TACUGAMA
CHIMPANZEE SANCTUARY

Sierra Leone Chimpanzee Rehabilitation Programme

Sierra Leone
National Chimpanzee Census
September 2010

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Tacugama Chimpanzee Sanctuary

Working as the Sierra Leone Chimpanzee Rehabilitation Programme, Tacugama cares for 100 confiscated and abandoned chimpanzees at the sanctuary close to Freetown and supports the enforcement of the laws protecting chimpanzees in Sierra Leone. Founded in 1995, Tacugama operates education, community development, field research, conservation and ecotourism projects to address the root cause issues that threaten the survival of chimpanzees and their habitat in Sierra Leone.

The Report Authors

Dr Terry M Brncic has a PhD in Tropical Forest Ecology from Oxford University, UK. She has spent several years carrying out fieldwork in central Africa on the ecology of gorillas and forest plant species. Her latest postdoctoral research was concerned with the long-term ecology of African rainforests, where she analysed sedimentary records from the Congo basin to determine changes in forest composition in response to climate change and human impacts over the last several thousand years.

Bala Amarasekaran has been the programme director of Tacugama Chimpanzee Sanctuary since its foundation in 1995. A Sierra Leonean resident, he formally trained as an auditor and worked in management accountancy for fifteen years before relinquishing his professional career to run the sanctuary. He has built an excellent network of supporters and has developed a strong working relationship with the Government of Sierra Leone and its agencies.

Anita McKenna has worked with Tacugama as fundraising manager and project co-ordinator since 2008. She originally came to Sierra Leone in 2007 as a VSO volunteer in organisational development with twenty years international business management experience, a BSc in Biological Sciences and an MBA.

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The Census Field Team – who worked in all weathers, in challenging terrains and have significantly increased understanding of wild chimpanzee populations in Sierra Leone.

Figure 1. The Sierra Leone National Chimpanzee Census Project team

From left to right; Joseph Marah, Yirah Koroma, Farrah Kargbo, Terry Brncic, Papanie Bai-Sesay, Alako Kamara, Joseph (Bangalie) Brima, Marah Conteh, Foray Konteh, and Yirah Koroma. (Not shown: Samba Jalloh and John Conteh.

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The staff at Tacugama Chimpanzee Sanctuary who supported the census in many ways

Census donors

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- Sweden Chimpanzee Trust
- Chester Zoo, UK
- Amersfoort Zoo, Jellow Wildlife Fund, Netherlands
- Sea World / Busch Gardens, USA
- Columbus Zoo, Ohio, USA
- Augsburg Zoo, Germany
- Karlsruhe Zoo, Germany
- Parco Natura Viva, Italy
- Conservatoire pour la Protection des Primates, Vallée de la Singe, France
- Barcelona Zoo, Spain
- La Palmyre Zoo, France
- ZooParc de Beauval, France
- Hamilton Zoo, New Zealand
- Zoos South Australia
- IPPL UK
- Dublin Zoo, Ireland
- Ljubljana Zoo, Slovenia

EXECUTIVE SUMMARY

Following the Pan African Sanctuary Alliance (PASA) Managers' Meeting held in Sierra Leone in April 2008, Tacugama Chimpanzee Sanctuary undertook to complete a National Chimpanzee Census Project. Sierra Leone was known to be an important country for the endangered Western Chimpanzee *Pan troglodytes verus* but accurate scientific data as to the state of the country's chimpanzee population was not available. Previous estimates dated from the 1980s. With the number of orphaned chimpanzees continuing to arrive at the sanctuary at a significant rate it had become increasingly urgent to increase understanding of the state of the wild chimpanzee population and how to increase its protection.

With the endorsement of the Government of Sierra Leone (GoSL) and the support of PASA, Tacugama raised sufficient funds to start the project in October 2008, fieldwork commenced in January 2009 and completed in May 2010. Early findings led to the scope of the fieldwork being expanded and resulted in the development of innovative methodology to harness qualitative data collection and quantitative survey techniques to ensure a thorough and robust survey of wild chimpanzees across the country.

In addition to determining the abundance and distribution of chimpanzees and collecting data for a subsequent Population & Habitat Viability Assessment (PHVA) and conservation planning, the census objectives also included building the capacity of Sierra Leone nationals, identifying potential release sites for rehabilitated chimps from Tacugama and contributing to the sub-species data set and the Ape Populations, Environments and Surveys (APES) database. Data has also been collected on large mammals but significant analysis of this is not included in this report.

The results of the Sierra Leone National Chimpanzee Census Project[1] indicate that the number of chimpanzees remaining in the wild exceeds 5,500 and more than half of these are to be found outside protected areas. This doubles the previous estimates for Sierra Leone and establishes the country as one of the most important for chimpanzees in West Africa. Whilst it is positive news, the survey findings also clearly indicate that chimpanzee numbers have fallen and the remaining populations are threatened by many factors. Urgent conservation focus is needed to ensure that Sierra Leone can protect its remaining chimpanzees and their habitats – especially in those areas that have no existing conservation status.

The first formal presentation of this census report was made to a group of key national stakeholders at a dissemination workshop held in Freetown on 15th and 16th September 2010. Along with many positive outcomes, the workshop resulted in the proposal that chimpanzees should become formally recognised as a national emblem and a flagship species for Sierra Leone to enhance their conservation. This is an important, positive endorsement of the census findings.

The census has also demonstrated the significant role that local organisations and sanctuaries can play in conservation action. The project was locally initiated and managed and delivered cost effectively. Significant additional information has been collected through the census project that will be made available for further analysis and journal publication.

[1] It is clear that survey is a more accurate description of the process than census but the initial project name has remained

1 BACKGROUND TO THE CENSUS

1.1 Chimpanzee status in Sierra Leone

The Common Chimpanzee (*Pan troglodytes*) and its four sub-species are currently categorised as Endangered by the Species Survival Commission of the International Union for Conservation of Nature and Natural Resources (IUCN 2006). The sub-species found in Sierra Leone, the Western Chimpanzee (*Pan troglodytes verus*) ranges from the Dahomey Gap westward to Senegal. Extinction has already probably occurred in three of its former range countries - Benin, Togo and Burkina Faso - and populations in Senegal, Guinea Bissau and Ghana are extremely threatened. With an estimated remaining population of between 20,000 and 50,000, the Western Chimpanzee is among the two most endangered chimpanzee sub-species, suggesting that if no action is taken to halt their decline they are highly likely to face extinction in the near future (Kormos *et al*., 2003). Sierra Leone lies entirely within the natural range of Western Chimpanzees and they are distributed throughout the country (Hanson-Alp *et al*., 2003). The most recent estimates (Teleki and Baldwin 1981) put the number of remaining chimpanzees at 1,500 to 2,500 individuals.

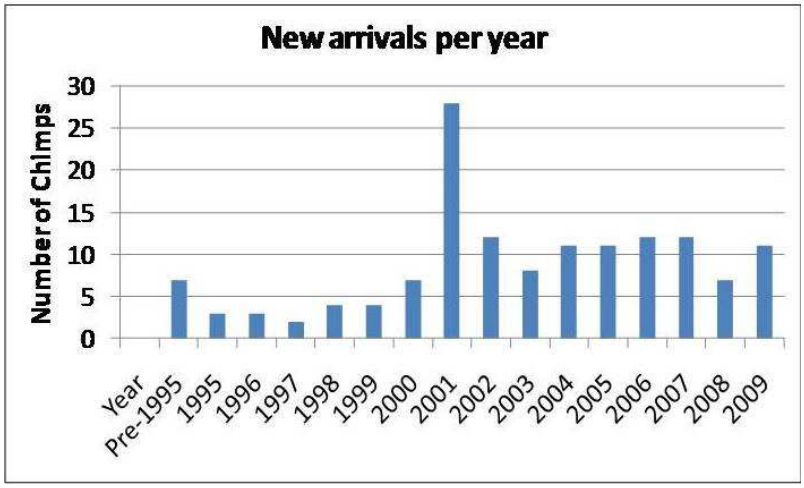
In the 1970s and into the 1980s, Sierra Leone was a major source for the live chimpanzee trade; most were exported for biomedical research and to the entertainment industry. Estimates on the number of infant chimpanzees exported from Sierra Leone vary widely and it is thought that some of those exported may have been of Guinean or Liberian origin. From 1957-1968 an estimated 2,574 chimpanzees were exported from Sierra Leone (Robinson 1971). Detailed customs records from 1973-1979 show that a total of 1,582 live chimpanzees were exported from the country, primarily to the United States; thus Geza Teleki estimates that over 2,000 infants were sold overseas during the 1970s (Teleki & Baldwin, 1981, Teleki 1980). Ten infant chimpanzees were confiscated at Schiphol Airport from Sierra Leone-based wildlife exporter Franz Sitter in 1978. By 1981, Sitter was still stockpiling wildlife and had at least 44 infant chimpanzees at his farm in Rokel. In 1983, 50 chimpanzees were exported to Japan and Austria; it is unclear whether this number includes the same 44 chimpanzees documented in 1983. It is possible, therefore, that at least 5,000 chimpanzees from the region were exported via Freetown between 1950 and the mid 1980s.

Following reports to the GoSL about the state of chimpanzees in Sierra Leone, a presidential ban was put in place in 1985 banning live trade in chimpanzees and making illegal the killing, sale, capture or keeping of chimpanzees as pets. Nonetheless the pet trade continued, often in the open (Teleki 1985). Law enforcement was largely non-existent and there were limited attempts at making the public aware about the protected status of chimpanzees and some other wildlife.

In 1995, the Sierra Leone Chimpanzee Rehabilitation Programme was implemented by Bala Amarasekaran working with the GoSL and the Conservation Society of Sierra Leone. This resulted in the establishment of Tacugama Chimpanzee Sanctuary located south of Freetown in the Western Area Peninsular Forest Reserve (WAPFR). The existence of the sanctuary significantly enhanced the ability of the GoSL to enforce the Sierra Leone Wildlife Conservation Act of 1972 with respect to chimpanzees. Tacugama finally allowed illegally held chimpanzees to be confiscated, cared for and rehabilitated. Since then Tacugama has confiscated orphan chimpanzees at a rate of approximately ten per year (Figure 2). As of 2010 Tacugama has recorded over 150 orphan chimpanzees, most of which were rescued.

Geza Teleki, who reviewed the capture practices of wildlife traders in the 1970-80s, estimated that for every live captive infant chimpanzee that arrives in a laboratory or sanctuary, 5-10 chimpanzees have been killed (the mother and often other members of the community are killed either for bushmeat or to retrieve the infants and not all infants survive) (Teleki 1989). Previous population sizes will never be known for certain but it is possible to make rough estimates of attrition. Taking export records together with the findings from Tacugama and using a conservative estimate of five mortalities for every one captured, these could represent the estimated loss of at least 25,000 chimpanzees from Sierra Leone (and perhaps its neighbours) in the last 60 years.

Figure 2. The number of orphan chimpanzees brought to Tacugama or confiscated each year from 1995-2009.



1.2 The need for a nationwide survey and objectives

The need for a census has been highlighted on several occasions; it was a key recommendation of a workshop on the status of West African chimpanzees held in Abidjan in 2002 (Kormos *et al*., 2003) and of the Western Chimpanzee Action Plan (Kormos and Boesch 2003). A recent review (Kormos 2008) of the impact of the Western Chimpanzee Action Plan indicated that maximum effectiveness was achieved in those countries that had good baseline knowledge of their chimpanzee populations.

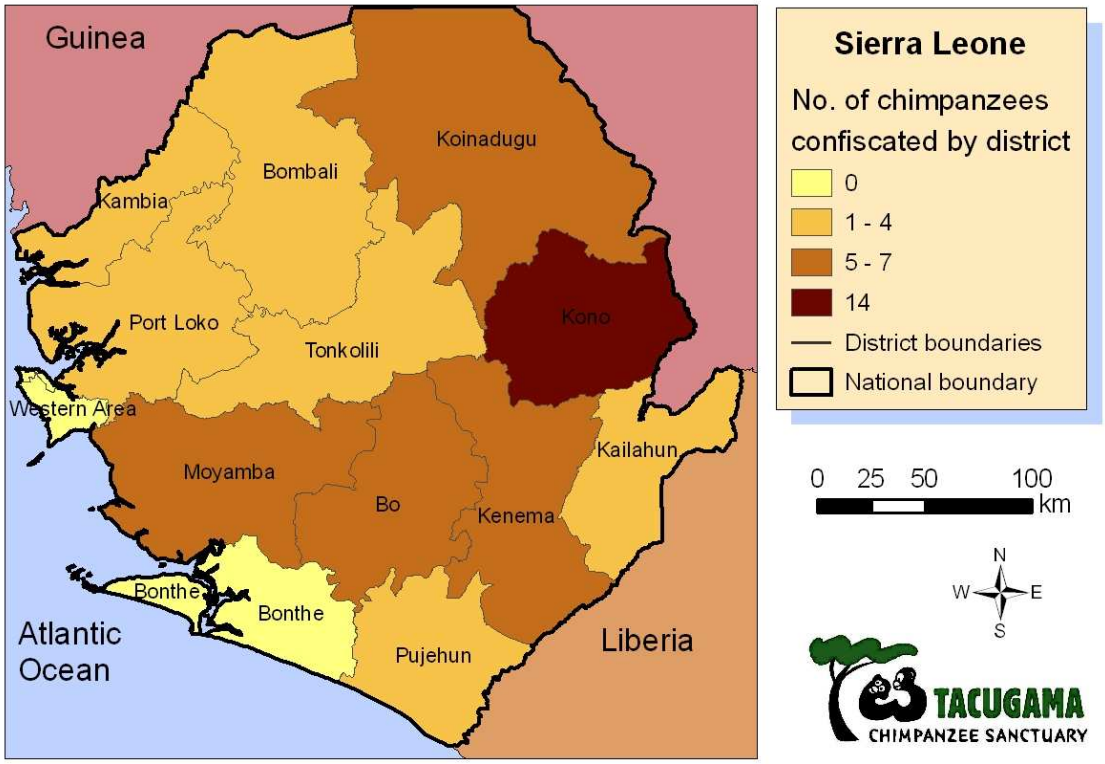
The increasing human population in Sierra Leone coupled with the urgent need to alleviate the extreme poverty in the country is placing pressure on the environment through escalating exploitation of the country's rich natural resources. Together with so much uncertainty regarding the size, density and distribution of the wild chimpanzee populations in Sierra Leone, and the need to address the root causes behind the continuing arrival of new orphan chimpanzees it became imperative that a survey took place as soon as possible. With the support of PASA and the endorsement of the GoSL, Tacugama Chimpanzee Sanctuary undertook in April 2008 to conduct the first-ever comprehensive survey of wild chimpanzees in the country.

The main priority of the census has been to provide an accurate baseline of chimpanzee population data from which a well-founded population habitat and viability assessment could be conducted and a national chimpanzee conservation action plan implemented. Further objectives were to increase national wildlife research and conservation capacity, determine the state and availability of suitable chimpanzee habitat, document evidence of human impact, identify potential release sites for existing rehabilitated, captive chimpanzees, and contribute to enhanced regional and continental species understanding. In addition to these goals, the project has also collected baseline information on the relative abundance and distribution of other mammals across Sierra Leone; some of this is presented in this report.

1.3 Scope

The geographical scope of the survey was to update information about areas where chimpanzees were known to exist but where there was no accurate data on their current status, such as Outamba-Kilimi National Park, Gola Forest, WAPFR and Loma Mountains Non-hunting Forest Reserve. Furthermore, there were many community forest blocks and smaller reserves within the country where locals indicated the presence of chimpanzee populations through reports of crop raiding and sale of bush meat products. There were also reports of chimpanzees living in places outside of protected areas or forests (J. F. Oates, personal observation). Data available on the known origins of 53 of Tacugama's orphans suggested that chimpanzees were being captured all over Sierra Leone, not just in forest reserves (Figure 3). These fragmented locations needed to be effectively sampled to allow accurate determination of population sizes to take place.

Figure 3. Known origin by district of 53 chimpanzees confiscated and brought to Tacugama from 1996-2009.



2 ABOUT SIERRA LEONE

2.1 Physical

Sierra Leone is a small country in West Africa bounded by Guinea to the north, Liberia to the southeast, and the Atlantic Ocean to the southwest. The total area of the country is approximately 72,500 km^2. Topography varies from low coastal plains in the southwest (below 100 m elevation) to the north-eastern plateau (300-600 m elevation), which is two main massifs: Sankan Biriwa (1780 m) and Bintumani (1945m). Ten major rivers flow from the uplands southwest towards the sea (Figure 4C). The climate of Sierra Leone is moist tropical, with annual precipitation ranging from >3000 mm in the southwest to around 2000 mm in the north. The rainfall is highly seasonal, with the main wet season from June to September. Average temperature is around 27°C.

Sierra Leone lies at the western end of the Upper Guinean Forest Block and major vegetation types include moist equatorial lowland forest, forest-savanna mosaic in the north, mangrove swamps along the coast. The forests of the Upper Guinean Forest Block are among the most biologically rich in the world, and among the most threatened. They have been designated as one of 25 global biodiversity hotspots (Myers *et al*., 2000) and one of the two highest priorities for primate conservation in the world (Mittermeier *et al*., 1999). However, Sierra Leone is one of the most severely deforested of the countries in the region. Over 60% of Sierra Leone has the climatic and edaphic conditions for the establishment of closed-canopy moist evergreen and semi-deciduous forest, but only 4-5% of the country was covered in forest in 1976 (Davies and Palmer 1989). Now the land area is dominated by a patchwork of agriculture, bush fallow, and secondary forest. Unsustainable resource use is continuing to exert extreme pressure on the environment leading to over-harvesting of timber, expansion of grazing and slash-and-burn agriculture, and continuing deforestation, forest degradation and soil erosion.

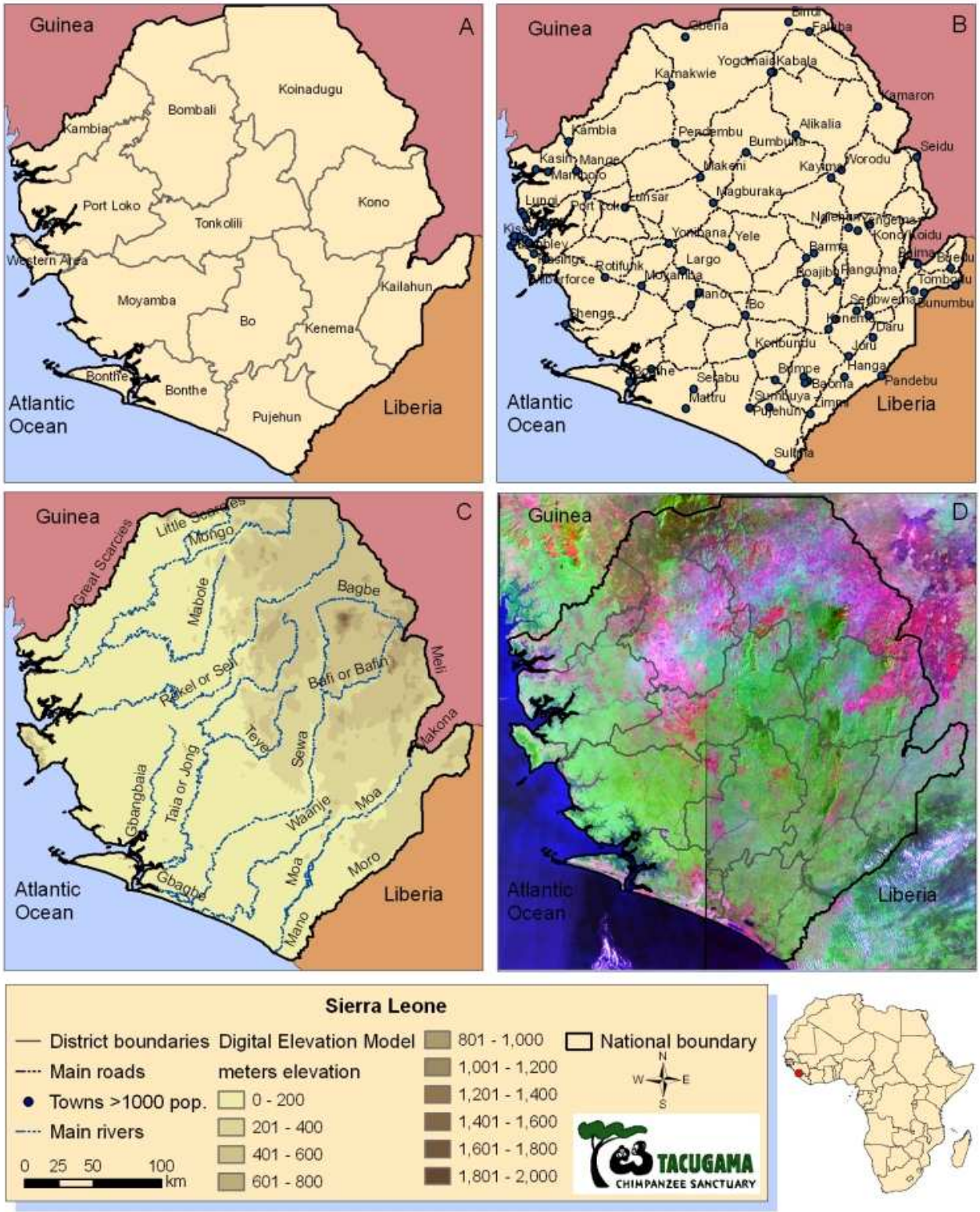
2.2 Political and social

Sierra Leone is divided into 4 provinces, 12 Districts, and 149 chiefdoms. According to the 2004 Population and Housing Census, the population stands at approximately 6 million. The urban population was estimated to pass 40% by the year 2000. A vicious 10-year civil conflict that ended in 2002 resulted in large numbers of internally displaced people moving from rural to urban centres. This temporarily slowed the rate of forest clearance and allowed some regeneration of farmland. However, as the war progressed rebels used different forest areas as bases (e.g. Kangari Hills) which likely had a strongly negative impact on fauna. As of 2009, Sierra Leone was ranked 180th out of 182 on the United Nations Human Development Index. The economy is based primarily on minerals and agriculture. Agriculture employs about 70% of the population and, as of 2008, accounted for about 44% of the GDP. The mining sector accounts for 2% of employment and 18% of GDP, and has historically generated the majority of export receipts. Sierra Leone has broadened its export base from an almost exclusive concentration on diamonds in recent years to include rutile (titanium bearing ore), bauxite (aluminium ore), and a growing volume of cash crops.

In the Western Area, land tenure is based on registered and state land ownership. In the rest of the country, land is controlled by communal and traditional patterns, with paramount chiefs as heads of each chiefdom. Forest reserves and the single national park are under legal control of the government, although this is still contested by local communities, particularly at Outamba-Kilimi National Park.

Approximately 60% of the population are Muslim and around 30% follow Christian faiths. There is a strong adherence to traditional cultural beliefs among many Sierra Leoneans.

Figure 4. Map of Sierra Leone showing A) Districts, B) Major road network and towns with a population above 1000, C) Topography and major rivers, and D) Landsat satellite image of vegetation. In the Landsat image, dark green represents closed forest, light green is farmbush or secondary forest, pink is grassland, and purple is woodland savanna.



2.3 Fauna

Large mammals of Sierra Leone include elephant, common and pygmy hippopotamus, leopard, golden cat, caracal, bush pig, water chevrotain, bongo, bushbuck, waterbuck, kob, ten species of

duikers, and 15 species of primates. Historically Sierra Leoneans have eaten antelopes, monkeys, and cane rats, but Muslims do not eat primate meat. Mammals are hunted either with guns, nets, or snares. Bounty payments were made for over 240,000 monkey carcasses during pest control programmes in eastern Sierra Leone between 1947 and 1962, with some of the meat going to Liberia (Teleki and Baldwin 1981). A lucrative international trade continued, with over ten 30-ton lorries carrying smoked bushmeat to Liberia each month in the dry season until 1985. The market for bushmeat is now largely domestic. In 1988-89, sales of bushmeat in Kenema exceeded 2 million Leones (then the equivalent USD 6,700) (Davies and Palmer 1989).

2.4 National conservation strategies

The original Forestry Ordinance of 1912 was set up by the colonial government to establish forest reserves and protected forests. The primary interest in establishing forest reserves was for the management of timber production and watershed protection rather than protecting wildlife within the reserves. The Forestry Act of 1988 was an amendment to the Forestry Ordinance of 1912 and 1942. It focused on promoting multiple-use management of forests at sustainable yields. Responsibility for forest management and biodiversity conservation is with the Forestry Division of the Ministry of Agriculture, Forestry and Food Security (MAFFS). The Wildlife Conservation Act of 1972 focused more on species preservation and placed restrictions on hunting and trapping, and emphasised establishment of protected areas.

The GoSL is committed to the on-going protection and management of its biodiversity assets under the Convention on Biological Diversity, and has developed a National Biodiversity Strategic Action Plan (Republic of Sierra Leone 2003). It is also a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). However, the GoSL has extremely limited resources available and is currently unable to implement the majority of its desired conservation strategy without external support.

The National Environment Protection Act of 2008 established a National Environment Protection Board to facilitate coordination among Ministries, agencies and local authorities in all areas relating to environmental protection. It also addressed the necessity to obtain an environmental impact assessment license for certain projects. Also in 2008, the government established the Sierra Leone Environmental Protection Agency (SLEPA) within the Ministry of Lands, Country Planning and Environment as the agency responsible for environmental management. As of July 2010 SLEPA now reports directly to the Office of the President.

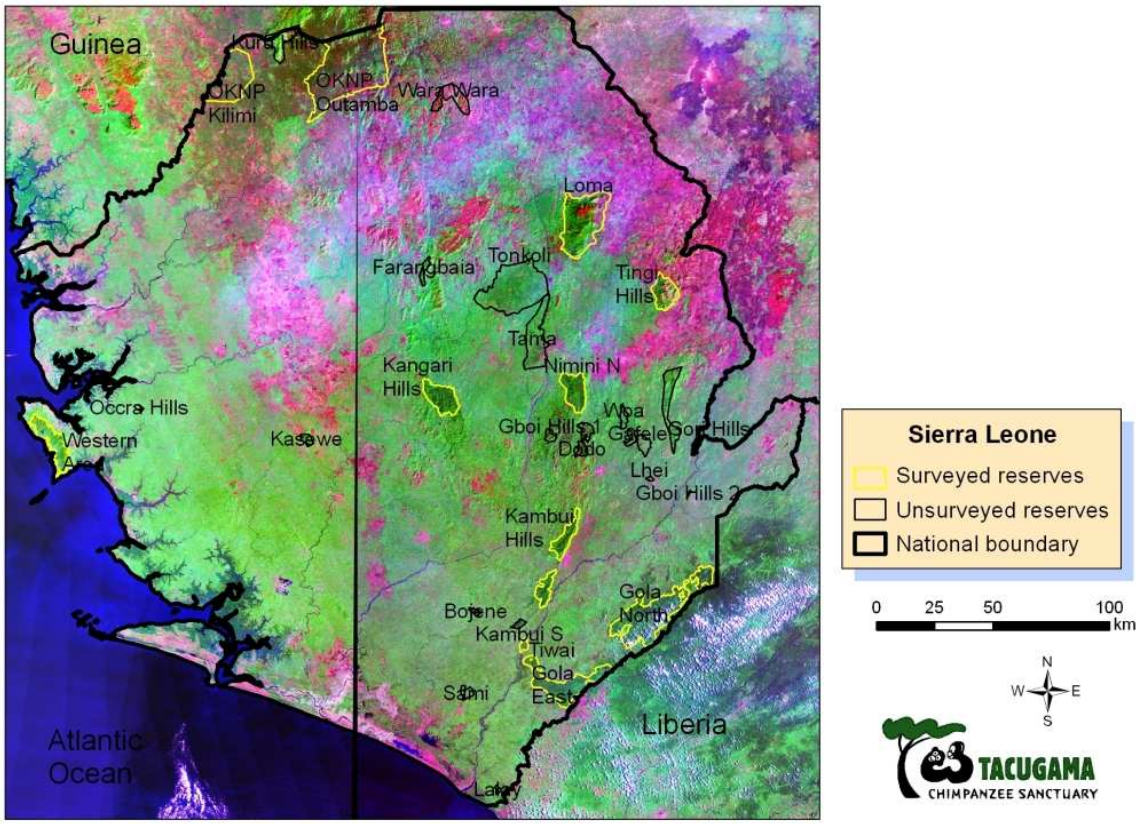
The GoSL has recently launched its second Poverty Reduction Strategy (PRS), which represents the Government's overarching development strategy for the period 2008-2012. The PRS acknowledges the importance of sustainable management of Sierra Leone's natural resources – forests, wildlife, biodiversity, soil, water, land, fisheries and mineral resources – for achieving future economic growth.

An existing network of 48 forest reserves and conservation areas are managed by foresters assigned by MAFFS through district offices. Each district office is headed by a District Forest Officer, who oversees logging concessions and overall management of forests in the region. Foresters, located near some reserves, are responsible for enforcing laws as stipulated in the Forestry Act.

The Conservation and Wildlife Management Unit, Forestry Division of the Ministry of Agriculture, Forestry and Food Security is the responsible body within the GoSL. Several of the designated protected areas are managed by game wardens and guards located on site (Outamba-Kilimi National Park (OKNP), Tingi Hills Non-Hunting Forest Reserve, Western Area Peninsula Forest Reserve, and Gola Forest Reserve). Government funding for the Wildlife Conservation Unit is limited only to payment of staff salaries. Lack of funds for infrastructure, transportation, field equipment and housing constrains the effectiveness of conservation activities.

For the purposes of this report, protected areas refer to both national parks and forest reserves where activities such as logging, farming or hunting are theoretically controlled.

Figure 5. Map of Sierra Leone showing all forested or partially forested protected areas.
Protected areas outlined in yellow were surveyed systematically with line transects. Gola North, Gola East, and Tiwai Island were surveyed by the Gola Forest Programme (Ganas 2009). Reserves outlined in black were not included in the protected areas survey.



2.5 Previous chimpanzee surveys in Sierra Leone

2.5.1 Nationwide

In 1979, Teleki and Baldwin endeavoured to conduct a nationwide chimpanzee survey (Teleki and Baldwin 1981). They covered 9,000 km by car and 1,200 km on foot during 6 months (2 months of which was spent in Outamba-Kilimi National Park) (G. Teleki personal communication). The areas that were surveyed were 11 of the 21 reserves proposed by Phillipson in 1978, and some other locations recommended by local informants, such as the central region around the Bumbuna hydro-electric dam construction project. Teleki and Baldwin reported that chimpanzees were extremely scarce in all but a few places, the highest population being in the proposed Outamba-Kilimi National Park. Loma Mountains, Tingi Hills, Kangari Hills, and Gola North all had some chimpanzees, but Teleki and Baldwin did not consider them to be viable populations at the time. They talked to many communities who reported chimpanzees everywhere, but these reports were not confirmed and were discounted (Teleki personal communication). The estimates reached by Teleki and Baldwin were 1,500-2,500 chimpanzees, but the survey was not quantitative or systematic and is believed to be an underestimate for the country (Kormos *et al.*, 2003). The report for the 1979-1980 nationwide survey was never published because wildlife exporters were still

active at the time and the authors did not wish to reveal the locations of the remaining chimpanzee population.

2.5.2 Bumbuna Dam Catchment

A large mammal survey was carried out in the catchment area of the proposed Bumbuna dam in 2006 (Nippon Koei UK 2007). The primate study defined the territories of four groups of chimpanzees inhabiting the valley above Bumbuna based on nest sites, observations, vocalisations and other physical evidence. The population there was estimated at 33-58 individuals, with an estimated density of 0.44-3.6 chimpanzees/km^2. This estimate however included only the area of known home ranges of the chimpanzee groups and cannot be extrapolated to the whole catchment area.

2.5.3 Loma Mountains Non-Hunting Forest Reserve

The West African Chimpanzee Action Plan report for Sierra Leone states that sporadic surveys were conducted around the Loma Mountains before 1993 and in the late 1980s Loma was proposed as the prime area to capture wild chimpanzees and establish a biomedical research facility. However later studies reported that hunting and agriculture were extensive and few signs of wild chimpanzees were found (Kormos *et al*., 2003).

As part of a long term plan to provide an environmental offset for biodiversity losses resulting from inundation of the Bumbuna hydro-electric project catchment area, a rapid survey was conducted in 2008 to assess large mammal diversity at Loma (Kortenhoven 2008). The survey was conducted between 800-1700 m above sea level (asl) in the northwest portion of the Loma Reserve sampling within an area of approximately 15% of the total area of the reserve. The results of the survey suggested an astonishingly high density of chimpanzees of between 5.75 and 7.41 chimpanzees/km^2. The preliminary results suggest that this remote upland section of the Loma Mountains has one of the highest densities of chimpanzees recorded in West and Central Africa. On the assumption that all the remaining forest on Loma contained chimpanzees at that density, there would be 1427-1839 chimpanzees, but it was acknowledged that this was not the case and that approximately 25% of the reserve area had been disturbed and probably contained a lower density of chimpanzees.

2.5.4 Outamba-Kilimi National Park

In a study done in 1983 in the Kilimi section of the park, chimpanzees were recorded on an ad hoc basis wherever encountered and plotted on a map. Feeding sites were visited where chimpanzees were thought to frequent and pre-selected routes were walked by field teams and all observations recorded. Chimpanzee signs and sightings led to the estimation of 5 groups of chimpanzees using the Kilimi section with a total population assumed to be 49-60 individuals. The estimated density was approximately 0.3 chimpanzees/km^2 (Harding 1984).

A 1989 field survey of wild chimpanzees in central Outamba section confirmed there to be high populations occurring throughout this section of the park (Alp 1989), thought to be home to possibly the largest population of wild chimpanzees in Sierra Leone (Teleki and Baldwin 1981). Chimpanzee population size in Outamba was estimated to be between 200–300 individuals but was thought to be as high as 600–700 (Hanson-Alp *et al*., 2003, Kormos *et al*., 2003).

2.5.5 Gola Forest Reserves

In 2009 a systematic chimpanzee survey covering 173 km of line transects was carried out in the Gola Forest Reserves and potential corridors (Ganas 2009). The calculated density of chimpanzees was 0.27 individuals/km^2 (Percentage Coefficient of Variation (%CV) = 20.6; 95% Confidence Interval (CI) = 0.18 – 0.42) with a population of 305 individuals (%CV = 20.6; 95% CI = 203 – 458). Data from the Gola Forest survey were obtained from the A.P.E.S. database with permission from the Gola Forest Project and re-analysed as part of the nationwide analysis.

2.6 Chimpanzee behaviour

Documented knowledge about chimpanzees and their behaviour has increased immensely in the last 50 years, most notably through the pioneering research of Jane Goodall in Tanzania.

The following are some of the important features of chimpanzee behaviour that relate to this survey and the long-term conservation of chimpanzees.

Chimpanzees do not live in a fixed group but have what has been described as a 'fission-fusion' society. They live in communities that can vary in size, and within the communities individuals frequently split and rejoin. Group sizes from around 15 to over 100 individuals have been recorded in various studies. Communities are generally extremely territorial and adult males from different communities have been known to fight to the death to protect their range. Mature female chimpanzees may move between communities, so reducing the likelihood of inbreeding.

Females give birth only once every four or five years and usually to a single infant. They reach reproductive age at around ten years old. This low reproductive rate means that chimpanzee populations take many years to recover from any decline in their numbers. Externally induced mortalities through hunting or disease can be devastating to chimpanzee communities.

It is not easy to count chimpanzees as they are difficult to see in the wild and their population densities are often low. Members of the same community are almost never together at one place. Long-term observation of communities is needed to be able to distinguish individuals and therefore to gradually assemble a picture of the social group's composition. Survey methods usually look for signs that can include direct sightings, feeding remains, dung, or nests. As chimpanzees typically make a new nest each night to sleep in by bending branches into a solid bowl up in a tree, nests are the most commonly observed signs of wild chimpanzees. These nests can remain visible for up to several months.

3 METHODS

3.1 Pre-survey questionnaires

A tested, one-page questionnaire was distributed to communities across Sierra Leone in October 2008 to identify where chimpanzees are known to be seen. The questionnaire aimed to confirm proper identification of chimpanzees, whether they are seen by community members, and requested a small amount of additional data to confirm numbers seen and frequency, habitat and season of chimpanzee encounters.

The questionnaire was delivered through forest guard visits, aiming to reach all 149 chiefdoms within Sierra Leone, with the support of the MAFFS Forestry Division and coordinated through the 13 district forest officers. It was intended that questionnaires be completed for five villages in each chiefdom. Communities that responded to questionnaires were mapped using data produced by Sierra Leone Information Services.

3.2 Pilot interview study

In March and April 2009, two teams crossed Moyamba District interviewing communities in every chiefdom about chimpanzees in order to determine a) if there were patterns in the distribution of chimpanzees, b) to determine if a transect survey was feasible, and, if so, c) to guide the design of the transect survey. The pilot study also served to train teams for conducting interviews and helped guide the structure of interviews used in the systematic nationwide survey. Usually the chief and as many other people as could be gathered were questioned about whether chimpanzees were present around the community. Interviews were followed up on foot where possible to confirm any signs of chimpanzees.

During July 2009, extra interviews were undertaken around Lake Sonfon and Tonkoli Forest Reserve in Koinadugu District. These areas were thought to be potential chimpanzee habitats, but were not surveyed with line transects. Although not falling within the protected areas transect survey data from the analysis of the interviews in these two areas is reported in the protected areas detailed results section of this report.

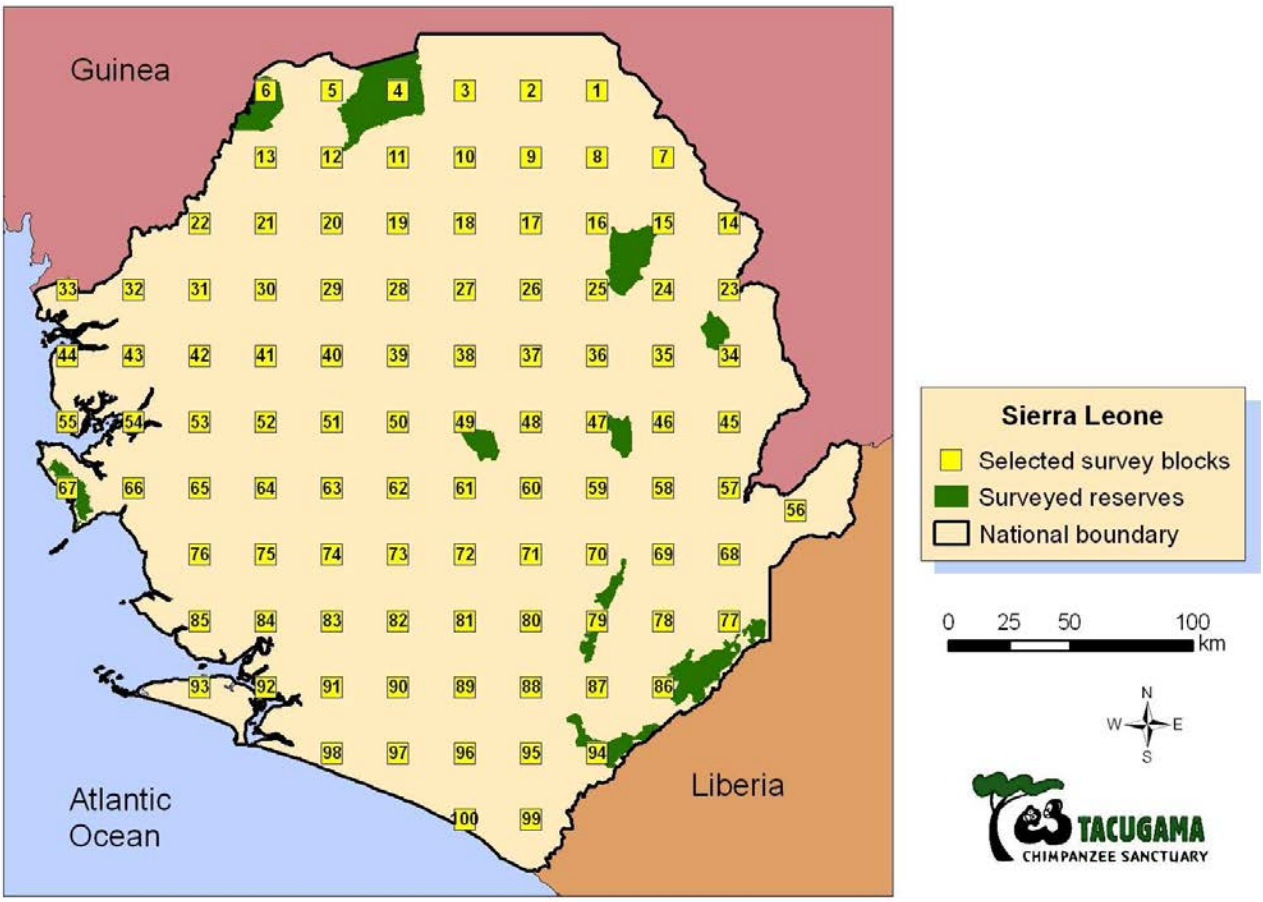
3.3 Block survey design for non-protected areas

Results from the questionnaires and from the pilot interview study in Moyamba District confirmed that chimpanzees could be found throughout Sierra Leone and therefore a nationwide survey design was needed. Based on information from the pilot study and a transect survey in neighbouring Guinea, it was decided that randomly placed transects alone would have been unlikely to obtain enough observations of chimpanzee nests to produce a reliable abundance estimate for the whole country (Ham 1998). Stratification by vegetation was not a valid option because chimpanzees seemed to occur in all vegetation types. Interview data alone would provide valuable information about chimpanzee distribution, but could not be used to obtain chimpanzee abundances. Therefore a new technique has been piloted in Sierra Leone that uses a combination of interview and transect surveys to gather both qualitative and quantitative information on the abundance and distribution of chimpanzees and other animals. This combination has allowed the transect effort to be targeted to increase sampling efficiency (reduce number of empty transects). It also allowed us to determine community attitudes towards chimpanzees, identify biodiversity threats and conservation opportunities, and determine the factors related to chimpanzee and other mammal densities.

The technique used interview data to pre-stratify a sample area into predicted high and low chimpanzee densities. These data provided an estimate of what proportion of the country can be

considered high density and low density for chimpanzees. Transects carried out in each of these areas gave the average chimpanzee density in both high density and low density areas and allow a population estimate for the whole country. To this end, the sampling area to be pre-stratified with interview information was chosen as 9 x 9 km grid squares (blocks). Sierra Leone was thus divided into 9 x 9 km blocks and every 9th block was selected for detailed sampling giving 100 blocks across the country (Figure 6). Each selected block was divided into nine 3 x 3 km squares which were to be assigned individually as low or high density squares using interview criteria described below (Figure 7). However, a 3 km long transect was always walked in the centre of each block, so that a subset of the data consisted of purely systematic transects across the country that could be analysed separately if enough nests were encountered.

Figure 6. Map of Sierra Leone showing the division of the country into 9 x 9 km grid blocks.
Selected blocks to be surveyed by a combination of interview and transect methods are shown as yellow squares. The protected areas shown in green were surveyed separately using systematic line transects with a random start point.



3.3.1 Block interviews

Interview questions were directed at determining whether chimpanzees occurred at a high or low density within a specific 3 x 3 km square within the block. This information was gathered by asking if people knew of chimpanzee nest sites in the target area, how frequently chimpanzees had been seen or heard in the last 3-4 months, how many chimpanzees were seen in a group at any given time, and how often chimpanzees raided crops or fruit trees near the community. This data was collected for each square and used to score each square as low or high density. It was assumed that high density squares would have a higher probability of nest detection on transects.

Square density was assigned by the following criteria:

Do people know of chimpanzee nests in the target area? A yes answer meant that the square was automatically assigned as high density. If a negative answer was given, then the following three questions were used to derive a score for the square:

1. How often have chimpanzees been seen or heard in the square in the last 3-4 months?
2. How often have chimpanzees eaten crops or fruit trees in the square in the last 3-4 months?
3. What is the largest number seen at any one time in the last 3-4 months?

Question	Answer	Score
How often seen or heard?	Never 1-2 times 3 or more times	0 1 2
How often have chimpanzees raided crops?	Never 1-2 times 3 or more times	0 1 2
What is largest number seen?	None 1-3 >3	0 1 2
	Total score	

A total score of 0-3 meant the square was assigned as a low density square. A score of 4-6 meant the square was assigned as a high density square. If there were no villages in or near the square where we could obtain information, then the density of adjacent squares was used to assign square density. If there were two adjacent squares with different assigned densities, then the score from the square with more similar vegetation type was used. If there were no adjacent squares with information, then cell density was taken from the nearest known square with the same vegetation. Landsat satellite images were used to determine vegetation types within each block.

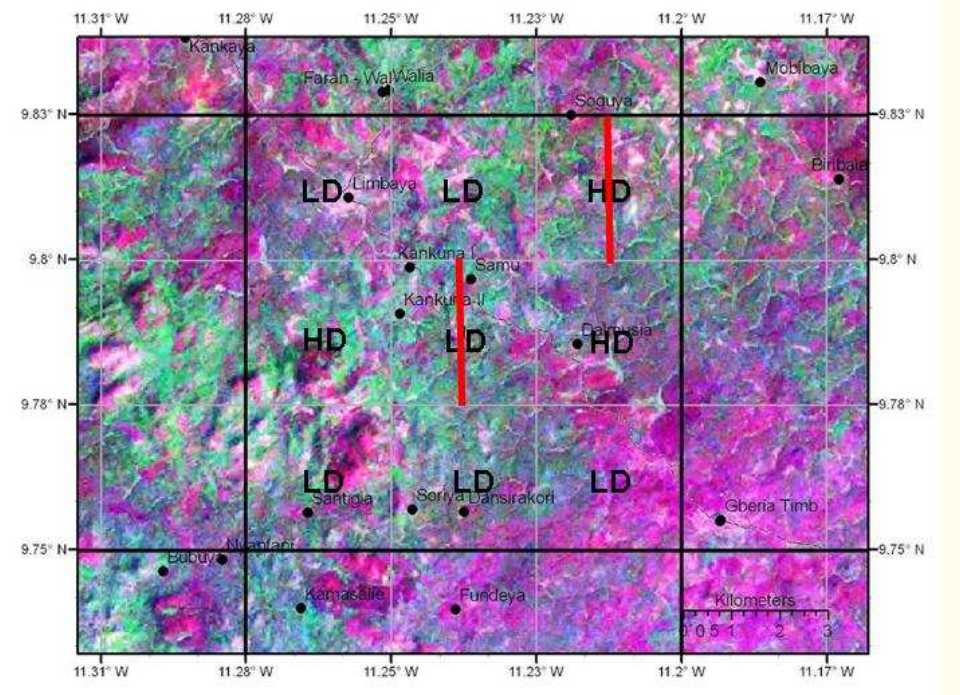
In addition to gathering information about chimpanzees around the community, further questions were targeted at determining people's attitudes towards wildlife and existing conflicts with wildlife. Anecdotal evidence was also gathered relating to hunting or farming practices, perceived causes of chimpanzee decline, and information about other animals.

3.3.2 Block transect placement

Transect protocol followed that described below for protected area transects. A 3 km transect was always walked in the centre square whether high or low density. If the centre square was classified as high density, a second transect of 1.5 km was walked in a low-density square chosen at random from all the low-density squares in the block. If the centre square was low density, a second transect of 3 km was walked in a high-density square chosen at random within the block. If the block was all high or all low density, then a 3 km transect was walked in the centre square, and a 1.5 km transect was walked in another square chosen at random. All transects were laid on a north-south bearing with the centre of the square used as the midpoint of the transect. An example of transect placement where the centre square is low density is shown in Figure 7.

Figure 7. Map of Block 1 showing classification of each square in the block as high or low density and the placement of transects within the block.

Each transect in this example is 3 km long because the centre square is low density.



The block design allowed for three levels of data analysis. At the qualitative level, widespread interviews would provide information about chimpanzee distribution and presence or absence. In the event that chimpanzees were at very low densities and patchy in distribution, stratification by interview data into areas of high and low chimpanzee density could still provide quantitative estimates of chimpanzee abundance. Finally, if chimpanzees densities were sufficiently high, then the purely systematic transect placement in the centre squares would give a robust estimate of chimpanzee density across the country.

3.4 Protected area surveys

3.4.1 Distance line transects

Methods for data collection follow the "Best Practice Guidelines for Surveys and Monitoring of Great Ape Populations" (Kühl *et al.*, 2008) and Distance line-transect sampling techniques (Buckland *et al.*, 2001). Because direct sightings of chimpanzees are extremely rare, density estimates for chimpanzees were determined from the standing crop nest count method (Ghiglieri 1984). Straight-line transects were used to estimate chimpanzee nest density, and chimpanzee abundance was calculated from nest density by incorporating estimates of nest production and duration and the proportion of individuals old enough to build nests. For other mammal signs, a relative abundance was obtained from the encounter rate (signs/km).

For large intact forest areas, line transects of 2 km length (1.5 km for Tingi Hills) were placed systematically across survey strata using a random start point. DISTANCE (Thomas *et al.*, 2006) and ArcView software was used to place line transects using the ''Systematic Segmented Trackline Sampling'' design for all reserves except WAPFR and Loma Mountains. For these two reserves, transects were placed without the use of DISTANCE software. The number of transects in each reserve varied from 8 to 31 (102 for Gola).

Teams walked along transects following a compass bearing in a straight line at an average speed of 0.7 km/hr (0.25-2.09 depending on terrain). Field teams usually consisted of four people, including two observers, one compass bearer, one local guide, and porters if necessary. For the 3 km block transects, sometimes two or three trail cutters assisted when the vegetation was very thick. One of the observers focused on the ground, looking for signs such as dung and footprints. The other observer focused on looking up for chimpanzee nests and feeding remains. Using two such dedicated observers reduced the chance that signs were missed. All observations were recorded and the coordinates marked using a Garmin GPSmap 60CSx.

On each transect, the following variables were recorded and geo-referenced:

Chimpanzee Sign: Nest number, perpendicular distance to each nest, and age were recorded; assignment of nest age categories followed Tutin & Fernandez (1984). Additionally, other direct and indirect signs were recorded: visual sightings, feeding remains, dung, and vocalizations.

Other Mammals: Data was collected on direct and indirect signs of mammal species including duikers, monkeys, forest buffalos, etc.

Human Sign: Including signs of power-saw logging, hunting (hunters, snares, hunting camps, gun shells), human trails and farms.

Vegetation Type: Distance was marked at each point that the vegetation changed along the transect so that the percentage of each vegetation type could be estimated from the total distance. Forest types were assigned based on forest structure rather than species composition. This was primarily because it would have been impossible to train all team members to accurately identify trees. A classification based on structure allows different forests to be compared and shows to what extent they may have been modified by man in areas where human activity was recorded.

3.4.2 Reconnaissance (recce) surveys

Opportunistic data was collected on animal sightings and signs of human activity while moving between transects. Effort on recce surveys depended on the terrain and the time available and therefore represents a minimum record of number of observations. All observations on recces were also geo-referenced with a GPS.

3.5 Estimation of auxiliary variables

3.5.1 Nest Duration

Due to the range of habitats across Sierra Leone, nest decay rates were calculated separately for those nests found in forests and woodland savanna. Furthermore, many nests were made in oil palm trees which were thought to have longer nest duration due to the coarseness of the leaves. Therefore, three separate nest decay studies were undertaken to try to capture the variation in nest duration likely to be encountered across the country. Nest duration was calculated by retrospective estimation using two visits (Laing *et al.*, 2003). This involved marking nests at different start times and re-visiting them once to see whether they had decayed. A nest was counted as decayed if it was no longer recognizable as a nest, even if some damage to the tree could still be seen (bent branches in a tree, or broken palm leaves). We calculated a logistic regression on start date (fresh nest first marked), stop date (last censused), and status (present, decayed). Nest decay time was estimated using a Markov model approach:

$$p_i = \prod_{i=1}^{i=n} \frac{1}{1+e^{-p_s}},$$

where i is the time in number of days from nest construction ($i=1$) to decay ($i=n$), and p_s is the estimated decay parameter. The maximum likelihood and estimate for p_s was found by maximizing decay probability for nests decayed between the first and second visit and minimized for nest not decayed at the second visit.

Mean decay time was then calculated by summing the products of daily nest decay probability and number of days over 1000 days. We then used non parametric bootstrapping to derive 95% confidence intervals of the nest decay estimates.

All analyses were done in R.

Palm tree nests

From April to December 2009, 70 recent or fresh nests were marked in palm trees. Monitoring took place from December 2009 to March 2010. Most nests disappeared not because if *in situ* decay, but rather because as palm trees put out new leaves at the top, old leaves drop from underneath the crown. Either the distal ends of the broken leaves drop off, or the whole leaves are shed from the tree before the nest itself might have otherwise decayed. Logistic regression resulted in a mean nest decay rate of 187 days (SE = 30.35, 95% Confidence Limits = 138-257 days). However, because the exact construction date for each nest was not known for all nests, 60 days were added to the mean for a conservative palm tree nest duration of 247 days.

Woodland savanna nests

75 nests were marked from May 2009 to February 2010. Most were marked after the wet season of 2009, from October 2009 to February 2010. The last nests were monitored in July 2010.

Mean nest duration for woodland savanna nests was 139 days (SE = 23.22, 95% CL = 101-190 days).

Forest nests

The number of nests used to calculate nest duration for forest nests was 67. Some nests were marked and monitored during the middle of the dry season at the start of the survey (December 2008 to January 2009), but the bulk of nests were marked from November 2009 to April 2010. The last nests were monitored in July 2010. Mean nest duration for forest nests was 109 days (SE = 19.76, 95% CL = 76-154 days).

3.5.2 Nest production rate and nest re-use

Nest production rates must be calculated from observations of habituated chimpanzee communities. There are no such data available for Sierra Leone, but estimates are available from other African countries. Chimpanzees usually build one sleeping nest every evening and abandon it the next morning. However, occasionally a day nest is built. Nest production rate has been estimated for Budongo forest, Uganda at 1.23 nests each day (Plumptre and Reynolds 1997) and in Goualougo Triangle, Congo at 1.09 nests per day (SE = 0.05) (Sanz, 2004). Nest construction at Taï National Park in Côte d'Ivoire was 1.143 (SE 0.04) (Kouakou *et al.*, 2009). Because Taï National Park is the closest location to Sierra Leone, the rate of 1.143 nests per day was used in this study.

Plumptre and Reynolds (1997) also noted the frequency that chimpanzees occasionally re-use nests on subsequent nights. This behaviour could lead to an under-estimate in chimpanzee density. The frequency of nest re-use in Budongo, Uganda was 13.8%. When included with the nest production rate, the number of nests per day per chimpanzee was 1.09. It was noted in Sierra Leone that chimpanzees sometimes re-use the same palm tree for nesting, but it was only observed in instances where a new nest was built from emerging leaves on top of an old nest. Because of the lack of data about this behaviour in Sierra Leone, nest re-use was not included in calculations for this study.

3.5.3 Proportion of nest builders

In wild chimpanzee communities, it is usually only weaned individuals above approximately 4 years of age which build nests. The proportion of weaned individuals observed in habituated communities in Uganda range between 0.80 - 0.85 (Plumptre and Cox 1996). One group of wild chimpanzees was observed in February-March 2010 in the WAPFR with camera traps and was reckoned to contain 15 individuals, 12 of which are estimated to be old enough to build nests. This gives a proportion of 0.8, consistent with the Ugandan data. A proportion of 0.83 was used for this study. No published standard error value is available.

3.6 Data analysis

Analysis of the chimpanzee nest data was done using DISTANCE 5.0 software which is designed specifically for estimating animal densities (Thomas *et al.,* 2006). We calculated density estimates with their associated coefficients of variation and 95% confidence intervals.

Using standard strip transects of a fixed width, the density (D_{nests}) of animal signs, in this case chimpanzee nests, can be calculated by the formula:

$$D_{nests} = \frac{n_{nests}}{a} = \frac{n_{nests}}{wL}$$

where n_{nests} is the number of nests detected, and a is the area sampled (width (w) x length (L) of transects walked).

Using Distance line transect sampling, the area of the transect is not fixed *a priori* and perpendicular distances are measured to each nest along the length of the transect. This allows for more efficient use of data collected, as well as accounting for the fact that only a proportion of nests in the area surveyed are detected (Buckland *et al.,* 2001). Therefore w is replaced by μ, a function of the probability of detection at measured distances. The new formula for calculating nest density is thus:

$$D_{nests} = \frac{n_{nests}}{2\mu L}$$

where μ is the Effective Strip Width (or effective strip half-width) calculated in DISTANCE software. The effective strip width is the distance up to which as many objects are missed as are seen beyond. In calculating the ESW, the furthest nests were truncated prior to analysis in order to delete outliers that make modelling of the detection function difficult (Buckland *et al.,* 2001).

Chimpanzee densities (D_{chimp}) were calculated from nest densities using the formula:

$$D_{chimp} = \frac{D_{nests}}{\text{mean nest duration} * \text{nest construction rate} * \text{proportion of weaned individuals}}$$

Standard errors of decay and production rates were combined with estimated standard errors of sign encounter rate on transects and variability associated with detectability, and incorporated in the overall estimate of variation of the abundance estimates.

Chimpanzee population estimates were made for each of the forest reserves, Outamba-Kilimi National Park (woodland savanna habitat), and the rest of the country outside of protected areas. The total number of chimpanzees outside of protected areas was calculated as the sum of chimpanzee numbers in high and low density areas. These were calculated from:

$$N_{HD} = D_{chimp} \text{ for HD squares} * P_{HD} * A_{np}$$
$$N_{LD} = D_{chimp} \text{ for LD squares} * P_{LD} * A_{np}$$

Where P_{HD} and P_{LD} are the proportion of squares classified as high or low density respectively, and A_{np} is the total area of Sierra Leone excluding protected areas.

The estimate of the total population of chimpanzees in Sierra Leone is thus:

$$N_{Total} = N_{Non\text{-}protected} + N_{Reserves} + N_{OKNP}$$

3.7 Access to fieldwork locations

After an initial training period where they worked as one larger group, the team generally worked in sub-groups to cover the interviews and transect work. They would spend around 20 days in the field before coming back to Tacugama to report findings, download data, rest and resupply for up to 10 days. While in the field, the team normally worked in the same geographic region, as demonstrated by the summary block data in Appendix 1.

The teams were transported to the field locations using 4x4 vehicles where accessibility permitted and would then continue journeys on foot, very occasionally using local motorbike taxis where appropriate. At all locations permission to work was sought from local traditional leaders and elders and at most locations, local guides, porters and cooks were recruited to support the fieldwork activity which generated income for the communities visited. Through discussion with the leaders, elders and guides, the teams ensured that respect was shown for traditional sacred sites and in most cases access was granted to complete the transects as designed. The composition of the team meant also that the major tribal languages of Sierra Leone were covered and good communication was maintained at the fieldwork sites.

4 RESULTS

4.1 Questionnaires

A total of 410 questionnaires were returned from 11 districts covering 82 chiefdoms across Sierra Leone. Several communities returned multiple questionnaires completed by different individuals, therefore the 410 questionnaires represent 357 villages, of which 309 could be located geographically. These 309 villages are shown in Figure 8, with red circles denoting reported presence of chimpanzees and yellow squares denoting absence. Of the 410 questionnaires, 329 reported presence of chimpanzees near their communities (Table 1). The apparent widespread distribution of chimpanzees in Sierra Leone again reinforced the need for a comprehensive nationwide survey. Of the 315 individuals who responded positively and reported a frequency of seeing or hearing chimpanzees, 95 individuals reported seeing or hearing chimpanzees or their signs at least every week, while 150 individuals claimed that chimpanzees were near the community every month, and 70 individuals reported chimpanzees were around, but were seen or heard infrequently. That so many people reported frequent sightings of chimpanzees suggests that the chimpanzees are living quite close to communities, or that they must revisit the same farms frequently to find food.

There are indications that chimpanzees may utilize different areas seasonally, probably as food availability changes and as chimpanzees move to avoid seasonal human activities such as burning of farmland in preparation for planting. 137 individuals reported chimpanzees primarily in the dry season, 21 said chimpanzees were around primarily in the wet season, whereas 138 individuals reported seeing or hearing chimpanzees in both seasons equally.

Table 1. The number of questionnaires returned for each district, and the number of respondents reporting presence or absence of chimpanzees near their village.

	Are there chimpanzees near your community?		
District	No	Yes	Total
Bo			0
Bombali	12	30	42
Bonthe	0	25	25
Kailahun	29	41	70
Kambia	10	25	35
Kenema	1	11	12
Koinadugu	0	34	34
Kono	17	47	64
Moyamba	7	33	40
Port Loko	2	53	55
Pujehun	1	21	22
Tonkolili			0
WAPFR	2	9	11
Grand Total	81	329	410

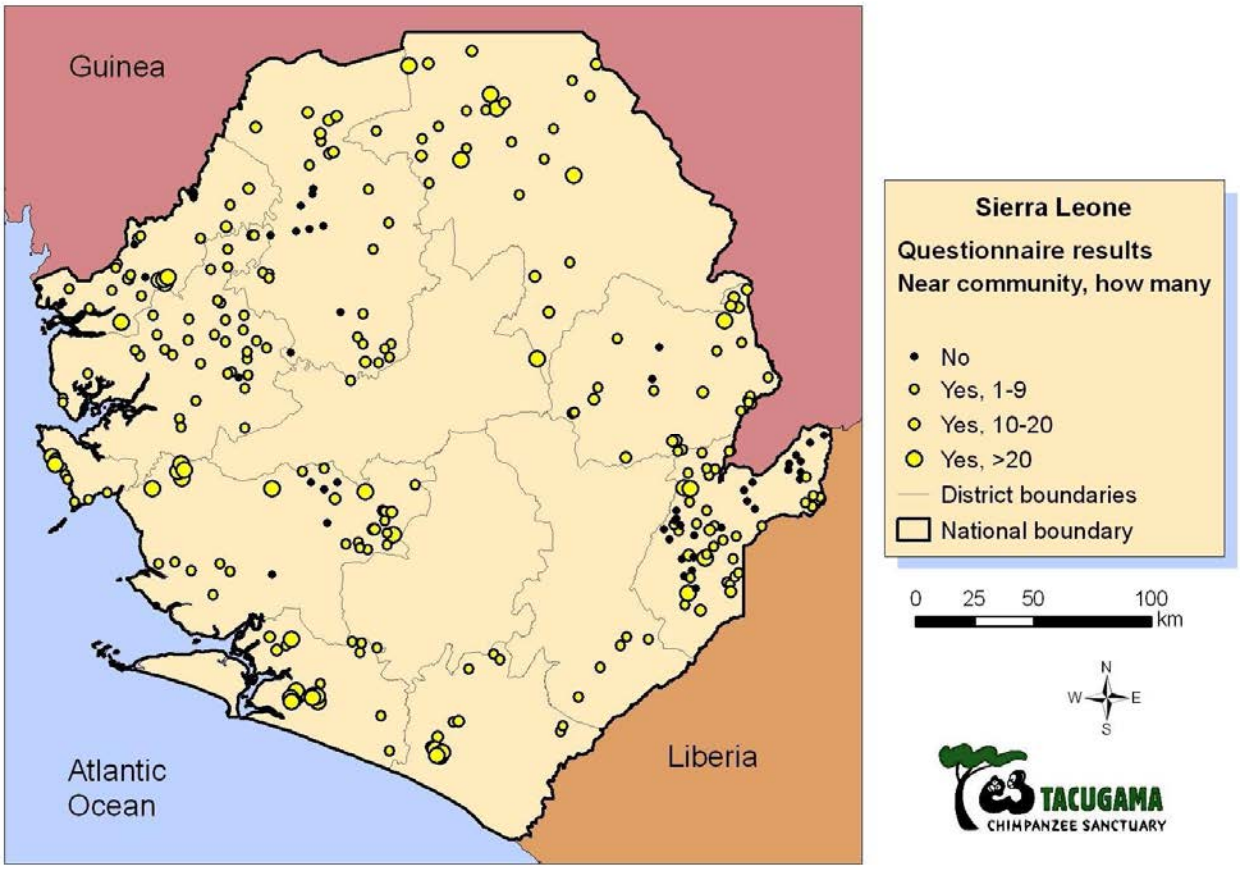
It is difficult for people to estimate the number of chimpanzees around their communities because a) chimpanzees live in a fission-fusion society where the chimpanzee community may divide into smaller units for extended periods, b) chimpanzees usually avoid people and may flee when people approach, and c) people tend to fear chimpanzees and do not usually try count them when they encounter a group. Nevertheless over time people may get an idea of the size of the chimpanzee groups that they do come into contact with repeatedly. Of the 317 responses to the question of how many chimpanzees were around the community, 210 people estimated that the chimpanzee

population around their villages comprised 1-9 individuals, 63 people estimated group sizes of 10-20 chimpanzees, and 44 estimated group sizes of over 20 individuals (Figure 8).

Most of the group sizes reported were 1-9 individuals, which may be because people see only a proportion of a chimpanzee group at a given time, or chimpanzees that live in disturbed habitats are in smaller groups. Groups of larger than 20 chimpanzees were reported in most of the districts, suggesting that chimpanzees can still occur outside of forest reserves in fairly large communities.

Figure 8. Map of Sierra Leone showing the locations where census questionnaires were administered and returned by Forestry Officers.

Responses to two of the questions, Are there chimpanzees near your community, and if so, how many?, are shown by black circles (no chimpanzees) and different-sized yellow circles (reported numbers of chimpanzees).



4.2 Interviews

4.2.1 Moyamba District pilot study

Teams were able to interview 244 communities in Moyamba District in March and April 2009 as part of the pilot study. Most of the communities (69%) reported having chimpanzees living nearby. These interviews were followed up on foot where possible to test the reliability of interview information. This led to the teams making 186 direct observations of chimpanzee signs (nests, dung, calls, feeding remains, and trails). Nests were found at 156 locations, totalling over 2300 nests, of which the vast majority were in palm trees. These data showed that people were able to give reliable information about chimpanzee presence or absence in proximity to their communities, and thus this became the basis for the block design of the nationwide survey.

The Moyamba District is a heavily populated area near Freetown with a human population density of 7.3-99.4 people/km^2 (DACO/SLIS data from 2004). Very few places existed with mature forest,

even within forest reserves. Narrow strips of forest approximately 10 m wide lined the sides of most rivers and very few roads. Otherwise the landscape is entirely dominated by active or fallow farm land. Some areas of secondary forest exist, but are under imminent threat of clearance. Many people reported that chimpanzees used to be more abundant around their communities before the war, but that in the last 10-15 years the places where they stayed have been cleared for farming and subsequently they do not see chimpanzees as much.

Almost all villages reported extensive crop damage and threats to their livelihoods posed by chimpanzees. In particular, chimpanzees were reported to raid farms for pineapples, pawpaw, and cassava, and destroy palm trees.

4.2.2 Lake Sonfon and Tonkoli Forest Reserve interviews

Eight additional interviews were completed around Lake Sonfon, of which only three communities reported chimpanzees. Many of the villages in the vicinity of the lake identified mining, hunting, and farming activities as causing a decline in the chimpanzee population since the war. Of the 24 communities interviewed in and around the Tonkoli Reserve, 8 reported having chimpanzees and 16 no chimpanzees in the vicinity. Many people reported that there were chimpanzees around their community before the war, but now they have not seen any for some time. More detailed information on each of these reserves is presented in the Individual Reserves section of this report.

4.2.3 Block interviews

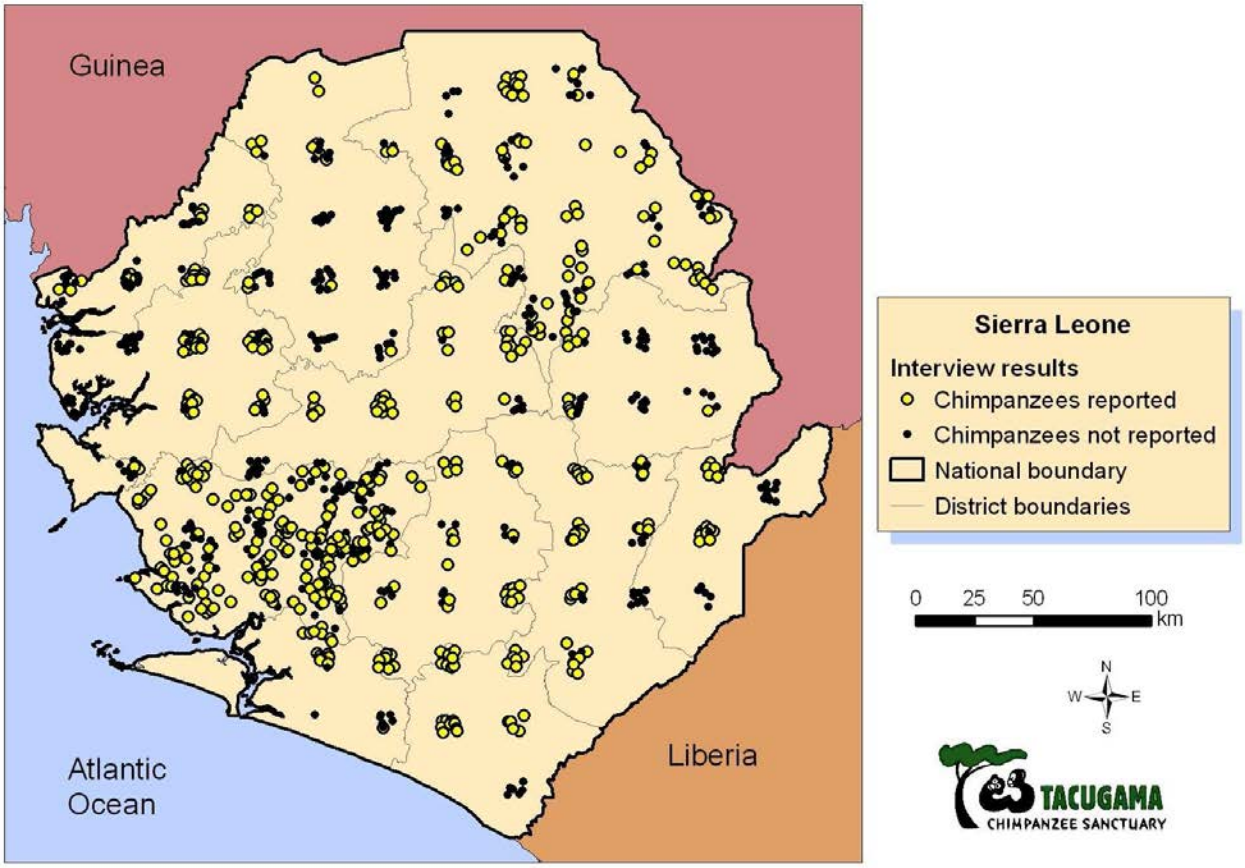
Interviews were carried out in 91 blocks across Sierra Leone from July 2009 to February 2010. Nine blocks were not surveyed because they fell in protected areas or the majority of the block was inaccessible such as in estuaries or ocean (see Appendix 1). Of the 663 interviews carried out in blocks, 352 (53%) communities reported no chimpanzees in their vicinity, while 311 (47%) said chimpanzees were present (Figure 9).

Including the interviews for the Moyamba pilot study (244), the nationwide block survey (663), extra interviews at Lake Sonfon (8), and Tonkoli Forest Reserve (24), the total number of interviews completed for the country was 939. The number of interviews per district and the percent of interviews reporting chimpanzee presence around the community are given in Table 2. The location of each interview, and whether communities reported chimpanzee presence or absence, is shown in Figure 9.

Table 2. Number of interviews carried out by district in Sierra Leone and the percentage of communities reporting chimpanzee presence near the community.

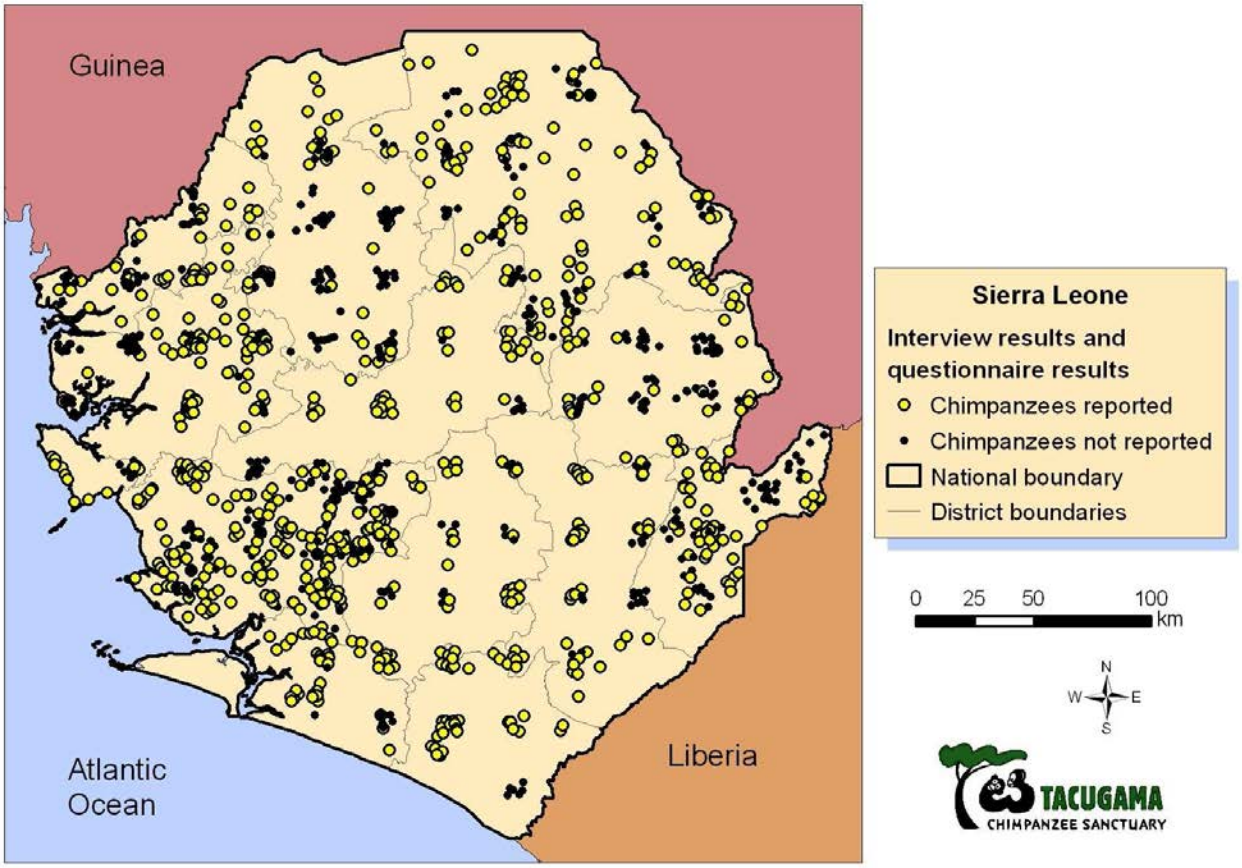
District	Number of Interviews	% reporting chimp presence	District	Number of Interviews	% reporting chimp presence
Bo	48	69	Kono	50	20
Bombali	82	17	Moyamba	279	66
Bonthe	18	56	Port Loko	89	46
Kailahun	37	43	Pujehun	24	71
Kambia	36	36	Tonkolili	64	58
Kenema	64	66	Western Area Rural	9	11
Koinadugu	139	53	**Total**	**939**	**52**

Figure 9. Locations of all 939 community interviews completed in Sierra Leone showing whether communities reported chimpanzee presence or absence.



The results of the questionnaires and interviews show that chimpanzees are reported for every district in Sierra Leone. The only areas where chimpanzees appear to be largely absent are in southern Bombali, central Kono, eastern Kailahun, and western Port Loko Districts (Figure 10).

Figure 10. Combined results of all interview and questionnaire data showing locations where community members reported chimpanzee presence or absence.



4.2.4 Supplementary information from block interviews

The block interviews also provided information about crop raiding, people's attitudes towards chimpanzees, hunting practices, and perceived trends in chimpanzee numbers. This information was gathered for 671 interviews on the nationwide block survey, but occasionally not all supplemental information was collected during each interview. Thus the number of responses varies for each question.

Trends

The perceived trend in chimpanzee populations for Sierra Leone is almost universally one of decline. 385 (75%) of the 511 communities that responded to this question said that there were fewer chimpanzees around their communities now than in the past (Figure 11A). The primary perceived cause for the decline in chimpanzee numbers was deforestation (275 communities). Hunting was the next most common reason given (100 communities), followed by the war (58 communities). The war was blamed either because of uncontrolled hunting, or because the sound of the guns drove the chimpanzees away. Farming was given as a reason in 28 communities, presumably linked to deforestation. Mining was cited as a reason for chimpanzee decline in 8 communities in Koinadugu, Kono, and Tonkolili Districts.

Only 75 communities (15%) reported that chimpanzee numbers around their communities were stable, and 10 (2%) said chimpanzee numbers had actually increased. Places where chimpanzee numbers were thought to have been stable were north-eastern Pujehun District, Bonthe District, and northern Bo District (Figure 11A). Reasons given for this were because there were no weapons for

hunting them with or because people did not hunt chimpanzees (43 communities). Another reason given was that there was still forest around for the chimpanzees (8 communities).

41 communities reported that there had never been chimpanzees around their communities (8%).

Hunting

Interviews from 507 communities showed that almost half of them (252) would eat or hunt chimpanzees (Figure 11B). Districts where the majority of respondents said they would eat chimpanzee meat were Bo, Bonthe, Kailahun, and Kono. Even communities that claimed to know about the law protecting chimpanzees still said they would eat chimpanzee meat if it was available (41 out of 77 communities). Chimpanzee meat is usually consumed locally or sold, but 20 communities reported eating it for medicinal purposes (as a cure for river blindness, tuberculosis or other diseases), while 3 reported killing chimpanzees in order to protect their crops. Of the 255 communities that said they would not eat or hunt chimpanzees, reasons cited were that chimpanzees were similar to humans (58 communities), because their religion forbade it (36 communities), it was against their custom or totem (18 communities), they lacked weapons to hunt them with (4 communities), or because it was against the law (2 communities). That the law does not seem to be a major reason for people not hunting or eating chimpanzees suggests that law enforcement is weak, and that softer approaches emphasising similarity with humans or traditional/religious practices might be more effective for protecting chimpanzees.

Crop raiding

Of the 294 communities that reported chimpanzee presence and responded to questions about crop raiding, only 35 said that chimpanzees did not disturb their crops or fruit trees. 137 communities reported some crop raiding, whereas 122 reported frequent disturbance by chimpanzees. The frequency of reported crop raiding is given by district in Table 3. The districts that reported having more problems with frequent crop raiding by chimpanzees were in the south and east of the country: Bo, Bonthe, Kailahun, Kenema, and Pujehun. Crop raiding did not seem to be as much of a problem in the north of the country, particularly in Koinadugu and Bombali Districts (Figure 11C).

Table 3. Number of interviews reporting chimpanzee presence and crop raiding by chimpanzees, for each district.

	Reported crop raiding		
District	**None**	**Some**	**Frequent**
Bo	1	11	21
Bombali	6	6	2
Bonthe	1	0	9
Kailahun		4	12
Kambia	2	10	1
Kenema	1	18	23
Koinadugu	16	24	6
Kono	2	7	1
Moyamba		12	2
Port Loko	3	23	15
Pujehun		1	16
Tonkolili	3	20	14
Western Area Rural		1	
Total	35	137	122

The most common crop damaged was oil palm trees, where chimpanzees not only eat the palm fruit, but also destroy the palm heart by pulling out the uppermost leaves and eating the base of the leaf. People felt that this either caused the tree to die or reduced its future capacity to produce fruit. This was more commonly reported in the south-western districts of Bo, Bonthe, Pujehun and Moyamba where palm oil and palm wine production are important to local communities (Table 4). Cacao was an important cash crop that is eaten by chimpanzees primarily in Bo, Kailahun, Kenema, and Pujehun. Other crops which were more commonly reported as damaged by chimpanzees were bananas, cassava, corn, papaya, and pineapple.

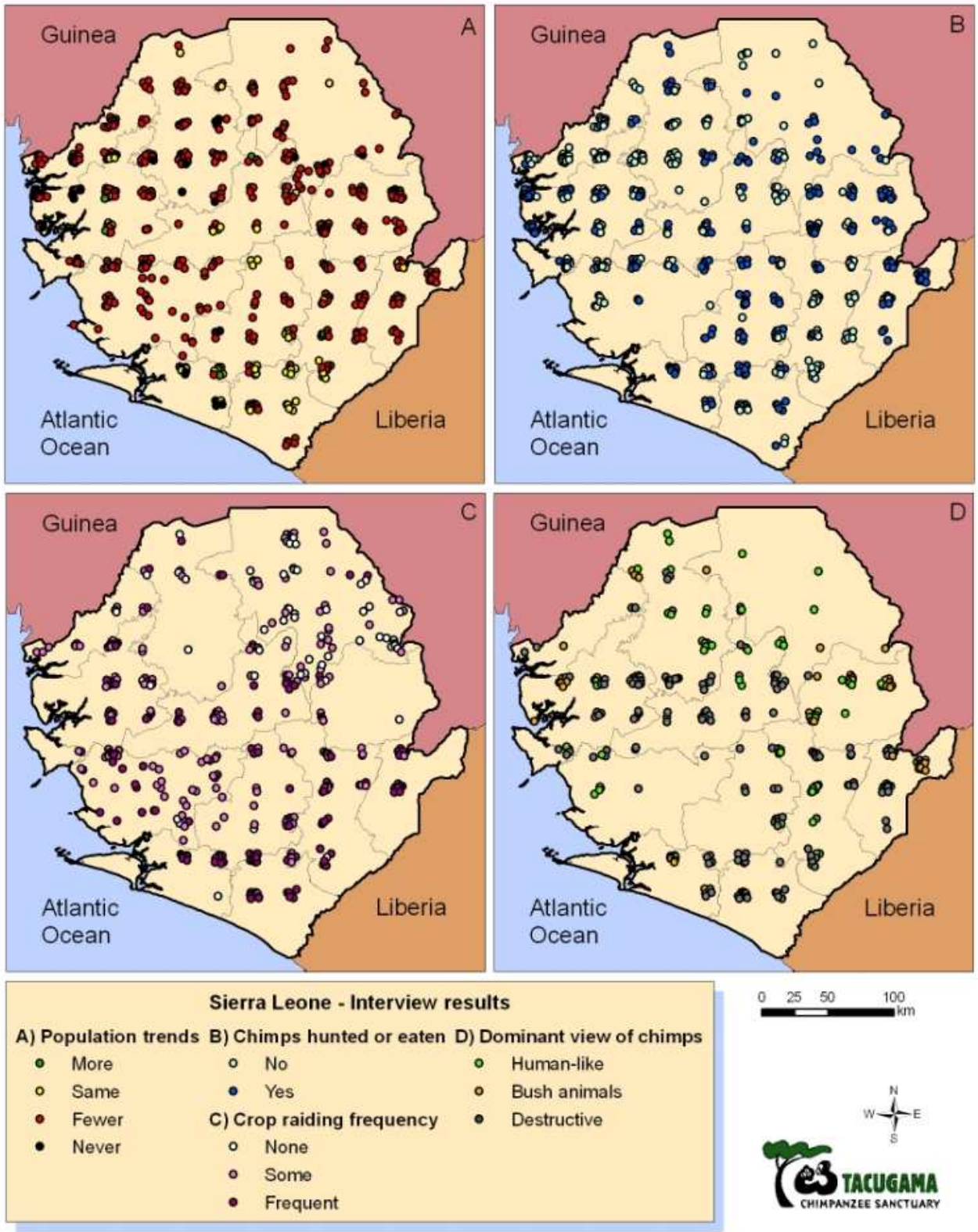
Table 4. The number of times each crop was reported in interviews as eaten by chimpanzees, by district.

District	Palm	Banana	Cassava	Cacao	Corn	Papaya	Pineapple	Orange	Mango	Potato	Beans	Groundnut	Yam
Bo	23	17	21	14	4	7	12	6	1	2	1		1
Bombali	2	1	2		2			2	3		1		
Bonthe	7	2	6		4	1	2	1	2	2			
Kailahun	9	12	1	14	2	5	3	3					
Kambia	9	4	2		3	3		6	3			1	
Kenema	23	21	15	35	14	14	10	6	6		1		
Koinadugu	2	18	3		3	8	3	2	5		1		
Kono	5	5		1		3	2						
Moyamba	11	7	3		6	1	4	6	3		1		
Port Loko	13	4	14		13	7	7	12	8	4	1	1	
Pujehun	16	4	11	13	1	1	10	2	1				
Tonkolili	8	15	23	1	13	14	5	1	7	1	1	3	3
Western Area Rural	1					1							
Total	**129**	**110**	**101**	**78**	**65**	**65**	**58**	**47**	**39**	**9**	**7**	**5**	**4**

Attitudes and knowledge

Attitudes towards chimpanzees are overwhelmingly negative. The most common opinion of chimpanzees was that they are destructive to crops (178 communities). This was particularly true in communities where frequent crop raiding was reported. However, there was some appreciation that chimpanzees were similar to humans (80 communities), primarily in the north of the country where crop raiding was not a major issue, and in Kenema where some sensitization may have taken place through the Gola Forest Programme (Figure 11D). Only 77 communities reported knowing about laws protecting chimpanzees, but this is likely to be an underestimate as this question was not asked directly in order to not bias further answers. However, 41 of those 77 who knew there were laws protecting chimpanzees said they would still eat chimpanzee meat. 49 communities thought of chimpanzees as just animals in the bush and did not ascribe any human qualities to them.

Figure 11. Summary of supplementary interview data regarding A) community perceptions on chimpanzee populations trends, B) hunting or eating of chimpanzees, C) crop raiding frequency, and D) the predominant attitude of communities towards chimpanzees.



4.2.5 Predicted density stratification

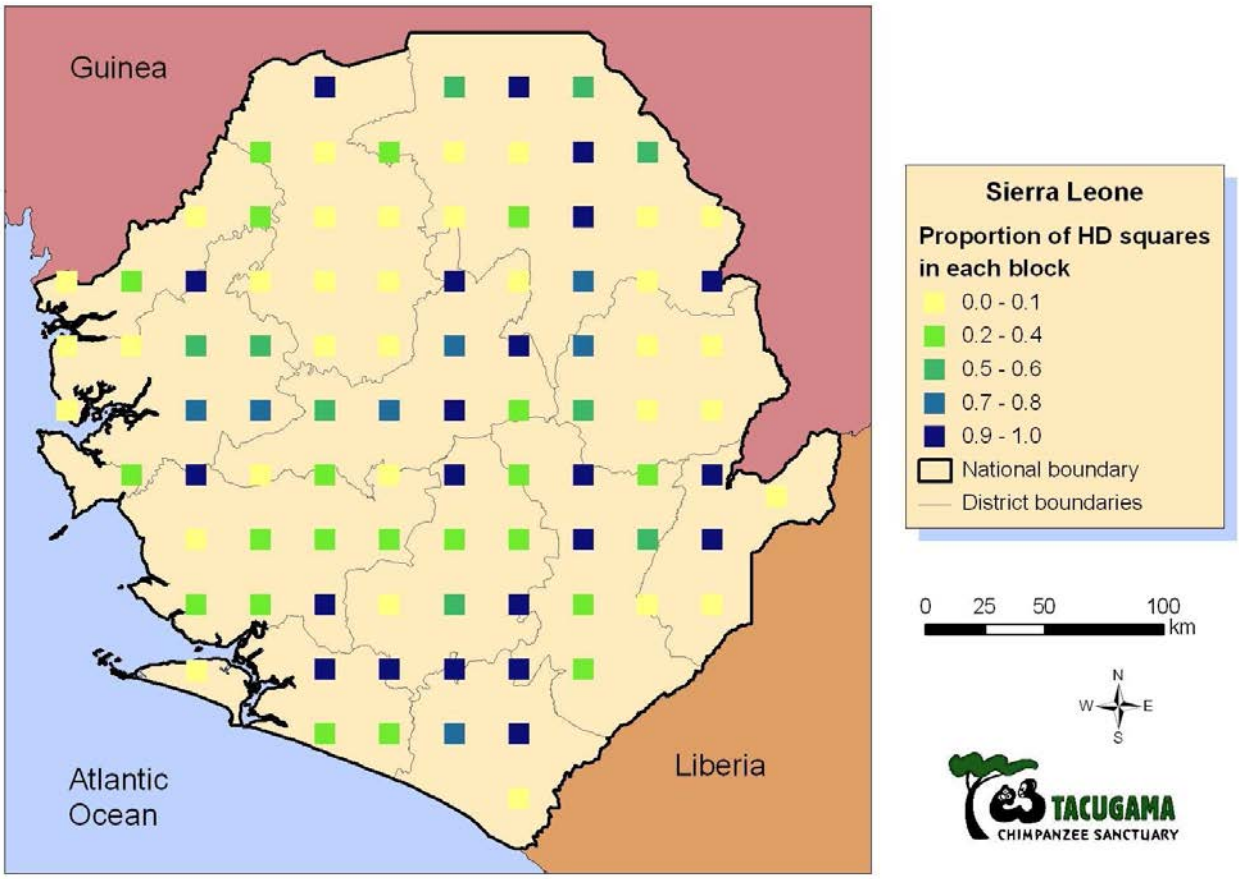
Interview data was used in the block survey to stratify each square of each block as having a low or high predicted chimpanzee density. The number of villages interviewed in each block ranged from

1-14 (average 7.6). Information about each block, including the district(s) and chiefdom(s) in which they fell, month surveyed, number of interviews, number of high and low-density squares, geographic coordinates, density of the centre square, and length of centre transect are shown in Appendix 1. Within the 91 blocks surveyed, 799 squares were stratified as high or low density (326 high density squares, 473 low density squares) using the classification criteria. These 799 squares surveyed represent 9.9% of the total surface area of the country.

Although only the predicted density of individual 3x3 km squares was used to determine transect placement, interview information was summarised by block in order to simplify visually the predicted density of chimpanzees across the country. Interview information was summarized per block by calculating the proportion of squares in each block that were classified as high density, that is, squares where communities reported higher frequencies of chimpanzee calls, sightings, crop raiding, or nests. The areas of predicted high and low chimpanzee density are shown in Figure 12. Again, chimpanzees are less reported in much of Bombali and Kono Districts, as well as parts of Koinadugu, Kailahun, and Kambia Districts. Chimpanzees are frequently reported in the south and centre of Sierra Leone, as well as central and northern Koinadugu District.

Figure 12. Summary results of block interviews showing the proportion of squares in each block that were classified as high density.

Darker blocks had more squares where chimpanzees were frequently heard, seen, crop raided, or built nests as reported in interviews.



Approximately 30% of the blocks had only low-density squares (Table 6) and 15% had only high-density squares. Thus 55% of the blocks had a mix of low and high-density squares.

Table 5. Frequency of high-density squares in each of the 89 surveyed blocks.

No HD squares	Frequency
0	27
1	5
2	10
3	10
4	3
5	5
6	4
7	5
8	7
9	13

4.3 Transect results

4.3.1 Block transects

In total, 173 transects were completed in 89 blocks (76 in high density squares, 97 in low density squares). The total transect length in blocks was 386 km, divided almost equally between high and low-density strata (Table 6). While only 2 nests were found in low density squares, 213 were found in high density squares. This 100-fold difference in nest counts shows that the interview information was very effective at predicting chimpanzee density.

The number of transects in block centres, representing systematically stratified transects, was 89 for a total of 242.1 km. Six of these transects could not be walked in the centre square because permission could not be obtained by communities or rivers prevented access, and were bumped to another square with the same density. Of the 89 centre squares, over half (46) were classified as high density, whereas the proportion of all squares that were classified as high density was only 41%. The total number of nests on centre (or equivalent) transects was 147, of which 95 nests were within the truncation distance. Thus sufficient nests were found to also analyse the systematically placed centre transects alone.

Table 6. Transect summary data for transects in high density, low density and centre squares.

	High Density	Low Density	Block centre transects only
Number of squares	326	473	89
Number of transects	76	97	89
Total transect length (km)	196.7	189.2	242.1
Number of transects with chimpanzee nests	24	1	19
Total chimpanzee nests	213	2	147
Total chimpanzee nest groups	83	1	55
Average nest group size	2.57	2	2.67
Nest encounter rate (nests/km)	1.08	0.01	0.61
Number of transects with chimpanzee signs	42	3	32
Total chimpanzee signs	347	8	255
Chimpanzee sign encounter rate (signs/km)	1.76	0.04	1.05

4.3.2 Protected area transects

A total of 137 transects was completed for all protected areas for a total distance of 253.3 km. An additional 101 transects were walked in the Gola Forest, adding 166.8 km to the nationwide total. 1305 chimpanzee nests were found on transects in protected areas. Average nest group sizes were larger in each of the forest reserves where nests were found than outside of protected areas (Table 6 and Table 7). This suggests that chimpanzee groups in disturbed landscapes are much reduced in size, or that they break up into smaller sub-groups to avoid detection. The highest nest encounter rates were in the Outamba section of Outamba-Kilimi National Park and in the Loma Mountains Non-hunting Forest Reserve. Three reserves had no nests on transects: Kambui Hills, Kangari Hills, and Nimini Hills, although other chimpanzee signs were found on Kambui Hills transects and nests and signs were found on recces in all three reserves. Although fewer transects were walked in these reserves, the results suggest that chimpanzee populations are so low there that they would be unlikely to contribute greatly to the nationwide total.

Table 7. Transect summary data for all protected areas

	Gola*	Kambui	Kangari	Kilimi	Loma	Nimini	Outamba	Tingi	WAPFR
No. transects	101	10	8	17	31	10	27	19	15
Total transect length (km)	166.8	20.0	15.8	34.0	59.8	19.9	52.2	24.6	27.0
No. transects with chimpanzee nests	32	0	0	5	20	0	24	5	3
Total chimpanzee nests	137	0	0	72	495	0	524	47	30
Total chimpanzee nest groups	24	0	0	17	179	0	168	18	7
Average nest group size	5.75	0	0	4.24	2.77	0	3.12	2.35	4.29
Nest encounter rate (nests/km)	0.82	0	0	2.12	8.27	0	10.04	1.91	1.11
No. transects with chimpanzee signs	n/a	2	0	6	20	0	25	6	5
Total chimpanzee signs	n/a	4	0	77	517	0	579	51	33
Chimpanzee sign encounter rate (signs/km)	n/a	0.20	0	2.26	8.65	0	11.09	2.08	1.22

* Data provided by the Gola Forest Programme (Ganas 2009)

The locations of all 411 transects and their respective strata are shown in Figure 13. For reserves (including OKNP), the area covered by transects was 0.47% of the total reserve area. For non-protected areas, block transects covered 0.03% of the country (Table 8).

Figure 13. Locations and strata of all 411 transects walked in Sierra Leone as part of the nationwide survey, including the 101 transects completed by the Gola Forest Programme.

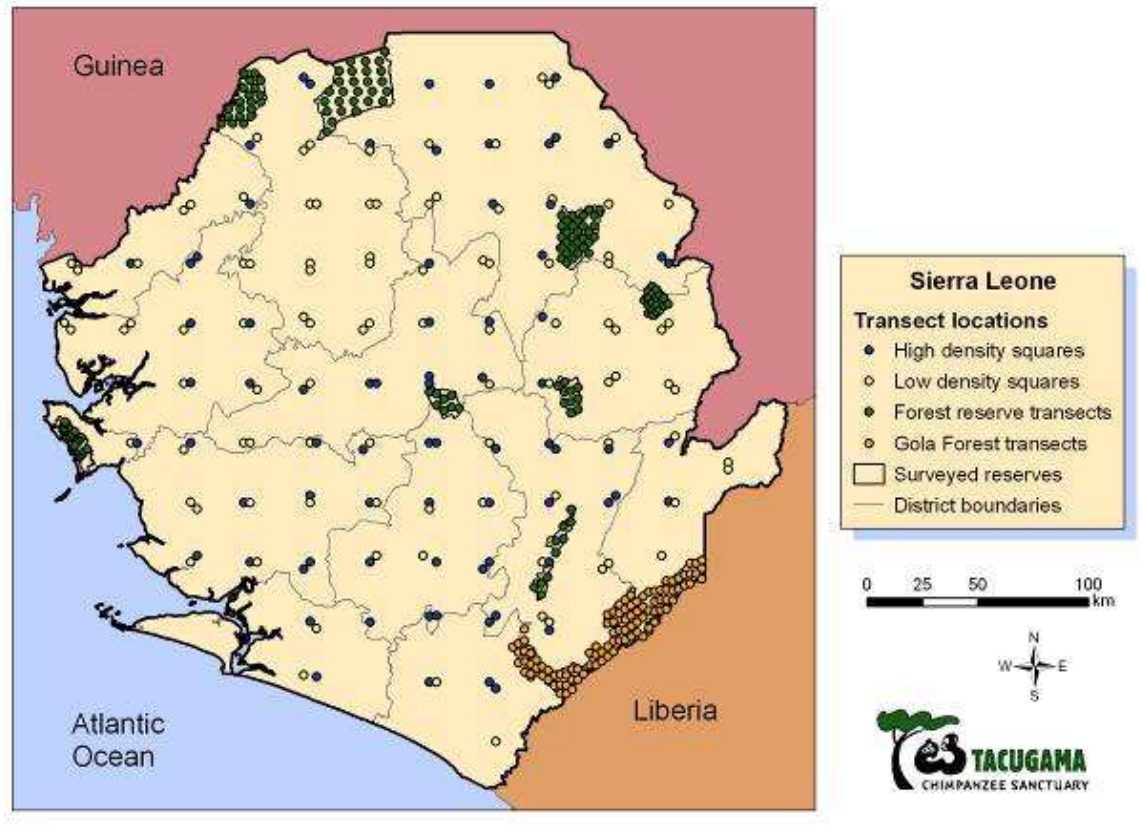


Table 8. Areas of protected and non-protected area strata calculated from ArcView polygons used in the calculation of chimpanzee population estimates and the proportion of each area surveyed.

Strata	Area (km^2)	Transect area‡ (km^2)	% of strata surveyed
Sierra Leone total area	72,596		
Gola*	1,085	4.87	0.449
Kambui	152	0.58	0.384
Kangari	141	0.46	0.328
Kilimi	274	2.21	0.808
Loma	396	1.75	0.442
Nimini	129	0.60	0.462
Outamba	783	3.12	0.399
Tingi	116	0.72	0.618
WAPFR	158	0.79	0.499
Total protected areas	3,234	15.11	0.467
Non-protected area high chimp density†	28,301	11.52	0.041
Non-protected area low chimp density†	41,062	11.08	0.027
Total stratified non-protected area transects	69,363	22.61	0.033
Non-protected area block centre transects only	69,363	12.35	0.018

* Gola area includes community forests that were surveyed as part of the Gola chimpanzee survey (Ganas 2009)

† Area of Sierra Leone classified as high or low density is based on the proportion of high density (0.408) and low density (0.592) squares multiplied by total area outside of protected areas.

‡ Transect area calculated as 2xESWxLength

4.3.3 DISTANCE analysis by stratum

Preliminary analysis suggested that the detection function varied significantly between forested habitats, woodland savanna, and the human modified landscapes that made up much of the rest of the country. Furthermore, as described in the methods section, the nest duration also varied between forest, woodland savanna, and the palm-tree nests that comprised part of the non-protected area data. Although the DISTANCE program can calculate individual detection functions for each stratum, it does not allow for the input of different nest durations in a single analysis. Therefore the countrywide dataset was split into three separate groups by primary habitat type for DISTANCE analysis. However, this precludes the calculation of a percentage coefficient of variation for the combined nationwide population estimate.

4.3.3.1 Block transects outside of protected areas

Analysis of block centre transects only

This analysis uses a subset of the stratified block data – only the centre transect of each block. The perpendicular distances were truncated at 45 m, removing the outermost 35% of observations. The removal of a high proportion of the nests is due to the higher visibility of palm nests in farms and farmbush, and it was these more distant nests which were truncated. Because nests found during the block surveys spanned a variety of habitats and tree types, the nest duration used in the DISTANCE analysis of block nest data was an average of the palm, forest, and woodland savanna nest durations weighted by the proportion of nests of each type. Nest duration was calculated from the 95 nests remaining after truncation: 43 were palm tree nests, 28 were in woodland savanna, and 24 were in forest or farmbush. This resulted in an average nest duration of 180 days. The model with the best fit to the data was half-normal function with the simple polynomial adjustment term. Chimpanzee density and abundance calculated from block centre transects only are shown in Table 9.

Analysis of stratified block data

To utilise all transect data collected, analysis of transects stratified by high and low density squares was also carried out. Perpendicular distances were truncated at 50 m, removing the outermost 35% of observations. Nest duration was calculated from the 139 nests remaining after truncation: 58 were palm tree nests, 55 were in woodland savanna, and 26 were in forest or farmbush. Thus the average nest duration used was 178 days.

High and low density strata were post-stratified in DISTANCE, where encounter rate and density were calculated by stratum, but detection function was calculated from the pooled data. The pooled estimate of density was made from area weighted stratum estimates. The model with the best fit to the data was half-normal function with the simple polynomial adjustment term.

Table 9. DISTANCE estimates for encounter rate, chimpanzee density, and chimpanzee numbers with 95% confidence intervals for block transects (non-protected areas).

The percentage coefficient of variation (%CV) incorporates variance of nest production and nest duration.

Stratum	Area (km^2)	No. nests after truncation	Encounter rate (nests/km) [95% CI]	Density (ind/km^2) [95% CI]	No. chimps [95% CI]	%CV
Centre transect only	69,363	95	0.39 [0.21-0.74]	**0.05 [0.02- 0.09]**	**3100 [1540-6341]**	**36.98**
High density	28,301	137	0.70 [0.39-1.23]	0.07 [0.037-.134]	2000 [1043-3805]	33.57
Low density	41,062	2	0.01 [0.002-0.04]	0.001 [0.0003-0.004]	40 [11-182]	82.09
Pooled estimate of stratified block transects				**0.03 [0.02-0.06]**	**2040 [1073-3864]**	**33.07**

Results of block transect analysis differed when transects were stratified compared to analysis of the centre transects only (Table 9). The number of chimpanzees estimated from centre block transects is 3,100 individuals, much higher than the estimate of 2,040 individuals determined from stratification of the block transects, although the 95% confidence intervals largely overlap. This is likely to be due to the greater proportion of high density squares in the block centres as compared to all squares just by chance.

However, in the stratification method the placement of the second transect into a high or low-density square in the block reduces the independence of that transect, possibly introducing a bias into the results. As there were so few nests on low-density transects, this does not affect the low-density estimate. In cases where the block had both high and low density squares (about 55% of the blocks) however, the transect placement was slightly biased because the transect did not have an equal chance of occurring in any high-density square in the country. Systematically placed transects were more likely to land in high-density squares when most of the block was high-density and high density transects were also more likely to have nests when a greater proportion of the block was high density. This could potentially underestimate densities. There was no trend of increasing nest encounter rate with high-density transects in blocks with a greater proportion of high-density squares.

Therefore the estimate of chimpanzee density and abundance calculated from the block centre transects of 3,100 individuals was used in the final estimate of chimpanzee population size. The result of the analysis using centre transects shows that although chimpanzees are distributed across most of the country, densities outside of protected areas are very low (0.05 chimpanzees/km^2). The lower number of nests encountered on the centre transects resulted in a greater percentage coefficient of variation than using the stratified data, thus the 95% confidence interval was 1,540 - 6,341 individuals.

4.3.3.2 Forest reserves

Forest reserves were post-stratified in DISTANCE, where encounter rate and density were calculated by stratum, but detection function was calculated from the pooled data. The pooled estimate of density was made from area weighted stratum estimates. The perpendicular distances were truncated at 33 m, removing the outermost 3% of observations. The model with the best fit to the data was half-normal function with the simple polynomial adjustment term.

Table 10. DISTANCE estimates for encounter rate, chimpanzee density, and chimpanzee numbers with 95% confidence intervals for all forest reserves individually and then pooled.

The percentage coefficient of variation (%CV) incorporates variance of nest production and nest duration.

Stratum	Area (^{2})	No. nests after truncation	Encounter rate (nests/km) [95% CI]	Density (ind/km^2) [95% CI]	No. chimps [95% CI]	%CV
Gola*	1,085	126	0.76 [0.51-1.14]	0.25 [0.14-0.43]	270 [159-468]	27.90
Kambui	152	0				
Kangari	141	0				
Loma	396	486	8.13 [4.84-13.67]	2.69 [1.44-5.01]	1065 [572-1986]	31.91
Nimini	129	0				
Tingi	116	44	1.79 [0.60-5.35]	0.59 [0.19-1.84]	70 [22-213]	58.79
WAPFR	158	29	1.08 [0.30-3.90]	0.36 [0.10-1.32]	55 [15-209]	68.50
Pooled estimate: All forest reserves				**0.67 [0.39-1.15]**	**1460 [854-2509]**	**27.06**

* Survey area includes community forests as well as all sections of the Gola Forest Reserve (Ganas 2009)

Of the forest reserves, Loma Mountains Non-hunting Forest Reserve has by far the highest density of chimpanzees in the country, with a total estimate of over 1,000 chimpanzees. Although the Gola Forest has higher numbers of chimpanzees than the remaining reserves, Tingi Hills and the WAPFR Reserves actually have higher densities than the Gola Forest area (Table 10). Chimpanzee densities in forest reserves range from undetectable (Kambui, Kangari, and Nimini) to 2.69 individuals/km^2 in the Loma Mountains. The total estimate of chimpanzee abundance in the surveyed forest reserves is 1,460 individuals (95% CI=854-2,509).

4.3.3.3 Outamba-Kilimi National Park

Outamba-Kilimi National Park was analysed separately from the forest reserves because the habitat is primarily woodland savanna, which has a different nest duration. The Outamba and Kilimi sections of the park were post-stratified in DISTANCE, where encounter rate and density were calculated by stratum, but detection function was calculated from the pooled data. The pooled estimate of density was made from area weighted stratum estimates. The perpendicular distances were truncated at 40 m, removing the outermost 11% of observations for Outamba and 7% of observations for Kilimi. The model with the best fit to the data was hazard rate function with the simple polynomial adjustment term.

Table 11. DISTANCE estimates for encounter rate, chimpanzee density, and chimpanzee numbers with 95% confidence intervals for Kilimi and Outamba sections of the national park individually and then pooled.
The percentage coefficient of variation (%CV) incorporates variance of nest production and nest duration.

Stratum	Area (km^2)	No. nests after truncation	Encounter rate (nests/km) [95% CI]	Density (ind/km^2) [95% CI]	No. chimps [95% CI]	%CV
Kilimi	274	67	1.9 [0.61-6.41]	0.27 [0.08-0.90]	70 [22-246]	62.67
Outamba	783	465	8.9 [6.71-11.83]	1.21 [0.78-1.88]	950 [615-1472]	22.28
Pooled estimate: OKNP				**0.97 [0.62-1.51]**	**1020 [658-1596]**	**22.10**

Although there was actually a higher nest encounter rate in Outamba than in the Loma Mountains, the longer nest duration and wider effective strip width in woodland savanna resulted in a lower density estimate for Outamba. Kilimi had a much lower nest encounter rate than the Outamba section and thus made up a small proportion of the total population of OKNP, estimated to be 1,020 (95% CI=658-1,596) chimpanzees (Table 11).

4.3.4 Total chimpanzee population of Sierra Leone

To determine a total estimate for the chimpanzee population in Sierra Leone, the number of chimpanzees and the 95% confidence intervals for each habitat type were combined (Table 12). Thus the total chimpanzee population of Sierra Leone is estimated as 5,580 individuals (95% CI=3,052-10,446). More than half of the chimpanzees in the country are found outside of protected areas.

Table 12. Total chimpanzee population in Sierra Leone with associated lower and upper confidence intervals.

Abundance estimate for Sierra Leone has been calculated by summing the abundance estimates from each pooled estimate from the different habitat types. p is the probability of nest detection within the effective strip width (ESW). These results are based on the centre block data analysis

Habitat	No. of chimpanzees	Lower CI	Upper CI	p	ESW
Non-protected area	3100	1540	6341	0.58578	25.509
Forest reserves	1460	854	2509	0.44266	14.608
OKNP	1020	658	1596	0.69504	27.802
Sierra Leone	**5580**	**3052**	**10446**		

Using the stratified block data analysis the total estimate would have been lower as shown below

Habitat	No. of chimpanzees	Lower CI	Upper CI	p	ESW
Non-protected area	2035	1073	3864	0.58578	29.289
Forest reserves	1465	854	2509	0.44266	14.608
OKNP	1025	658	1596	0.69504	27.802
Sierra Leone	**4525**	**2585**	**7969**		

The longer ESW in non-forested areas meant that more nests were detected farther from the transect line (Table 12). This indicates that nests could be seen farther away in farmbush and woodland savanna than in forest. This was particularly true for disturbed landscapes where chimpanzees frequently nested in palm trees. In fact, many of the palm tree nests were truncated because they were very far from the transect line. For example, on a transect in Tonkolili District, palm tree nests could be seen an estimated 1800 m from the transect across a large valley. It is unlikely that they would have been visible in non-palm trees. Other nests were seen approximately 500 m from the transect line on several transects. These were truncated in the analysis, but suggest that caution should be taken in determining truncation distances in the field in non-forest habitats. The probability of detection (p) was also much higher in woodland savanna than farmbush, and lowest in forest. The open canopy of the woodland savanna landscapes makes it easier to reliably detect nests within the effective strip width than in dense forest.

The effective strip width (Table 12) was used in the calculation of chimpanzee density estimates for each transect. These results are compared with predicted chimpanzee densities from block interviews in Figure 14. The chimpanzee density from nest data does not match particularly well with interview data, but this is likely due to the low nest encounter rate on transects. When compared with chimpanzee signs, for which the encounter rates were higher, the interview data matches with the transect data very well (Figure 15). Nests were found on 32% of high density transects, whereas chimpanzee signs were found on 56% (Table 6).

Figure 14. Spatial comparison of chimpanzee density on transects (blue circles) with predicted chimpanzee occurrence from block interviews (blue shading). Blue shading is the proportion of high density (HD) squares in each block, interpolated between blocks. Data on chimpanzee densities for the Gola Forest area is provided by the Gola Forest Programme (Ganas 2009).

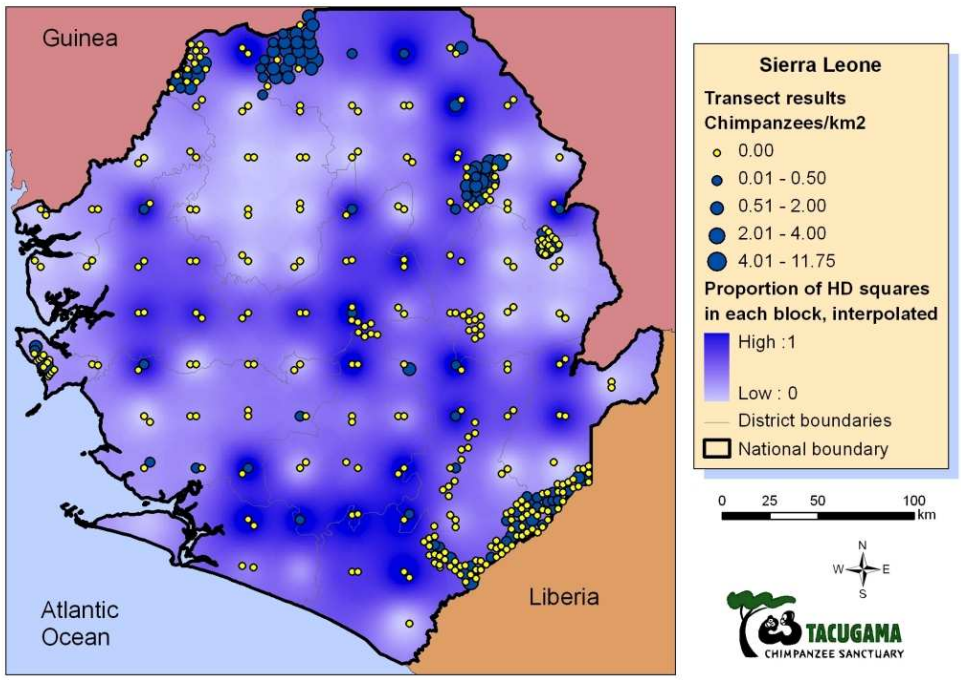
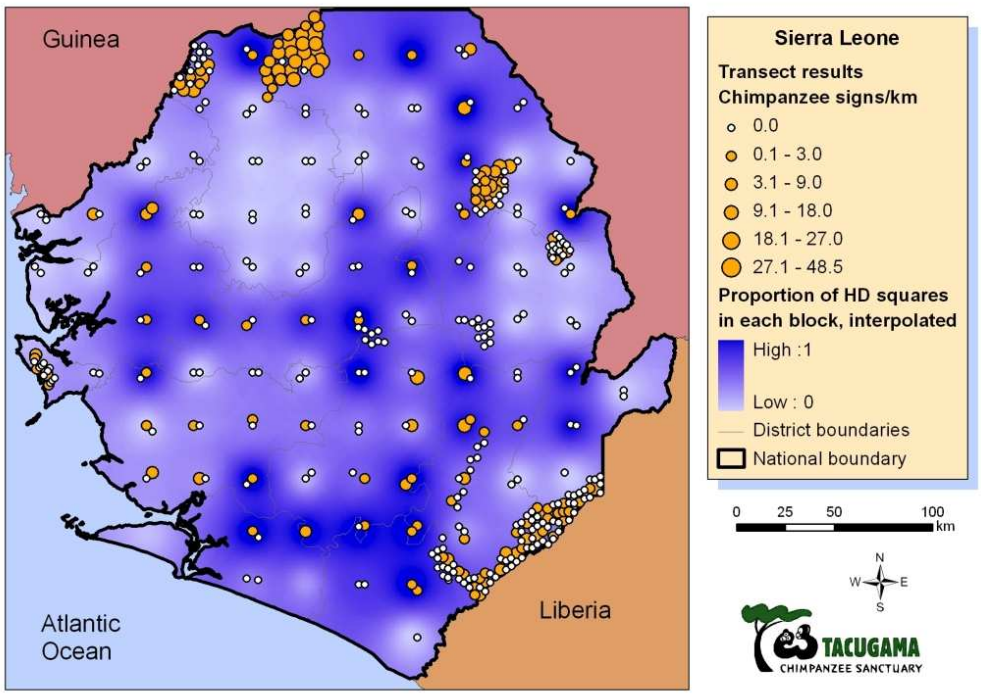


Figure 15. Comparison of chimpanzee sign encounter rates on transects (orange circles) with predicted chimpanzee occurrence from block interviews (blue shading). Blue shading is the proportion of high density squares in each block, interpolated between blocks. The encounter rates for the Gola Forest area only include nests and not other chimpanzee signs (Data provided by the Gola Forest Programme, Ganas 2009).



Districts where chimpanzee nests occurred on a higher proportion of transects were Koinadugu, Kenema, and Moyamba. The most important districts for chimpanzees based on where chimpanzees were more frequently reported in interviews and also where chimpanzee signs were seen on a higher proportion of transects were Koinadugu, Kenema, Moyamba, Tonkolili, Bonthe, Pujehun, and Bo (Figure 15).

5 INDIVIDUAL PROTECTED AREAS – DETAILED RESULTS

5.1 Gola Forest Reserves

5.1.1 Study area

The Gola Forest Reserves cover 750 km^2 and contain the largest block of lowland rain forest in Sierra Leone It spans Kenema, Kailahun, and Pujehun Districts and is divided into three main blocks: Gola East, West, and North, with several extensions. The Gola forest was depopulated by warfare around the turn of the century, and then abandoned. The forest now is a patchwork of primary growth with some old re-growth on former farm sites. The reserves were established in 1926 (Gola East and West) and 1930 (Gola North). Logging operations took place before the war and around 15% of the forest has been damaged by commercial logging (Davies 1987).

The reserves are now a proposed national park and are managed by the Gola Forest Programme. This was established in the early 1990's with the Conservation Society of Sierra Leone, MAFFS Forestry Division and the Royal Society for the Protection of Birds (RSPB) and is now funded by many international donors including the European Union and Fonds Français pour l'Environnement Mondial (FFEM).

The Gola Forest Programme has a comprehensive research program to assess the biodiversity and provide data for long-term monitoring of the reserve. Systematic surveys of birds, mammals and trees were undertaken across the Gola Forest between October 2005 and June 2007. Seven short surveys were also undertaken during this time of plants, butterflies, dragonflies, white-necked picathartes, riverine wildlife, orchids and birds and mammals (Klop *et al.,* 2008). The detailed reports for these surveys are available on the Gola Forest website: www.golarainforest.org**.** The findings show that the forest is largely intact, though substantial areas have been degraded by logging which mostly took place prior to the war. Almost all threatened species known to occur in Gola Forest were documented during the surveys and many additional species were found. Around 1700 species of all taxa were recorded.

Earlier systematic surveys of Gola Forest's mammals and birds date were carried out in the late 1980s (Davies 1987, Allport *et al.,* 1989). Further reports were completed on the status of the elephant population (Merz 1986). For a full list of research carried out in Gola, see Klop *et al.,* 2008 and the references therein.

Ecological research and monitoring of the Gola Forest Reserve (www.golaforest.com):

Following a baseline survey, conducted between 2005 and 2007, the project has continued to survey key species and key ecological processes. This includes a survey of Western Chimpanzees, funded by the US Fish and Wildlife Service Great Apes Program, a survey of pygmy hippos, remote camera trap surveys for mammals and birds, and the habituation and corresponding ecological study of Diana monkeys. Other studies conducted include:
Small mammal surveys (mice, rats, shrews): Dr. Pius Anadu
Rapid botanical assessment: Dr. William Hawthorne, Oxford University
Bat survey: Natalie Weber and Dr. Jakob Fahr, Ulm University, Germany
Bat epidemiology: Drs. Fabian Leendertz and Kathrin Nomak, Robert Koch Institute, Berlin, Germany
Fish survey: Dr. Ian Payne, Marine Resources and Fisheries Consultants
Butterfly assessment: Safian Szabolcs
Jentink's Duiker, Africa's rarest forest Duiker-B.Huffman/ultimateungulate

Research is also focused on some of the iconic bird species such as white-necked picathartes nests and rufous fishing owl surveys.

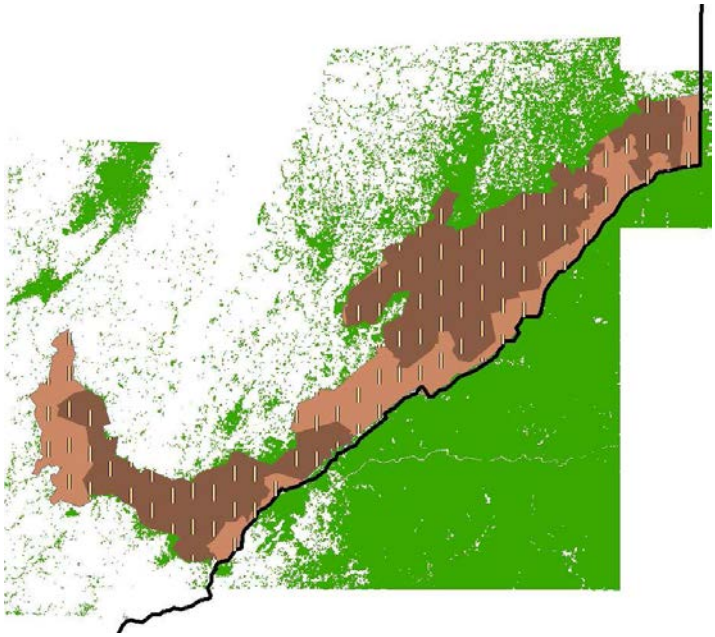
Longer term studies include a tree phenology study, crop-raiding by wild animals in forest and non-forest edge communities, and studies into ecosystem services: water quality and stream characteristics in and around the Gola Forest.

Thus far recorded are 296 species of birds, 49 species of mammals, and 771 species of plants. Additionally we have documented Leopard, Jentink's Duiker, Pygmy Hippo, Zebra Duiker, Bongo, White-breasted Guinea fowl, Water Chevrotain, and Yellow-backed Duiker, species difficult to record during traditional surveys and have greatly expanded our knowledge on the range of Pygmy Hippos in and around the Gola Forest.

5.1.2 2009 Gola Forest Programme chimpanzee survey results

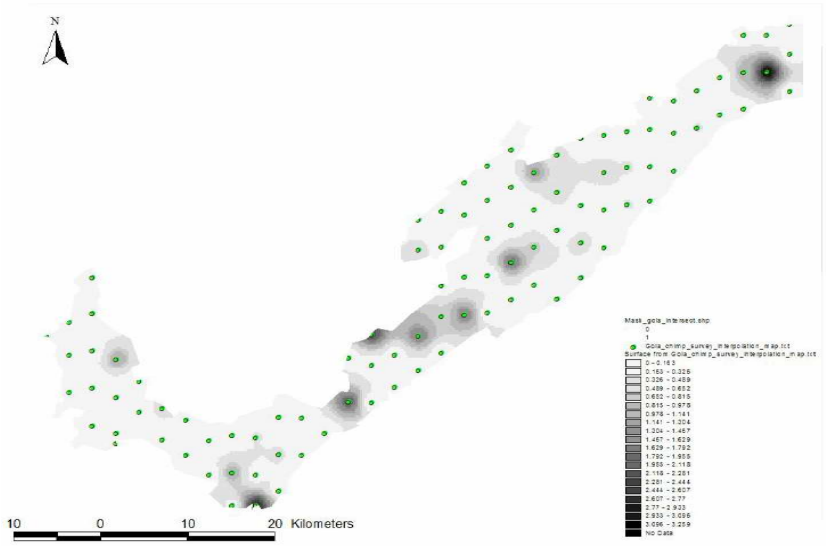
A survey of chimpanzees took place in between February and July 2009, the report of which is also available on the Gola Forest website (Ganas 2009). The area surveyed included community forests and potential corridors between the main forest blocks, making the total area surveyed 1,085 km^2. The survey design consisted of a standing crop nest study using transects and DISTANCE methods, with 2 km long transects. Based on this design and the entire area to be covered, the total number of transects to be surveyed was 104, totaling 208 km of transects (Figure 16).

Figure 16. Transect locations in the Gola Forest Reserve (brown shading) and community forests (pink shading). Forest cover is shown in green. Map by H. Kuehl (Ganas 2009).



The main findings from this survey showed that the Gola Forest contains approximately 240 chimpanzees, and the area of community forest between Gola North and Gola South also has a population of chimpanzees of around 68 individuals (Ganas 2009). The study also showed that human encroachment into the Gola Forest Reserve was highest in Gola North and Gola West and the most frequent forms of encroachment were hunting and farming. The analysis used nest duration rates from Taï National Park, Ivory Coast of 91 days.

Figure 17. An interpolation map of the density of chimpanzees in the Gola forest regions from Ganas 2009. Darker colours represent higher chimpanzee densities.



The interpolation of chimpanzee density across the study area was made by first calculating the chimpanzee density for each transect (number of nests / length * 2 * estimated strip width *nest duration (91 days) * nest construction rate * proportion of nest builders). The interpolation was then done using the inverse distance method. The centre point of each transect and the associated density was used to create this interpolation. The map was then constructed in ArcGIS 9.

5.1.3 Results of re-analysis

All details about methods and a summary of the data are presented in Ganas 2009. As part of the nationwide survey, the original Gola chimpanzee data set was re-analysed as one strata in the forest reserve dataset and only these results are presented here. Forest reserves were post-stratified in DISTANCE, where encounter rate and density were calculated by stratum, but detection function was calculated from the pooled data. The pooled estimate of density was made from area weighted stratum estimates. The perpendicular distances were truncated at 33 m, removing the outermost 3% of observations. The model with the best fit to the data was half-normal function with the simple polynomial adjustment term. A longer nest duration of 109 days was determined for nests in Sierra Leone as part of the nationwide survey.

The use of a longer nest duration in the re-analysis resulted in a slight drop in density and abundance estimates from 0.27 individuals/km^2 and 305 individuals to 0.25 individuals/km^2 and 270 individuals for the Gola Forest sections and surrounding community forest (Table 13).

Table 13. Data summary for the re-analysis of the Gola Forest Reserve and community forest dataset.

	Gola Forest Reserve & community forests
Study area (km^2)	1,085
Area surveyed by transects‡ (km^2)	4.87
Percent of study area covered by transects	0.449
Number of transects	101
Total transect length (km)	166.84
No. transects with chimpanzee nests	32
Total chimpanzee nests before truncation	137
Nest encounter rate (nests/km) before truncation	0.82
Total chimpanzee nest groups	24
Average nest group size	5.75
Number of nests after truncation	126
Encounter rate (nests/km) [95% CI]	0.76 [0.51-1.14]
Density (individuals/km^2) [95% CI]	0.25 [0.14-0.43]
Number of chimpanzees [95% CI]	270 [159-468]
Percentage coefficient of variation (%CV)	27.90

‡ Transect area calculated as 2xESWxLength

5.1.4 Conclusions

The Gola area contains almost 5% of Sierra Leone's remaining chimpanzees. It is managed by the Gola Forest Programme and is likely to be declared a national park, so its future seems relatively secure. However, we heard many grievances voiced by the communities around the reserve who felt that they should be benefiting more from the reserve's existence. Some villages in Kenema and Kailahun, even those far away from the reserve felt that the land had been taken from them and that they were being denied access to 'their' land. Several communities were so hostile to the project that they blocked the nationwide census survey teams from carrying out transects near their communities on the grounds that we were 'prospecting' for new land to annex to Gola Forest. It is not clear whether these feelings are genuine, especially for those communities far from the reserve, or if it is based on jealousy towards those communities who are benefiting directly from involvement with the Gola Forest Programme. It is also possible that this was used as an excuse to hide mining activities that the communities did not want discovered.

5.2 Kambui Hills Forest Reserve

5.2.1 Study area

The Kambui Hills are a production forest of originally around 200 km^2 located in Kenema District. The forest reserve includes areas encompassing the highest peak in the southern sector of the country, which stands at 645 m. The reserve supports catchment areas for a number of reservoirs that supply water to Kenema and surrounding communities (http://www.birdlife.org). Vegetation in the reserve is closed forest belonging to the Upper Guinea forest zone, but the hills have been extensively logged and much of the Kambui Hills are still accessible through existing logging roads.

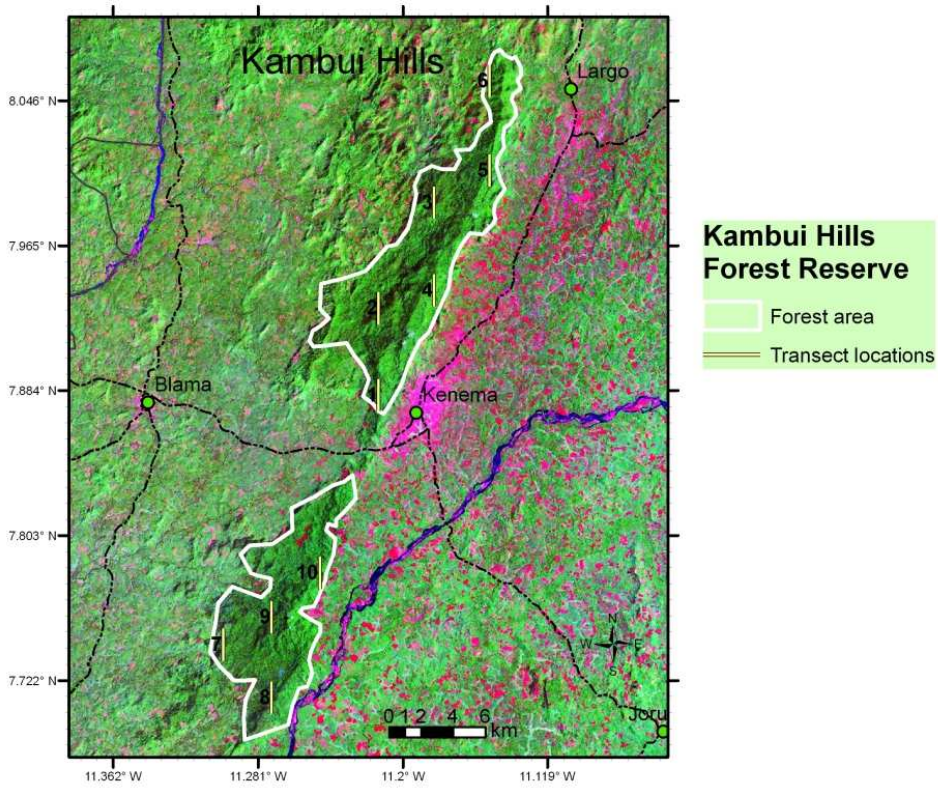
Previous biodiversity surveys in the Kambui Hills (Conservation Society of Sierra Leone and BirdLife International (2009). (http://www.birdlife.org).

G.D. Field conducted a survey of the bird of Kambui Hills forest reserve in the mid 1960s and recorded over 200 species including two globally threatened – Green-tailed Bristlebill and White-necked picathartes - and three near-threatened species. Thompson (1993) did an extensive survey of the White-necked picathartes as part of a study of the ecology and breeding biology of the species. Five active breeding colonies containing a total of 16 nesting sites were discovered.

The forest reserve at Kambui Hills was at one time home to a variety of mammal species including the Western Chimpanzee, red colobus, black-and-white colobus, sooty mangabey and Diana monkey. Several other threatened mammals were previously reported, including forest elephants, Jentink's duiker, black duiker and Maxwell's duiker.

For the Kambui Hills, the survey area was drawn to include remaining forest area, which may or may not coincide with the original reserve boundaries. Therefore the total reserve are of 152 km^2 used in the analysis is much less then the approximate 200 km^2 of the original reserve boundaries (Figure 18).

Figure 18. Satellite map of the Kambui Hills forest area showing the forest boundary and the location of the 10 transects completed within the reserve.



5.2.2 Results

Chimpanzee status

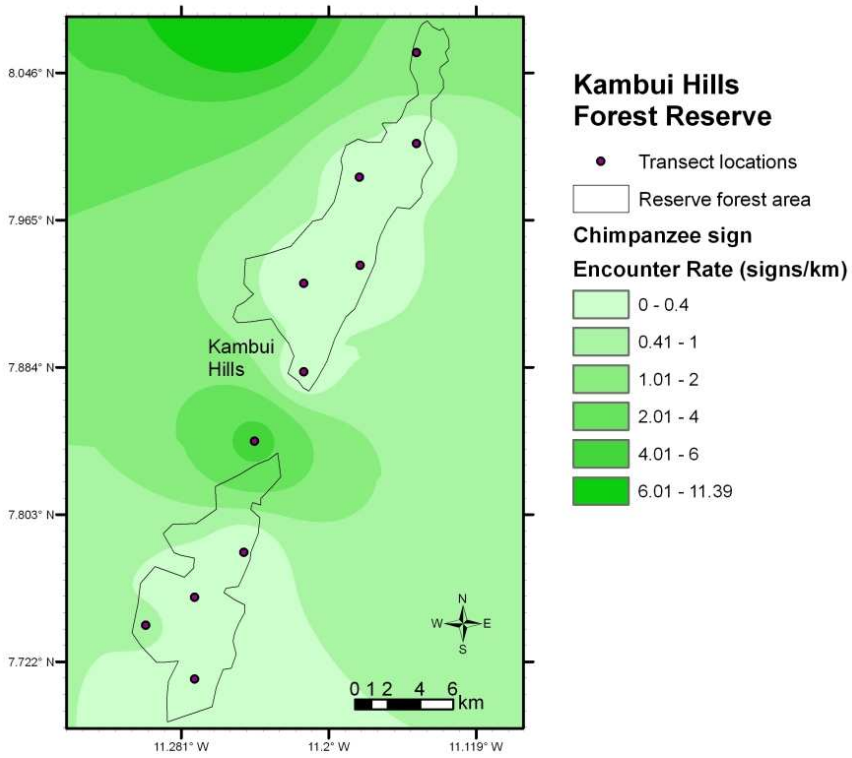
No chimpanzee nests were found on transects within the Kambui Hills, making a chimpanzee density estimate impossible. Only four chimpanzee signs were found on transects and two nests on recce walks within the reserve. Feeding remains were seen on one occasion on transect 6 in the far north of the reserve, chimpanzee calls were heard on transects 6 and on transect 7 at the far south of the reserve. It is believed that although there are some chimpanzees using the forest, there is not a substantial chimpanzee population within the reserve (Figure 19). It is also possible that chimpanzees move in and out of the forest seasonally, but more long-term data would be needed to confirm this.

Table 14. Transect summary for the Kambui Hills Forest Reserve.

	Kambui Hills
Study area (km^2)	152
Area surveyed by transects‡ (km^2)	0.58
Percent of study area covered by transects	0.384
Number of transects	10
Total transect length (km)	20.0
No. transects with chimpanzee nests	0
Total chimpanzee nests	0
Total chimpanzee signs	4
Chimpanzee sign encounter rate (signs/km)	0.20

Although not found on transects within the reserve, chimpanzee nests and signs were found on a block transect between the northern and southern sections of the Kambui Hills (Figure 19). The location of chimpanzees at the periphery of the reserve suggests that chimpanzees may actually be avoiding the reserve itself.

Figure 19. Chimpanzee sign encounter rates for Kambui Hills Forest Reserve and surrounding blocks. Encounter rates are interpolated using ArcView inverse distance weighted function.



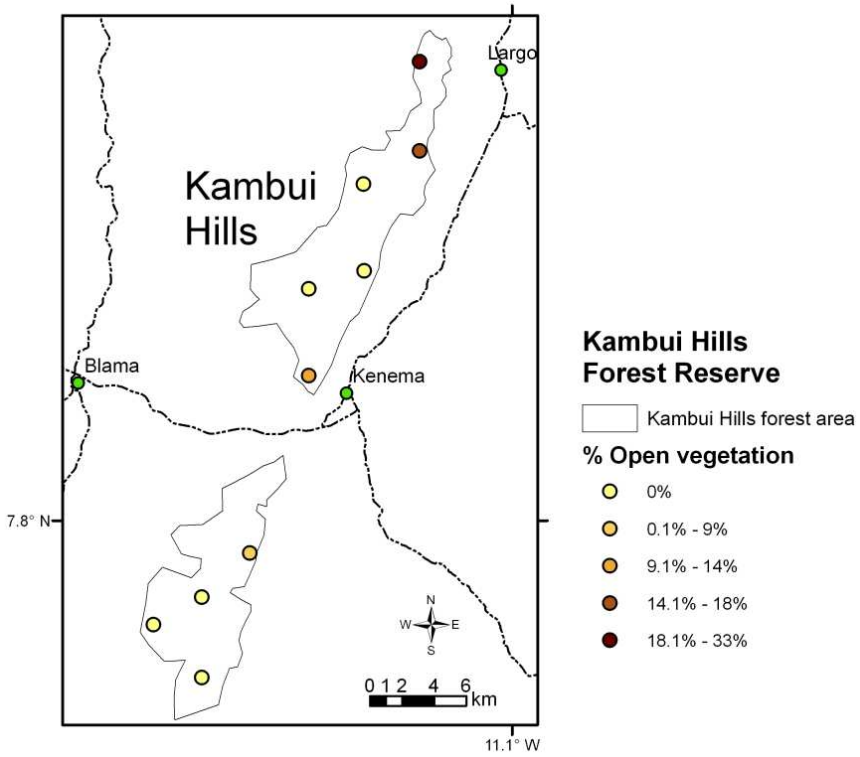
Vegetation

Inside the reserve the vegetation is still closed, albeit logged forest, with logged forest making up 91.8% of the vegetation. The remaining vegetation types by percentage on transects were farmbush (6.7%), farm (0.8%), and vine forest (0.7%). Although the District Forestry Office in Kenema is adjacent to the hills, farms are spreading into the hills directly behind the headquarters. Most of the

forest has been logged and still continues to be logged illegally. Census teams came across trees and boards that had been cut and left to rot in the forest, presumably because of the recent logging embargo.

Because the forest boundaries used in this study are smaller than the original reserve boundaries, it is likely that the percent of forested area was overestimated and farm encroachment was underestimated. The percentage of open vegetation is highest on those transects that are close to the edge of the reserve forest (Figure 20).

Figure 20. Percentage of open vegetation (farms, farmbush) on each transect in the Kambui Hills Forest Reserve.



Human activities and other mammals

The most commonly encountered signs in the Kambui Hills were human signs (Table 15). The majority of signs were trees cut with a power saw as most of the reserve had been logged previously (Table 16). The encounter rate data does not take into account human-altered vegetation apart from logging, so human impact is underestimated because vegetation types such as agriculture and former agriculture are not taken into account in this table. Overall the encounter rate for animal signs shows that for most species the Kambui Hills are greatly impoverished. Only 11 large mammal species were encountered on transects. The most common signs encountered were from red river hogs, of which only 6 signs were seen on 20 km of transects. Bongo dung was found one time on a recce in the southern part of the reserve.

Table 15. Mammal sign (dung, sightings, calls, feeding remains) encounter rate on transects in the Kambui Hills Forest Reserve.

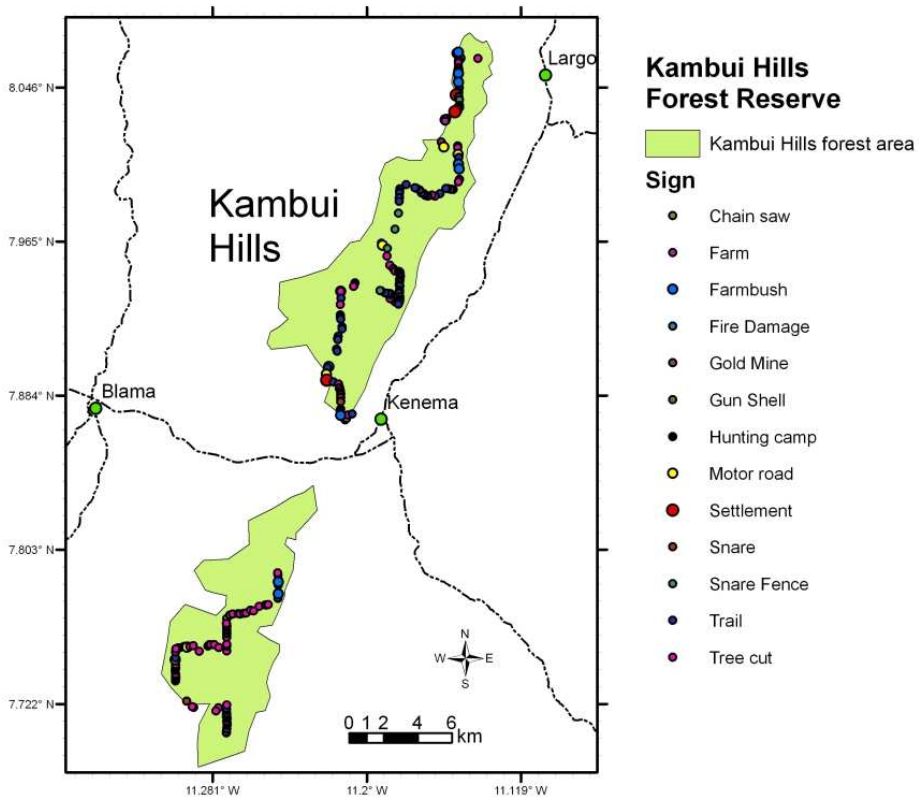
Species	Encounter rate (signs/km)
Human	7.35 (2.70 w/o logging)
Red river hog	0.30
Chimpanzee	0.20
Maxwell's duiker	0.15
Brush-tailed porcupine	0.15
Red colobus	0.10
Sooty mangabey	0.10
Yellow-backed duiker	0.10
Monkey	0.05
Giant rat	0.05
Mongoose	0.05
Black & white colobus	0.05

Table 16. Encounter rates for different human signs on transects in the Kambui Hills Forest Reserve.

	Encounter rate (signs/km)
Logging	4.65
Footpaths or motor roads	2.05
Snares and snare fences	0.45
Gunshots and gun shells	0.10

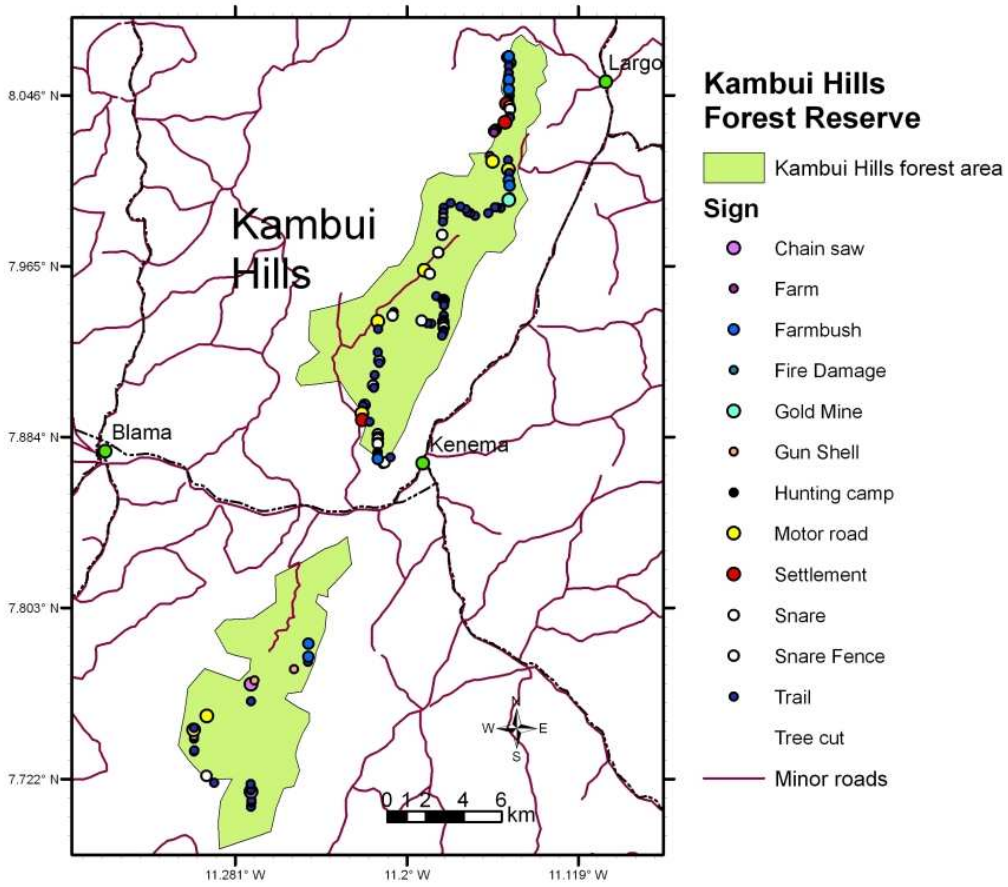
The intensity of human disturbance within the Kambui Hills can be seen in Figure 20, which shows human signs found on and between transects and recces within the reserve. The frequency of human signs is so high that the exact path walked by the survey teams can be seen as a series of detection points. It appears that no place within the reserve is untouched by human activities. This may be a strong explanation as to why there is so little wildlife with the Kambui Hills.

Figure 21. All human signs detected on transects and recce walks throughout the Kambui Hills Forest Reserve.



Because the forest was previously logged, many of the signs detected were the stumps of trees cut with chain saws during logging operations (4.65 logging signs/km). To show more clearly the impact of other human activities in the reserve, trees cut with power saws were removed in Figure 22. The Kambui Hills are also very accessible by means of former logging roads and foot paths. Logging roads enter the forest from the Bo-Kenema highway and in the north near Largo. Footpaths and motorable roads were the second most common human sign encountered on transects with an encounter rate of 2.05 paths or roads/km (Table 16). Apart from logging signs, the northern section of Kambui Hills is much more impacted by human activities than the southern section.

Figure 22. All human signs except logged trees detected on transects and recce walks throughout the Kambui Hills Forest Reserve. Logged trees (tree cuts) were removed to more clearly show other human signs.



5.2.3 Conclusions

Given that the forest habitat could potentially support chimpanzees, it is likely that logging and hunting pressure have severely reduced the chimpanzee population and other wildlife. Studies in Gabon show that territoriality in chimpanzees may contribute to their decline in logged areas because communities are unable to shift their territories without coming into conflict with neighbouring chimpanzee communities (White and Tutin 2001). Chimpanzees may also have been heavily hunted there in the past by professional hunters given that the long narrow shape and many logging roads make the reserve easily accessible. The northern section of the reserve seems more impacted than the southern section: In the northern section the survey team came across extensive signs of hunting and farming.

Despite the depleted wildlife in the reserve, the vast majority of the area is still covered with closed forest. If the forest is managed responsibly for logging activities, it is likely to retain much of this forest cover. However, if hunting is not controlled, it will continue to be an empty forest. It is also unlikely if logging continues that chimpanzees will move back into the reserve from the surrounding landscape. Serious protection efforts and rehabilitation of the reserve are needed before it will return to an important site for biodiversity conservation in Sierra Leone.

Villages immediately to the south of the Kambui Hills Reserve such as Jagbema appeared to be good communities to work with, and may be incorporated into community co-management efforts for the Kambui Hills.

5.3 Kangari Hills Non-Hunting Forest Reserve

5.3.1 Study area

The Kangari Hills Forest Reserve is located in Kunike and Bonkolenken Chiefdoms in Tonkolili District and Valunia chiefdom in Bo District. The Kangari Hills reserve is 141 km^2 and ranges in elevation from 300-600 m. The reserve is a watershed for some of the country's main river systems.

In 1924 the Kangari Hills was first designated as a forest reserve, and was gazetted in 1955. In 1973 it was upgraded to a Non-hunting Forest Reserve and management was transferred to the Wildlife Conservation Branch of the Forestry Division in accordance with the Wildlife Conservation Act of 1972. In 2006 an extension to the reserve was proposed by the World Bank and is included in management plans as part of a protected area system.

According to past agreements, the way in which forest reserve was originally negotiated between the colonial government and the local paramount chiefs implies that reserved lands were acknowledged as belonging to local communities and that the government took them into trust on an indefinite lease. The Forestry Division was meant to control farming, timber felling and some hunting, and a portion of royalties paid by timber companies was to be paid to the local communities via paramount chiefs. Forest guards and rangers were supposed to patrol and administer the regulations, but there have not been any forestry and wildlife personnel posted in the reserve for over 15 years.

Mining leases have been given to Cluff Gold to mine gold to the immediate south of the reserve. Although a small part of the entire mining lease falls within the reserve, there will be no mining activities within the reserve itself. The proposed mining method will be open cast and will involve drilling and blasting followed by removal of ore through the use of backhoe excavators and dump trucks; before being then transported to the crusher or stockpiles for the processing plant.

5.3.2 Previous surveys

The ‘Important Birds Area’ survey indicated that Kangari Hills contains 115 bird species representing 34 families (including three globally threatened species - white necked picathartes, black-faced stream warbler, and green-tailed bristlebill).

An Environmental and Social Assessment (ESA) for the mining of the concession areas for Cluff Gold (SL) Ltd was carried out by CEMMATS Group Ltd in 2008. The ESA constituted a field survey, the findings of which are summarised below:

The reserve is an important area for remnant Guinean Forest and also includes Sudano-Guinean species. A remnant population of forest elephants was found, as well as threatened primate species including Western Chimpanzee, red colobus, and black and white colobus.

Threats to the reserve include damage done by temporary settlement of rebels inside the reserve during the war. Current threats are primarily encroachment of the reserve boundaries for agriculture, gold mining, and hunting. The reserve boundaries are not clearly demarcated, so farming encroachment is most acute along the edges, but encroachments deep inside the reserve area are almost non-existent due to the steep terrain. On the lower slopes with its low relief and generally fertile valley swamps, farms of 1-2 acres exist around the villages.

Forest Division records from 1970 revealed that not more than 1% of the reserve was affected by farming encroachment, but reports in 1991 showed that 1,250 ha was farm bush, 215ha was cleared land (probably for mining) and 45ha was cultivated land, giving a total of 15.2% of the reserve encroached.

The ESA also found some evidence of illegal logging and pole collection due to the absence of forestry officers to monitor and protect the reserve. Pressure through hunting (mainly with the use

of snares and traps by local communities) was thought to be moderate. Before the rebel war there were raids by Liberian hunters searching for big game.

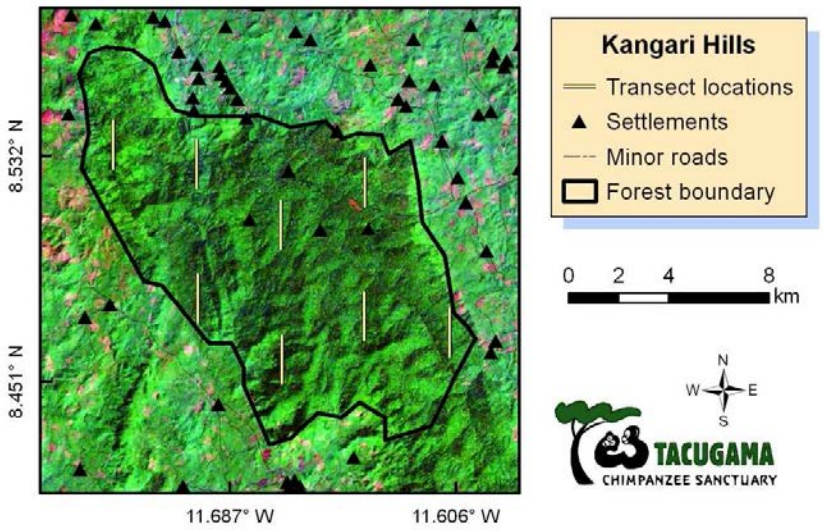
Extraction of gold by artisanal miners was found to occur extensively in the vicinity of the Kangari Hills Forest Reserve. The extent of the mining could not, however, be quantified. The extraction of gold by artisanal miners represents potentially the greatest threat to forest conservation, especially around Baomahun where several deposits are believed to exist. There are several reports in Forestry Division files relating to mining for gold within and outside the reserve especially around Baomahun.

5.3.3 Results

The exact boundaries of the reserve are not clearly marked, so the survey area was drawn to include remaining forest area, which may or may not coincide with the original reserve boundaries. Therefore the total reserve are of 141 km^2 was used. The Kangari Hills were not thought to harbour significant populations of chimpanzees, so only eight transects of 2 km length were planned as a pilot study (Figure 23). Survey methods used are presented in the methods section of this report.

Figure 23. Transect locations in the Kangari Hills Forest Reserve.

Vegetation is shown by a Landsat satellite image: dark green is closed forest, light green is farmbush/secondary forest, red inside the reserve is bare rock, purple is woodland-savanna, and pink is cleared areas or grassland swamps.

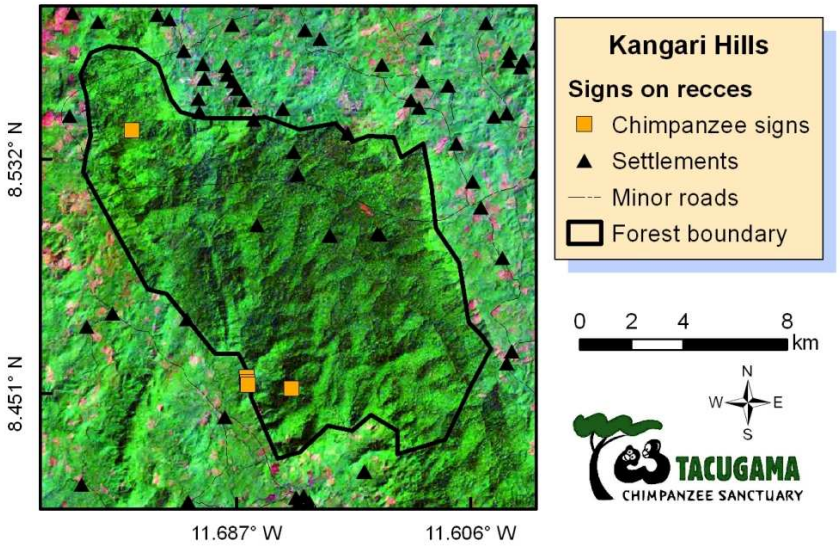


All eight transects planned for the Kangari Hills were completed and observations were also collected on recces between transects. No chimpanzee signs were seen on any transects (Table 17), but nests and feeding remains were observed on recces in the northwest and southwest sections of the reserve (Figure 24). The lack of any chimpanzee signs on transects suggests that the chimpanzee population in the Kangari Hills is very low and probably does not make up a significant proportion of the total chimpanzee population in Sierra Leone. However, there are likely to be some groups that include the reserve, at least partially, in their range.

Table 17. Transect summary for the Kangari Hills Non-hunting Forest Reserve.

	Kangari Hills
Study area (km^2)	141
Area surveyed by transects‡ (km^2)	0.46
Percent of study area covered by transects	0.328
Number of transects	8
Total transect length (km)	15.84
No. transects with chimpanzee nests	0
Total chimpanzee nests	0
Total chimpanzee signs	0
Chimpanzee sign encounter rate (signs/km)	0

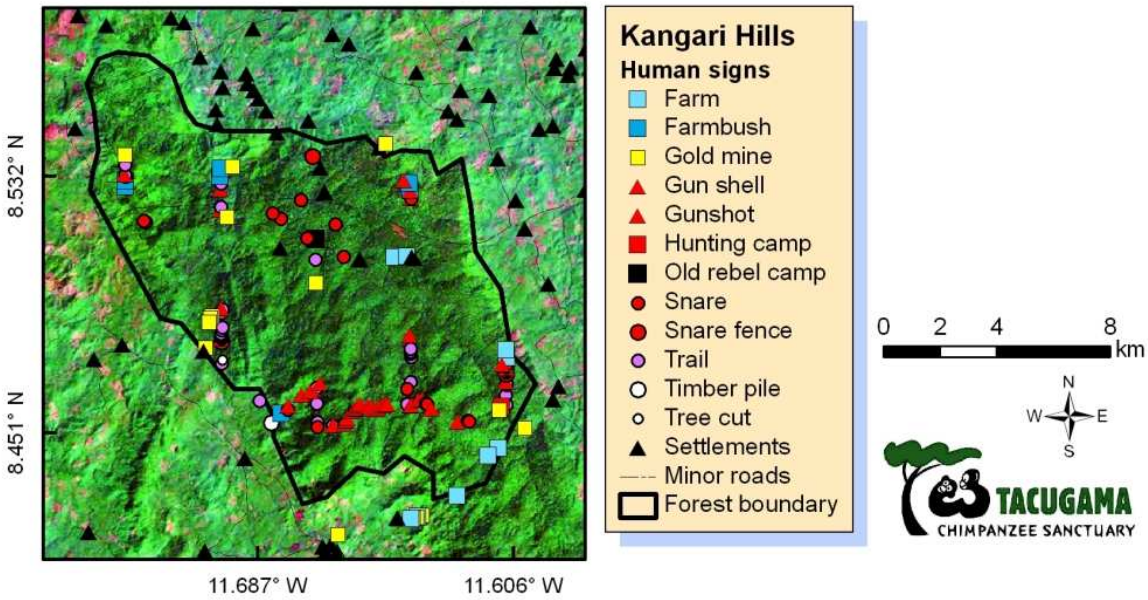
Figure 24. Location of chimpanzee signs (feeding remains, nests) seen on recces in the Kangari Hills. No chimpanzee signs were found on transects.



Human activity

Signs of human activity were found throughout the Kangari Hills Forest Reserve, the most common of which were gun shells, trails, snares, and small-scale gold mines (Figure 25). Hunting with guns seemed to be very common in the south of the reserve (over 75 gun shells found), while snares were more common in the north. Many villages are located in the northern part of the reserve, and thus agriculture is more common there and may explain the higher use of snares. Logging signs were not commonly observed inside the reserve boundaries, except in the south, where logging roads penetrate the reserve and standing piles of sawn boards await removal. Gold mines were frequently encountered in the north of the reserve and at the edges of the reserve boundaries in the south. The far south of the reserve is part of the mining concession of Cluff Gold, and although no transects were walked there, mining activities can be seen on the hillsides to the north of Baomahun village. It is unclear whether these are within the reserve boundaries or not, but undoubtedly there are more illegal mining activities in the southern part of the reserve than were detected.

Figure 25. Location of human signs observed on transects and recces in the Kangari Hills Forest Reserve.

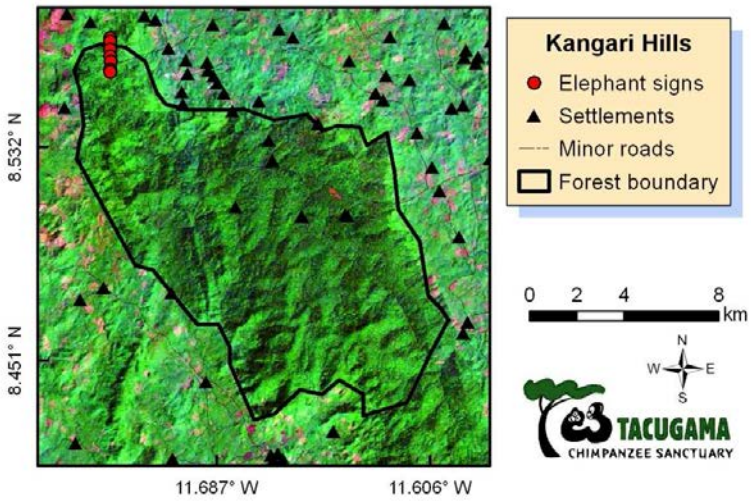


Elephants

Confirmation of elephant presence within the reserve was given by the observation of elephant paths and footprints in the far northwest of the Kangari Hills (Figure 26). These signs were actually found as part of the nationwide block transect survey, which partially overlapped with the reserve boundaries. Communities in this area reported frequent crop destruction by elephants. The size of this remnant population is unknown, but it is likely to be only a few individuals. It is also unknown whether this group migrates out of the area or is connected to any of the other populations in the north or east of the country.

Information on other mammals found in the Kangari Hills will be presented in later publications.

Figure 26. Elephant trails and footprints seen on transect 49E in the block survey, which partially overlapped with the Kangari Hills Forest Reserve.



5.3.4 Conclusions

The Kangari Hills have been heavily impacted by humans, through hunting and farm encroachment and do not contain a significant population of chimpanzees. If adequate protection measures are enacted for the reserve, there is a large possibility that chimpanzee groups that are currently peripheral to the reserve may repopulate it. Given that the forest is relatively intact in the core of the reserve, it could be a potentially important place for chimpanzees and other wildlife in Sierra Leone, especially elephants. However, if hunting is not controlled, it will continue to be an empty forest. Serious protection efforts and rehabilitation of the reserve are needed before it can return to being an important site for biodiversity conservation in Sierra Leone.

Although at least 15% of the Kangari Hills forest has been degraded, the core of the reserve still retains closed canopy forest cover. Inventory and management of the forest resources are necessary to maintain this resource into the future. If managed carefully, the Kangari Hills could serve as a sustainable production forest for timber or non-timber forest products. However, the massive demand for gold will continue to put pressure on the integrity of the reserve. It is illegal gold-mining that probably poses the greatest threat for the remaining forest and wildlife here. Mining camps create a constant human presence in the reserve and encourage hunting and tree-felling to supply miners with meat and wood.

Fortunately, opportunities exist for effective management of the reserve in the future. Cluff Gold should actively support the recommendations of the CEMMAT Group ESA. The management measures proposed in the ESA for the Kangari Hills Forest Reserve include:

- Demarcation of boundaries and establish buffer zones around the reserve to reduce encroachment;
- Enforce legislation against illegal mining activities, which threatens the land and rivers;
- Restoration programmes for degraded areas such as reforestation on natural regeneration should be undertaken;
- Improve facilities in and access to the reserve especially for the convenience of staff and visitors;
- Improved training and facilities for staff to strengthen law enforcement;
- Systems of land tenure developed by central government should recognise and legitimise traditional tenure arrangements where such arrangements are locally acknowledged as legitimate;
- Conservation education at all level should include segments on the biodiversity values maintained in traditional agro-systems;
- When carrying out negotiations on conservation/development strategies and actions outside protected areas, all concerned actors and interest groups need to be defined. Their perceptions and needs must be understood and taken into consideration;
- Degraded and secondary forest/forest regrowth can be managed to mitigate the effects on climate change;
- Encourage tree planting in the villages and on farms for fuelwood, shade tree, fruit trees and erosion control; and
- Encourage Agro-forestry cropping systems as a sustainable farming system at higher elevations.

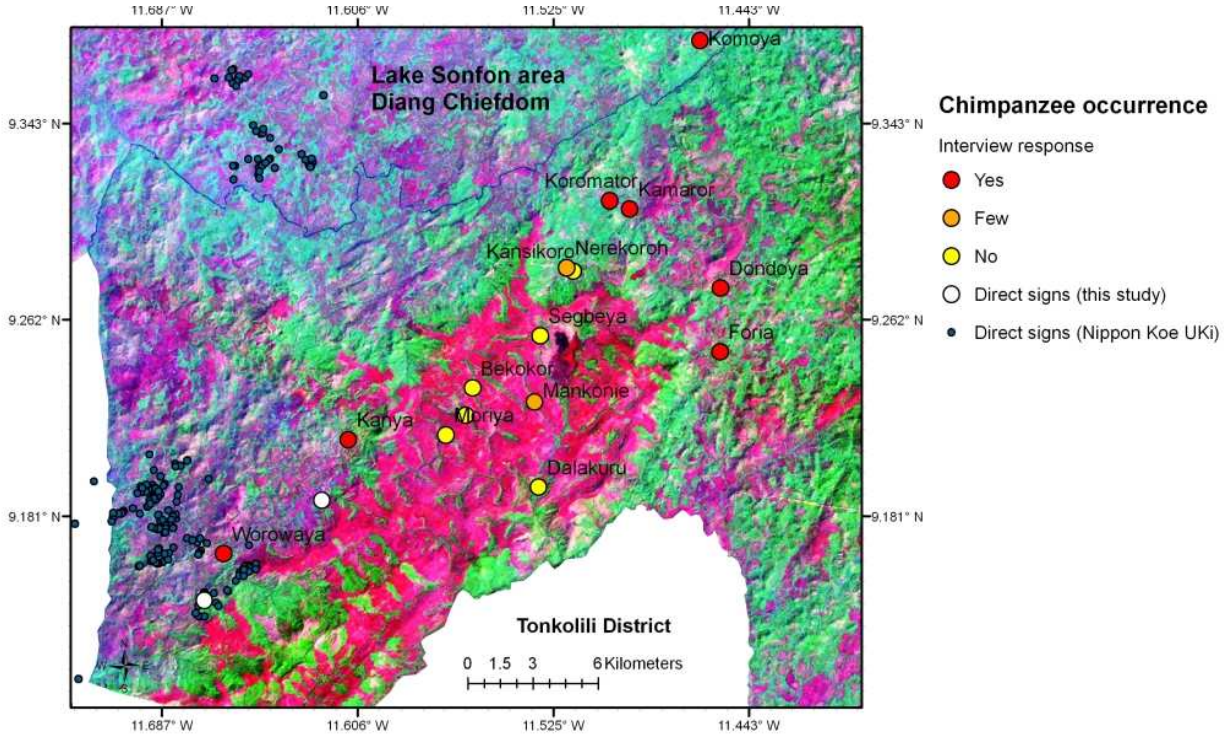
Furthermore, the Kangari Hills are included in the World Bank/GEF Protected Area initiative starting in 2010. Increased funding for management of the reserve will be absolutely crucial for its protection.

5.4 Lake Sonfon

Interview results directly around Lake Sonfon suggest that it does not contain a substantial chimpanzee population. The vegetation is primarily savanna with occasional riverine or gallery forest, which may not be sufficient habitat for chimpanzees. Furthermore, many of the villages in the vicinity of the lake identified mining, hunting, and farming activities as causing a decline in the chimpanzee population since the war. However, the surrounding forest and woodland savanna seems to have several groups of chimpanzees. Two of these groups were identified during the Bumbuna Hydroelectric Project Baseline Biodiversity Survey (Nippon Koei UK, 2007). The southernmost group is based near Worowaya ranging to the Seli River and comprises 8-16 individuals (Nippon Koei UK, 2007). This census identified two other nest sites which extend the range of this group towards Kanya (Figure 27). A second group is located northeast of the Seli-Mawoloho confluence, and comprises approximately 6-9 individuals (Nippon Koei UK, 2007). A third group may range to the east of Lake Sonfon near the villages of Foria, Dondoya, and Kamaror. Other large mammals in the Lake Sonfon environs include warthog, bay duiker, Maxwell's duiker, bushbuck, buffalo, red river hog, and various monkeys.

Figure 27. Satellite map of the Lake Sonfon area showing chimpanzee presence/absence based on interview responses at villages in and near the reserve.

Direct signs include nests, feeding remains, and sightings. Lake Sonfon is to the east of Segbeya. Pink areas represent savanna vegetation, green is forest, and purple is woodland savanna.



Recommendations have been made for wildlife and habitat conservation within and around the Bumbuna catchment area that include wildlife monitoring, environmental awareness programmes, controlling of hunting, promotion of fishing within the reservoir, and conservation of 'chimpanzee forests'. These activities may benefit the chimpanzees to the west of Lake Sonfon that are in the catchment area. However, the lake itself and the immediate environs are threatened primarily by artisanal gold mining. A significant amount of mining activity was seen at the lake and in the communities nearby. This is likely to reduce water quality, increase wildlife exploitation and increase forest clearance.

5.5 Loma Mountains Non-hunting Forest Reserve

5.5.1 Study area

The Loma Mountains Non-hunting Forest Reserve is located in southern Koinadugu District and is split between Neini and Neya Chiefdoms. The reserve covers approximately 396 km^2 and is one of Sierra Leone's four non-hunting forest reserves after the 1972 Wildlife Act. The mountains are a granite massif, the tallest of which is Mt. Bintumani. At 1945 m, it is the tallest peak in West Africa west of Mt. Cameroon (Figure 28).

The natural vegetation for the Loma Mountains has been described in detail for the Bumbuna PIU botanical survey (Hawthorne 2008). The reserve consists primarily of closed moist tropical forest. In addition, at lower elevations (<1000 m) primarily in the east and north of the reserve, there is a mix of woodland savanna (Guinea savanna) and tall elephant grass savanna. In the upland areas (915-1945 m) other vegetation types such as submontane shrub savanna, montane grassland, submontane gallery forest, submontane forest, and dry forest exist. The distribution of different vegetation types can be seen in Figure 28.

Figure 28. Landsat satellite image and topographic map of the Loma reserve.

In the Landsat image, green represents tree cover, purple/pink indicates woodland savanna, and red represents montane grassland.

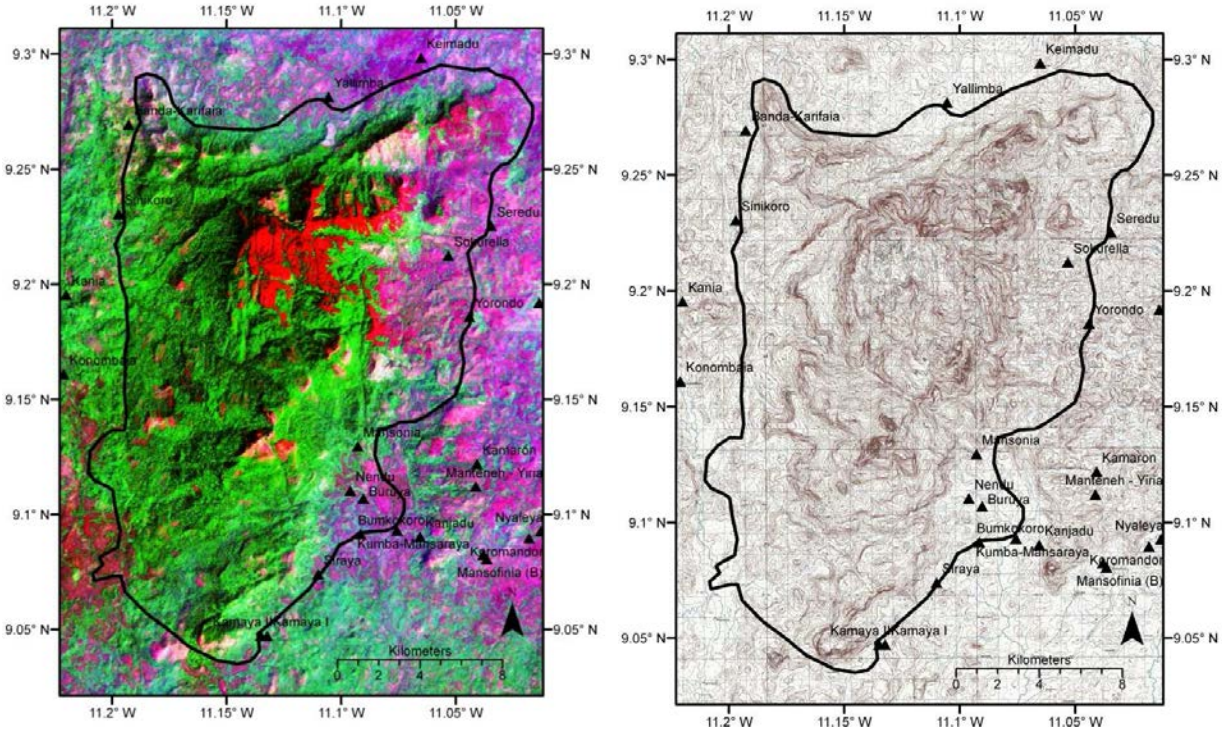


Figure 29. Vegetation of the Loma Reserve; A) closed moist forest on the shoulders of Serelenkonko peak as seen from the slopes of Mt. Bintumani, and B) montane grassland on a steep slope in the Loma reserve.

5.5.2 Previous chimpanzee survey in the Loma Mountains

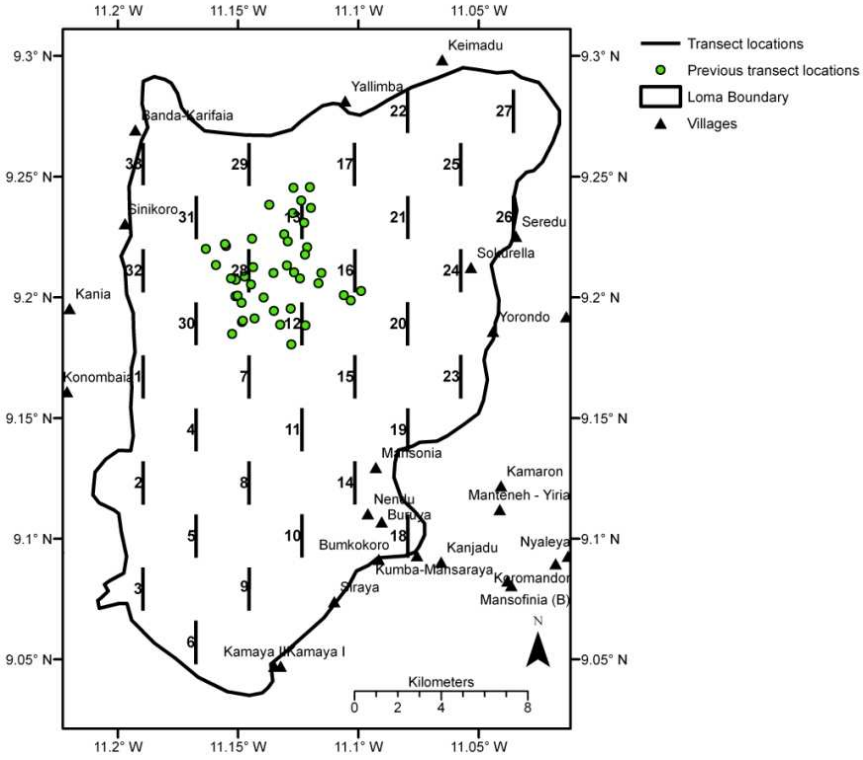
The West African Chimpanzee Action Plan report for Sierra Leone states that sporadic surveys were conducted around the Loma Mountains before 1993, and in the late 1980s Loma was proposed as the prime area to capture wild chimpanzees and establish a biomedical research facility (Kormos *et al.*, 2003). Later surveys reported that hunting and agriculture were extensive, and few signs of wild chimpanzees were found. A Mt Loma (Bintumani) rainforest expedition was carried out in 1991 by members of the University of East Anglia which reported frequent chimpanzee calls in the northwest of the reserve (Broad and Turner 1991).

As part of a long term plan to provide an environmental offset for biodiversity losses resulting from inundation of the Bumbuna hydro-electric project catchment area, a rapid survey was conducted in 2008 to assess plant, bird, amphibian, small mammal and large mammal diversity (Kortenhoven 2008). The survey was conducted between 800-1700 m asl in the northwest portion of the Loma Reserve covering approximately 15% of the total area of the reserve (Figure 30). The results of this survey suggested an astonishingly high density of chimpanzees of between 5.75 and 7.41 chimpanzees/km^2. These preliminary results suggest that this remote upland section of the Loma Mountains has one of the highest densities of chimpanzees recorded in West and Central Africa. Unfortunately these results could not be extrapolated to the whole reserve, and thus an accurate assessment of the abundance of chimpanzees in Loma could not be established.

Survey Design

At the time of the nationwide survey in June 2009, the reserve boundaries were not well-mapped and existed only on a hand-drawn map from the creation of the reserve in 1958. For this study, the delineation of the reserve boundaries was created by digitizing the hand-drawn map using ArcView 9.2. The boundaries are imprecise because the features on the hand-drawn map are not in great detail, making verification of the digitization difficult. This is an approximation with the information at hand, and a thorough re-surveying and geo-referencing of the reserve boundary is necessary, which in many places is marked by a line of planted *Gmelina* trees. A map of the approximate reserve boundaries is shown in Figure 30 with the locations of the 33 transects planned for this study. Although the reserve has been reported in previous studies to be 332 km^2, the digitization of the boundaries shows the area to be 396 km^2. This is the figure used for all density calculations of chimpanzees in this study.

Figure 30. Digitized reserve boundaries for the Loma Mountains Non-hunting Forest Reserve with the locations of the 33 transects planned for this survey, and endpoints of transects surveyed in previous studies (Kortenhoven 2008, 2009).



5.5.3 Results

Across the reserve 31 transects were walked for a total of 59.77 km of survey effort. Transect 21 was not surveyed because steep cliffs made the terrain too dangerous to access. Transect 26 was thought to be outside the reserve and also not surveyed. Two other transects (6 and 15) were approximately half-completed because dangerous terrain was encountered.

Chimpanzees

No chimpanzees were observed directly during the survey in Loma reserve, although chimpanzee calls were heard 9 times on transects. 495 chimpanzee nests were recorded, giving a nest encounter rate of 8.27 nests/km. However, three transects were not completed because of dangerous terrain. These steep areas may be preferred areas for nesting by chimpanzees precisely because it is difficult for humans to access. Thus we may have underestimated the encounter rate for chimpanzee nests in the reserve. The current encounter rate is much lower than the encounter rate of 26.45 nests/km observed in the Bumbuna PIU survey (Kortenhoven 2008) and probably reflects the fact that transects in the lower elevations of the reserve had high human disturbance and lower chimpanzee density.

The Loma chimpanzee dataset was analysed as one stratum in the forest reserve dataset in DISTANCE and only the results for Loma are presented here. Details of the analysis are presented in the methods section of this report.

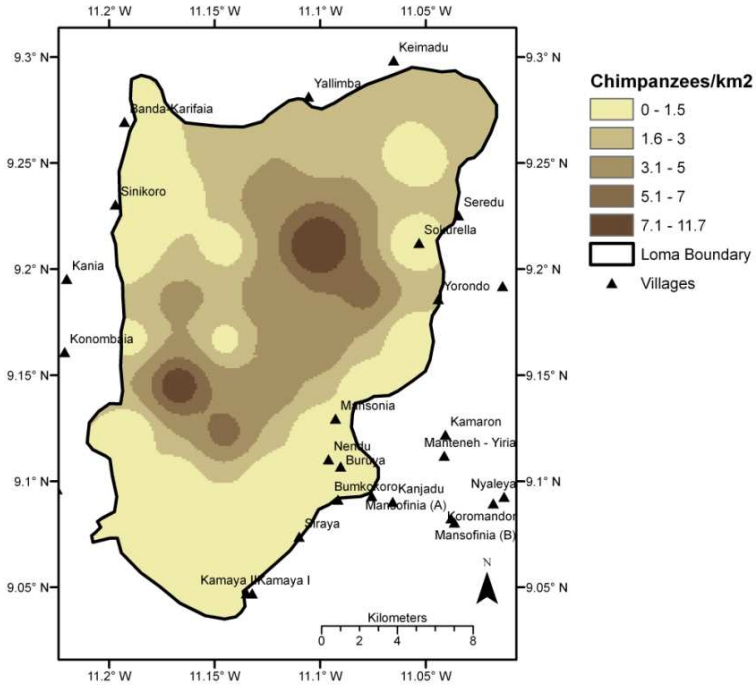
Table 18. Data summary for the analysis of the Loma Forest Reserve.

	Loma Reserve
Study area (km^2)	396
Area surveyed by transects‡ (km^2)	1.75
Percent of study area covered by transects	0.442
Number of transects	31
Total transect length (km)	59.77
No. transects with chimpanzee nests	20
Total chimpanzee nests before truncation	495
Nest encounter rate (nests/km) before truncation	8.27
Total chimpanzee nest groups	179
Average nest group size	2.77
Number of nests after truncation	486
Encounter rate (nests/km) [95% CI]	8.13 [4.84-13.67]
Density (individuals/km^2) [95% CI]	2.69 [1.44-5.01]
Number of chimpanzees [95% CI]	1065 [572-1986]
Percentage coefficient of variation (%CV)	31.91

‡ Transect area calculated as 2xESWxLength

The total number of chimpanzees in the Loma Reserve is estimated to be 1065 (95% CI=572-1986) with a density of 2.69 chimpanzees/km^2. Interpolation of chimpanzee densities across the reserve shows that the highest densities are found at the centre of the reserve (Figure 31). This may be due to chimpanzees moving to higher elevations in the interior of the reserve to avoid human encroachment in the lowlands.

Figure 31. Interpolation map of chimpanzee densities across Loma reserve.



Vegetation

Approximate percentages of each vegetation type within the reserve were calculated from the length of transect that crossed each vegetation type. Table 19 lists the vegetation types in order of abundance for the Loma reserve. The most common vegetation type is closed moist forest, which covers just over 50% of the reserve. The next most abundant vegetation type is woodland savanna, estimated to cover approximately 16% of the reserve. A digitized outline of woodland savanna from the satellite images indicates that this percentage is a good estimate. The digitized area for woodland savanna was calculated to be approximately 18% of the reserve, but did not take into account conversion of woodland into farmland.

Combining the percentage of farm, farm bush, secondary forest, fire-damaged forest, and plantation forest, the transect data indicate that approximately 15% of the Loma vegetation has been cleared for agriculture. The percentage of disturbed vegetation on each transect has been interpolated in Figure 33 below to show the areas most intensively impacted by human activities within the reserve. Damage on the south-eastern edge has probably been underestimated because no transects fell near the reserve boundary.

Figure 32. Early farm regrowth, or 'farmbush' on Transect 10.

Table 19. Percentage of each vegetation type within the Loma reserve based on transect data

Vegetation	% of transect length
Closed Moist Forest	50.1
Woodland Savanna	15.9
Farmbush	9.1
Vine forest	5.5
Farm	3.6
Montane Grassland	3.4
Tall-grass Savanna	3.2
Riverine forest	2.3
Dry Forest	1.8
Swamp	1.3
Secondary Forest	1.3
Fire Damaged Forest	0.9
Submontane Bamboo Forest	0.4
Plantation forest	0.4
Submontane Shrub Savanna	0.3
Swamp Forest	0.3
Submontane Gallery Forest	0.1
Bare rock	0.0

Human activity

Signs of human activity were observed in almost all parts of the Loma reserve with the exception of the mountainous areas near Mt. Bintumani in the north central part of the reserve (Figure 33). Farming activities were the predominant signs in the lowland areas near the park boundaries. Hunting trails, camps, snares, shotgun shells, and trapped animals were found all over the reserve, although much less frequently near Bintumani peak where previous ecological studies and anti-poaching patrols had been carried out by Aaron Kortenhoven and a dedicated team of local research assistants.

Figure 33. Interpolation map of vegetation disturbance percentages across the Loma reserve based on transect data.

Darker shading represents less vegetation disturbance. Lighter shading represents a higher percentage of disturbance recorded as new farms, old farm bush, fire-damaged forest, secondary forest, and vine forest. Signs of human activities recorded on and between transects are shown as symbols. Hunting signs include snares, gun shells, gunshots heard, and hunters.

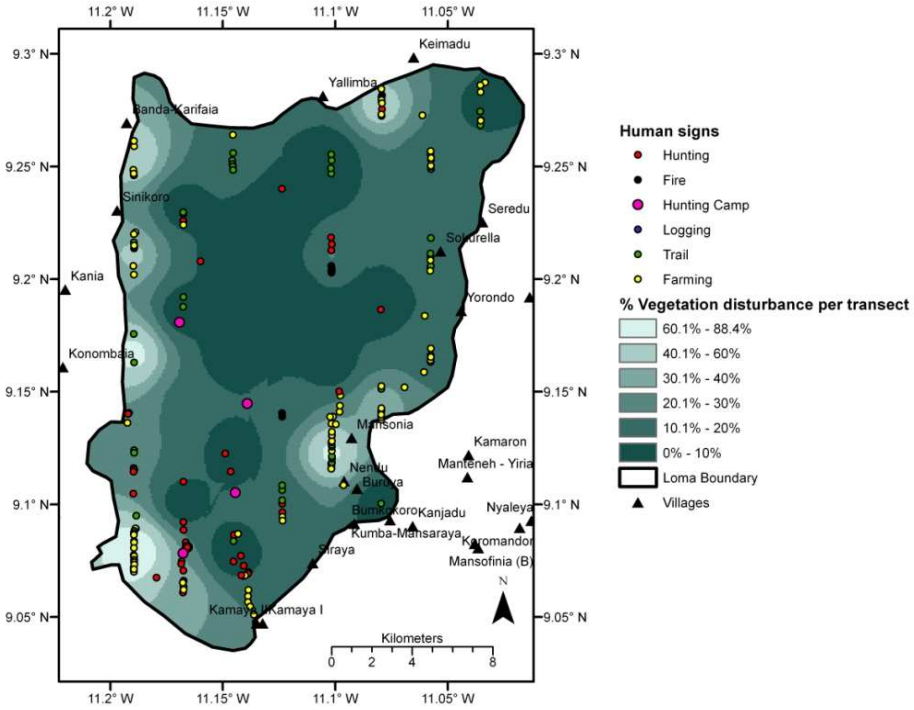


Figure 34. Transect 14 passing through a new groundnut farm near the village of Nendu inside the reserve boundaries.

Two large hunting camps on the shoulders of Serelenkonko peak were discovered. Camp A (N9.105, W11.145) had been very recently used and still had a smouldering fire. Camp B (N9.145, W11.139) contained a large rack for drying buffalo meat, two empty boxes of Guinean shotgun shells (see photo figure 8) and was surrounded with snare-lined hunting trails. Along a short section of the trail leading to Nendu village inside the reserve, 24 snares were collected. Another small hunting camp was found next to the Bengki River (N9.1808, W 11.1692) and two different small hunting camps were found in the south-western part of the reserve (N9.08097, W11.16575 and N9.07826, W11.16771).

Figure 35. Snares and shotgun shells collected along a trail running between Nendu village and a hunting camp. Two empty boxes of Guinean shotgun shells were also found in the hunting camp.

Near the southern edge of the reserve we encountered a monkey carcass being smoked. When we reached the nearest town of Kamaya and spoke to the chief we were told that recently someone had stolen two duikers and two monkeys that were being dried at small camps within the reserve. The chief told us that their community depended on hunting within the forest, although the hunter who claimed that his bushmeat had been stolen was from Kono. Two hunters with guns were encountered in the park, one on the western side towards the south, and one in the far north-eastern corner. In both cases the hunters were very aware that what they were doing was illegal and tried to flee as soon as they saw the survey teams.

Figure 36. Monkey trap found along Transect 3 in the south-western corner of the Loma reserve. Hunter encountered in a newly cleared farm within the south-western boundary of the reserve.

Other mammal signs in Loma Reserve

Direct and indirect signs of 24 other species of mammals were observed on transects, including the footprint of a pygmy hippopotamus near a river in the south-western part of the reserve. A summary table of the number of observations for the signs of each species is shown below. Some monkey calls and sightings were not able to be identified to species, and these are recorded as 'monkey'. Similarly, occasionally the species of porcupine was not recorded, and thus is listed below as 'porcupine'. Interpolation maps of ungulate dung encounter rates are shown in figures 12 and 13. These show very clearly that animals are highly concentrated in the core of the reserve, particularly in the sheltered, steep valley between Mt. Bintumani and Serelenkonko peak.

Table 20. The number of observations of mammal signs on transects. The number of sightings does not take into account the group size observed.

Species	Sign	No. of observations
Aardvark	Dung	1
	Hole	1
African Clawless Otter	Dung	1
Bay Duiker	Dung	59
	Sight	2
Black & White Colobus	Call	4
Black Duiker	Dung	29
	Sight	1
Brush-tailed Porcupine	Dung	8
	Feeding Remains	1
Bushbuck	Dung	14
	Sight	1
Campbell's guenon	Bones	1
	Call	6
	Sight	1
Cane Rat	Dung	7
Crested Porcupine	Dung	2
Diana monkey	Call	3
Forest Buffalo	Dung	31
	Sight	1
Genet	Dung	2
Lesser spot-nosed guenon	Call	1
	Sight	1
Maxwell's Duiker	Dung	29
	Sight	1
Monkey	Call	2
	Sight	1
Olive Baboon	Call	2
Porcupine	Dung	14
Red Colobus	Call	2
	Sight	1
Red River Hog	Dung	11
Rock Hyrax	Call	1
	Dung	2
	Sight	2
Sooty Mangabey	Call	15
Warthog	Dung	1
Yellow-backed Duiker	Dung	9
	Sight	1

Figure 37. Interpolation map of combined Ungulate dung encounter rates for bay duiker, black duiker, Maxwell's duiker, bushbuck, yellow-backed duiker, red river hog, warthog, and forest buffalo. Aardvark dung was not included in this interpolation.

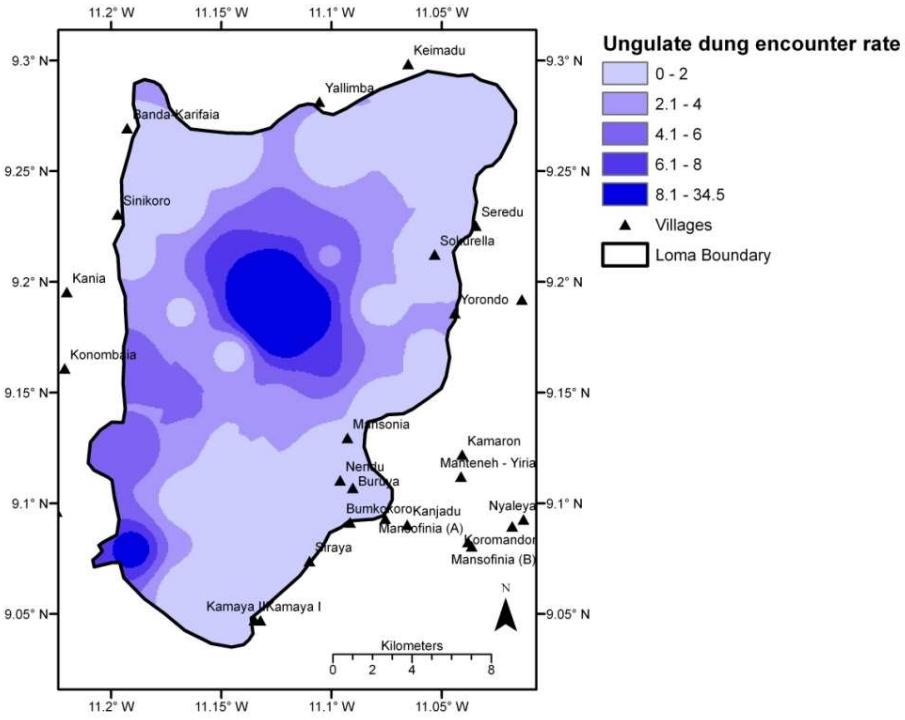
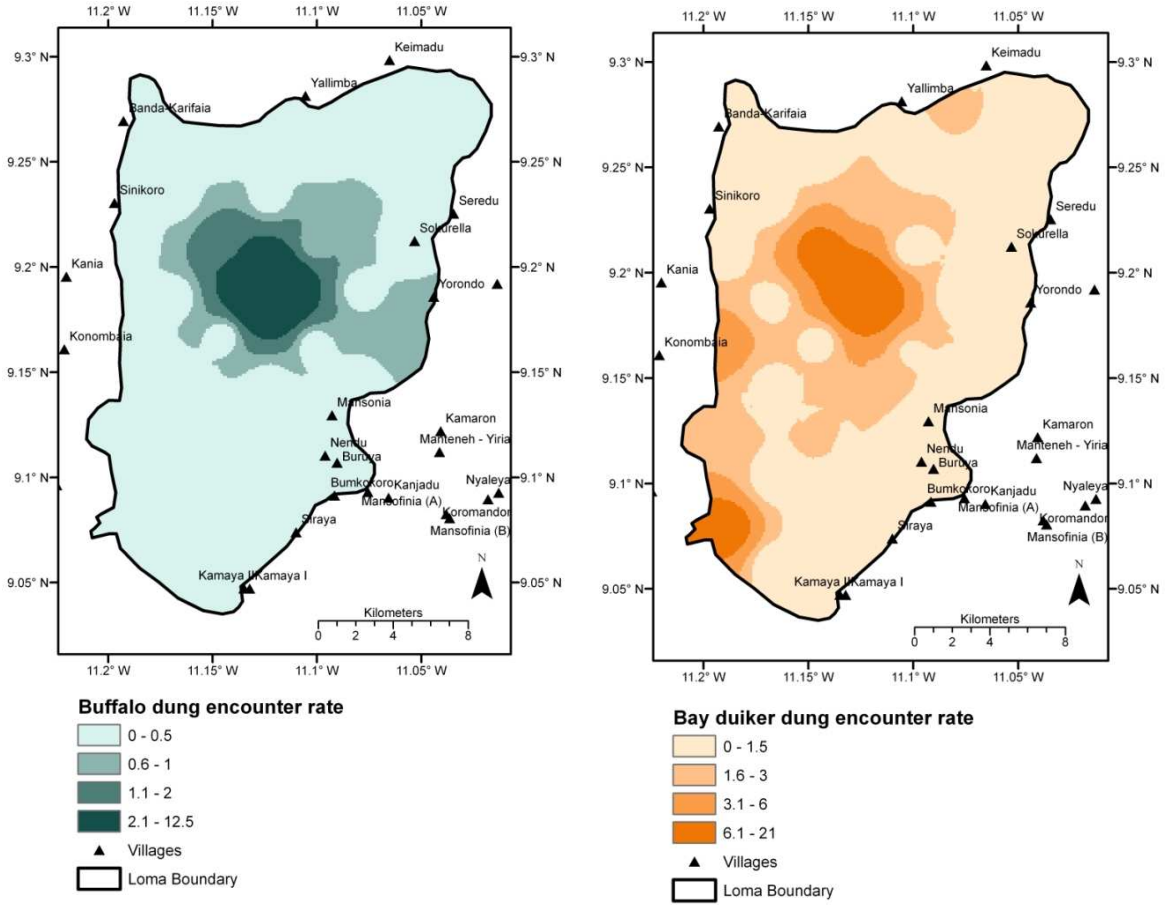


Figure 38. Interpolation map of bay duiker and forest buffalo dung encounter rates.



Picathartes nests

Although not part of the mammal survey, observations of picathartes nests were recorded due to their status as a rare bird of interest. Two picathartes nests were observed on transect 28 near the base camp on the Loma Mountains.

Threats to the biodiversity of the reserve

No signs were apparent during this survey that chimpanzees were being deliberately hunted. However, the much lower density of chimpanzees and ungulates in the transects located near the edge of the reserve (Figures 11 and 12) suggests that either animals have been hunted out of these parts, or that they are being driven to higher elevations due to destruction of lowland forest habitat.

Hunting and forest clearance for agriculture are currently the only major threats to the reserve integrity. The lack of any forest guard presence within the reserve and no incentive for people to respect reserve boundaries means that hunting and forest clearance are likely to continue unabated.

It is not just the edges of the reserve that are threatened with forest loss. Isolated farms were also being cleared well within the reserve boundaries (Figure 5). The primary crops being grown were rice, groundnuts, pepper, corn and okra. Older farms, near Mansonia in particular, had well established kola nut and banana trees.

Attitudes and practices of neighbouring communities

None of the villages reported crop raiding by chimpanzees, thus there was no animosity towards chimpanzees as was seen in Moyamba District. This could indicate that the forest area is still sufficient to provide food resources to the chimpanzee population so that they do not need to rely on human crops to survive.

Communities on all sides of the reserve may be willing to cooperate and respect reserve boundaries if they see some benefit from the reserve. In a bid to secure some income from the reserve, a district councillor based in Yiffin informed us that the two sections bordering the west side of the reserve had agreed a new ‘law’ that every foreign visitor to the reserve must pay Le 20,000 to the council. There was no indication of how the money would be spent, but it shows awareness of the reserve as a tourist attraction and potential income generator from something besides farming and hunting.

Villages on the western side: Bandakarafaia, Sinikoro, Kononbaia

Because of long-term ecological research that was based out of Kononbaia and Sinikoro between 2003 and 2005, these three communities seemed to have a reasonably good attitude towards the reserve. They also benefit to a small degree from the trickle of visitors that come to climb Mt. Bintumani. Regardless, forest clearance had taken place inside the western edge of the reserve boundary.

Villages on the southern side of the reserve: Pirankoro, Kamaya, Siraia

Extensive forest clearance for farming has taken place along the southern edge of the reserve, particularly near Pirankoro and Kamaya. From the vantage point of a well-placed hunting camp, we could see several new farms deep inside the southern reserve boundaries. The chief of Kamaya mentioned that hunting was very important for their livelihoods, but the hunting does not appear to be done exclusively by members of these communities as evidenced by the presence of a hunter from Kono in the village.

Villages on the eastern side: Mansonia, Mansonia Town, Sokurela

Farming was spreading up the main river valley that descends from the watershed between the large peaks of Bintumani and Serelenkonko. Although Mansonia may be a relatively new village, the chief said that his grandfather had also farmed in this valley. Surrounding the farms were snares set to catch cane rats, duikers, civets, porcupines and other animals that may be drawn to the farms.

Villages inside the reserve: Buriya, Nendu

We passed through Nendu en route to transect 14. We found the community very friendly and receptive to our mission, perhaps because they were aware that their village had been established illegally within the reserve. Transect 14 just to the west of Nendu was almost entirely new farm or older farm bush, so encroachment of farming activities is a major problem from the presence of these villages within the reserve. More alarmingly, the largest well-established hunting camp on the north-west side of Serelenkoko Mountain seemed to have a direct snare-lined trail to Nendu. It is clear that extensive hunting within the reserve is being facilitated, if not carried out, by members of these communities.

Figure 39. **Inhabitants of Nendu village, located within the Loma reserve boundaries.**

5.5.4 Conclusions

Without a doubt the Loma Reserve is the most important area of biodiversity in Koinadugu District, if not the whole country. Chimpanzee density is extremely high towards the centre of the reserve on the slopes of Mt Bintumani; amongst the highest chimpanzee densities found anywhere in Africa, and Loma is now estimated to harbour around 20% of Sierra Leone's chimpanzees. Previous studies have identified the presence of pygmy hippos and leopards within the reserve. Compared to other forest reserves such as the WAPFR or Tingi Hills, the Loma Mountains Non-hunting Forest Reserve has much less hunting pressure. The remoteness of the reserve perhaps only protects it from large-scale exploitation, but nonetheless there are still villages bordering and within the reserve that pose a moderate threat to the biodiversity and integrity of the reserve. Approximately 15% of the reserve has already been cleared for farming. Given that villages are relatively few, and that land is available outside the reserve for farming activities, increased sensitization and conservation/development activities around the reserve could have a large impact on the preservation of this crucial area for biodiversity conservation in Sierra Leone. Good communities to work with in this area are Bandakarifaia, Sinikoro, and Kononbaia because they are situated between the Loma Reserve and the Kurakoro forest discussed below. These communities have had exposure to conservation activities through previous research projects carried out in the Loma Reserve. Furthermore, they are already getting some small tourism revenue from visitors wishing to climb Mt Bintumani and this could be developed and formalized to link conservation practice with direct economic benefits.

It has been proposed that the Loma Mountains be protected as a biodiversity offset for the habitat lost with the inundation of the Bumbuna hydro-electric dam reservoir. In 2010 plans were proposed by the World Bank and the Global Environment Facility to support conservation of the Loma Mountains and promote it to national park status. To date, a boundary survey has been completed for the reserve.

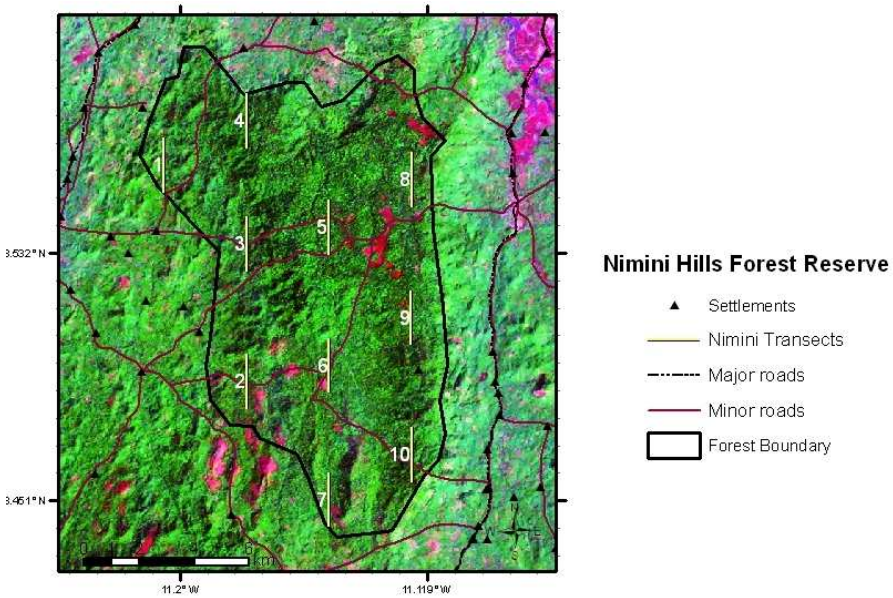
5.6 Nimini Hills North Forest Reserve

5.6.1 Study area

The Nimini Hills Forest Reserve is approximately 129 km^2 and located in the southwest of Kono District. The original reserve boundaries are not clearly demarcated so the boundaries used to calculate reserve area are approximate, modified from satellite maps of existing forest cover. Commercial logging has taken place across much of the district, with Nimini Hills partially logged. In 2008 the Trans-Atlantic logging company did a forest inventory in the Nimini Hills North Extension 1, but the 2009 logging ban has temporarily shut down commercial logging in the district. Currently, small-scale logging with power-saws is rampant, with only a few of the saw owners obtaining a timber license.

The survey area of Nimini Hills was drawn to include remaining forest area, which does not always coincide with the original reserve boundaries. Therefore it is possible that the percent of forested area was overestimated in relation to the original reserve boundaries, while farm encroachment was underestimated in this survey. Even within the given boundaries, farm encroachment had occurred. Ten transects were completed in Nimini Hills for a total length of 20 km (Figure 40).

Figure 40. Satellite map of the Nimini Hills forest area showing the location of the 10 transects completed within the reserve.



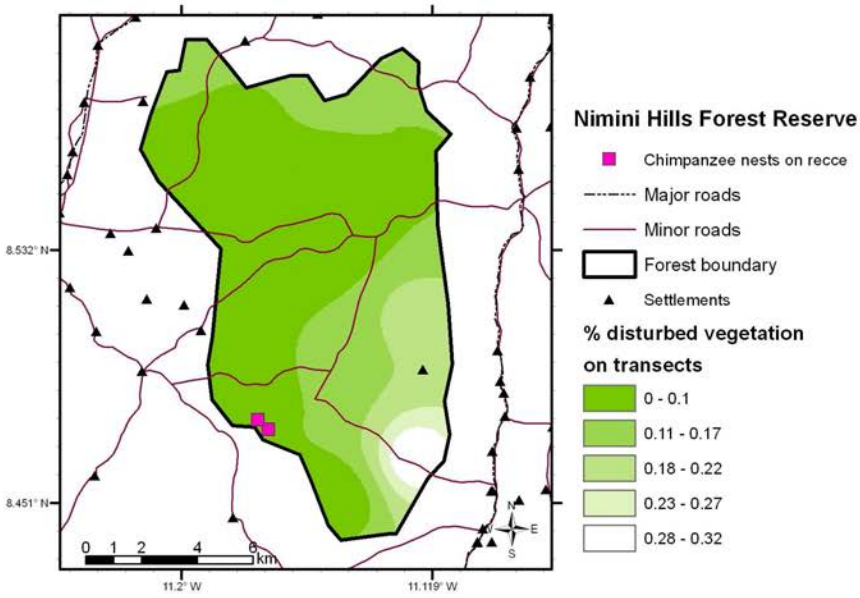
5.6.2 Results

Chimpanzee status

No chimpanzee nests or other signs were found on any of the block transects in Kono District or on Nimini Hills transects. Although no signs were found on transects, nests were found in the southwest of the reserve on recces (Figure 41). This indicates that there are some chimpanzees in the reserve, or at least at its periphery, though probably not in significant numbers.

Figure 41. Detailed map of Nimini Hills showing percentage of vegetation disturbance (farms, farmbush, and plantation) on each transect in green shading.

No chimpanzee nests were found on transects, so calculated densities for transects are all zero. Nests were found on recces in the southwest of the reserve, shown as pink squares.



Vegetation

Vegetation disturbance is occurring mostly in the southeast of the reserve (Figure 41). However, the forest is largely intact, with forest being the main vegetation type as a percentage of total transect length (65.6%). Vine forest (24.3%) predominated on transect 5. In Nimini Hills this was a natural vegetation formation likely to do with soil type or slope. Disturbed vegetation such as farmbush (2.3%) and secondary forest (0.9%) was not significant in the reserve, but this is probably because the reserve boundaries were redrawn to only include what was thought to be closed forest. Forest that showed signs of small-scale logging covered 6% of the transects (Table 21).

Table 21. Percentage of each vegetation type along transects in the Nimini Hills Forest Reserve.

Vegetation type	Nimini Hills % transect length
Forest	65.6
Vine forest	24.3
Logged forest	6.0
Farmbush	2.3
Secondary forest	0.9
Swamp Forest	0.4
Stunted rock forest	0.4

Human activity

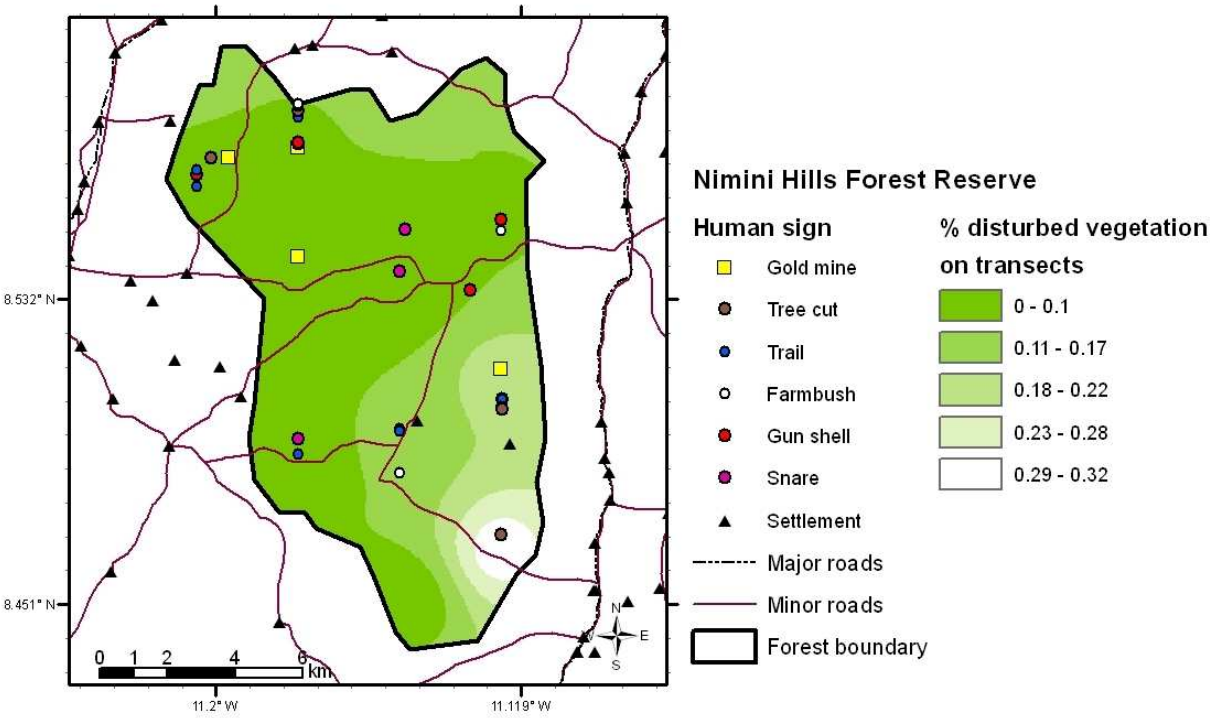
In the Nimini Hills, human encroachment occurred throughout the reserve except for in the far south. In particular, four small-scale gold mines were discovered on transects or recces throughout the reserve, but the survey team said they saw many more. Other frequent signs were footpaths and trees cut with power saws (Table 22). The easier terrain may facilitate human encroachment across the reserve. It is likely that active illegal gold mines and the two settlements found within the reserve (Figure 42), with their constant associated human presence, may have pushed chimpanzees to the south or out of the reserve completely.

Table 22. Encounter rates of human signs on transects in the Nimini Hills Forest Reserve

Human Signs	Encounter Rate (signs/km)
Footpaths and motor roads	0.55
Hunting - snares	0.20
Hunting - guns	0.20
Logging	0.30
Mining	0.10
Charcoal production	0.00
Hunting camp	0.00

Figure 42. Map of the Nimini Hills forest area showing human signs encountered on transects and recces within the reserve.

The percentage of disturbed vegetation (farmbush, plantation, logged forest) on each transect is interpolated between transects (green shading).



Other mammals

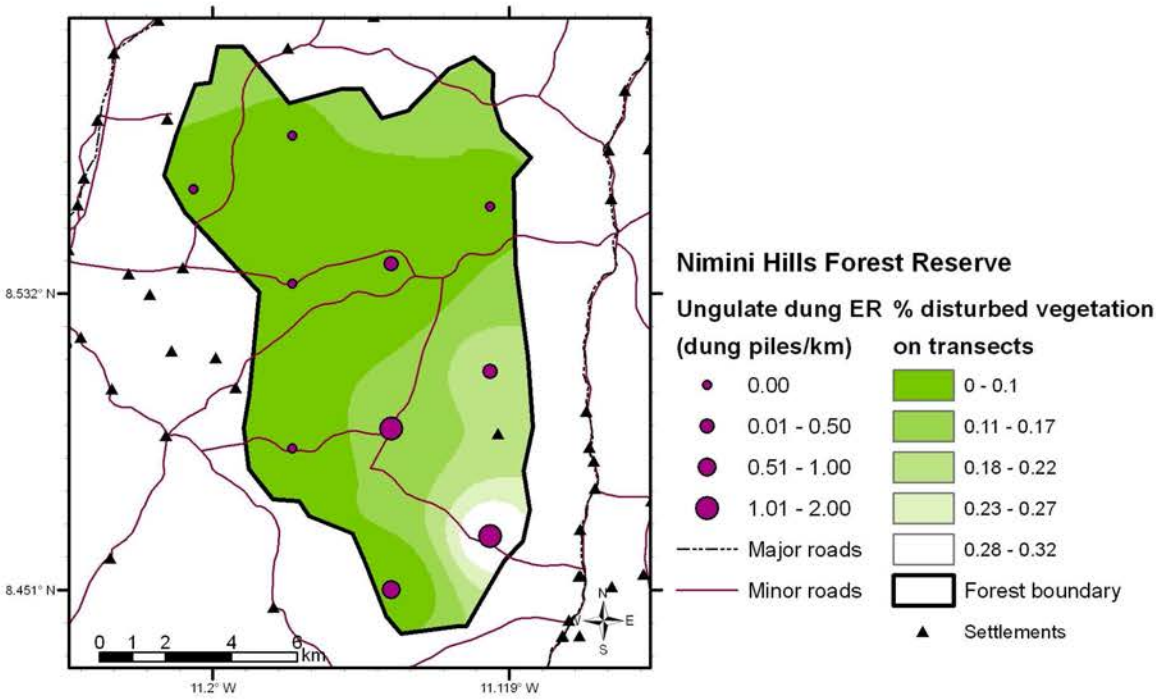
Overall the encounter rate for animal signs in the Nimini Hills shows that for most species the Nimini Hills are already greatly impoverished. Human encroachment in Nimini Hills is likely to be the reason for low encounter rates there. The most common animals recorded on transects are shown in Table 23. The most frequent signs were attributed to humans; primarily footpaths, snares,

gold mining and shotgun shells (Table 22); far fewer mammal signs were seen, the most common after humans being Maxwell's duiker. Relative ungulate density across the reserve is shown in Figure 43. The few signs that were seen were primarily in the south of the reserve where there were less human signs except for vegetation disturbance.

Table 23. Encounter rate of all mammal signs found on transects in Nimini Hills.

	Encounter Rate (signs/km)
Human	1.35
Maxwell's duiker	0.25
Black duiker	0.05
Bushbuck	0.05
Red river hog	0.05
Bay duiker	0.10
Yellow-backed duiker	0.05
Porcupine	0.10
Civet	0.10
Colobus Monkey	0.05

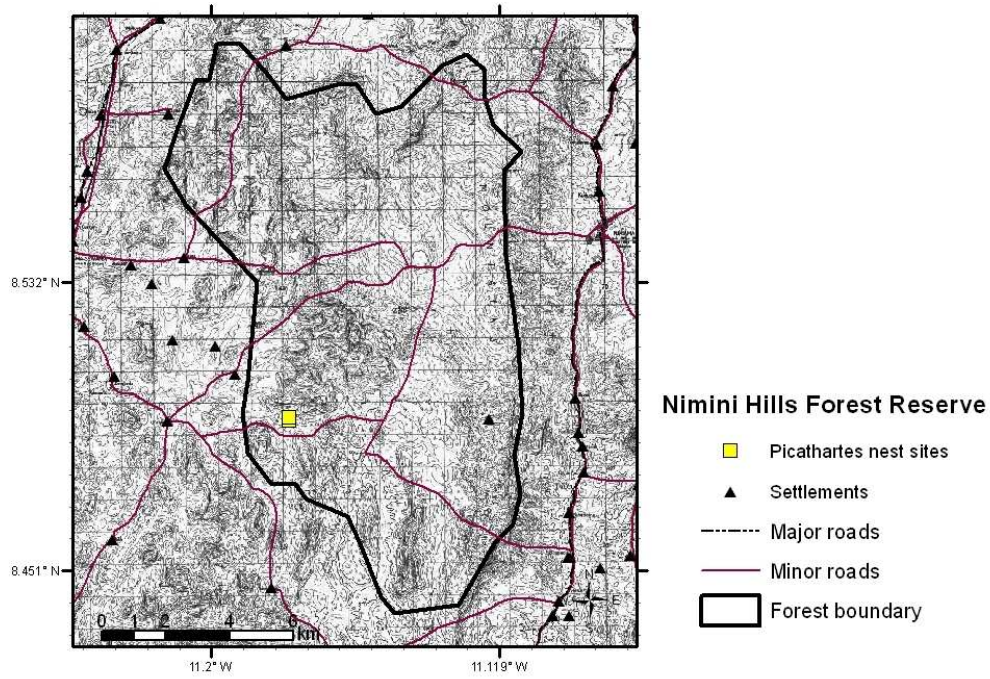
Figure 43. Ungulate dung encounter rates overlaid on an interpolated map of percent disturbed vegetation for the Nimini Hills



White-necked picathartes

Of special conservation significance is the white-necked picathartes. Two nests sites were found in the Nimini Hills in the southwest part of the reserve (Figure 44).

Figure 44. Topographic map of Nimini Hills showing locations of picathartes nest sites found on transects.



5.6.3 Conclusions

The Nimini Hills Forest Reserve is already a deeply depleted and threatened forest. Very few signs of wildlife were encountered, and human signs were found almost everywhere in the reserve. Chimpanzee nests were only found in the very southwest edge of the reserve, and probably those chimpanzees are utilizing areas outside of the reserve where hunting pressure might actually be less. It is illegal gold-mining and timber felling that probably poses the greatest threat for the remaining forest and wildlife here. Mining camps create a constant human presence in the reserve and encourage hunting and tree-felling to supply miners with meat and wood. Chain saws are operating within the reserve for small-scale timber production.

The Nimini Hills retain much of their forest cover, and inventory and management of the forest resources there are necessary to maintain this resource into the future. Small-scale logging with power-saws should be controlled before it slowly eats into the standing timber in the reserve. If managed carefully, the Nimini Hills could serve as a sustainable production forest for timber or non-timber forest products. However, forestry interventions are unlikely to be effective there until illegal gold mining operations are stopped. The massive demand for gold and diamonds in Kono District means that wildlife and forest conservation may not be taken seriously. There is a real need to ensure that licensed and sustainable mining occurs within managed land use planning to ensure that the social and environmental costs are considered alongside economic gain.

If hunting is not controlled, it will continue to be an empty forest. Currently it is only listed as a forest reserve, not a non-hunting forest reserve like the Tingi Hills. This may also help to explain why wildlife has already been depleted in the reserve. If logging continues it is also unlikely that chimpanzees will move back into the reserve from the surrounding landscape. Serious protection efforts and rehabilitation of the reserve are needed before it can return to being an important site for biodiversity conservation in Sierra Leone.

5.7 Outamba-Kilimi National Park

5.7.1 Study area

Outamba Kilimi National Park is currently the only national park in Sierra Leone. Located in the far north of Sierra Leone on the border with Guinea, it is divided into the larger Outamba section (783 km^2) in the east and Kilimi section (274 km^2) in the west of northern Bombali district. The terrain is relatively flat with low rolling hills or plateaus which offer excellent views across the spectacular landscape. The eastern side of Outamba is more varied, with more hills reaching 300-400 m elevation. Vegetation is primarily southern Guinea savanna woodland with trees such as *Lophira* and *Daniellia*. A small proportion of the area is made up of forest, narrow riverine forest, or small patches of savanna. The savanna grasses are primarily a tall elephant grass which is burned annually by people in the park. Almost all areas of the park are affected by the burning.

The site supports at least nine species of primates including Western Chimpanzee, red colobus, black and white colobus, sooty mangabey, and olive baboons. The total number of bird species recorded in the park is 220. A small population of forest elephant occurs at Outamba. Other large mammals include leopard, pygmy hippopotamus, water chevrotain, Maxwell's duiker, and forest buffalo.

Both sections of the reserve are located within one chiefdom (Tambakha, the least populated of all chiefdoms in the country. Both sections were first proposed by the Government of Sierra Leone in 1965 as two separate game reserves. After Outamba and Kilimi were proposed as game reserves, wildlife dealer Franz Sitter intensified hunting there, hiring a white Kenyan hunter and 200 locals, to try to take as much wildlife as possible from the area before it could be protected (Teleki 1985). In 1976 Franz Sitter's outpost in Tambakha chiefdom was closed down due to local disputes about payments for specimens.

In the 1980s Dr Geza Teleki spent many years in the region planning for the establishment of a national park with support from IUCN and WWF. A detailed provisional management plan was completed in 1986 and submitted to the government. However, conflicts with local people residing within the demarcated areas posed considerable problems with implementation. Considerable attention was given to resettlement of villages located within the boundaries with a lack of consideration given to traditional Susu ties to the land. Therefore the plan met with great resistance and problems have persisted to this day.

5.7.2 Previous chimpanzee surveys in Outamba-Kilimi National Park

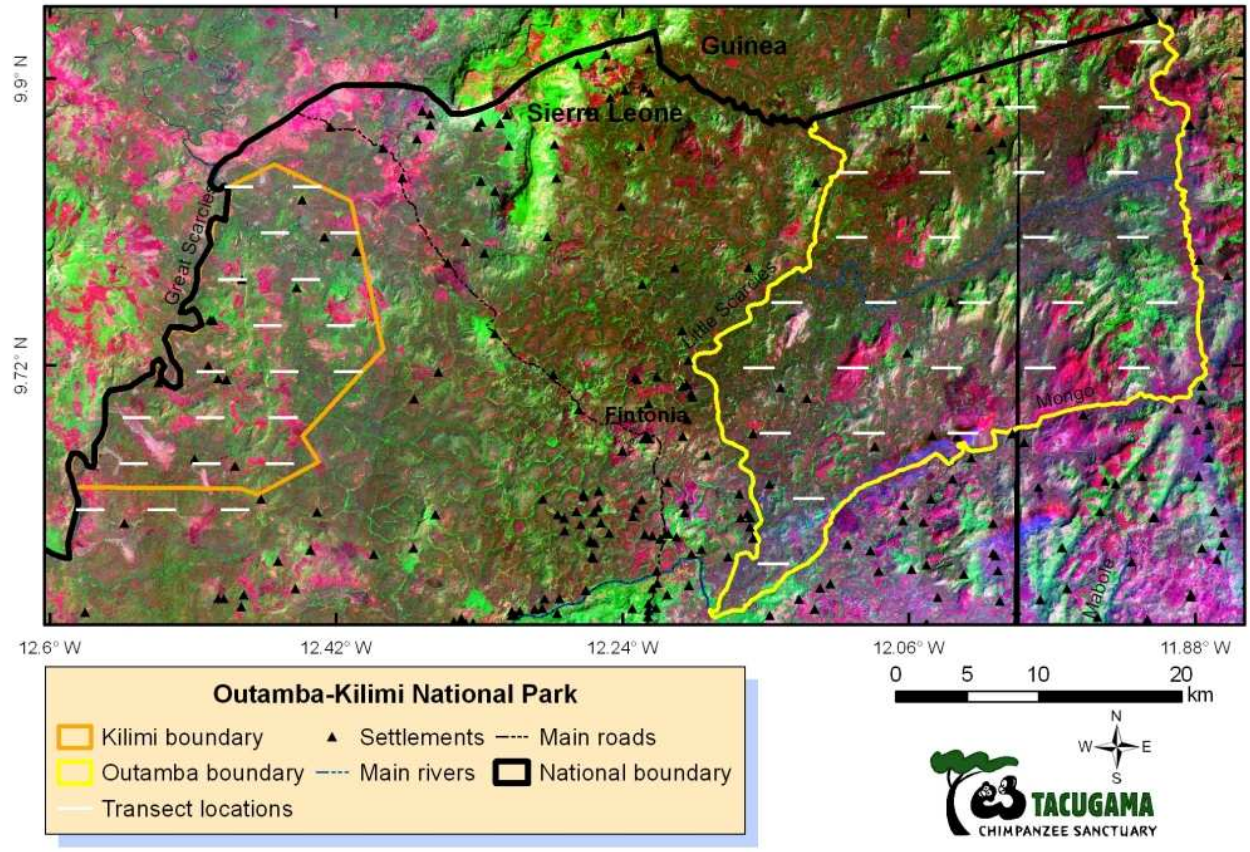
As part of their 1979-1980 nationwide chimpanzee survey, Teleki and Baldwin spent two months in Outamba-Kilimi National Park (Teleki and Baldwin 1981). They thought the proposed national park had perhaps the largest population of chimpanzees in the country, though exact figures are not available.

In a study done in 1983 in the Kilimi section of the park, chimpanzees were recorded on an ad hoc basis wherever encountered and plotted on a map (Harding 1984). Feeding sites were visited where chimpanzees were thought to frequent and pre-selected routes were walked by field teams and all observations recorded. Chimpanzee signs and sightings led to the estimation of 5 groups of chimpanzees using the Kilimi section with a total population assumed to be 49-60 individuals. Estimated density was approximately 0.3 chimpanzees/km^2.

Alp's 1989 field survey of wild chimpanzees in central Outamba confirmed there to be high populations occurring throughout this section of the park. During her fieldwork from 1991 to 1994 in Tenkere, Outamba, 18 individuals were recognizable, a total of 27 individuals were observed in a group at one particular time, and the largest number of nests encountered at once was 24 (Alp,

unpublished data). A minimum of 27 individuals made up the Tenkere community, living within a range of at least 30 km^2, but it was thought that the Tenkere community population size was much larger. The chimpanzee population size in Outamba was estimated by Alp to be between 200–300 individuals. Given that Outamba offers a richer habitat for chimpanzees than the less-forested Kilimi, which is predominantly savanna and more populated by humans, Outamba was thought to potentially harbour a population of approximately 600–700 chimpanzees (Kormos *et al.*, 2003).

Figure 45. Landsat satellite image for Outamba-Kilimi National Park showing vegetation coverage and the locations of transects. The town Fintonia is the chiefdom headquarters.



5.7.3 Results

A pilot study in the western part of Outamba and the southern part of Kilimi was carried out in May 2009. The main survey took place in OKNP in February and March 2010, during the dry season when the Little Scarcies River was at its lowest and thus able to be crossed easily on foot inside the park. However, at this time, all other small rivers across the park were dry which may have potentially influenced animal distributions.

All 29 transects in Outamba and 20 transects in Kilimi were run in an east-west direction (Figure 45). Due to mapping errors, two transects in Outamba were actually north of the reserve boundary and three transects in Kilimi were south of the reserve boundary. These were subsequently discarded in the chimpanzee density analysis of the reserve data, but were retained for other analyses and mapping purposes.

Chimpanzee status

Outamba-Kilimi National Park was analysed separately from the other reserves because the habitat is primarily woodland savanna, with a longer nest duration of 139 days. The Outamba and Kilimi sections of the park were post-stratified in DISTANCE, where encounter rate and density were calculated by stratum, but detection function was calculated from the pooled data. The pooled estimate of density was made from area weighted stratum estimates. The perpendicular distances were truncated at 40m, removing the outermost 11% of observations for Outamba and 7% of observations for Kilimi. The model with the best fit to the data was hazard rate function with the simple polynomial adjustment term.

Chimpanzee nests were found on almost all transects in Outamba section for a total of 524 nests (Table 24). Only five transects in the Kilimi section had nests giving a total of 72, but 36 nests were also present on two of the transects to the south of the reserve boundary.

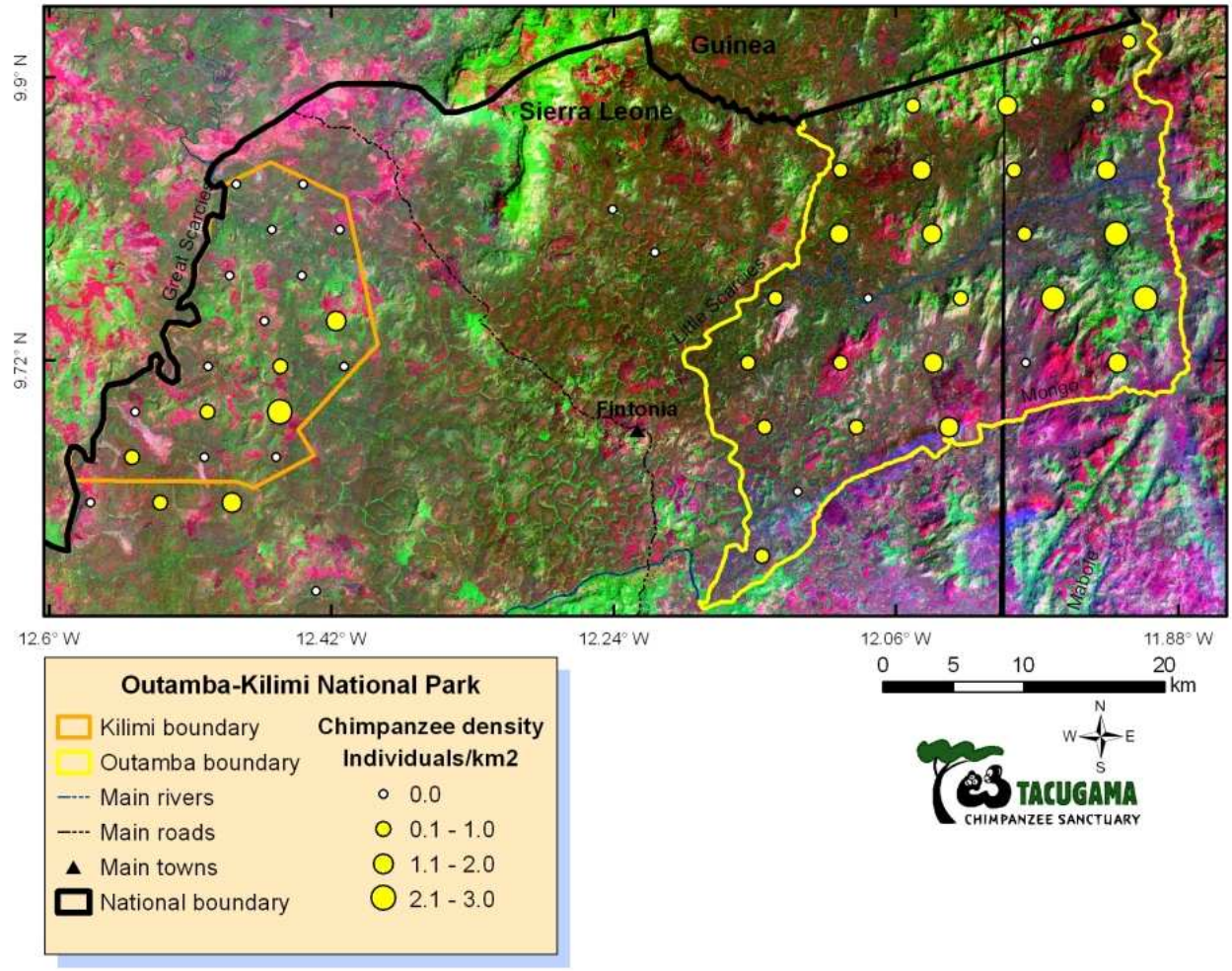
Table 24. Data summary for Outamba-Kilimi National Park.

	Outamba	Kilimi	Pooled estimate
Study area (km^2)	783	274	
Area surveyed by transects‡ (km^2)	3.12	2.21	
Percent of study area covered by transects	0.399	0.808	
Number of transects	27	17	
Total transect length (km)	52.20	34.00	
No. transects with chimpanzee nests	24	5	
Total chimpanzee nests before truncation	524	72	
Nest encounter rate (nests/km) before truncation	10.04	2.12	
Total chimpanzee nest groups	168	17	
Average nest group size	3.12	4.24	
Number of nests after truncation	465	67	
Encounter rate (nests/km) [95% CI]	8.9 [6.71-11.83]	1.9 [0.61-6.41]	
Density (individuals/km^2) [95% CI]	1.21 [0.78-1.88]	0.27 [0.08-0.90]	0.97 [0.62-1.51]
Number of chimpanzees [95% CI]	950 [615-1472	70 [22-246]	1025 [658-1596]
Percentage coefficient of variation (%CV)	22.28	62.67	22.10

‡ Transect area calculated as 2xESWxLength

Although there was actually a higher nest encounter rate in Outamba than in the Loma Mountains, the longer nest duration and wider effective strip width in woodland savanna resulted in a lower density estimate for Outamba. Kilimi had a much lower nest encounter rate than the Outamba section and thus made up a small proportion of the total population of OKNP, estimated to be 1,020 (95% CI=658-1,596) chimpanzees (Table 24).

Figure 46. Chimpanzee densities on transects across Outamba-Kilimi National Park. Points outside of the park are from block transects.

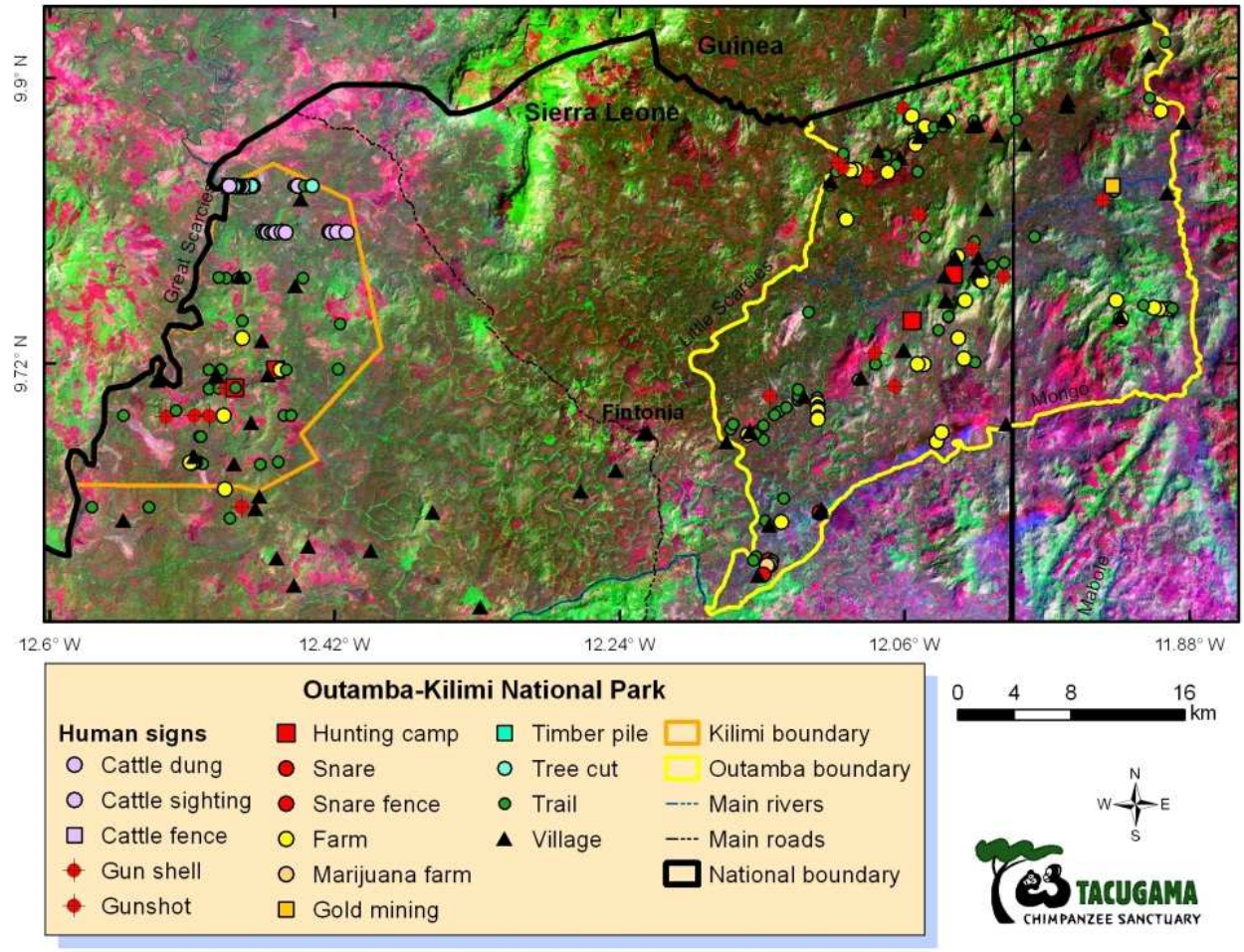


Human activity

More villages were located in the park than had been previously mapped. These are shown in Figure 47 along with all other human signs found on transects or recces within the reserve. Included are signs seen during the 2009 pilot study. The Kilimi section has human signs throughout, except for the southwest corner and along the eastern edge. The northern part of Kilimi is currently being used for grazing cattle and most of the timber extraction that is occurring in the park is in the north. Hunting signs were more common in the central part between the two park guard bases at Kankan and Ganya.

In the Outamba section, activity is concentrated along the main trails connecting villages starting from the park headquarters near Fintonia, to Loma, north to Yatia, and back towards the Lolo River on the western border of the park. Small farms are usually associated with these villages, but hunting with both guns and snares occurs. Guns are found in villages throughout the park, with guns and ammunition supplied from Guinea. All of the villages within the park are severely underdeveloped, lacking any schools or health facilities. Most trade is with Guinea, and the preferred currency in these villages is the West African Franc. Gold mining has just started in the east of the park along the Little Scarcies River. Many of the settlements in the south and east are people who have crossed from Koinadugu to come farm within the park.

Figure 47. Location of human signs found on transects and recces in Outamba-Kilimi National Park. Not all villages outside the park boundaries are shown.



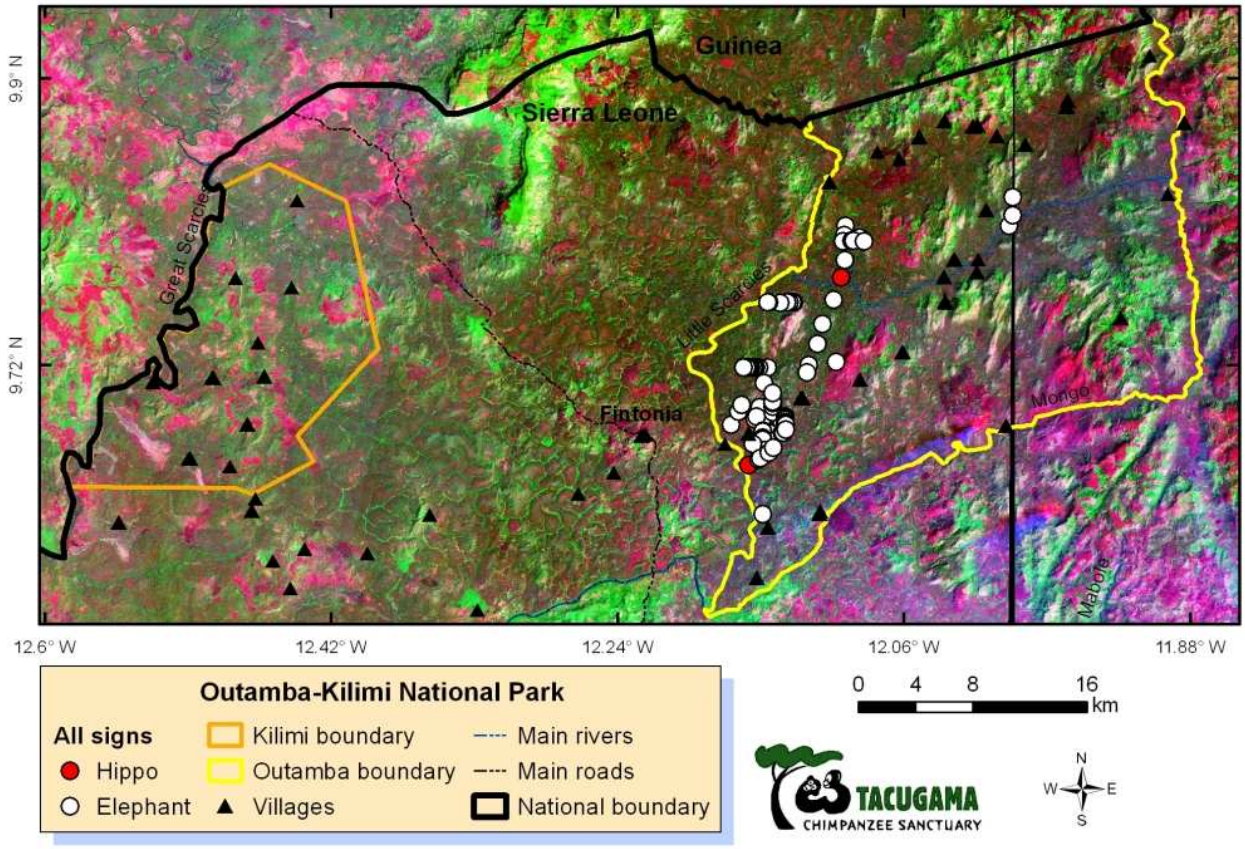
Although not mapped in this report, widespread annual burning affects most of the park and may have caused and continue to cause significant changes in vegetation composition and wildlife habitats. The effects of the burning need urgent study to determine whether current burning practices are causing degradation in soil and habitat quality.

Other mammals

Not all mammals within the reserve will be discussed here, but of particular importance to OKNP and the country are the abundance and distribution of the remaining elephant population. Unfortunately elephants are completely absent from Kilimi and so scarce in Outamba that not enough dung piles were encountered to enable a reliable estimate of population size. A map of the locations of all elephant signs encountered in the park show that elephants only occur in a small fraction of Outamba, primarily in the west around Yembere and Gbereya villages (Figure 48). Mame Hill, just south of the confluence of the Little Scarcies and the Lolo Rivers is also known for having elephants. A few elephant signs were also seen in the centre of Outamba. From this data it is unknown whether this group of elephants crosses the border into Guinea, or is connected to any other populations in Sierra Leone as no signs were seen in other parts of Outamba. In 2009, several elephants were killed inside Outamba. Given the small, concentrated population that remains, without further protection, it is very likely that elephants will be eliminated from the park in the near future.

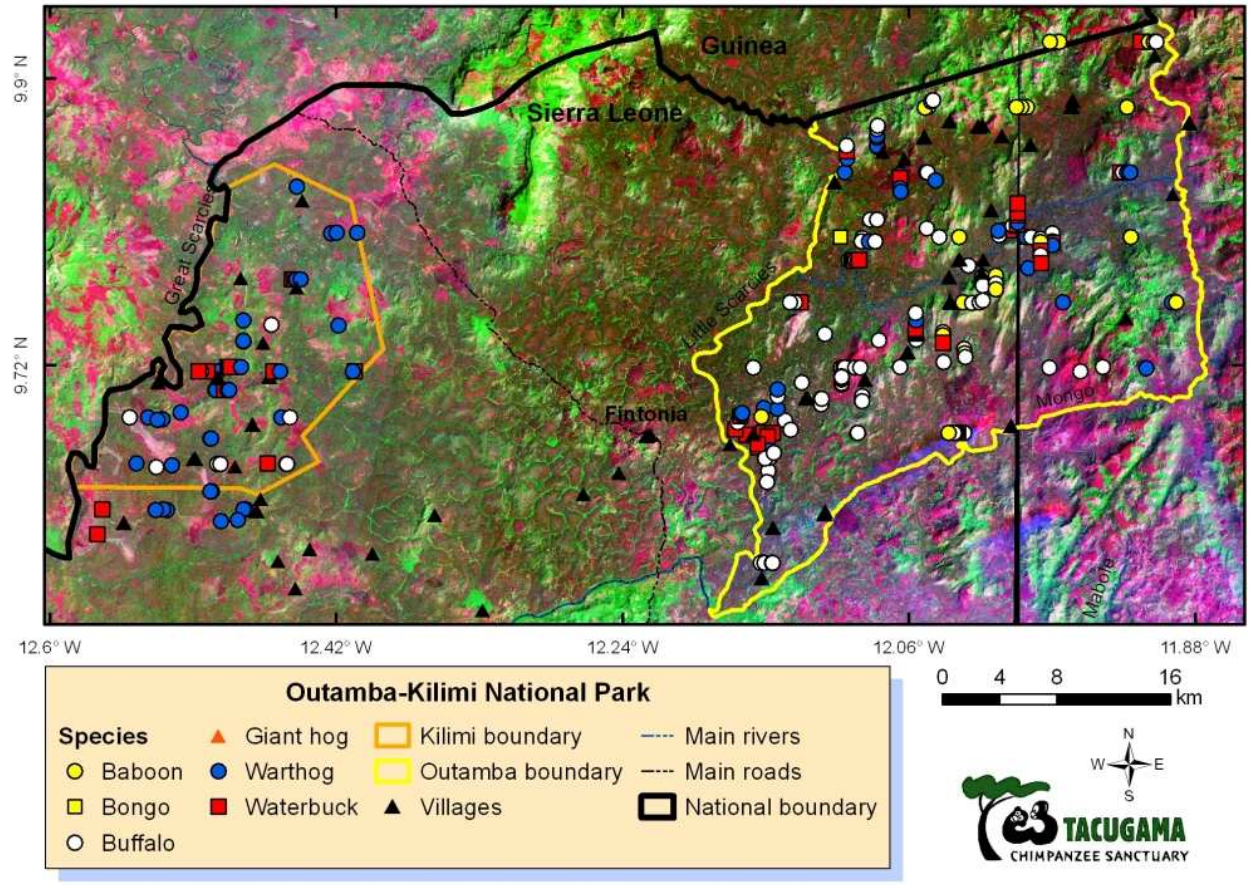
Common hippopotamus signs were only seen in two areas of Outamba, though there may be more along the major rivers bordering the park. One area is near the park headquarters, and this group is a major part of the wildlife experience for park visitors. The area where hippo signs were observed was further up the Little Scarcies River above the confluence with the Lolo River (Figure 48).

Figure 48. Locations of all signs of common hippopotamus and elephant (dung, footprints, trails) seen on transects and recces within Outamba-Kilimi National Park. Not all villages outside of the park are shown.



The most common large mammal signs recorded on transects and recces apart from chimpanzees were from bushbuck, Maxwell's duiker, black duiker, buffalo, elephant, red-flanked duiker, bay duiker, red river hog, and warthog. The locations of signs of some of the less-common large mammals are shown in Figure 49. Signs of warthogs were common all over the Kilimi section, and buffalo and waterbuck signs were also frequently encountered there. Baboons, giant forest hog and bongo were found only in the Outamba section. More information on distribution and abundance of mammals in OKNP will be presented in later papers.

Figure 49. Distribution of signs (dung, sightings, trails, and footprints) of several large mammals found on transects and recces in Outamba-Kilimi National Park.



5.7.4 Conclusions

Home to around 20% of Sierra Leone's chimpanzees, Outamba-Kilimi National Park is the area of second-most importance for chimpanzees in the country after the Loma Mountains. Earlier estimates on chimpanzee populations for Outamba-Kilimi National Park were close to current estimates. Harding (1984) estimated a chimpanzee density of 0.3 chimpanzee/km^2 and a total population of 49-60 individuals, while this study found a density of 0.27 chimpanzees/km^2 and population size of around 74 individuals. Although initial estimates of 200-300 individuals for Outamba were low, the idea that the population there could be as high as 600-700 (Hanson-Alp *et al.*, 2003) was closer to the estimate of around 950 chimpanzees found in this study. It is likely that populations used to be much higher before wildlife dealers heavily hunted in the area in the 1960s and 1970s.

Outamba is also a crucial area for survival of elephants in Sierra Leone. Although the population size is unknown, it is likely to be very small.

Currently there is no real income reaching human communities in the park except for trade in bushmeat and some pepper plantations. The observations of the census team and reports from the park guards suggest that guns are regularly brought from Guinea into the park, and in fact we encountered one such gun trader moving through the park in May 2009. In the north of Outamba and parts of Kilimi, much trading goes on across the border to Guinea and the currency of choice is the West African Franc. Nascent gold mining efforts in the east of Outamba may pose a new threat to biodiversity and water quality. Despite this, large areas of the Outamba section seem to be mostly unaffected by people and wildlife still seems abundant in the park.

Although OKNP has immense tourism potential, it is unlikely in the near future that there will be sufficient tourism in Sierra Leone to support the running costs of protected areas in the country. Furthermore, given the current road infrastructure for reaching Tambakha Chiefdom, most of the tourists that reach Freetown will not make the arduous journey to the park. Until this changes, conservation efforts for OKNP should focus on gaining support and trust from the communities in and around the park. In order to do this, these communities need to see tangible, long-lasting benefits from any conservation measures put into place. Direct enforcement of wildlife laws in the park, without reciprocal benefits, are likely to meet with continued resistance.

Individuals from Yembere, just inside the park boundaries from the Outamba headquarters, have indicated that they are ready and willing to move out of the park. They are frustrated with the lack of schools and relative isolation, and are waiting for some support that would allow them to make that transition. If this is the desired management strategy for OKNP, then Yembere could serve as a test case for community relocation from the park. If they receive adequate benefits and support, other communities might be willing to follow suit.

5.8 Tingi Hills Non-Hunting Forest Reserve

5.8.1 Study area

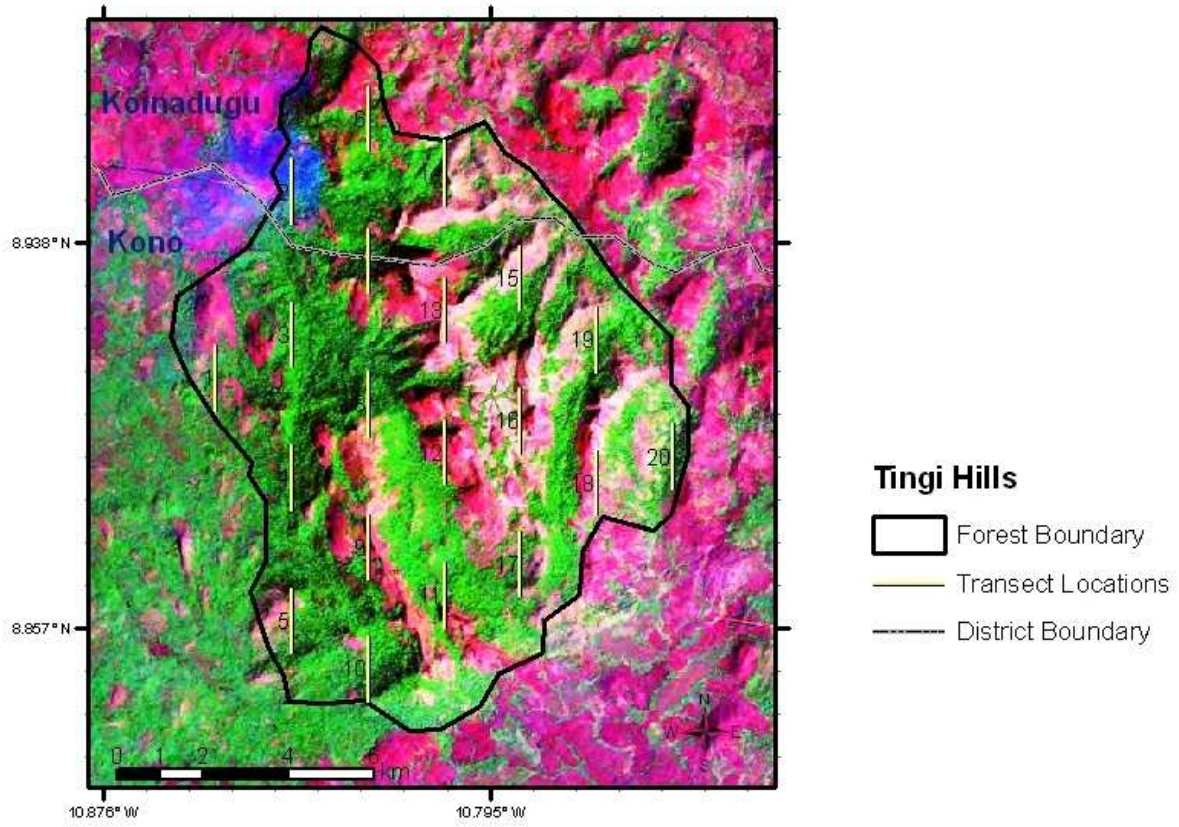
The Tingi Hills are a stunning forested landscape of steep hills topped by bare rock and sub-montane savanna of 116 km^2, located in the northeast of Kono District and crossing over partially into Koinadugu District. The Tingi Hills has the second highest peak in Sierra Leone, Sankan Biriwa, which stands at 1860 m high. The vegetation at lower altitudes (300-900 m) is predominantly moist semi-deciduous forest, but much of it has been reduced to derived savanna. Sub-montane gallery forest occurs up to 1700 m. A mixture of shrubs and tree savanna occurs at 900-1680 m which gradually changes into grass savanna above 1680 m (Figure 50). Sedge flora interspersed by bare rock outcast is found at the summit of peaks. Some of the common tree species are *Lophira alata, Lophira lanceolata, Heriteria utilis, Uapaca guineensis, Daniella thurifera, Terminalia ivorensis, Terminalia superba, Parinari excelsa, Bridelia grandis, Treculia africana,* and *Pycnanthus angolensis*.

Over 200 species of birds have been recorded at Tingi Hills including 3 globally threatened species (Field 1974).

The Tingi Hills are known to contain four threatened primate species; Western chimpanzee, red colobus, black & white colobus and sooty mangabey. A small population of forest elephant is thought to exist in the hills. Other large mammals include leopard, pygmy hippopotamus, and forest buffalo (IUCN 2006).

Forest boundaries were redrawn from boundary maps available from Sierra Leone Information Services to better capture the remaining forest area (Figure 50). Therefore it is possible that the percent of forested area was overestimated in relation to the original reserve boundaries, while farm encroachment was underestimated in this survey. Even within the given boundaries, farm encroachment had occurred.

Figure 50. Satellite map of the Tingi Hills forest area showing the location of the 20 transects designed for the reserve.



5.8.2 Results

In March 2010, 19 of the planned 20 transects were walked (transect 16 was missed due to error), but due to the extremely hilly and dangerous terrain, eight transects were only partially completed. A total transect length of 24.55 km was walked in Tingi Hills (Table 25).

Chimpanzee status

Nests were detected on five out of the 19 transects in Tingi Hills (47 nests total). Chimpanzee signs, including feeding remains, calls, and nests, were found on six out of the 19 transects (51 signs total) (Table 25). Tingi chimpanzee nest data were analyzed collectively as part of the nationwide dataset of forested reserves. Details of the analysis are presented in the methods section of this report. Because so few nests were found, the coefficient of variation is very high (58.79%), meaning there is a lot of uncertainty in the final population estimate for Tingi Hills. This results in a density estimate of 0.59 chimpanzees/km^2 (95% CI=0.14-1.30) and a total population estimate of 70 (95% CI=22-213) chimpanzees living in the Tingi Hills. In order to reduce the % CV to an acceptable level, roughly twice as many transects would have to be done.

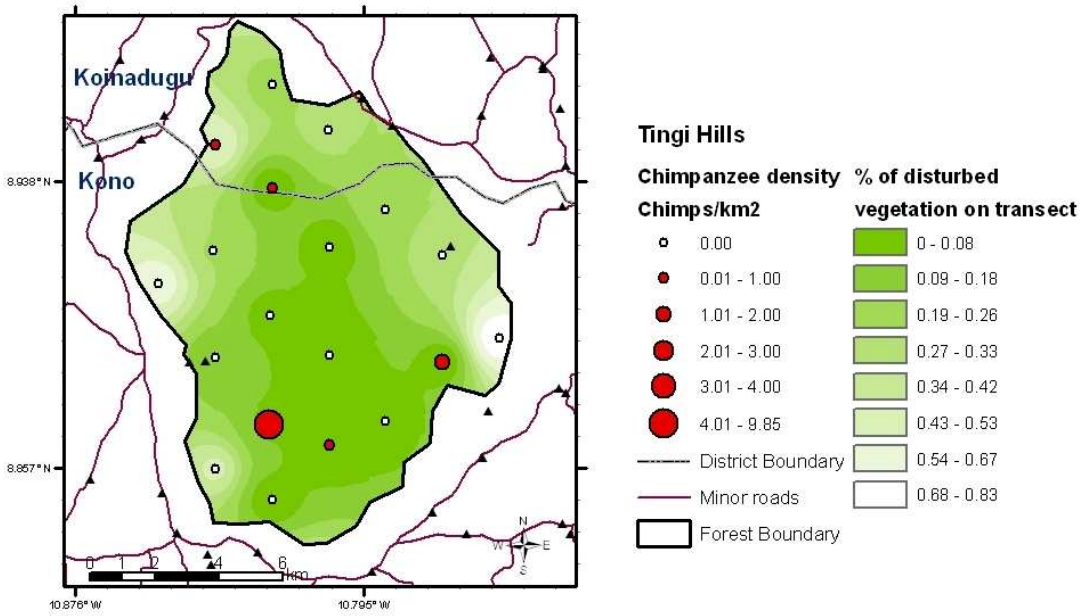
Table 25. Data summary for the analysis of the Tingi Hills Forest Reserve.

	Tingi Hills
Study area (km^2)	116
Area surveyed by transects‡ (km^2)	0.72
Percent of study area covered by transects	0.618
Number of transects	19
Total transect length (km)	24.55
No. transects with chimpanzee nests	5
Total chimpanzee nests before truncation	47
Nest encounter rate (nests/km) before truncation	1.91
Total chimpanzee nest groups	18
Average nest group size	2.35
Number of nests after truncation	44
Encounter rate (nests/km) [95% CI]	1.79 [0.60-5.35]
Density (individuals/km^2) [95% CI]	0.59 [0.19-1.84]
Number of chimpanzees [95% CI]	70 [22-213]
Percentage coefficient of variation (%CV)	58.79

‡ Transect area calculated as 2xESWxLength

The existence of chimpanzees in the Tingi Hills is likely to be due to the extremely rough terrain and high hills, which offer chimpanzees some protection from hunters and the loss of habitat through deforestation. Chimpanzee densities were highest in areas with less vegetation disturbance (Figure 51).

Figure 51. Chimpanzee density calculated from nests on transects (red circles) overlaid on an interpolated map of percentage vegetation disturbance (farms, farmbush, vine forest, plantation) on each transect in the Tingi Hills.



Vegetation

The percentage of open vegetation is highest on those transects that are close to the edge of the reserve forest with up to 83% of the vegetation being disturbed on some transects (Figure 51). The main vegetation types as a percentage of total transect length were forest (46.5%) and woodland savanna (11.6%). Of the 24.55 km of transects in Tingi Hills, 22.5% was in disturbed vegetation (farm, farmbush, vine forest, and plantation) (Table 26).

Table 26. Percentage of different vegetation types along transects in the Tingi Hills Forest Reserve.

	Tingi Hills
Vegetation type	**% transect length**
Forest	46.5
Woodland savanna	16.4
Farmbush	11.5
Farm	7.5
Montane savanna	4.7
Savanna	4.5
Stunted rock forest	4.0
Vine forest	2.5
Plantation	1.0
Swamp	0.7
Bare rock	0.7

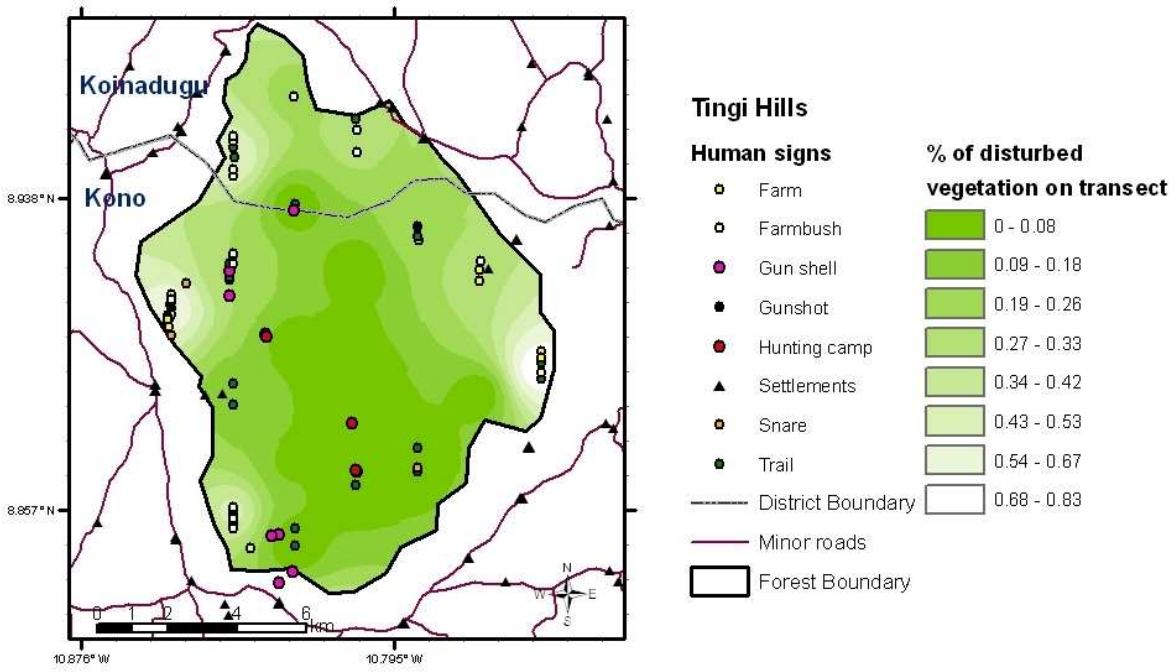
Human activity

Tingi Hills had many footpaths throughout the reserve, followed by snares and evidence for hunting with guns. The map in Figure 52 shows that it is primarily the periphery of the reserve that is affected, although three hunting camps were found in the heart of the reserve.

Table 27. Human sign encounter rates on transects in the Tingi Hills Forest Reserve.

Human Signs	Encounter rate (signs/km)
Footpaths	1.21
Hunting - snares	0.28
Hunting - guns	0.24
Hunting camp	0.04
Logging	0.00
Mining	0.00
Charcoal production	0.00

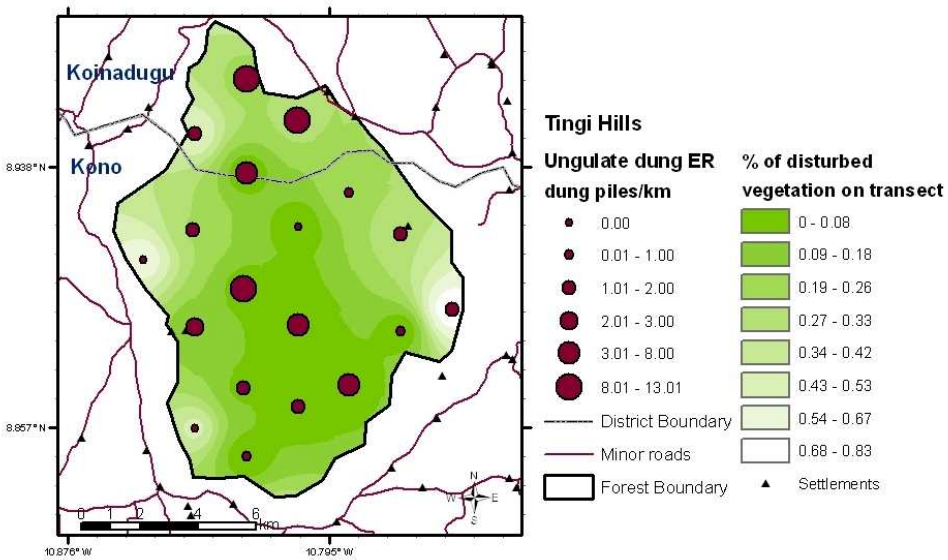
Figure 52. Human signs encountered on transects and recces within the reserve. The percentage of disturbed vegetation (farms, farmbush, vine forest, plantation) on each transect is interpolated between transects (green shading).



Other mammals

Within the Tingi Hills, ungulate dung encounter rate is concentrated in the centre of the reserve and to the north, primarily where human encroachment is less (Figure 53). Maximum dung encounter rates were up to 13 dung piles/km of transect walked. This is in contrast with the Nimini Hills, also in Kono District, where the maximum ungulate dung encounter rate was 2 dung piles/km.

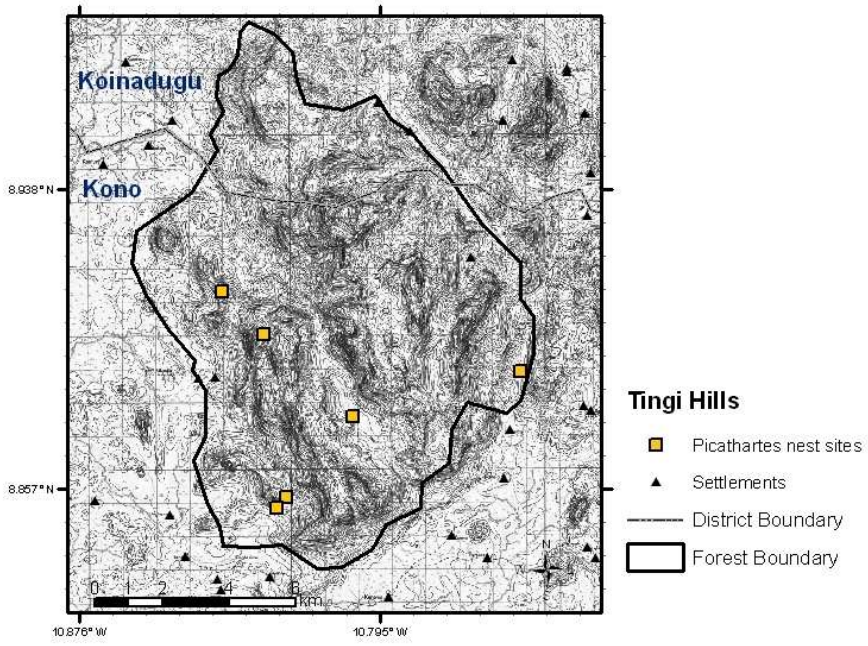
Figure 53. Detailed map of Tingi Hills showing ungulate dung encounter rates and an interpolated map of percent disturbed vegetation.



White-necked picathartes

Of special conservation significance is the white-necked picathartes. The Tingi Hills Forest Reserve is an important habitat for these birds, and 6 nest sites were found on transects during the survey (Figure 54).

Figure 54. Topographic map of Tingi Hills showing locations of picathartes nest sites found on recces and transects.



5.8.3 Conclusions

Within Kono District the Tingi Hills Forest Reserve is the most important area for wildlife and forest conservation, particularly for chimpanzees. However, nationwide it only holds just over 1% of the country's remaining chimpanzees.

The reserve is also important for other species including monkeys, duikers, and buffalo. No sign of elephants was seen in the Tingi Hills although they were reported there as part of a nationwide elephant survey (Phillipson 1978). The reserve is also an important location for white-necked picathartes.

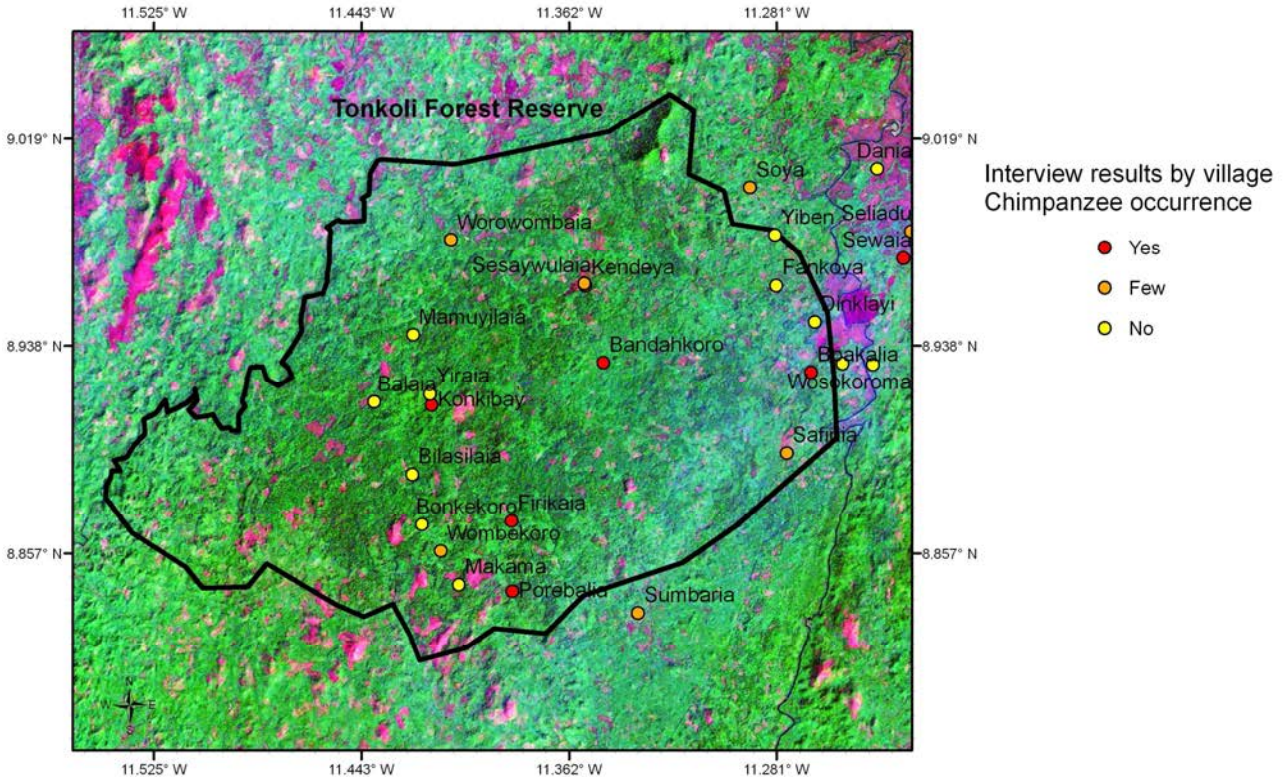
Tingi Hills has the best prospects for chimpanzee protection in Kono District if hunting and farm encroachment can be controlled. The district has just received 7 new, salaried forest guards that are undergoing training for deployment to various forest reserves. At the moment it is the steep terrain that is protecting the interior of the reserve from human encroachment, but the edges are slowly succumbing to the spread of slash-and-burn agriculture, and the interior is threatened by uncontrolled hunting.

The unsustainable demand for agricultural land means that farming is pushed higher into steeper slopes and difficult terrain, and requires ever more forest clearance and shorter rotations of bush fallow. Agricultural practices on steep slopes do little to decrease erosion, so top soil may be extensively lost or damaged. This is the main threat to the Tingi Hills ecosystem. Helping communities around the Tingi Hills to improve their farming practices, thus making expansion into the reserve unnecessary would prevent further loss of area in this already small reserve.

5.9 Tonkoli Forest Reserve

Because it is an existing forest reserve on paper, the Tonkoli Forest Reserve might be given some consideration for biodiversity conservation. However, much of the forest appears to have been cleared for crops such as rice and pepper, and a logging company appears to have a concession to harvest timber inside the reserve. Furthermore, the area was used extensively by the rebels during the war. The consequence of this is that much of the forest has been damaged or lost and chimpanzees have largely been hunted out or driven from the area. Of the 23 villages interviewed, 5 reported having chimpanzees, 6 reported seeing a few chimpanzees, and 12 had no chimpanzees in the vicinity (Figure 10). Many of the villages reported that there were chimpanzees around their community before the war, but now they have not seen any for some time. This was attributed to a relatively recent decline due to the war itself, hunting, farm clearance, and logging activities. Kendeya, in the centre-north of the reserve reported that although there are still chimpanzees on a nearby hill, they used to be much more abundant. Not all of the reserve was visited, and early indications from interviews in Tonkolili District to the SE of the reserve suggest that there are chimpanzees in eastern Tonkoli Forest Reserve. The southwest section of the reserve was not visited, and may harbour chimpanzees as it is between several villages that reported having chimpanzees. Block data from Kono (36) and Tonkolili (37) Districts were used to create the interpolated block density map. These two blocks had higher abundances of chimpanzees, and account for the higher density in southern Tonkoli Reserve (Figures 7 and 8).

Figure 55. Satellite map of the Tonkoli Forest Reserve in Nieni Chiefdom showing chimpanzee presence/absence based on interview responses at villages in and near the reserve.



5.10 Western Area Peninsular Forest Reserve

5.10.1 Study area

The Western Area Peninsular Forest Reserve (WAPFR) covers a narrow chain of hills on the Freetown Peninsula. It ranges from almost sea level to 971 m elevation at the tallest peak, Picket Hill. The reserve is probably the western-most remnant of Upper Guinean forest. It is also the largest remaining moist closed forest in western Sierra Leone. The forest reserve protects the watershed of the Guma Valley Dam and Congo Dam which supply water to the entire Freetown urban area. In the 1800s the forest was logged to supply timber for ship-building. In 1916, the WAPFR was amongst one of the earliest protected areas declared by the British Administration. After the 1972 Wildlife Act it became one of four non-hunting forest reserves in the country.

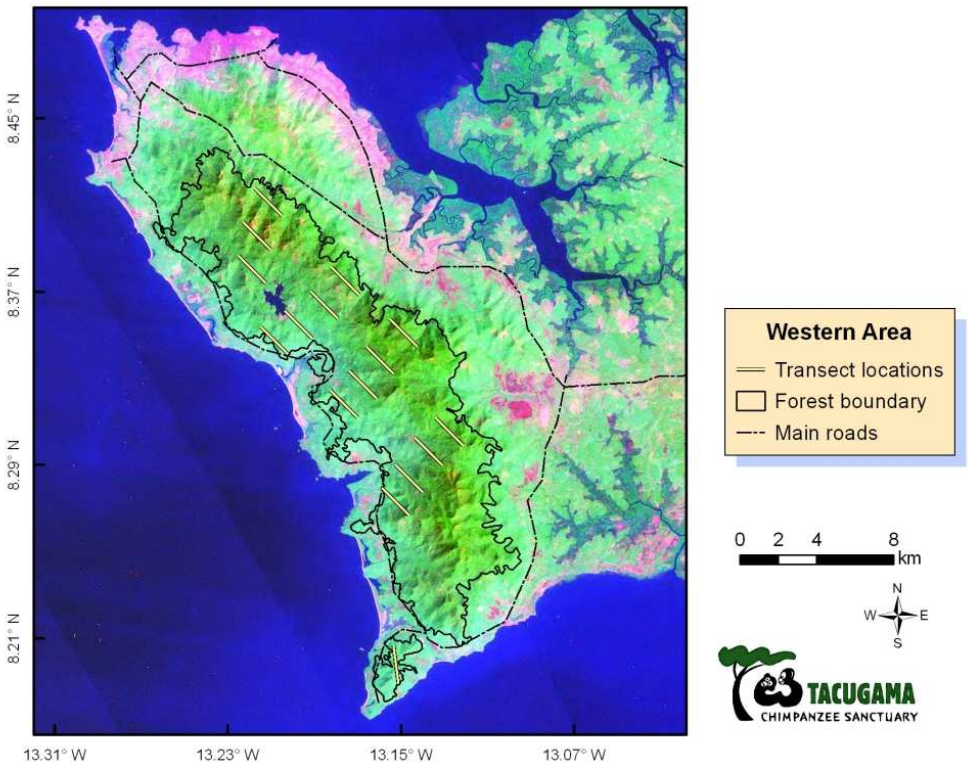
A total of 374 bird species have been recorded in the forest and over 50 species of mammals. Seven species of primates have been reported including the Western Chimpanzee, red colobus, black and white colobus, sooty mangabey, and Diana monkey.

Urban expansion and demand for fuelwood have led to massive encroachment of the reserve boundaries, and its proximity to large human populations has meant that hunting is extensive. The tree species *Uapaca guineense* has been almost completely removed in the John Obey area, where charcoal makers had been active for decades (Davies and Palmer 1989).

The WAPFR was used for training the teams on transects methods, therefore the study design varies from the other reserves surveyed in the country. Transects were positioned so that that the project leader could transfer between teams and so that teams could meet regularly to discuss results.

Figure 56. Transect locations and Landsat satellite image showing vegetation in the WAPFR.

Darker green is closed forest, light green is farmbush or early secondary forest, and pink is urban area (out of forest reserve) or bare rock (inside forest reserve).



5.10.2 Results

A total of 15 transects of 2 m length were walked in the WAPFR (Figure 56). Due to the extremely rugged terrain, time constraints, and the low number of nests found, transects were not completed in the far south or north of the reserve, but approximately 12 km of recce walks were done across the centre and south of the reserve instead.

Chimpanzee status

Nests were detected on three out of the 15 transects in WAPFR (30 nests total) (Table 28). An additional 16 nests were found on recces. Chimpanzee signs, including feeding remains, and nests, were found on five transects. In addition to transects, chimpanzee nests and other signs were also found on recces (54 signs total). WAPFR chimpanzee nest data were analyzed collectively as part of the nationwide dataset of forest reserves. Details of the analysis are presented in the methods section of this report. Because so few nests were found, the coefficient of variation is very high (68.50%), meaning there is a lot of uncertainty in the final population estimate for the WAPFR. This results in a density estimate of 0.36 chimpanzees/km^2 (95% CI=0.10-1.32) and a total population estimate of 55 (95% CI=15-209) chimpanzees living in the WAPFR.

Table 28. Data summary for the analysis of the Western Area Peninsular Forest Reserve.

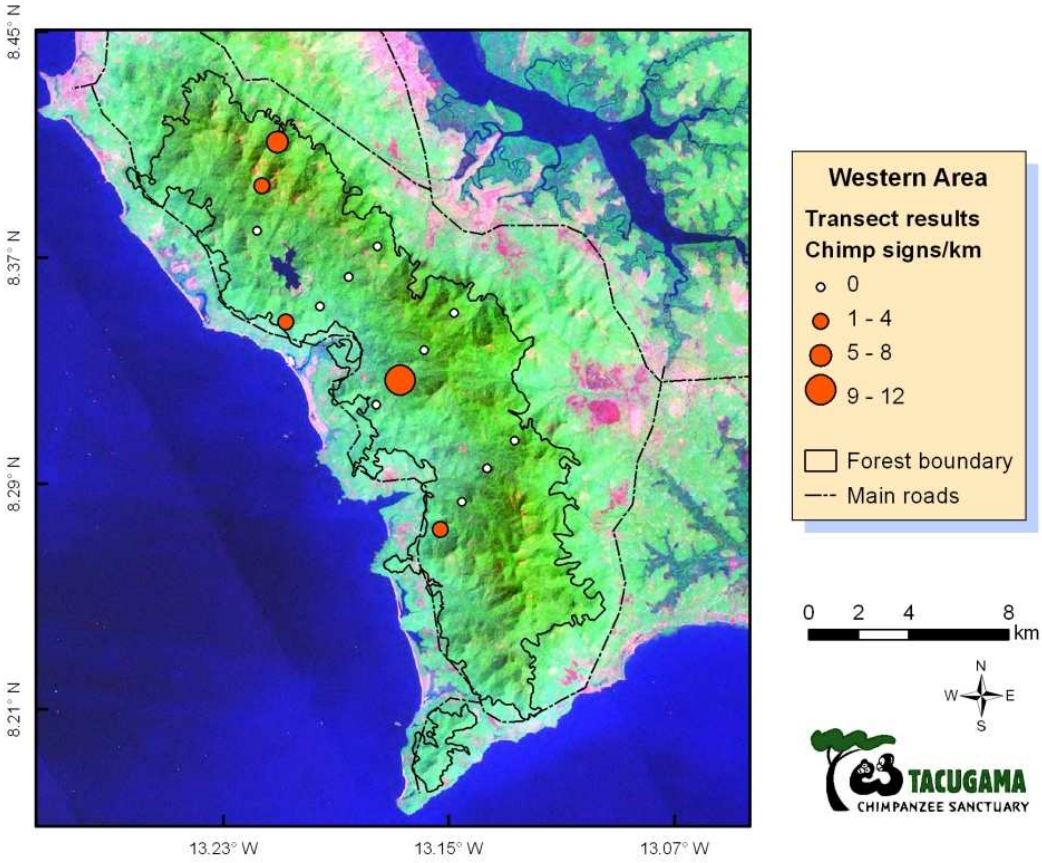
	WAPFR
Study area (km^2)	158
Area surveyed by transects‡ (km^2)	0.79
Percent of study area covered by transects	0.499
Number of transects	15
Total transect length (km)	26.97
No. transects with chimpanzee nests	3
Total chimpanzee nests before truncation	30
Nest encounter rate (nests/km) before truncation	1.11
Total chimpanzee nest groups	7
Average nest group size	4.29
Number of nests after truncation	29
Encounter rate (nests/km) [95% CI]	1.08 [0.30-3.90]
Density (individuals/km^2) [95% CI]	0.36 [0.10-1.32]
Number of chimpanzees [95% CI]	55 [15-209]]
Percentage coefficient of variation (%CV)	68.50

‡ Transect area calculated as 2xESWxLength

From the distribution of nests and other signs there appear to be at least three communities of chimpanzees in the WAPFR (Figure 57). One group at the north of the reserve is based near Tacugama Chimpanzee Sanctuary. Camera trapping has determined that there are at least 15 members in this group. Although range sizes for chimpanzees are not known in this area, it is likely that this group crosses the peninsula to the west and has been seen near Mile 13 village. A second group is located in the centre of the reserve east of Tokeh village. This may also be a larger group because a nest site of 13 nests was found on one transect. Chimpanzee dung was also found just south of Guma Valley Reservoir. It is unclear whether this might be part of the Tokeh group. Chimpanzee signs were also seen east of John Obey and up to Black Johnson in the southern part of

the reserve. No nests were found in this area, so group size is not known. Because the WAPFR is relatively small, it is possible that these groups may all be part of one large chimpanzee community. Further study is needed to determine the ranges and group composition of the chimpanzee communities in this area.

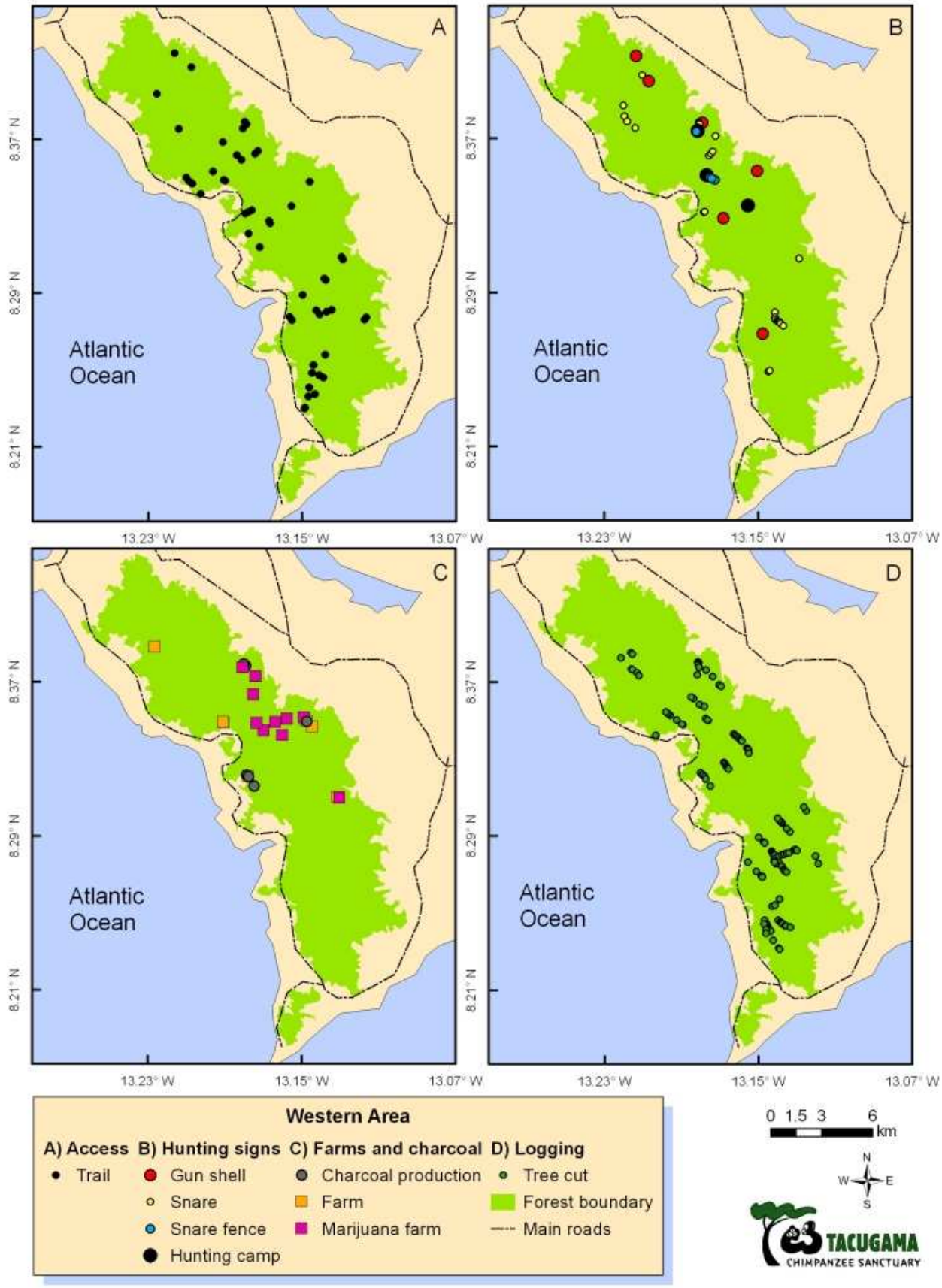
Figure 57. Location of all chimpanzee sign (nests, dung, feeding remains) on transects and recces in the WAPFR. Chimpanzee density calculated from nests found on transects is shown as orange circles.



Human Activity

Because the far north and far south of the reserve were not covered by recces or transects, human impact in these areas is not known with confidence. However, it is very likely that these areas are impacted as much if not more than the area covered by the survey. Virtually the whole reserve is accessible with trails (Figure 58A). Signs of active hunting were present throughout the forest, including shotgun shells, snares, and hunting camps (Figure 58B). Teams also encountered multiple active, large-scale marijuana farms, particularly in the area adjacent to Hastings town. Many of the marijuana farms were surrounded by snare fences up to 200 m long and hunting camps were located in the periphery of the farms. The scale of the problem is apparent in Figure 58C, where it can be seen that the reserve risks being cut in half near Hastings because of the encroachment of marijuana farms and charcoal production. Signs of past logging are evident all over the reserve (Figure 58D). As the age of the tree stumps was not estimated, it cannot be reported whether any of the trees were cut recently.

Figure 58. Human signs observed on transects and recces in the WAPFR.



5.10.3 Conclusions

The WAPFR holds potentially three communities of chimpanzees with an estimated population of around 55 individuals. This comprises about 1% of Sierra Leone's chimpanzee population. Ironically the number of chimpanzees currently held in Tacugama Chimpanzee Sanctuary is more than the wild population in the reserve. This however, makes it a potential location in which to release some of the rehabilitated female and juvenile chimpanzees into the adjacent wild population. The addition of captive chimpanzees may bolster the long-term viability of this small, and probably relatively isolated, population.

The proximity of the forest reserve to the capital, Freetown, means that there are tremendous pressures on the forest through encroachment of housing, demand for fuelwood, bushmeat, and farmland. Illicit farming of marijuana occurs frequently deep in the reserve where the plantations are protected by the steep hills.

The WAPFR forest is crucial for the supply of water to the capital. Thus, the prevention of further forest loss should be a top priority of the government. Currently there are plans for an EU funded project for the protection of the WAPFR and its watershed, but its implementation has been delayed by more than one year while the unsustainable rate of incursion and forest loss has continued.

6 DISCUSSION

6.1 Comparison with previous chimpanzee population estimates

If only the protected areas are considered in the current nationwide survey, the estimate of 2,480 chimpanzees (95% CI=1,512-4,105) would be comparable to Teleki and Baldwin's 1980 estimate of 1,500-2,500. However, their survey is frequently cited as representing a complete nationwide estimate. New data presented in this report show that by only surveying a limited number of reserves, Teleki and Baldwin's estimate omitted significant populations occurring outside of these reserve areas, potentially more than half of the total present in the country.

Only one block overlapped with the Bumbuna dam catchment area, of which 8 out of 9 squares were classified as high density. The high density transect, which ran next to the dam itself gave a chimpanzee density of 0.13 chimpanzees/km^2. This is much lower than the density estimates given by Nippon Koei UK (2007) 0.44 - 3.6 chimpanzees/km^2, but the 2007 estimate only looked at density within the ranges of known groups. The different methodologies mean that the results of this study are not directly comparable with previous studies in the Bumbuna catchment area.

For the Loma Mountains, this study found a much lower chimpanzee density of 2.69 chimpanzees/km^2 compared to 5.75-7.41 chimpanzees/km^2 reported in Kortenhoven 2008. This is due to the fact that the 2008 survey was limited to the 15% of the reserve with the highest nest encounter rates. The current study covered the reserve systematically, and the lower nest encounter rates at lower elevations near the reserve boundaries provide a more accurate picture of chimpanzee abundance across the whole reserve.

Earlier estimates for the Kilimi section of Outamba-Kilimi National Park were close to current estimates. Harding (1984) estimated a chimpanzee density of 0.3 chimpanzee/km^2 and a total population of 49-60 individuals, while this study found a density of 0.27 chimpanzees/km^2 and population size of around 70 individuals.

Although initial estimates of 200-300 individuals for Outamba were low, the idea that the population there could be as high as 600-700 (Alp *et al.,* 2003) was closer to the estimate of around 950 chimpanzees found in this study.

The re-analysis of the Gola chimpanzee survey data (Ganas 2009) in this study resulted in a slight drop in density and abundance estimates from 0.27 individuals/km^2 and 305 individuals to 0.25 individuals/km^2 and 270 individuals. This difference can be ascribed almost entirely to the different nest duration used in the analysis. Ganas used a nest duration from Taï National Park in Ivory Coast of 91 days, whereas this study calculated a duration of 109 days from a concurrent nest decay study in Sierra Leone forests.

6.2 Significance of the Sierra Leone chimpanzee population

Given current knowledge about the status of Western Chimpanzees, the results from this study put Sierra Leone as the second most important country in West Africa for *Pan troglodytes verus* (Table 29). Only Guinea is estimated to have a larger population of chimpanzees than Sierra Leone. A Pan-African chimpanzee survey is being launched which aims to redress the lack of comprehensive great ape surveys across Africa. In 2010 nationwide surveys similar to this one will be carried out in Liberia and Ivory Coast. Nationwide chimpanzee surveys in other West African countries will be completed in the next 3-5 years. Sierra Leone may see its status change as this new information is collected.

Table 29. Population status of the Western Chimpanzee (*Pan troglodytes verus*), adapted from the West African Chimpanzee Action Plan (2003).

		Population estimate		
Rank	**Country**	**Minimum**	**Maximum**	**Source**
1	Guinea	8,100	29,000	Ham 1998
2	Sierra Leone	3,000	10,400	This study
3	Mali	1,600	5,200	Duvall *et al.,* 2003
4	Liberia	1,000	5,000	Nisbett *et al.,* 2003
5	Côte d'Ivoire	800	1,200	Campbell *et al.,* 2008
6	Guinea-Bissau	600	1,000	Gippoliti *et al.,* 2003
7	Ghana	300	500	Butynski 2001
8	Senegal	200	400	Butynski 2001
9	Burkina Faso	0	Few?	Butynski 2001
10	Nigeria	0	?	Butynski 2001
11	Togo	0	0	Butynski 2001
12	Benin	0	0	Butynski 2001
	Total	**15,600**	**52,700**	

6.3 Priority areas for conservation in Sierra Leone

Based on the number of remaining chimpanzees, the sites with the highest importance for chimpanzees are the Outamba section of Outamba-Kilimi National Park and the Loma Mountains Non-hunting Forest Reserve. These sites have some of the highest concentrations of chimpanzees anywhere in Africa (Table 30).

Table 30. A comparison of chimpanzee densities at sites across Africa.

Study site	**Country**	**Density (ind/km^2)**	**Source**
Kalinzu Forest	Uganda	2.8-4.7	Hashimoto, 1995
Wambabya	Uganda	3.62	Plumptre *et al.,* 2003
Loma	**Sierra Leone**	**2.69**	**This study**
Kibale	Uganda	2.32	Plumptre *et al.,* 2003
Odzala	Congo	2.20	Bermejo, 1999
Bugoma	Uganda	1.90	Plumptre *et al.,* 2003
Goualougo	Congo	1.53	Morgan *et al.,* 2006
Outamba	**Sierra Leone**	**1.21**	**This study**
Koulako	Guinea	1.09	Ham, 1998
Nouabalé-Ndoki	Congo	1.03	Stokes *et al.,* 2010
Ma'an	Cameroon	0.8-1.0	Mathews & Mathewes, 2004
Moyeria	Guinea	0.90	Ham, 1998
Tai	Ivory Coast	0.89	Kouakou *et al.,* 2009
Haut Niger	Guinea	0.87	Fleury-Brugiere & Brugiere, 2010
Tingi Hills	**Sierra Leone**	**0.59**	**This study**
Kahuzi-Biega	DRC	0.40 (weaned)	Hall *et al*., 1998
Djakoli	Mali	0.39	Granier & Martinez, 2004
WAPFR	**Sierra Leone**	**0.36**	**This study**
Faragama	Mali	0.30	Granier & Martinez, 2004
Kilimi	**Sierra Leone**	**0.27**	**This study**
Bafing	Mali	0.27	Pavy 1993
Siria	Guinea	0.26	Ham, 1998
Gola	**Sierra Leone**	**0.25**	**This study, Ganas 2009**
Diecke	Guinea	0.17	Ham, 1998
Dzanga	C.A.R.	0.16	Blom *et al.,* 2001
Niokolo Koba	Senegal	0.13	Pruetz *et al.,* 2002
Sierra Leone (non-protected areas)	**Sierra Leone**	**0.03**	**This study**

Other reserves which still hold small populations of chimpanzees are Gola Forest Reserve, Tingi Hills Non-hunting Forest Reserve, and the WAPFR. Their densities might be relatively high, but because of the very small areas of these reserves their populations are very small.

Outside of protected areas in Sierra Leone there are still significant numbers of chimpanzees. While their patchy distribution makes targeted conservation efforts very challenging, these extra-reserve populations are important to maintaining the long term viability of the overall Sierra Leone population by preventing genetic isolation of groups in separated protected areas. No individual districts can be singled out as being more important for chimpanzees. The threats that face chimpanzees vary across the country according to the types of human disturbance that are taking place.

6.4 Threats to chimpanzees

That there is still such a wide distribution of chimpanzees in Sierra Leone is likely due to several factors. The survival of chimpanzees outside of protected areas where little unmodified habitat is left attests to their adaptability to human-dominated landscapes. But this may be possible only because Sierra Leone has not yet developed large-scale, intensive, mechanized agriculture. Small-scale subsistence farming may allow enough areas of farmbush and secondary forest to remain for chimpanzees to find food and shelter. Religious and cultural taboos against eating chimpanzee meat, and a recognition of chimpanzees as similar to humans in some communities has probably also prevented a more rapid decline. Undoubtedly the post-war arms embargo has made killing of chimpanzees in the last eight years more difficult and laws protecting chimpanzees have stopped the international trade in live chimpanzees that so devastated the population in the before the 1980s. The establishment of Tacugama Chimpanzee Sanctuary through the Sierra Leone Chimpanzee Rehabilitation Programme in 1995 has ensured that law enforcement can occur, increased sensitisation and helped to shut down the domestic pet trade. However, chimpanzees in Sierra Leone continue to face growing threats to their survival.

6.4.1 Hunting

The hunting and killing of chimpanzees for their meat and as a defence against crop-raiding is one of the greatest threats to the remaining chimpanzee populations in Sierra Leone. Hunting chimpanzees without guns is a difficult and dangerous task and some communities claimed that the only reason they did not hunt chimpanzees near their communities was because they lacked weapons to do so. However, there are still many illegally owned guns in Sierra Leone, often obtained from Guinea or Liberia, that are being used for hunting throughout the country. Chimpanzees are often the target. Although many communities professed to not eat chimpanzee meat, many, including Muslims, said they would kill chimpanzees to sell the meat for money. Evidence for hunting with guns was most frequently seen in the protected areas (Figure 59B), particularly Tingi Hills, WAPFR, Kangari Hills, and Loma Mountains. There is extensive hunting with guns in Outamba-Kilimi National Park although the size of the area and the low population density mean that gun signs were not picked up on transects. However, gunshots were heard most nights while camped in the park and open gun trading was observed. A drying chimp skin was found in the Kilimi section of the park.

Although some communities are aware of the laws making it illegal to kill chimpanzees, the law is currently not enforced to any degree, and hunting of chimpanzees continues. That traditional chiefs are often the hunters themselves indicates that local authorities are currently not discouraging their communities from the practice.

The by-product of hunting - the pet trade - was also in evidence. Three chimpanzees were brought to Tacugama directly as a result of the survey and several others received at the sanctuary in 2009/10 are likely to be the result of the sensitisation undertaken by the field teams. Information has also been obtained about a minimum of seven more chimpanzees being kept as pets in villages around the country.

There were a few reports of chimpanzees being trapped in snares or poisoned. Evidence of extensive hunting with snares was seen in all forest reserves except OKNP (Figure 59A) and is a serious threat to small and medium-sized mammals.

6.4.2 Habitat loss

Logging

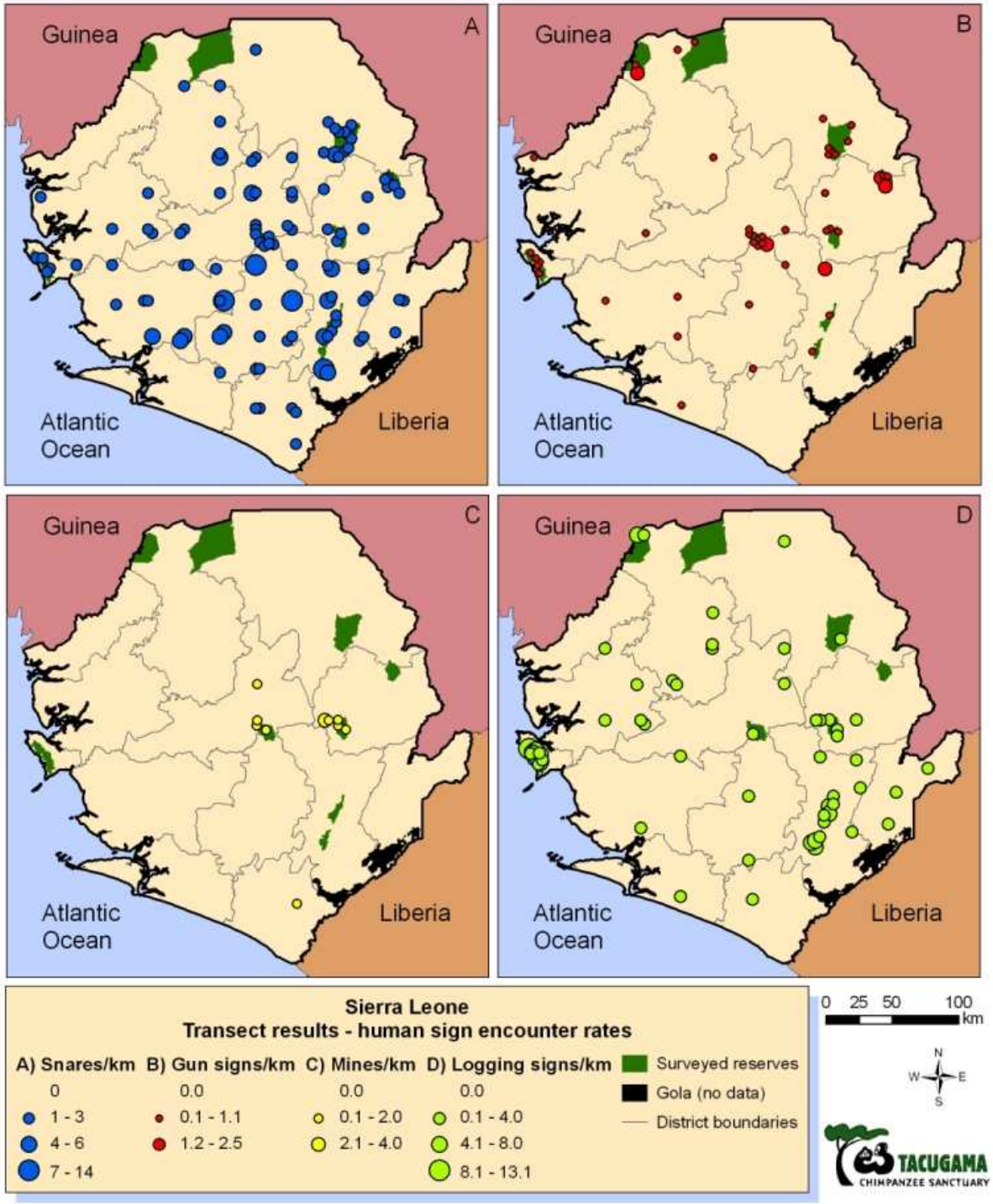
Although there was a ban on logging exports for much of 2009 in order to bring under control both legal and illegal logging activities, exports have now resumed. Despite this, many unlicensed power saws are being used throughout the country, in and out of forest reserves. Although this type of logging is small-scale, it has a profound effect on chimpanzees through the gradual destruction of the remaining forests.

Furthermore, the sound of power saws may drive chimpanzees out of their territories, pushing them into conflict with other groups (White and Tutin 2001). Forests which have been subjected to commercial logging in the past, such as Kambui Hills, Kangari Hils, and Nimini Hills are almost devoid of chimpanzees. The WAPFR and Gola Forest which were also partially logged have very low densities (Figure 59D). Logging in many places is followed by clearance for agriculture, and many of the smaller forest reserves have been severely degraded (e.g. Kasewe, Mokanji, and Moyamba Hills in Moyamba District and Tonkoli Forest Reserve).

Fuelwood consumption

The reality for forests in Sierra Leone is that around 80% of primary energy in the country is derived from wood fuels (The National Environmental Action Plan of Sierra Leone 1994). In 1990, FAO estimated that 95% of wood used in the country was for domestic energy, while 3% was used for construction poles and only 2% went to sawn timber. It is likely that dependence on fuelwood was only made more acute by the war. Also as population increases, the demand for fuelwood and charcoal will increase if energy needs cannot be met by other means such as hydro-electric or solar. The 1990 FAO assessment expected fuelwood demand to increase at a rate of 1.8-2.0% per annum.

Figure 59. Human sign encounter rates for all transects except Gola Forest Reserve. Larger circles represent higher encounter rates of A) snares and snare fences, B) guns, gunshots, or gun shells, C) artisanal gold or diamond mines, D) trees cut with power saws. Transects with no signs are not shown.



Agriculture

Agriculture in Sierra Leone is primarily small-scale subsistence agriculture that relies on the practice of 'slash-and-burn'. As human population increases in the country and demand for land grows, farms are pushed into steeper slopes and more difficult terrain and require ever more forest clearance and shorter periods of fallow. All of these have serious consequences for chimpanzees; as primary forest is lost and secondary forest not allowed to regenerate, chimpanzees lose habitat and are more likely to raid crops from the encroaching farms.

Mining

Alluvial diamond mining was estimated to affect more than 73,000 ha of land in 1993 (Conservation Society of Sierra Leone 1993). Lack of controlled mining for alluvial diamonds, gold, rutile and bauxite has created severe environmental problems. The two key impacts of mining operations on chimpanzee populations are deforestation and hunting. When areas are cleared for mining activities, forest cover is lost, leaving behind severely degraded land. The inflow of workers to mining areas significantly increases demand for bushmeat, often resulting in local areas being depleted of wildlife.

In Moyamba District, several communities with nearby chimpanzee populations indicated that their area was being prospected for potential rutile mining operations. They expressed strong opposition to this but said that they felt powerless to stop it. Although we also found chimpanzee groups living within a few miles of mining roads and settlements in the Lower Banta chiefdom, we do not have the historical perspective to know how chimpanzee populations have been affected by development of the mines. The large tracts of land required for mining operations will reduce the habitat available for chimpanzees.

Artisanal gold mining was most frequently seen on transects in the Kangari and Nimini Hills (Figure 59C).

Iron ore mining is also developing significantly, especially within Tonkolili district with plans to develop one of the world's largest mines in Sierra Leone. Together with the linked infrastructure developments will have a significant environmental impact.

Brush fires

Farmers burn land to clear areas for planting, while herders burn to increase grazing for cattle and hunters burn to be able to spot game more easily. During the dry season the sky is often obscured by smoke and ash rains. When fires are not controlled, much vegetation and wildlife can be unnecessarily destroyed. One village in south-eastern Koinadugu District reported a large group of chimpanzees that were trapped and killed by an out of control bush fire. Human fatalities also occur.

The composition of plant communities changes with repeated burnings; only fire resistant species can survive and burning late in the dry season leads to severe soil degradation. Until further research is done, it is unknown how burning may affect the tree species that chimpanzees depend on, for example in Outamba-Kilimi National Park. However, the change in species composition that has already taken place may have already profoundly changed the biodiversity of many areas of Sierra Leone.

6.4.3 Human-chimpanzee conflict

Outside of protected areas, the dependence of chimpanzees on human crops leads to constant conflict with people. Many communities reported losing entire crops of pineapples, cassava or oil palm to chimpanzees. Traps which are set to catch other animals may occasionally catch chimpanzees. People also used dogs to try to drive them off, but in Kenema District cacao growers reported trying to poison chimpanzees that were stealing cacao fruit. When possible, communities may also invite in hunters to get rid of chimpanzee groups that are causing persistent damage. The negative attitude that people have towards chimpanzees because of crop raiding will also make it difficult to persuade people that they are a globally important species worth saving.

6.5 Additional Project Outcomes

Further to establishing the distribution and abundance of chimpanzees in Sierra Leone and delivering data that will contribute to the production of a Population and Habitat Viability Assessment (PHVA) and conservation action plan, the project objectives included the following: building the capacity of Sierra Leone nationals; identifying potential release sites for rehabilitated chimps from Tacugama; contributing to the sub-species data set and the Ape Populations, Environments and Surveys (APES) database.

6.5.1 Capacity building

Building a Sierra Leonean field team was not an easy task. The disruption of the 10-year civil conflict has had a significant impact on the country's education system and there is not a ready cadre of trained personnel. The project initially recruited graduates of the two main universities: Fourah Bay College and Njala University. Early practical training rapidly unfortunately determined that very few of these potential field assistants had the inclination or capability to undertake demanding field work. The final team also included experienced field assistants who had previously supported Aaron Kortenhoven's field work in the Loma Mountains and members of the MAFFS Forestry Division staff.

The extensive work of the project built a capable team that now has significant knowledge and appreciation of Sierra Leone's environment having worked across the country. The team members developed interviewing and sensitisation skills, methodical working practices, photography, use of GPS, hip chain and other field survey skills. Many already possessed excellent mammal identification knowledge and this was further shared within the team.

6.5.2 Community sensitisation and revenue generation

In all the communities that were visited during the course of the survey, the teams took time not only to question but also to sensitise and be questioned about the importance of wildlife conservation. With over 900 interviews undertaken by the team, there is now much wider awareness of the laws protecting chimpanzees and their endangered status.

The survey teams regularly employed local guides, porters and cooks to support their work. This delivered revenue benefits directly back into the communities visited as a result of the project.

6.5.3 Potential release sites

There are many factors that need to be considered in identifying a release site for rehabilitated captive chimpanzees including proximity of existing wild chimpanzees, proximity of human settlements, protection measures and carrying capacity of the habitat. The level of research undertaken as part of this survey can only indicate areas that are suitable for further detailed investigation and is not definitive.

The Kangari Hills Forest Reserve has emerged as an area of key interest for further evaluation and the WAPFR could also be an option for the "soft" release of younger chimpanzees that could have the opportunity to be accepted by existing wild chimpanzees. Camera trap evidence collected in the WAPFR during the period of the census has provided valuable evidence of the movement and size of local wild chimpanzee populations.

6.5.4 Ape Populations, Environments and Surveys (APES) database

The data gathered from the census will be submitted to the APES database. This will ensure its availability to a wide range of conservationists and researchers and use in strengthening knowledge of global ape populations.

6.5.5 Methodology

The innovative methodology developed for the nationwide survey that combines qualitative and quantitative techniques has been well received by external advisors to the project. Although sufficient chimpanzee nests were found on systematically placed transects to estimate chimpanzee population size, this study showed that interview information can be very reliable and used successfully to target survey efforts, thus increasing efficiency in sites that have very low chimpanzee densities. With some modifications it is being adopted for use by forthcoming nationwide ape surveys including Liberia and Ivory Coast. One way to improve the methodology would be to classify the whole block as low or high density based on similar interview criteria, and place only one transect within each block, with transect length dependent on block density. This would avoid potential bias in the transect placement but still allow more survey effort to be focussed where chimpanzees are likely to be.

6.5.6 Photographic resources

The team have taken a wealth of photographs across Sierra Leone capturing the beauty of its landscapes and evidence of human impact. It is intended to categorise these images so that they can be used to showcase the country's attractiveness and to record key evidence of conservation challenges.

6.6 Recommendations

6.6.1 Chimpanzee conservation measures

The results of this study will be used in a preliminary dissemination workshop in September 2010 and a subsequent Population and Habitat Viability Assessment (PHVA). Various stakeholders, including community representatives, MAFFS, local and international NGOs, and primate researchers, will come together and the PHVA will result in the development of a chimpanzee conservation action plan for Sierra Leone. It is hoped that the involvement of multiple stakeholders and a thorough discussion of all the issues will result in an action plan that has the highest chance of being implemented and supported. More detailed recommendations are presented for individual protected areas in the previous section. Thus only a brief list of general recommendations is presented here.

The overall need within Sierra Leone is to create a significantly wider understanding of the importance of chimpanzees as a globally threatened species, their role in maintaining a healthy ecosystem and the international interest in their conservation. Currently the country realises no significant value from conserving its wildlife resources and this must be changed.

In the short term, greater awareness and education about chimpanzees may be the most effective means of conserving chimpanzees outside of protected areas. Interview results suggest that reinforcing traditional taboos and emphasising how chimpanzees are similar to humans could be effective. Very few people were aware of any laws protecting wildlife or any penalty for capturing or hunting a chimpanzee. A 2006 Knowledge, Attitudes, and Practices survey suggested that most people would not harm chimpanzees if they knew it was against the law (Conservation Society of Sierra Leone 2006). This was not always borne out in practice, but it represents a good starting

point for protecting chimpanzees across the country. Given that most communities can get information through local radio stations, the most cost-effective way to get this message out is through radio programming.

In the medium term there is a need to address crop-raiding by chimpanzees. This is a major issue across most of the country and contributes to a strongly negative attitude that farmers have towards chimpanzees. No matter how much people may admire the similarity of chimpanzees to humans, if they are losing their livelihoods to crop damage, they will be more likely to take measures to remove chimpanzees from their area. Targeting development activities linked to chimpanzee conservation towards these communities could help encourage them to tolerate chimpanzee presence.

Finally, sustainable development activities that would benefit people are likely to benefit chimpanzees and biodiversity in general. Improved farming practices that reduce the need for frequent crop rotation would allow areas to be fallow for longer and reduce the need to clear existing forest, providing more habitat. Logging needs to be well managed and bring benefits to local communities, so that it does not end up being the first stage of forest clearance. The development of plantation forests in order to meet energy needs, as well as the expansion of more efficient cooking methods (e.g. solar stoves or efficient charcoal cookers) should be a priority. However, reforestation with exotic, fast-growing species would be useless for biodiversity and chimpanzee conservation. Although potentially providing shelter, exotic species are unlikely to provide a source of food for animals like chimpanzees that primarily have a varied diet of fruits and leaves.

Even with proper development and awareness, there will still be a strong need for effective law enforcement to prevent illegal hunting and extraction activities continuing to threaten chimpanzees and their habitats.

6.6.2 Further research

It is important to recognise that this survey has established a baseline for understanding the status of the wild chimpanzee population in Sierra Leone. The PHVA will result in a recommended time interval for future population surveys that will be critical to understanding the ongoing health of chimpanzees and the continuing impact of human development and conservation measures.

Also new research questions have emerged about chimpanzees living in disturbed landscapes. If chimpanzees have adapted to survive in close proximity to humans there may be interesting differences in behaviour, group size and structure, ranging patterns, reproduction rates from populations in undisturbed areas. If not hunted, is there long-term population viability with these scattered communities? What is the disease risk to chimpanzees and humans who are living in proximity to each other? To understand these questions, in-depth behavioural and genetic studies of these communities are needed to determine the true status of chimpanzees outside of protected areas, to know if they are remnants of a disappearing population, or if they have truly adapted to disturbed habitats. How do these diffuse populations contribute to gene flow between larger populations in protected areas? These questions present a good opportunity to research institutions to develop longer term programmes that will add to pan-African conservation knowledge.

7 CONCLUSIONS

This is the first ever quantitative, systematic nationwide survey of chimpanzees in Sierra Leone. The results provide encouraging news that there are more chimpanzees in Sierra Leone than were thought to exist 30 years ago. The estimate of approximately 5,580 chimpanzees in the country provides an accurate baseline from which to monitor future trends in this population. Sierra Leone is now estimated to hold the second largest population of *Pan troglodytes verus* after Guinea. This may yet change as a result of new systematic nationwide surveys that are now beginning in other West African countries.

It is crucial to recognise that although chimpanzee numbers are higher than expected; this is because they were never before accurately measured and not because chimpanzee populations are increasing in Sierra Leone. Although previous population size can never be accurately estimated, indications from interviews and from records of live chimpanzee captures suggest that the current population is significantly less than what it was 60 years ago. It is clear that important threats remain to the survival of the remaining chimpanzee populations, especially those outside of protected areas.

That more than half of Sierra Leone's chimpanzees are living outside of protected areas presents a new conservation challenge. Obviously no protected area conservation model applies in this situation. How to protect these extra-reserve populations will require collaborative grass-root conservation and development projects that address the current human-chimpanzee conflicts that are occurring.

The census project has delivered a wealth of new data that can contribute to conservation and land use management decisions and it is a key priority to ensure that awareness of this information exists within key stakeholder groups.

8 REFERENCES

Allport, G., M. Ausden, P.V. Hayman, P. Robertson, and P. Wood, 1989. *The conservation of the birds in Gola Forest, Sierra Leone*. ICBP Study Report 38, Birdlife International, Cambridge.

Bermejo, M., 1999. Status and conservation of primates in Odzala National Park, Republic of the Congo. *Oryx*, 33(4):323-331.

Blom, A., A. Almasi, I.M.A Heitkonig, J.-B Kpanou, and H.H.T. Prins, 2001. A survey of the apes in the Dzanga-Ndoki National Park, Central African Republic: a comparison between the census and survey methods of estimating the gorilla (*Gorilla gorilla gorilla*) and chimpanzee (*Pan troglodytes*) nest group density. *African Journal of Ecology*, 39, 98–105.

Broad, G. and A. Turner, 1991, Mammal report, Mount Loma rainforest expedition. University of East Anglia, Preliminary report.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, L. Thomas, 2001. *Introduction to distance sampling: estimating abundance of biological populations*. Oxford University Press, Oxford, UK.

Butynski, T.M. 2001. Africa's Great Apes. In: *Great Apes and Humans: The Ethics of Coexistence.* Beck, B., Stoinski, T.S., Hutchins, M., Maple, T.L., Norton, B., Rowan, A., Stevens, E.F. and Arluke, A. eds. Smithsonian Institution Press, Washington, D.C., USA. Pp. 3–56.

Campbell, G., H. Kühl, P. N'Goran Kouamé, and C. Boesch, 2008. Alarming decline of West African chimpanzees in Côte d'Ivoire, *Current Biology*, 18(19):R2.

CEMMATS Group Ltd. 2008. *Environmental and social assessment of Baomahun gold project. Freetown, Sierra Leone*.

Conservation Society of Sierra Leone, 1993. *Wildlife and nature reserves of Sierra Leone*.

Conservation Society of Sierra Leone, 2006. *Results of the survey on Knowledge, Attitudes and Practices (KAP) relating to chimpanzees in Sierra Leone*. The Jane Goodall Institute Chimpanzee Conservation and Sensitization Program (CCSP).

Davies, G., 1987, *The Gola Forest reserves, Sierra Leone: wildlife conservation and forest management.* IUCN, Gland.

Davies, G. and P. Palmer, 1989. Conservation of forest resources in Sierra Leone. *Report for the FAO Joint Inter-Agency Forestry Sector Review of the Tropical Forestry Action Plan*. 18pp.

Duvall, C., B. Niagaté, J.-M. Pavy, 2003. Mali. Pp. 41-50 in: *West African Chimpanzees. Status Survey and Conservation Action Plan.* Kormos, R., Boesch, C., Bakarr, M.I., and Butynski, T., eds. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 77-88.

FAO, 1990. The "Guinea 1990" survey. CECAF/ECAF Ser. 91/5

Field, G.D. 1974. *Birds of Freetown Peninsula*. Fourah Bay College Bookshop, Ltd. Mount Aureol, Freetown, Sierra Leone.

Fleury-Brugière, M.C. and D. Brugière, 2010. High population density of the western chimpanzee *Pan troglodytes verus* in the Haut Niger National Park, Republic of Guinea: implications for local and regional conservation. *International Journal of Primatology*. DOI 10.1007/s10764-010-9391-9

Ganas, J, 2009. *Population status survey and monitoring of western chimpanzees (*Pan troglodytes verus) *in the Gola Forest Reserve, Sierra Leone*, Report to the U.S. Fish and Wildlife Service.

Ghiglieri, M.P. 1984. *The Chimpanzee of Kibale Forest*. Columbia University Press, New York.

Gippoliti, S., D.S. Embalo, and C. Sousa, 2003. Guinea-Bissau. Pp.55–61 *in: Status Survey and Conservation Action Plan:West African Chimpanzees* (eds. R. Kormos, C. Boesch, M.I. Bakarr and T.M. Butynski). IUCN, Gland, Switzerland and Cambridge, UK.

Granier, N. and L. Martinez, 2004. Premiere reconnaissance des chimpanzes *Pan troglodytes verus*

dans la zone transfrontaliere entre la Guinee *et al* Mali. *Primatologie*. 6:423-447.

Hall, J.S. L.J.T. White, B.-I. Inogwabini, I. Omari, H. Simons Morland, E.A. Williamson, K. Saltonstall, P. Walsh, C. Sikubwabo, D. Bonny, K.P. Kiswele, A. Vedder, and K. Freeman, 1998. Survey of Grauer's Gorillas (*Gorilla gorilla graueri*) and Eastern Chimpanzees *(Pan troglodytes schweinfurthi)* in the Kahuzi-Biega National Park Lowland Sector and Adjacent Forest in Eastern Democratic Republic of Congo. *International Journal of Primatology, 19(2):207-235.*

Ham, R. 1998. *Nationwide chimpanzee census and large mammal survey in the Republic of Guinea*. Report for the European Union, Conakry.

Hanson-Alp, R., M.I. Bakarr, A. Lebbie, and K.I. Bangura, 2003. Sierra Leone. In: *West African Chimpanzees. Status Survey and Conservation Action Plan.* Kormos, R., Boesch, C., Bakarr, M.I., and Butynski, T., eds. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 77-88.

Harding, R.S.O., 1984. Primates of the Kilimi area, northwest Sierra Leone. *Folia Primatologica*, 42:96-114.

Hashimoto, C., 1995. Population census of the chimpanzees in the Kalinzu Forest, Uganda: Comparison between methods with nest counts. *Primates*, 36, 477–488.

Hawthorne, W., 2008. Unpublished report on Loma Mountains vegetation survey. Bumbuna PIU **IUCN,** 2006. *2006 IUCN red list of threatened species: a global species assessment*. IUCN, Gland. Online at: www.redlist.org

Klop, E., J. Lindsell, and A. Siaka**, 2008. *Biodiversity of Gola Forest, Sierra Leone,* Royal Society for the Protection of Birds, Conservation Society of Sierra Leone, Government of Sierra Leone.**

Kouakou, C.Y., C. Boesch, H. Kühl, 2009. Estimating Chimpanzee Population Size with Nest Counts: Validating Methods in Taï National Park, *American Journal of Primatology* 71:447–457.

Kormos, R. and C. Boesch, (2003) Regional Action Plan for the Conservation of Chimpanzees in Western Africa. IUCN/SSC Action Plan. Washington DC: Conservation International.

Kormos, R., C. Boesch, M.I. Bakarr, and T. Butynski, (eds.) 2003. *West African Chimpanzees. Status Survey and Conservation Action Plan*. IUCN/SSC Primate Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 219 pp.

Kortenhoven, A.P., 2008. *Status and diversity of large mammals in the Loma Mountain Non-hunting Forest Reserve. World* Bank

Kortenhoven, A.P. 2009. *Use of gallery and non-gallery forest by ungulates inhabiting the Loma Mountains Non-Hunting Forest Reserve, Sierra Leone, West Africa*. Masters Thesis, University of Miami.

Kühl, H., F. Maisels, M. Ancrenaz, and E.A. Williamson, 2008. Best Practice Guidelines for Surveys and Monitoring of Great Ape Populations, *Occasional Paper of the IUCN Species Survival Commission No. 36*, IUCN.

Laing, S.E., S.T. Buckland, R.W. Burns, D. Lambie, and A. Amphlett, 2003. Dung and nest surveys: estimating decay rates. *Journal of Applied Ecology*, 40:1102–1111.

Mittermeier, R.A., N. Myers, and C.G. Mittermeier. 1999. *Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. CEMEX.

Mathews, A. and A. Matthews, 2004. Survey of gorillas (*Gorilla gorilla gorilla*) and chimpanzees (*Pan troglodytes troglodytes*) in Southwestern Cameroon. *Primates* 45:15–24. DOI 10.1007/s10329-003-0058-4

M**organ, D., C. Sanz, J.R. Onononga, and S. Strindberg,** 2006, Ape Abundance and Habitat Use in the Goualougo Triangle, Republic of Congo. *International Journal of Primatology*, 27(1):147-179. DOI: 10.1007/s10764-005-9013-0

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, and J. Kent, 2000. Biodiversity hotspots for conservation priorities. *Nature*, 403:853-858.

The National Environmental Action Plan of Sierra Leone, 1994. Summary Papers presented at the regional and national seminar – workshops.

Nippon Koei UK, 2007. *Bumbuna Biodiversity Survey: Baseline Primate Survey and Monitoring Programme Final Report (BBS – 9)*.

N**isbett, R.A., A.L. Peal, R.A. Hoyt, and J. Carter**, 2003. Liberia Pp 89-98 in: *West African Chimpanzees. Status Survey and Conservation Action Plan.* Kormos, R., Boesch, C., Bakarr, M.I., and Butynski, T., eds. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 77-88.

Pavy, J.M. 1993. *Bafing faunal reserve. Biodiversity and human resource: survey and recommendations*. Unpublished report, Cheverly, Maryland, USA.

Phillipson, J.A., 1978. *Wildlife conservation and management in Sierra Leone*. Freetown, Special Report to MAF.

Plumptre, A.J., D. Cox, and S. Mugume, 2003. *The Status of Chimpanzees in Uganda. Albertine Rift* Technical Report Series No. 2. Wildlife Conservation Society, New York, USA.

Plumptre, A.J. and D. Cox, 2006. Counting primates for conservation: primate surveys in Uganda. *Primates* 47:65–73.

Plumptre, A.J. and V. Reynolds, 1997. Nesting behavior of chimpanzees: Implications for censuses. *International Journal of Primatology*, 18(4) 475-485.

Pruetz, J.D., L.F. Marchant, J. Arno, W.C. McGrew, 2002. Survey of savanna chimpanzees (*Pan troglodytes verus*) in southeastern Senegal. *American Journal of Primatology*. 58:35-43.

The Republic of Sierra Leone, 2003. *Biodiversity Status and Trends in Sierra Leone; Biodiversity Strategy and Action Plan.* National Report

Robinson, P.T., 1971. Wildlife trends in Liberia and Sierra Leone. *Oryx*, 11:117-122.

Sanz, C., 2004. *Behavioral ecology of chimpanzees in a central African forest:* Pan troglodytes troglodytes *in the Goualougo Triangle, Republic of Congo*. PhD. Washington University, Saint Louis.

Stokes E.J., S. Strindberg, P.C Bakabana, P.W. Elkan, F.C. Iyenguet, B. Madzoke, G. Aimé, F. Malanda, B.S. Mowawa, C. Moukoumbou, F.K. Ouakabadio, and H.J. Rainey, 2010. Monitoring Great Ape and Elephant Abundance at Large Spatial Scales: Measuring Effectiveness of a Conservation Landscape. *PLoS ONE* 5(4): e10294. doi:10.1371/journal.pone.0010294

Teleki, G. 1980. Hunting *and trapping wildlife in Sierra Leone: aspects of exploitation and exportation*. Freetown, Special Report to MAF.

Teleki, G. 1985. *A brief chronology of nature conservation in Sierra Leone (1900-1985).*

Teleki, G., 1989. Population status of wild chimpanzees (*Pan troglodytes*) and threats to survival. *Understanding Chimpanzees*. P.G. Heltne and L.A. marquardt (eds). Harvard University Press, Cambridge, MA.

Teleki, G. and L. Baldwin, 1981. Sierra Leone's Wildlife Legacy: Options for survival. *Zoonooz* 54(10): 21-27.

Thomas, L., Laake, J.L., Strindberg, S., Marques, F.F.C., Buckland, S.T., Borchers, D.L., Anderson, D.R., Burnham, K.P., Hedley, S.L., Pollard, J.H., Bishop, J.R.B. and Marques, T.A., 2006. Distance 5.0. Release 2. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK. http://www.ruwpa.st-and.ac.uk/distance.

Tutin, C.E.G. and M. Fernandez, 1984. Nationwide census of gorilla (*Gorilla g. gorilla*) and chimpanzee (*Pan t. troglodytes*) populations in Gabon. *American Journal of Primatology*, 6:313-336.

White, L. and C. E. G. Tutin 2001. Why chimpanzees and gorillas respond differently to logging: A cautionary tale from Gabon. In W. Weber, L. J. T. White, A. Vedder and L. Naughton-Treves (Eds.), *African Rain Forest Ecology and Conservation: An Interdisciplinary Perspective*, 449-462. New Haven, CT, Yale University Press.

Appendix 1: Summary block data

Block	District	Chiefdom(s)	Month surveyed	No. interviews	No. HD squares	No. LD squares	Block center Latitude	Block center Longitude	Center square density	Center square transect length (m)
1	Koinadugu	Sulima	July	9	4	5	9.78892	-11.24081	Low	1505
2	Koinadugu	Dembellia Sinkunia	July	9	9	0	9.78892	-11.48405	High	3000
3	Koinadugu	Wara Wara Bafodia	Aug	4	5	4	9.78892	-11.72730	High	3000
4	Bombali	Tambaka (OKNP)	n/a				9.78892	-11.97054		
5	Bombali	Tambaka	Feb	2	9	0	9.78892	-12.21378	High	3000
6	Bombali	Tambaka (OKNP)	n/a				9.78892	-12.45703		
7	Koinadugu	Mongo	July	6	5	4	9.54568	-10.99757	High	3000
8	Koinadugu	Songbeh	Jan	1	9	0	9.54568	-11.24081	High	2804
9	Koinadugu	Sengbe	July	11	1	8	9.54568	-11.48405	High	3000
10	Koinadugu	Wara Wara Bafodia, WW Yagala, Kasunko	July	13	1	8	9.54568	-11.72730	Low	1000
11	Koinadugu	Kasonko	Jan	4	3	6	9.54568	-11.97054	High	3000
12	Bombali	Sella Limba	Feb	12	0	9	9.54568	-12.21378	Low	2717
13	Bombali	Tambaka	Feb	4	3	6	9.54568	-12.45703	High	2193
14	Koinadugu	Mongo	July	8	0	9	9.30243	-10.75432	Low	1000
15	Koinadugu	Mongo/Neya	July	6	0	8	9.30243	-10.99757	Low	934
16	Koinadugu	Nieni	July	3	8	1	9.30243	-11.24081	High	3010
17	Koinadugu	Diang	July	6	2	7	9.30243	-11.48405	High	2993
18	Koinadugu	Kasonko	Feb	5	0	9	9.30243	-11.72730	Low	3000
19	Koinadugu /Bombali	Biriwa/Magbaimba Ndorhahun	Aug/ Jan	11	0	9	9.30243	-11.97054	Low	3000
20	Bombali	Gbanti Kamaranka	Jan	6	0	9	9.30243	-12.21378	Low	3000
21	Kambia	Tonko Limba	Jan	3	2	7	9.30243	-12.45703	High	3000
22	Kambia	Tonko Limba	Sep	11	0	9	9.30243	-12.70027	Low	2332
23	Koinadugu	Neya	Aug	8	7	0	9.05919	-10.75432	High	3000
24	Koinadugu /Kono	Neya/Sandor	Aug	5	0	9	9.05919	-10.99757	Low	1000
25	Koinadugu	Nieni	July	8	6	3	9.05919	-11.24081	Low	3000
26	Tonkolili	Samaya/Sumbaya	Dec	9	0	9	9.05919	-11.48405	Low	3000
27	Tonkolili	Kalansogoia	Dec	5	8	1	9.05919	-11.72730	High	3000
28	Bombali	Safroko Limba	Jan	9	0	9	9.05919	-11.97054	Low	3000
29	Bombali	Gbendembu	Sep	11	0	9	9.05919	-12.21378	Low	3000
30	Bombali	Libie Sengahun	Sep	10	0	9	9.05919	-12.45703	Low	2645
31	Port Loko	Magbolontor	Sep	11	8	1	9.05919	-12.70027	High	2886
32	Kambia	Magboma	Sep	14	2	7	9.05919	-12.94351	High	3000
33	Kambia	Samu	Sep	8	0	9	9.05919	-13.18676	Low	3000
34	Kono	Lei	Jan	10	0	9	8.81595	-10.75432	Low	3000
35	Kono	Sandoh	Jan	8	0	9	8.81595	-10.99757	Low	3000
36	Kono	Sandoh	Aug	6	6	3	8.81595	-11.24081	High A	3000

Block	District	Chiefdom(s)	Month surveyed	No. interviews	No. HD squares	No. LD squares	Block center Latitude	Block center Longitude	Center square density	Center square transect length (m)
37	Tonkolili	Kunikesanda/Nieni	Dec	9	8	1	8.81595	-11.48405	High	2906
38	Tonkolili	Kafesamira	Dec	4	6	3	8.81595	-11.72730	High	2210
39	Bombali	Pakie Masabong	Sep	7	0	9	8.81595	-11.97054	Low	3000
40	Bombali	Makarigbanti	Sep	9	0	9	8.81595	-12.21378	Low	3000
41	Port Loko	Buyaromende	Sep	12	5	4	8.81595	-12.45703	High	3000
42	Port Loko	Maforki	Sep	14	5	4	8.81595	-12.70027	High	3000
43	Port Loko	Lokomasama	Sep	12	0	9	8.81595	-12.94351	Low	2829
44	Port Loko	Lokomasama	Sep	9	0	7	8.81595	-13.18676	Low H	2938
45	Kono	Sowa/Fiama	Jan	7	0	9	8.57270	-10.75432	Low	2423
46	Kono	Tankoro/Nimikoro	Dec	7	0	9	8.57270	-10.99757	Low	2267
47	Kono	Nimiyama	Jan	11	3	4	8.57270	-11.24081	Low	3000
48	Tonkolili	Kunikesanda	Dec	6	2	7	8.57270	-11.48405	Low	1900
49	Tonkolili	Kunikebana	Dec	3	7	0	8.57270	-11.72730	High	3000
50	Tonkolili	Kolifa Rowala/ Gbonkolenken Tene	Sep	11	7	2	8.57270	-11.97054	High	1690
51	Tonkolili	Kolifa Mabang	Sep	5	5	4	8.57270	-12.21378	Low	3000
52	Port Loko	Masimera	Sep	9	7	2	8.57270	-12.45703	High	3000
53	Port Loko	Koya/Marampo	Sep	12	7	2	8.57270	-12.70027	High	2862
54	Port Loko	Maforki/Koya/Loko masama (Estuary)	n/a				8.57270	-12.94351		
55	Port Loko	Kafubulon	Sep	8	0	5	8.57270	-13.18676	Low	0
56	Kailahun	Luawa	Jan	10	0	9	8.24838	-10.51108	Low	3000
57	Kailahun	Penguia	Jan	7	8	1	8.32946	-10.75432	High	3000
58	Kenema	Lower Bambara	Nov	7	3	6	8.32946	-10.99757	Low	2883
59	Kenema	Dodo/Falawador	Nov	6	9	0	8.32946	-11.24081	High	2020
60	Bo/ Kenema	Goramende	Oct	6	3	6	8.32946	-11.48405	Low	3000
61	Bo	Valunya	Oct	4	9	0	8.32946	-11.72730	High	3000
62	Moyamba	Kori/Kamajei	Nov	6	1	8	8.32946	-11.97054	Low	3000
63	Moyamba	Fakuny/Kori	Nov	7	3	6	8.32946	-12.21378	Low	3000
64	Tonkolili	Yoni	Nov	12	0	9	8.32946	-12.45703	Low	3000
65	Moyamba	Ribi/Koya	Oct	11	8	1	8.32946	-12.70027	High	3000
66	WestArea/ Port Loko	Koya/Rural	Sep	12	2	7	8.32946	-12.94351	Low	3000
67	WestArea	York Rural (WAPFR)	n/a				8.32946	-13.18676		
68	Kailahun	Upper Bambara/Mandu	Jan	10	8	1	8.08622	-10.75432	High	1810
69	Kenema	Malegohun/Lower Banbara/Nongowa	Nov	8	5	4	8.08622	-10.99757	High	3000
70	Kenema	Dodo/Lekpeama	Nov	11	8	1	8.08622	-11.24081	High	3000
71	Bo	Gbagbeh	Nov	4	2	7	8.08622	-11.48405	High	3000
72	Bo	Dambala	Nov	6	3	6	8.08622	-11.72730	High	3000

Block	District	Chiefdom(s)	Month surveyed	No. interviews	No. HD squares	No. LD squares	Block center Latitude	Block center Longitude	Center square density	Center square transect length (m)
73	Moyamba	Kowa	Oct	6	3	6	8.08622	-11.97054	High	3000
74	Moyamba	Kori	Nov	7	3	6	8.08622	-12.21378	Low	3000
75	Moyamba	Koyamba	Oct	5	2	7	8.08622	-12.45703	Low	2778
76	Moyamba	Bumpeh	Oct	11	0	9	8.08622	-12.70027	Low	2820
77	Kailahun	Malema	Jan	5	0	9	7.84297	-10.75432	Low A	1500
78	Kailahun	Dama	Jan	9	0	9	7.84297	-10.99757	Low	2210
79	Kenema	Small Bo/Nongowa	Nov	7	3	5	7.84297	-11.24081	High	3000
80	Bo/ Kenema	Jaiamabongor /Baioma	Oct	8	9	0	7.84297	-11.48405	High	3000
81	Bo	Tikonko/Njama-Bongor	Nov	6	4	5	7.84297	-11.72730	High F	3000
82	Bo	Bumpe Kowa	Oct	7	1	8	7.84297	-11.97054	High	3000
83	Moyamba	Lower Banta	Oct	9	9	0	7.84297	-12.21378	High	3000
84	Moyamba	Bagruwa/Lower Banta	Oct	1	2	7	7.84297	-12.45703	High	3000
85	Moyamba	Kargboro/Timbdale	Oct	6	2	7	7.84297	-12.70027	Low	3000
86	Kenema	Guara/Nomo (Gola Forest Reserve)	n/a				7.59973	-10.99757		
87	Kenema	Koya	Nov	10	2	7	7.59973	-11.24081	Low	3000
88	Kenema/ Pujehun	Njawa/Pejeh	Nov	6	9	0	7.59973	-11.48405	High	3000
89	Bo	Gumbu/ Naiagolehun	Dec	8	9	0	7.59973	-11.72730	High B	2130
90	Bo/ Bonthe	Lugbu/Bagbo	Dec	8	9	0	7.59973	-11.97054	High	3000
91	Bonthe	Jong	Dec	9	9	0	7.59973	-12.21378	High	2455
92	Bonthe	Imperi (Ocean)	n/a				7.59973	-12.45703		
93	Bonthe	Sittia (Sherbro Island)	n/a				7.59973	-12.70027		
94	Kenema/ Pujehun	Tunkia/Makpele (Gola Forest Reserve)	n/a				7.35649	-11.24081		
95	Pujehun	Gallinasperi	Jan	5	9	0	7.35649	-11.48405	High	3000
96	Pujehun	Kpangakabonde	Jan	10	6	3	7.35649	-11.72730	High	3000
97	Bonthe	Bum	Dec	7	2	7	7.35649	-11.97054	Low	0
98	Bonthe	Nongoba Bullom (Ocean/swamp)	Dec	1	1	2	7.35649	-12.21378		
99	Pujehun	Sorogbema	Jan	6	0	9	7.11324	-11.48405	Low F	3000
100	Pujehun	Manu Sakrim (Ocean)	n/a				7.11324	-11.72730		
			Total	**695**	**326**	**473**				**240,650**

Appendix 2: Dissemination Workshop 15th and 16th September 2010

As originally planned within the project scope, a dissemination workshop was held for key national stakeholders in Freetown on September 15th and 16th 2010 with the following objectives, to:

- Embed the knowledge generated by the census
- Generate understanding as to the importance of chimpanzees both for Sierra Leone and internationally
- Create a viable pathway from the census to the delivery of an endorsed and functioning chimpanzee conservation action plan

Over 40 people took part over the two days and attendees at the workshop covered a range of government ministries and agencies, conservation organisations and academic institutes. The agenda included the presentation of the census results and report, the current legal status and emerging challenges for the protection of chimpanzees and case studies covering community co-management, offset conservation planning and great ape ecotourism.

The second day saw participants enthusiastically taking part in break-out sessions to tackle objectives and identify actions in the areas of legal frameworks, community engagement, education, research & awareness, national & international engagement & collaboration, and value creation.

Attendees took ownership of the threat to chimpanzees in Sierra Leone and it was an important milestone in the history of their protection when the workshop overwhelmingly supported the proposal that chimpanzees should become a national emblem for Sierra Leone. We will now pursue the delivery of a presidential declaration to confirm this crucial proposal which should significantly increase the conservation profile for the species.

The workshop has really demonstrated that the completion of the census has kick-started the next phase for Tacugama's work in conserving chimpanzees in Sierra Leone.

The full workshop report can be downloaded from the Tacugama website – www.tacugama.com .

Appendix 3: List of Figures

Appendix 4: List of Tables

