard killed several domestic animals. Angolo, Bata district (Guinea Española, Jun.1923).

38. A leopard killed several domestic animals. Moganda, Bata district (Guinea Española, Jun.1923).

39. A leopard killed several domestic animals. Lipon, Bata district (Guinea Española, Jun.1923).

40. A leopard was reported to have killed 3 pigs, 7 dogs, 11 sheeps, 3 goats and 1 duck. Villagers made numerous attempts to catch the animal by baiting several cage-traps, but the leopard seemed to avoid them leaving its tracks on the perimeter of the cage clearing. Bata, Bata district (Guinea Española, Aug.1923).

41. Villagers were attacked by a female leopard when they attempted to capture a snared cub. Lipon, Bata district (Guinea Española, Aug.1923).

42. A 2.70m long leopard that had been preying on domestic animals was shot by a misionnary. The leopard had a snare in his front leg. Bata, Bata district (El Misionero, Jan. 1925).

43. A leopard was caught in a snare and shot by colonial. Cabo San Juan, Kogo district (Guinea Española, Jun. 1927).

44. A leopard was caught in a cage-trap and killed by a military commander. Kogo, Kogo district (Guinea Española, Sep.1928).

45. A colonial sportsman was killed by a leopard. Bala, Mbini district (Guinea Española, Jul. 1929).

46. A 1,24m long leopard was killed. Bimbiles area, Añisok district (La Guinea Española, May, 1948).

47. A little boy who left his mother's sight momentarily was snatched from the criddle by a leopard. His mother was filling up water from a nearby pond. Punta Mbonda, Bata district (La Guinea Española, May, 1948).

48. A sick man who was resting inside his hut was killed by a leopard which dragged the corpse a few meters out the hut. The noise made by the observing villagers caused the leopard scarper and disappear into the forest. The victim's chest had been ripped open and his abdomen was partially devoured. Evinayong, Evinayong district (La Guinea Española, May, 1948).

49. A man working in his field was startled by a growl behind him. He turned his head and stood up to see a leopard very close to him. As the leopard attacked the man managed to hit severely on its head with a stick and killed it. Evinayong, Evinayong district (La Guinea Española, May, 1948).

50. The "man-eater of Kukumankoc" was alleged to have left several settlements devoid of human beings in the forest between Aconibe and Akurenam districts. A man who had lost his parents and sister took his revenge and killed it. Aconibe/Akurenam districts (La Guinea Española, May, 1948).

51. A leopard entered a hut following a domestic cat and then attacked a woman found inside. She shouted causing the leopard to run off towards the forest. The victim sustained injuries on her face. Abumeyem, Nsork district (La Guinea Española, July 25, 1955).

52. A man killed a snared leopard by beating it on its head with a stick. Bonbon, Kogo district (La Guinea Española, July 25, 1955).

53. One cub was killed in the suburbs of the city. Akurenam, Akurenam district (La Guinea Española, July 25, 1955).

54. A pair of leopards was observed on two different occassions by nightime. Road that links Akurenam an Evinayong, Akurenam district (La Guinea Española, July 25, 1955).

55. Six lepoards were reported as killed over a nine months period. Eves Esandon, Nsok Nsomo district (La Guinea Española, July 25, 1955).

56. A leopard attacked a hunter who had shot it twice. After a brief struggle the leopard died. Recorded near the Congue river. Madya, Kogo district (La Guinea Española, July 25, 1955).

57. A leopard killed 15 animals – all goats and sheep - in an extensive oil palm plantation. Nkolamvan, Kogo district (La Guinea Española, July 25, 1955).

58. General survey. Leopard and golden cat reported as present north of Laña river within Monte Alén National Park, Niefang district. Leopard and golden cat reported as present in Monte Mitra Massif, Kogo district. Leopard and golden cat reported as present in Piedra Nzás Natural Monument, Aconibe district (IUCN, 1998, *La Conservación de los Ecosistemas Forestales de Guinea Ecuatorial en los albores del año 2000*, Oficina Regional de la UICN para África Central).

59. General survey. A local reported that a leopard had been killed the week before surveyors entered the forest. Monte Mitra, Kogo district (Larison et al. 1999).

60. General survey. Leopard and golden cat reported as common by locals. A recently killed leopard in the area was photographed. Monte Mitra, Kogo district (Nchanji et al., 2005).

61. Bushmeat study. Three leopards and eleven golden cats were snared and killed from

1 January 1998–26 April 1999. Monte Mitra, Kogo district (Fa, J. E. & García Yuste, J. E. 2001).

62. Bushmeat study. Two leopards killed. Monte Mitra, Kogo district (Kumpel, 2006).

63. Bushmeat study. One leopard killed. Midyobo, Kogo district (Rist, 2007).

Here follows all reports on leopards and golden cats gathered throughout the duration of this study:

64. The last leopard was captured around 50 years ago. Golden cats disappeared before, roughly 70 years ago. Ndjioveng, Añisok district.

65. A leopard was captured in 2002. Golden cats have not been seen for at least 50 years. Golden cats were easily trapped (as many as 10 or more in one month) near river banks. Oveng Ndong, Aconibe district.

66. Leopard tracks and semi-devoured prey (red river hog) were last seen three years ago. The rocky area where leopard signs were usually recorded has since been partially destroyed due to use of dynamite. This site was degraded further by trucks carrying excavating rocks for road construction. Golden cats disappeared in the early 70s. Mfulayong Esatop, Añisok district.

67. Last leopard captured about 45 years ago. The grandfather of our interviewee stated that golden cats had existed in the area as he had caught a number of them in his youth. According to him, golden cats disappeared at least 20 years earlier than leopards. Mbubuiñ, Bata district.

68. One leopard was captured 15 years ago. Ncolavam, Cogo district.

69. The last golden cat was captured in the late 70s near the Aye river. Bonbon, Cogo district.

70. A leopard was captured 10 years ago in the forest surrounding the SOFOGE logging camp. Mboete, Mbini district.

71. Leopards and golden cats disappeared from the area in the late 60s. Engong, Mbini district.

72. Leopards disappeared in the early 70s. Ewonanam, Cogo district.

73. Leopards and golden cats disappeared about 30 years ago. Amanening, Cogo district.

74. Leopards and golden cats disappeared about 30 years ago. Magameñi, Cogo district.

75. A leopard was captured 4 years ago. Golden cats disappeared about 20 years ago. Fegayong, Evinayong district.

76. Two leopards and 15 golden cats were captured in the last two years. Mitemle, Evinayong district.

77. A leopard that killed several goats near the village was captured with a cage-trap in the early fifties. Another leopard was snared in February 2010 on a mountain two km away from the village. The pelt was sold for 150,000 CFA and the teeth for 10,000 CFA. Golden cats disappeared in the early 60s. Golden cats were known to prey on plumed guineafowl and blue duiker. Ayactanga, Evinayong district.

78. Golden cats were frequently trapped 20 years ago in areas located at least 15 km from the village, on the banks of the Motorá river. The interviewee stated he had hunted these cats in Gabon in the 80s. Ncoho, Cogo district.

79. A golden cat was trapped 5 years ago near the mouth of the Aye river. Mondung, Mbini district.

80. The last leopard was killed 30 years ago. The hunter confirmed the case of the golden cat killed in the Aye river mouth. Akanabot, Mbini district.

81. Leopards disappeared 30 years ago. Golden cats disappeared 50 years ago. Monguma, Mbini district.

82. A leopard was killed about 30 years ago less than 4 km from the village. Golden cats disappeared some 60 years ago. Ondeng Nsomo, Añisok district.

83. Leopards and golden cats were captured around the village around 70 years ago. Anvam, Niefang district.

84. Two years ago a leopard was captured about 5 km from the village. Abenelang, Niefang district.

85. The last golden cat capture occurred 30 years ago. Corro, Niefang district.

86. Leopards disappeared about 15 years ago. Ecoayop, Niefang district.

87. Golden cats disappeared about 70 years ago. Nsang Ayong, Mongomo district.

88. Golden cats disappeared during the 1940s. Leopards disappeared in the 1950s. Nkum, Mongomo district.

89. Two leopards were killed 5 and 6 years ago respectively in the central area of Piedra Nzás Natural Monument of Aconibe.

90. A leopard was captured in September 2010 in the surroundings of SAHAF company campus. Kukumankok, Aconibe district.

91. Leopards and golden cats have not been captured nor have their signs been observed for some 30 years. Tohalen, Añisok district.

92. Leopard tracks and kills (red river hog, bay duiker) are still found about six km from the village within the Monte Temelón Natural Reserve. Hunters noted that leopards occasionally steal animals caught in snares. Golden cats disappeared about 25 years ago. Angonowañ, Añisok district.

93. Leopards and golden cats disappeared about 35 years ago. Ncama, Añisok.

94. One hunter estimated that some 3-4 leopards are currently living inside the Piedra Bere Natural Monument. Golden cats disappeared about 60 years ago. Avelemang, Añisok district.

95. The last leopard was captured 18 years ago. The last golden cat was captured about 25 years ago. The interviewee has always hunted in this area situated in the south central part of Rio Campo Natural Reserve. Bongoro, Bata district.

96. The last leopard was captured 20 years ago. Obee Okas, Mongomo district.

97. Leopards and golden cats disappeared some 70 years ago. Omonguen, Ebibeyin district.

98. A leopard was captured about 30 years ago. Afanegui, Micomeseng district.

99. Leopards and golden cats disappeared in the late 60s. Beayop, Micomeseng district.

100. Last leopard killed 20 years ago. Ncoenco, Micomeseng district.

101. Leopards disappeared 30 years ago. Golden cats disappeared about 70 years ago. Nkue, Micomeseng district.

102. Leopards inhabited the near Melebe rock until 1996, when the area experienced large-scale development for the new city of Oyala. Golden cats disappeared about 40 years ago. Oyala, Añisok district.

103. Golden cats disappeared about 20 years ago. Nsemsoha, Añisok district.

104. Leopards are still present in low numbers in the rocky outcrops of central Piedra Bere Natural Monument. Mocomo, Nsoc Nsomo district.

105. The last leopard was captured 30 years ago. Bisabat, Micomeseng district.

106. Leopards and golden cats disappeared about 60 years ago. Mbe, Micomeseng district.

107. Leopards disappeared about 60 years ago. Olong Amvam, Micomeseng district.

108. Leopards disappeared about 40 years ago. Bife Eseng, Ebebeyin district.

109. Leopards disappeared about 50 years ago. Golden cats disappeared during the 1930s. Ngocua, Ebebiyin district.

110. Leopards and golden cats disappeared during the 1950s. Mocoga Yebiveñ, Ebebiyin district.

111. Leopards disappeared about 60 years ago. Mengaha, Nsoc Nsomo district.

112. Leopards and golden cats disappeared in the late 60s - early 70s. Niezam, Micomeseng district.

113. Leopards and golden cats disappeared about 20 years ago. Mboete, Bata district.

114. Leopards disappeared about 50 years ago. Golden cats disappeared about 30 years ago. Seleyes, Bata district.

115. A leopard was killed three years ago. Another leopard was seen early in the morning in January 2010, on the logging road linking Ayamiken and Bidu villages. In April 15 2010, I recorded fresh leopard tracks on the same road, about 2 km from Ayamiken (02º05´59.4´´N -010º01´06.1´´E). Golden cats disappeared 30 years ago. Ayamiken, Bata district.

116. The last leopard was killed in 1985. Golden cats disappeared about 30 years ago. Bidu, Bata district.

117. Two leopards, a male and female, were killed the same week in May 2010. A golden cat was captured 5 years ago. Mosogo, Acurenam district.

118. Last golden cat captured some 30-35 years ago. Ayaesong, Acurenam district.

119. There are still a few leopards and golden cats in the forest 15 km west of the village. The hunter reported that in March 2010 he saw a leopard at night crossing the road linking Acurenam and Nsork districts, about 2 km east of Acurenam city. Nguolosoc, Acurenam district.

120. Three years ago, whilst checking his traps, a hunter was approached by his dog running and barking. A leopard then appeared from the woods and turned back at the sight of the hunter. Basile, Acurenam district.

121. There are still a few leopards and golden cats in the forest crossing the Mvi river, near the Gabonese border. Esong, Acurenam district.

122. A golden cat was killed 1 year ago nearby over the Gabonese border. They say that game is more abundant on the Gabonese side of the border. Acurenam, Acurenam district.

123. The last leopard was killed in the mid 90s. Golden cats disappeared during the 50s. Binguru, Mbini district.

124. Leopards disappeared about 40 years ago. Golden cats disappeared about 60 years ago. Ebian, Bata district.

125. A leopard was seen in broad daylight 5 years ago. Four golden cats were recently captured (5, 4 and 2 years, and six months, ago). Abia, Mbini.

126. A female leopard was seen two years ago in a rocky area feeding her two cubs on a mandrill carcass. This observation was made some 7-10 km west of the village, inside Altos de Nsork National Park. Golden cats disappeared 20 years ago. Modjom I, Nsork district.

127. Golden cats disappeared about 30 years ago. Epkuameyene, Nsork district.

128. Golden cats disappeared 20 years ago. Oveng, Nsork district.

129. A golden cat was killed less than 5 km away from the village about 20 years ago. Mesee, Nsork district.

130. Two years ago a leopard lost its front paw in a snare. This happened in a mountainous area about 15 km north of Mbam Efac and Alum villages, following the Abang river. The leopard is known to be alive as because the hunter has seen his distinctive tracks (3 paw-prints and one stump) frequently while visiting the traps. He says that this leopard survives by stealing animals from snares. The same hunter gave an account of a leopard he had killed in January 2010 by the nearby Midjihi river, in Gabon. On this occasion the hunter was patrolling the forest at night with a lantern before suddenly spotting a leopard on a fallen log about 10 metres away. The leopard, unsighted by the light of the lantern, roared and leapt out of view behind the log. Whilst trying to glimpse the hunter, its head reappeared over the fallen log, allowing the hunter the opportunity to shoot the animal in the head. When the hunter moved over the log to recover the leopard, he found a partially devoured red river hog a further 6 metres away from. The hunter claimed that he had never seen a leopard in this area, and that game is less abundant across the border in Gabon. The hunter sold the pelt to a Chinese road worker at 120,000 CFA, and the canines at 10,000 CFA each. I personally observed the animal's skull. Nsumu, Nsork district.

131. In January 2010 a female leopard accompanied by her cub was seen moving along a forest trail near the Uoro river. The hunter claimed he had not seen another leopard in the area for at least 20 years ago. Golden cats disappeared in the 1950s. Anguoc, Bata district.

132. Leopards and golden cats have been caught 3-4 times each over the last ten years in the forest where the Uoro and Laña rivers meet. We witnessed the skull of a large leopard killed three years ago. The area is situated in the north-western sector of Monte Alén National Park. Mosumu, Niefang district.

133. Last golden cat was captured 25 years ago. The hunter claimed that it was an easily hunted animal which lived near the rivers. Long ago, it was much more abundant than the leopard. Midyobo Amvom, Cogo district.

134. The last golden cat was captured about 20 years ago where the Senye and Mitemele rivers meet. Ocuamcos, Cogo district.

135. The last golden cat was captured 25 years ago. Acurenam, Evinayong district.

136. A leopard killed and devoured a blind elder in his bed inside his hut. This took place during the 1940s. This account is similar to a Basilio´s report, and although the name of the village it is not mentioned, it is in the same district. A leopard snared in the forest surrounding the village in March 2010. The photo of this animal appeared in the national

paper La Gaceta de Guinea Ecuatorial. Fimokua, Evinayong district.

137. Three leopards were captured in a two week period in June 2010. These leopards were trapped by the Tega river. A golden cat was captured 1 year ago. Teguete, Evinayong district.

138. Leopards and golden cats disappeared about 20 years ago. Nfaman, Evinayong district.

139. Golden cats disappeared about 20 years ago. Nfua, Evinayong district.

140. Leopards disappeared about 40 years ago. Bilosi, Mongomo district.

141. Leopards were common near the village 50 years ago. They were observed throughout the dry season (June, July, and August) and remained in rocky areas. They ate pangolins and left the scaly remains intact. When the rainy season commenced the leopards returned to the forest near the Uoro river. Acaasi, Mongomo district.

142. Leopards disappeared about 40 years ago. Meseng, Añisok district.

143. Leopards and golden cats were commonly trapped about 60 years ago within 6 km of the village. They have since disappeared. Mbam Efac, Nsork district.

144. Over a period of around 50 years, throughout which no leopard was caught or noted, one was shot in 2008 in the forest located 6 km north of the village. We were able to observe the animal's skull. The hunter suggested that this animal came to the area as a result of logging practices by SHIMMER near Engong (NW Altos de Nsork National Park) leading to many animals moving to the south, away from the noise. Acanabot, Acurenam district.

145. Leopards disappeared about 40 years ago. Golden cats disappeared about 60 years ago. Oveng, Acurenam district.

146. Golden cats disappeared about 60 years ago. Ebian, Acurenam district.

147. Golden cats disappeared about 40 years ago. Engongom, Aconibe district.

148. A golden cat was trapped 10 years ago on a large island situated on the river Uoro NE of Bisun camp. The hunter has been active in the area throughout the last 20 years and he stated that leopards are far more common than golden cats. Two leopards were killed 30 years ago in the area where the Manyana and Uoro rivers meet. Sendje I, Mbini district.

149. A leopard was killed 18 years ago in the Essamalán area of Monte Alén National Park. A golden cat was seen 8 years ago fleeing from a tree hollow as researchers were while cutting a transect line in the Essamalán area of Monte Alén National Park. Evinayong district (S. Eseñ com.pers.).

150. A semi-devoured bay duiker and several leopard tracks were observed near Eseng camp (this camp is used by hunters from Midyobo

Amvom, Cogo). These signs were observed during the formation of transects during 2007 Rist PhD study. Cogo district (S. Eseñ com.pers.).

151. Leopards and golden cats used to be common, but nobody has caught one for at least 50 years. Mongo, Niefang district.

152. The last known leopards and golden cats were hunted about 30 years ago. Akora, Bata district.

153. Ten years ago, a hunter saw a leopard at the time it was dragging his dog to the forest. Leopards still pass by the village (within two km). They live amongst rocks and caves. Engong, Aconibe district.

154. In the 1960s a leopard was trapped near the village. Now no leopards exist within 10-15 km of the village. Afaanam, Aconibe district.

155. A snared leopard was beated to death with a stick in January 2010. The hunter was wounded in the arm while doing so. Golden cat disappeared 25-30 years ago. Mibonde Elón, Cogo district.

156. A leopard found dead in a snare in June 2010. Mayang, Cogo district.

157. Two golden cats trapped about 30 years ago. These were the last known specimens hunted in the forest of the village. Mibonde San Miguel, Cogo district.

158. In August 2010 one leopard skin was displayed during a traditional dance celebration. Mbini, Mbini district.

Taking into consideration both the current distribution of felids and historical accounts on where they used to occur it appears that leopard and golden cat survival in Equatorial Guinea may be attributed to the fact that the rugged topography of the country may have provided refuge from hunting pressure and logging-associated disturbances. However, if we consider historical reports golden cats appear to have disappeared many years before than leopards from most sites. Why? Deforestation has been widely accepted as the greatest threat to this species. However, golden cats have been reported to do well in secondary forest (Kingdom 1977) and in Rio Muni there are still tracts of forest large enough to harbour species that require extensive forested areas, such as the forest elephant, and even within most of these forest the golden cat appear to be very rare or absent.

During the fieldwork phase of this study, I have tried wherever it was possible to talk to elders about their experiences with felids from the days in which these animals were present

or even common in their forest. Several of these former hunters coincided in their opinion regarding habitat preferences of cats: leopards were more locally abundant in rocky areas, while golden cats were more frequently catched in riverine habitat. This preference for areas near water courses was also previously noted for golden cats by Basilio (1948). The differences in vulnerability to human activities may be related to species-specific factors such as the above plausible habitat preferences.

Although being one of the world´s most poorly known cats all suggestions regarding the causes that may have driven to the current dramatic situation of this species in Rio Muni must be considered with caution, in the following I provide some plausible explanations that may apply for this topic.

1. Hunting niche of human hunters overlaps to a major degree with areas used preferentially by golden cats than with areas used by leopards. Based on the relative number of skins of different west African felids in collections, Rosevear (1974) though that golden cats were easily hunted. In the Monte Mitra area of Rio Muni, a relatively pristine area currently included within the Monte Alén National Park, 11 golden cats and 3 leopards were ensnared over a period of 16 months (Fa, J. E. & García Yuste, J. E. 2001). This higher capture rate for golden cats may be due to the fact that they were indeed more abundant than leopards in the area. Alternatively, because hunters do not use the landscape homogeneously but concentrate their efforts on the most accesible areas, it is plausible that the spatial niche overlap between humans and golden cats is higher than between humans and leopards and therefore golden cats are more prone to be catched than leopards. According to historical reports, riverine forest habitat appeared to be used frequently by golden cats in Rio Muni. Areas near freshwater courses have also been preferentially used by humans over the last 300 years (when the Fang and other Bantu tribes arrived to the region and became sedentary). Hunting along the course of rivers has been always a common practice in the area, where the abundance of large rodents (Emin´s rat and brush-tailed porcupine), pangolins and duikers appear to be higher at the village´s hunting territory scale (Rist 2007). Although this must have had little consequences on golden cat populations as the human population remained at low levels, its impact may have been significant by the mid of the XX century, when population density in Rio Muni became one of the highest of the Congo Basin nations. During a three-month period of wire-snare trapping at four sites in Lobeké, SE Cameroon, 13 golden cats were captured (Ray et al. 2005). It appears from the above information that although golden cats are not the primary target and constitute a small proportion of the catch, intensive hunting can

remove substantial numbers. Given that Rio Muni is one of the most intensively hunted tropical areas of the world since the advent of the commercial hunting of bushmeat, within this context golden cats may have suffered from "piggyback extinction" (Clayton, Keeling & Milner-Gulland 1997) while traps continue to produce acceptable yields of more common game species.

It is interesting at this stage to note that although leopards were once common in the coastal plain, they have been almost completely extirpated from this area and currently they appear to be present only in the southern tip of this plain, where there is some hilly terrain available. Leopards all over the world seem to be more resilient to human related activities and to competitive exclusion by other predators when living at or near topographic ecotones such as rocky outcrops surrounded by flat or slightly undulate terrain, edge of mountain ranges and gorges. The coastal plain shows a topographically homogeneous terrain and it is likely that the extirpation of leopards from the area may be related with the scarcity of refuges in the form of hard-edge topographic features less likely to be used by humans.

2. Logging associated disturbances. Commercial logging in Rio Muni started in the 1920´ in the easily accessible forest of the coastal plains and expanded further inland following the courses of major rivers. Widespread comercial logging accross the whole topographically accessible areas in Rio Muni was a process that took place gradually from the 1940´ to 2008. The most common behavioral change exhibited by wildlife to human-produced noise, such as that derived from logging activities, is active avoidance. Recent studies (Rabanal et al. 2010) assessing the impact of noise on a set of mammals in Gabon suggests it has a greater effect for mammals with larger home ranges (which have the possibility to move elsewhere further away from the noise), than for small-range mammals whose movements are more restricted. Although felids were not included in the above study, human-induced noise avoidance by leopards (Ngoprasert et al. 2007) and other felids such as bobcats and cougars (Reed et al. 2008) has been previously documented. It seems plausible that as wide-range species possessing highly acut sensory systems, felids in African rainforest may be highly sensitive to human-induced noise. Referring to the golden cat, Nowell & Jackson (1996) suggest that this species favour primary equatorial forest with little human disturbance. Virtually all lowland and easily accessible riverine areas of Rio Muni have been heavily exploited, while mountains, due to their topographic complexity, have tended to be somewhat less vulnerable to commercial logging and its associated noise disturbance. The leopard's natural tendency toward areas where the

magnitudes or rates of ecosystem properties changes abruptly in relation to those within the matrix appear to have better equipped them to deal with low and scattered remnant population as this topographic features are less favoured by humans to conduct high impact economic activities.

Finally, it is interesting to note that during our survey no golden cat reports were collected from the extensive tract of forest expanding in a contiguous form from north-eastern Evinayong district, all along the Uoro river basin in northern Aconibe district and to northern Nsork district. Human population density in this region has been historically, and continues to be so today, one of the lowest in Rio Muni. Therefore, the absence from this large area of the golden cat and other species included in this study, may not be atributed to intense levels of hunting. A plausible explanation is that a large portion of the latter forest is inland swamp forest, a habitat type in which the golden cat has not yet been recorded (Nowell & Jackson 1996).

Further research is needed.

Addressing site-specific opportunities and threats to cat populations

8. ADDRESSING SITE-SPECIFIC OPPORTUNITIES AND THREATS TO CAT POPULATIONS

Like all living beings, leopards and golden cats need food and space to survive. However, cats, their prey, and their habitat are all increasingly threatened in Rio Muni. This section outlines current understanding about the nature, scale, and cause of these threats.

8.1. Direct killing

Cats are not "traditional" bushmeat species and no special efforts are made to hunt them. They are generally captured on an opportunistic basis and when hunters can afford to be selective, they generally prefer large rodents, ungulates and primates. Consequently, cat poaching in Equatorial Guinea appears to be a very rare event.

8.2. Incidental killing

Individuals are more likely to be killed unintentionally in cable snares set up for other species. Cable snares are notoriously non-selective and they can reach high densities in the forest of Rio Muni.

8.3. Trade in cat parts

We have found indications for an international trade in leopard parts (mostly originating from Gabon). However, the scale at which it occurs appears to be currently insignificant (leopard parts were offered for sale in just 7 villages out of 198) in comparison to other threats described in more detail below.

8.4. Prey base depletion

Prey species are under heavy human subsistence and commercial hunting pressure. However, we have found that some of them (large rodents, blue duiker, red river hog and bay duiker) appear to be still common and widespread across Rio Muni if we exclude the most densely populated areas or the immediate vicinity of villages where cat populations were extirpated long ago. Therefore, we do not consider prey base depletion to be one of the current leading threats to cats in the country. However, the apparent robustness of the above prey species may change in the near future given that hunting pressures are expected to intensify with more urban wealth, further fragmentation of forest patches disrupting the source-sink dynamics of game species, fewer rural construction jobs, and a country-wide improved road network.


Figure 15. A servaline genet and two blue duikers waiting at hunter´s house for transport to big city markets. A yellow-backed duiker´s skull, Rio Campo Natural Reserve.

8.5. Habitat fragmentation due to transportation infrastructure

This is currently the main threat to cat populations in the country. With the increasing spatial demands of transportation infrastructure and predicted continued growth in traffic flows, conflicts between infrastructure development and preservation of tracts of forest large enough to harbor cats in the long-term are inevitably set to increase in the future. In Rio Muni, as a result of the location of human settlements along roads, the infrastructures may be acting as a permanent barrier to the movement of cats as they avoid wandering within several kilometers of areas of current human activity. Additionally, the detrimental effects of roads include increasing human access into formerly remote areas and subsequent disturbances and increased levels of hunting.

8.6. Human encroachment into forested areas

The direct effects of human activities such as habitat loss and poaching are readily discernible. However, the effects of other human activities are subtle and more difficult to document. This is the case of a form of virtual fragmentation of the habitat as a consequence of widespread and persistent human activity by trails, forest camps, non-timber forest product harvesting and so forth. In the human-dominated landscape of Rio Muni, this appears to be one of the main drivers of cat range contraction.

8.7. Habitat fragmentation due to large-scale commercial agriculture

Commercial agriculture will be one of the main areas of economic diversification in the country and the Government is currently working with chinese consultants on this topic.

Although they are still in an embrionary stage, monocultures are expected to expand greatly during the next decade further reducing the forest cover.

8.8. Indirect threats

The adverse impact of the above factors likely cannot be reduced without also addressing the broad underlying factors that contribute to environmental harm. These include weak legislation for Protected Area management, lack of funding for fieldwork, lack of legal enforcement, lack of land use planning that incorporates conservation concerns and priorities and lack of alternative protein/income sources in rural areas.

In addition to site-specific threats, in the following section we report on areas across the ranges of both cat species where conservation action and funds would have the greatest impact on conserving cats over the long term. With the aim of facilitate comprehension we divide the country into two macro-zones: the northern half of Rio Muni and the southern half of Rio Muni.

8.9. The northern half of Rio Muni

This area, roughly referring to the territories located north of the Uoro River, includes the districts harbouring higher human populations and a long history of logging and commercial agriculture activity. Moreover, during the last 10 years this area has been subject to a major increase in infrastructural development, including construction within some protected areas. For example, the Rio Campo Natural Reserve, an Important Priority Area for great apes according to the "Regional Action Plan for the Conservation of Chimpanzees and Great Apes in Western Equatorial Africa" (Brazzaville Workshop, Tutin et al, 2005), has been bisected during the last year by the road connecting Bindung and Rio Campo. The majority of cat populations remaining in this portion of the country are confined to small and isolated forest patches, which according to the current and future prospects of infrastructure development will be under increasing anthropegenic pressure. Considerable uncertainty surrounds the issue of minimum habitat area required to ensure the long-term survival of populations of forest carnivores facing hunting. However, if we take into account our average density for leopards in Rio Muni (2.7 leopards/100 km^2) and consider that a potentially viable population of leopards must include at least 7 breeding females or a total of 14 individuals if we assume an equal sex ratio at birth (Chapron et al. 2008), the minimum area needed to support a population of leopards with potential to persist in the long-term would be at least 518 km^2. Protected areas in this northern half of the country includes the above mentioned

Rio Campo Natural Reserve - 330 km^2, Monte Temelón Natural Reserve – 230 km^2 and Piedra Bere Natural Monument – 200 km^2. It is clear that none of these areas are large enough to support a viable population of leopards, especially as our average density for this area is likely to be slightly inflated (as estimations included areas in the southern half of the country, where leopard populations are in a much better shape).

Figure 16. The forest of Campo Ma´an National Park (Cameroon) as seen from the Equatoguinean side of the Ntem river.

The implementation of a habitat corridor for cats between the above protected areas would be both unattainable and unfeasible, across areas with both high and well established human population densities. Until 4-5 years ago, a large tract of relatively undisturbed forest spread in an almost contiguous form from southwestern Añisok district all along the Uoro River to south-central Mongomo district. Cats are still present in the area, but they are losing ground at an alarming rate. In the central part of this forest, the construction of an entirely new and modern city, Oyala, is currently underway. Its construction involves building new roads resulting in forest fragmentation (Añisok-Oyala, Oyala-Akonekieñ-Mongomeyen, Milong-Nguiep-Oyala, Oyala-Misión San José), a major construction site, traffic, construction noise, dust, pollution, explosions, and thousands of workers increasing local demand for wildlife and other forest products. With a stream of cars and construction trucks driving in and out of the area, the illegal bushmeat trade supplying Añisok city is rampant. Moreover, in the western edge of this forest the construction of the great dam of Djiploho is at an advanced state and, in combination with a large stone quarry near Akonekie village has also

contributed to the major degradation of this formerly magnificent forest. In conclusion, the long-term persistence of cat populations in the northern half of the country appears bleak.

The only area with remaining potential for the long-term conservation of cats is perhaps a rugged and sparsely populated unprotected area that appears to be out of the Government plans of infrastructure development, connected to the 2,640 km^2 tract of forest of Campo Ma'an National Park in southwest Cameroon. This area comprises a tract of forest bounded by the Mvuba river to the south, the Cameroonian border to the north, Maameñi villaje in the east and Yeayob hunter camp (formerly Mataamalong village) to the west. There are several sound reasons for pursuing some level of conservation here, given that in addition to harbour a few leopards and golden cats according to hunter reports, it represents the last refuge for the hippopotamus in the country (likely to count less than 10 individuals) and also holds healthy great ape populations. The abandonment of several villages in this area in recent times and the possibility of connecting this area with Cameroon's Campo Ma´an NP, where both leopards and golden cats are also present, adds to its conservation value, giving it potential to become a large international protected area. The main threat to the area is the heavy commercial poaching that is currently taking place to meet bushmeat demand from the cities of Niefang (Cameroonian and Equatoguinean hunters from Yeayob camp, and hunters from Anguma village), Nkue and Micomeseng (hunters from Maameñi villaje). However, its protection would be feasible, as it is accessible by only two roads: 1) Yeayob-Anguma-Niefang road and 2) the road linking Maameñi to the primary road that connects Nkue and Micomeseng. In addition to the easily controlled access to the area, there are very few villages left. Therefore, the implementation of a bushmeat alternative project in just 2-3 villages could likely exert a major impact in the area.

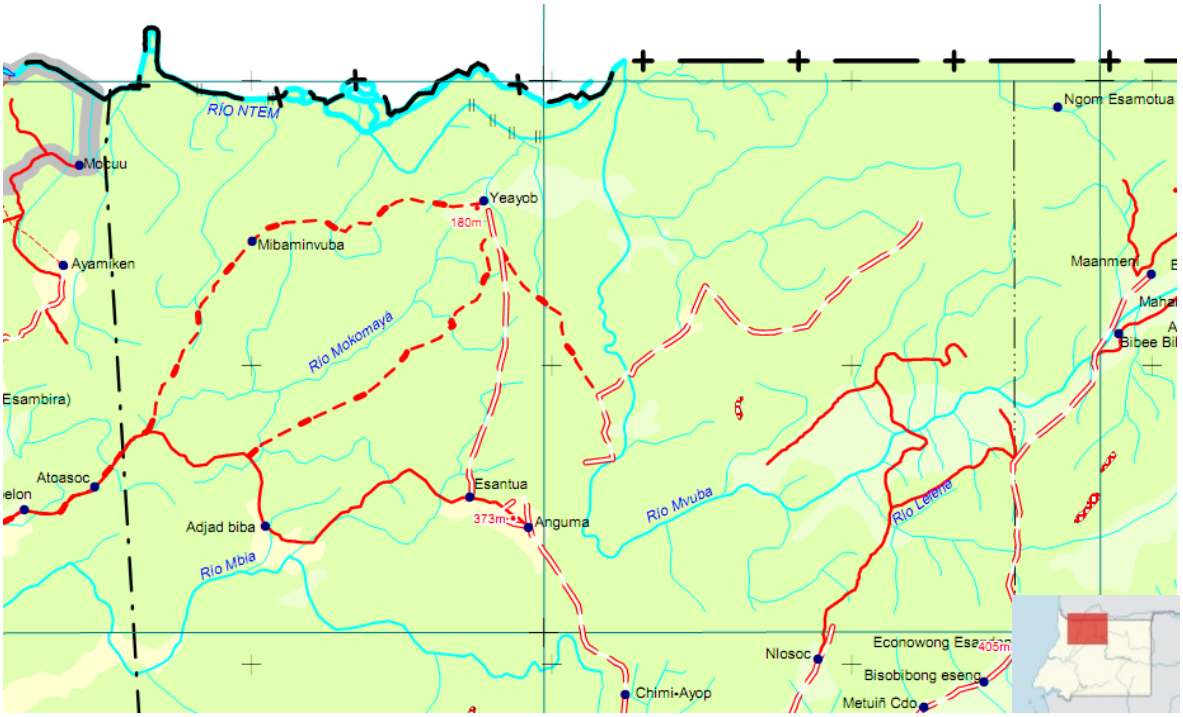


Figure 17. The forest bounded by the Mvuba river to the south and the Cameroonian border to the north, offers *a priori* the best chance for long-term conservation of both leopard and golden cat throughout the northern half of the country.

8.10. The southern half of the country

Given that large and relatively intact areas will be required to support viable populations of cats, major conservation efforts should be focused in the still heavily forested and sparsely populated southern half of the country. There are several protected areas enclosed within this portion of Rio Muni (Piedra Nzás Natural Monument-190 km^2, Altos de Nsork National Park- 700 km^2, Monte Alén National Park-2000 km^2 and the Rio Muni Estuary Natural Reserve –with a terrestrial surface of 505 km^2) and most of the land outside of the above protected areas is divided up into abandoned concessions roughly covering 5,000 km^2. Now that timber concessions are cancelled or abandoned, the status of this large tract of forest is uncertain, providing new opportunities for the substantial expansion of some of the above protected areas.

In between the areas that appear to hold better promise for successful long-term conservation, the most outstanding in terms of cat´s occupancy values, overall integrity and potential for connectivity with other important cat areas is the Monte Alén National Park (MANP). Currently, the primary threat to the area is commercial hunting of bushmeat and lack of effective law enforcement. The northern half of Monte Alén (roughly matching the

area located north of the Laña river) is entered on its eastern side by hunters from the villages located on the main road Niefang-Evinayong, such as Bicaba, Nkumekieñ and Bisun. These hunters operate in the rugged area located between the main road and the Mbono and Bilene rivers, and reach the Essamalán bai located in the central part. In the western side, hunters from the villages of Miyobo, Mibaminga and Mosumu enter the protected area after crossing the Uoro river, and operate along the courses of the Nyono, Makeng and Laña rivers. We have reported several recent events of incidental ensnaring of both leopards and golden cats from this area. Main point destination of bushmeat from this area is the city of Niefang.

The Monte Mitra area (the sector of Monte Alén National Park located south of the Laña river) is also subjected to heavy commercial poaching, mainly by hunters from the villages of Sendje I, Emangos and Ncoho in its western side (point destination of bushmeat from this area is the city of Bata), and by hunters from Misergue in the eastern side (point destination of bushmeat from this area is the city of Evinayong). There are many hunting camps inside this area (Churu, Ongamsok, Tomasi, Abengnam, Evodulu, Mabumom, Bisun, Avindja, Etombong, etc.) although hunters report that most of them have been abandoned in recent times. Leopards are reported to be common around several of these remote camps, especially in the triangle Churu-Abengnam-Mabumom. Despite high levels of hunting, wildlife is still abundant in Monte Alén National Park. Its dramatic topography, combined with the absence of permanent human settlements and the size of the forest in which it is embebbed (that spreads contiguously into northern Gabon via the western third of the National Forest) makes of this protected area a stronghold for cats in Equatorial Guinea and across the whole Biafran region.

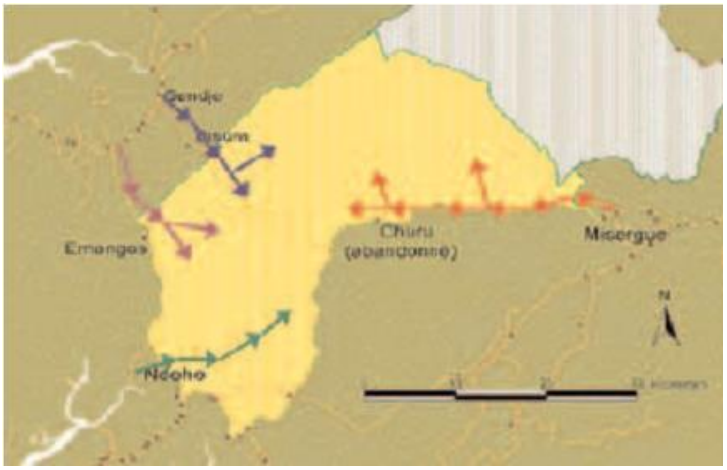


Figure 18. Commercial hunting routes in the Monte Mitra area of Monte Alén National Park. Source: ECOFAC 2004.

Also critical is the western third of the proposed National Forest. This forest block spreads in a contiguous form from the Monte Mitra area of MANP, all across the Mitemele river valley and to the Mont Seni sector of Monts de Cristal National Park in northern Gabon. This area is extremely important for conservation of large mammals as it supports an intact assemblage rarely found elsewhere in the country. There are very few roads in this portion of Rio Muni and the current human population density is low, with villages mainly concentrated along the Ebolowa-Cogo road. In some remote areas, several villages have been abandoned and fields recolonized by forest. The whole area is under heavy poaching pressure, mainly from hunters from the villages of Cuma, Midyobo Amvom, Ocuamcos, Efulán and Mibonde San Miguel (Cogo district) and Acurnnam, Oveng, Teguete and Mbe Bosque (Evinayong district).

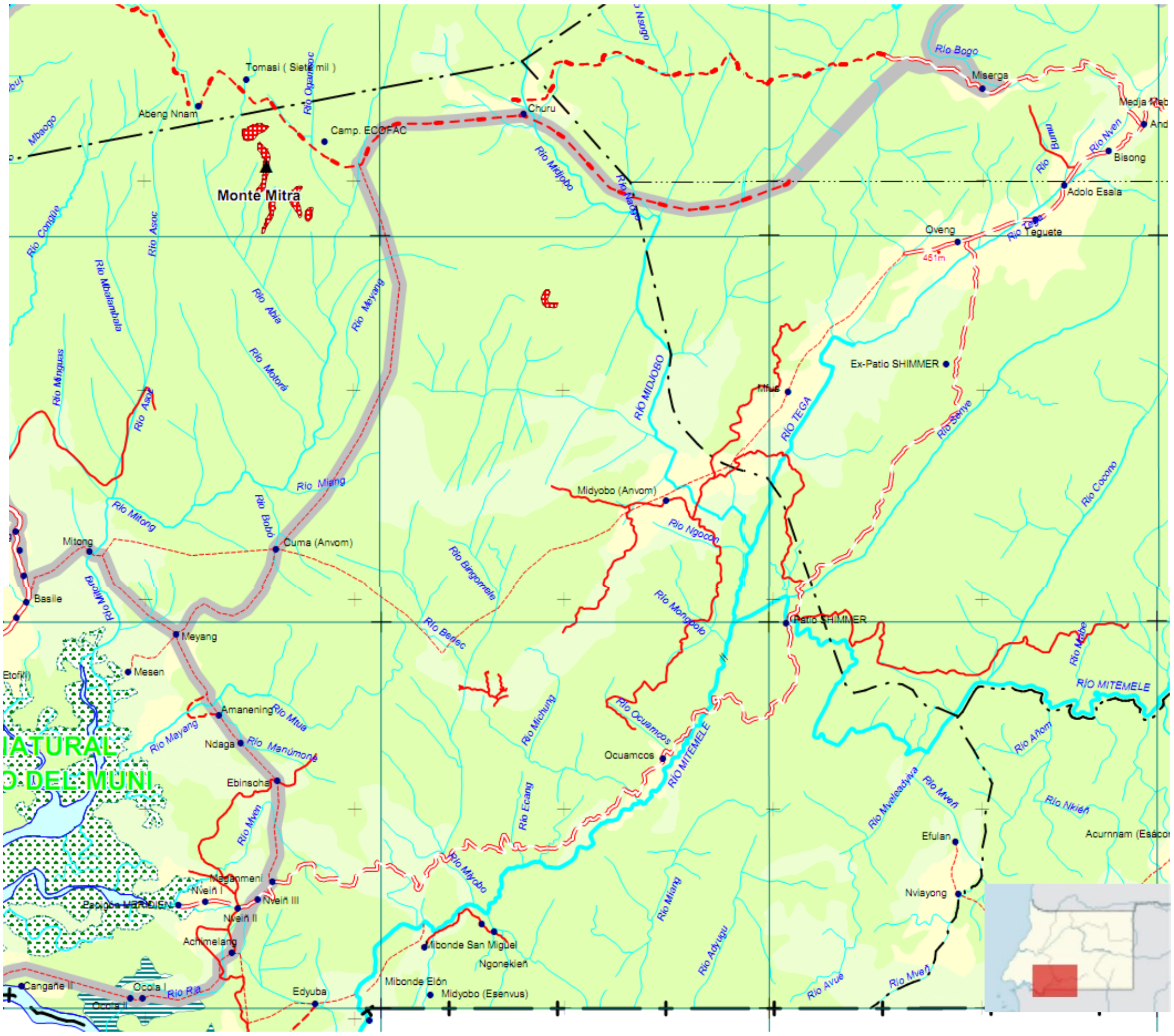


Figure 19. The western block of the proposed National Forest. This area provides for the physical linkage with Protected Areas to achieve CARPE´s Landscape 1 conservation objectives.

While the western block of the proposed National Forest retains a substantial share of the country's largest tracts of intact rainforest, these forests are becoming increasingly open to human access by enhancement of old roads and building of new ones. Of particular concern is the planned road that would link Alenasi (Acurenam district) and Midyobo Amvom (Cogo district), and the road Midyobo Amvom-Ocuamcos-Ngonekieñ (currently in an early stage of construction). If finally implemented, these roads would fragment the central part of the forest of the Mitemele river, that are crucial for the implementation of a corridor not only for cats, but for other wide-ranging species, such as elephants, that use this area in their movements between Equatorial Guinea and Gabon. In this regional context, the future management of the Mitemele river valley area could be extremely important and would enormously increase the likelihood of maintaining viable populations of cats and other keystone species in the long-term. Certainly, with a proper analysis of all of the human and biological factors involved, a sensible project for the conservation of biological diversity could be established. It would have to be a reserve that would provide integral protection for a number of small core zones containing key habitats and wildlife populations and a general management scheme for the entire area.

Figure 20. The author and INDEFOR staff displaying a leopard skin somewhere between Acurenam and Cogo districts.

Other important cat areas can be found in the eastern block of the National Forest. This area comprises the forest of Aconibe, eastern Acurenam and Nsork districts. Leopards are present in several remote areas, although they appear to be less common than in the western block of the National Forest. Golden cats appear to be extremely rare throughout this area. There are two protected areas embebbed in this forest block: the Altos de Nsork National Park and the Piedra Nzás Natural Monument. The main threat for both areas is heavy commercial hunting of bushmeat and, more recently, increased levels of isolation as a result of recent and ongoing road network rehabilitation (Mongomo-Nsork-Acurenam, Engong- Nzang Ayong, Asok-Aconibe-Evinayong). Hunters operating in Piedra Nzás are mainly from Ovengasem village (Mongomo district), one of the main sources of the bushmeat sold in Mongomo city. Altos de Nsork is also heavily hunted to feed demands from Mongomo. Villagers from Modjom I and Mesee enter this protected area by its eastern side and to its very centre, while hunters from Nsumu, Akoasakira and Mocula operate in the southern areas. In general, the same type and scale of threats facing Altos de Nsork and Piedra Nzás are operating across the other forested areas included in the eastern block of the National Forest. Concerns about the future of cat populations in the Eastern block are especially relevant given that they are mainly limited as to where they can seek refuge in the area, and the flat or slightly undulate topography that characterizes most of this area may not provide the levels of protection against human activities found in the Monte Alén/western block area. Additionally, the two protected areas included in this forest block are too small to harbor cat populations over the long-term and in the face of increasing isolation.

The good news is that currently there still remain blocks of habitat capable of sustaining cats. One option to secure cat populations would be to increase the current size of protected areas. There is great potential for expansion of Altos de Nsork National Park, given that a substantial area of uninhabited forest located in its western side appears to be out of the Government plans of infrastructure development. This forest spreads from the Abang river (western limit of Altos de Nsork NP) to the sources of both the Mbo and Ntoro rivers, located further west. With effective management, this region of southeastern Rio Muni could remain one of the most important areas for cats in the country.

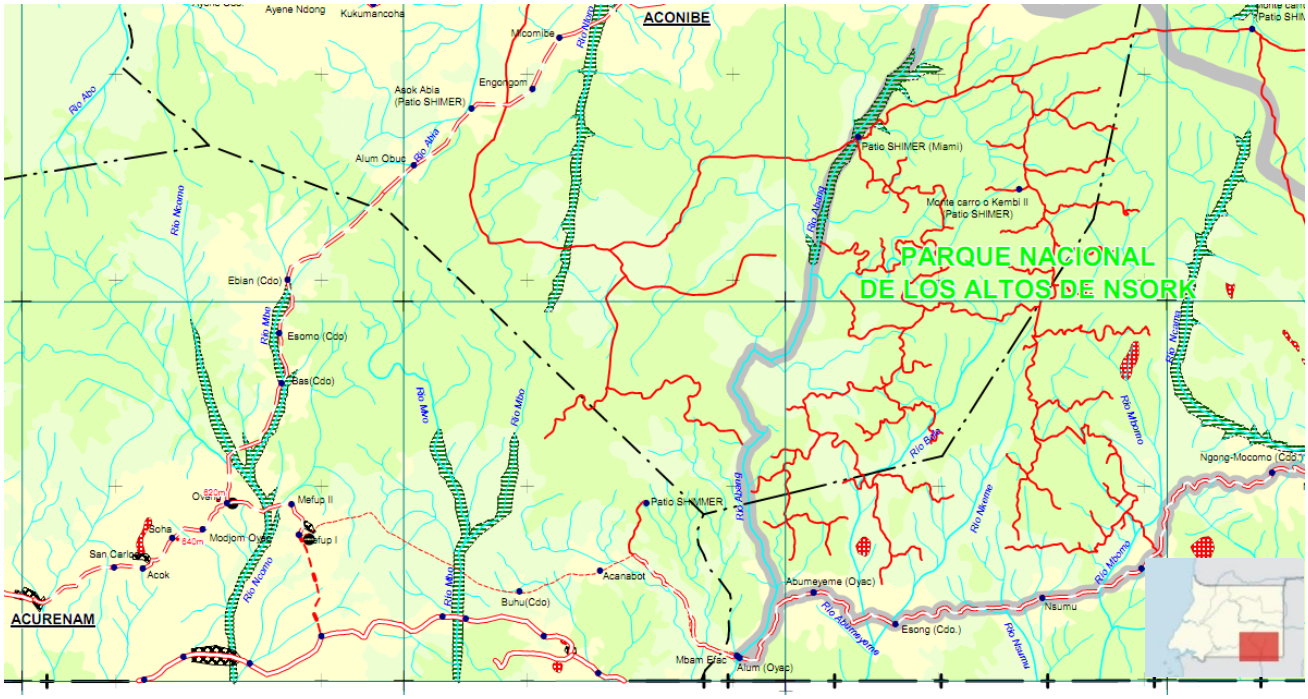


Figure 21. Altos de Nsork National Park and the block of forest between the Abang and Mbo/Ntoro rivers.

9. CONSERVATION ACCOMPLISHMENTS AND EVALUATION

The support of this project by collaborators and partners has lead to major steps being taken in the right direction for conservation in the Biafran region. Overall, our results are likely to be useful in crafting conservation strategies that appropriately blend protected areas, land-use changes and law enforcement to ensure the persistence of Equatoguinean large predators. Despite the great damage already inflicted upon cat populations, there is still time to work with national and international partners to ensure a future for them in the country. The effectiveness of our efforts, however, will depend upon working in synergy with other conservation initiatives, long-term site based presence and on-going financial commitments. The strong involvement of local counterparts and stakeholders provides an excellent opportunity to push for the integration of cat conservation and rural development policies in the country. I really believe that the strong and well functioning collaborations I have witnessed in EG places us in a unique position to build upon each other's respective projects and work towards conservation success in the country. The following presents a detailed account on accomplishments that have been achieved:

1. This study has improved and updated the overall distributional knowledge and status of leopards and golden cats in a poorly documented region, and has contributed in redressing the geographical bias towards carnivore research and conservation in the continent.

2. Our results provide a comprehensive baseline for meaningful large-scale monitoring and adaptive management of felids and a set of other threatened species, and broadly describe how historic changes in landscape composition and human demography has altered mammal community structures in Rio Muni over the last century.

3. We have identified new and persistent factors threatening the future of cats and other threatened species in Rio Muni, identified important landscape attributes around the remnant core cat populations, identified critical areas for cat conservation and potential dispersal corridors, including opportunities for future transboundary cooperation.

4. We have empowered conservation managers in three important ways: 1) By increasing the accuracy of the knowledge of the distribution and abundance of cats, their prey and several species of global conservation concern so that conservation managers can precisely target and counter threats; 2) By increasing the

understanding of the extent and character of the threats that create extinction risks for cats so that conservation managers can precisely target and counter threats; 3) By disseminating this improved knowledge so conservation managers and conservationists can educate and engage key audiences and more effectively mobilize multi-sector support in efforts to secure a future for cats.

5. We have identified key contacts within the national implementing institutions for biodiversity conservation, and have increased their awareness about the plight of Equatoguinean's cats. We have developed our work in collaboration with the major local environmental NGO (ANDEGE) and initiated collaboration for cat conservation with the major country-based international conservation organization (CI). This study has also provided data for input into other conservation-oriented programs. For example, it has contributed to determine some of the most suitable locations for research and subsequent pilot project implementation for ZSL's new bushmeat alternatives project in the country and has also identified human-elephant conflict hotspots across Rio Muni that will be included in a Conservation International´s initiative aimed to initiate actions towards the management of this problem.

6. We have gathered spatially-explicit information on current and historical presence and mortality of cats across the country with the aim of including it in a national cat information database that will be created to allow us to understand the cat population trajectory.

7. Although this study has relevance to advancing both the scientific understanding and conservation of cats and a range of other species in the country, it has also involved development of methodology. Our method has proved to be useful for large-scale estimation of multiple-species distributions and abundances from a single cost-effective survey in a systematic and statistically sound manner. In light of ever increasing costs of wildlife research and conservation, inexpensive methods like this warrant special attention. In our opinion the method has strong potential for application to other areas in forested nations of West and Central Africa where hunter activities are widespread and the status of medium-to large sized mammals is uncertain. Another of the possible applications of this methodology is to determine which areas have already lost large-vulnerable species and may be able to supply urban market(s) with robust bushmeat species in order to delineate landscapes into zones for more effective management and enforcement.

10. LOOKING AHEAD: GOALS/ACTIVITIES FOR THE NEXT YEAR

The paucity of information available prior to this study suggested that felids would be found in low numbers in several remote areas all over the country, mainly in the south-central districts. Our results have confirmed this, and conclude that a national cat action plan is urgently needed to secure their long-term persistence in this rapidly changing country. In the initial phase of implementing such an action plan, the following immediate actions will be taken:

1. To generate on the ground "high resolution" information to be used as a local conservation planning tool. We will conduct an intensive photo capture-recapture survey to estimate cat densities at several strategic sites identified by means of this study. By means of this survey we will also generate information on the effects of anthropogenic disturbance, physical features and prey availability on population state variables of cats. We will attempt to identify the potential costs to felids associated with this disturbance, in terms of their ability to optimize use of territory resources, and we will investigate the mechanisms by which cats exposed to human activities may adapt to this disturbance.

2. To build local capacity in modern and cost-effective sampling techniques so that the monitoring of cat populations and their prey in the country can be continued.

3. To keep on gathering reports on cats and include it in the cat database for use with designing cat conservation activities and decision-making.

4. To initiate large-scale promotion of leopard and golden cat conservation status and research in Equatorial Guinea. We will achieve this by preparation and publication of scientific literature in English outside of Equatorial Guinea and of popular literature in Spanish inside the country. Additionally, we plan to present our findings to professional societies, interest groups, stakeholders, and all levels of educational institutions in Equatorial Guinea.

5. To strength collaborations with ZSL, CI and ANDEGE in projects on alternative livelihoods and socioeconomic monitoring located in cat priority sites.

6. To lobby for the recognition of both leopard and golden cat as species of the highest concern in the CARPE Landscape 1 (Monte Alén – Monts de Cristal).

11. PROBLEMS AND CONSTRAINTS

The process of acquiring permits to enter the country was more time-consuming than originally expected and as a result a period of three months elapsed before actual fieldwork started. Additionally, the two team members came down with malaria. Despite these set-backs, the team has been always encouraged by the work and motivated by the valuable information gleaned from all surveyed sites.

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POR UNA GUINEA MEJOR

El Delegado Regional

Vº B º

EL DELEGADO DE GOBIERNO DE MBINI

Mbini, 14 Julio 2.010

09.07.2010

Akurenam a 23 de Junio 2.010
POR UNA GUINEA MEJOR
EL DELEGADO DE GOBIERNO
P.O.
EL SECRETARIO TECNICO,

Vº B º
EL DELEGADO DE GOBIERNO,

Niefang, 13 de Abril del 2.010

Micomeseng, a 19 de Abril de 2.010

Vº B º
LA DELEGADA DE

Ebibeyín, 21 de Abril del 2.010
POR UNA GUINEA MEJOR
Vº B º
EL DELEGADO DE GOBIERNO.

NSOK-NSOMO, a 22 de Abril 2010.-
POR UNA GUINEA MEJOR
Vº B º
EL DELEGADO DE GOBIERNO

Mongomo, a 23 de Abril 2.010,
POR UNA GUINEA MEJOR
Vº B º
EL DELEGADO DE GOBIERNO, P.O.

NsorKa 20 de Mayo 2.010
POR UNA GUINEA MEJOR
Vº B º
EL DELEGADO DE GOBIERNO

Añisok, 23 de Abril de 2.010
POR UNA GUINEA MEJOR
EL DELEGADO DE GOBIERNO,

Evinayong 23-6-2010
El Delegado de Gobierno

Aconibe, 24 de mayo de 2.010
Por Una Guinea Mejor
El Delegado de Gobierno, P.O.