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Natural Habitats
Sierra Leone
organic products grown in a sustainable habitat

Natural Habitats High Carbon Stock (HCS) Assessment, Zimmi, Sierra Leone

23rd May 2017

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HCS ASSESSMENT DETAILS

Date of Report: 23rd May 2017

Lead Assessor: Philip Patton

Contact No.: Tel: +27 72 157 2032

Location of Assessment: Zimmi town, Makpele Chiefdom, Sierra Leone

Organisation commissioning HCV Assessment: Natural Habitats (SL) Ltd

Heemraadssingel 188, 3021 DM, Rotterdam | The Netherlands

M: +31-6-30 632 967| E: janhein@natural-habitats.com

Size of Assessment Area: 41,218ha

Total Area Designated as HCS Areas 1, 2 and 3: 10,185 ha

Current Land Use of Assessment Area: Subsistence farming and oil palm.

Assessment Area: Planned oil palm plantation for Natural Habitats intended for RSPO certification.

Assessor Licensing Scheme (ALS) license type: ALS15041PP

Certification Scheme: RSPO New Planting Procedures (NPP)

LIST OF ABBREVIATIONS AND ACRONYMS

AGB	Above Ground Biomass
AGLB	Above Ground Live Biomass
DBH	Diameter at Breast Height
EHS	Environmental, Health and Safety
EP	Equator Principles
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
FAO	Food and Agricultural Organization of the United Nations
FPIC	Free Prior and Informed Consent
GAR	Golden-Agri Resources
GRNP	Gola Rainforest National Park
HCS	High Carbon Stock
HCV	High Conservation Value
IBA	Important Bird Area
IFC	International Finance Corporation
IFI	International Financial Institution
ILO	International Labour Organization
IUCN	The International Union for Conservation of Nature
KBA	Key Biodiversity Area
ME	Montrose Environmental
NGO	Non-Governmental Organization
NH	Natural Habitats
POM	Palm Oil Mill
PS	Performance Standard
RSPB	Royal Society for the Protection of Birds
RSPO	Roundtable for Sustainable Oil Palm
TFT	The Forest Trust
USA	United States of America
WWF	The World Wide Fund for Nature

1. INTRODUCTION AND BACKGROUND

Natural Habitats (Sierra Leone) Limited (Natural Habitats) has acquired a land lease concession for 99 years in the Makpele Chiefdom, Pujehun District, near Zimmi, south-eastern Sierra Leone (Figure 1). The land lease is currently for 50 years, with an option to extend for 21 years + 21 years + 7 years. The total size of the area/concession under land lease is approximately 41,218ha. Natural Habitats aims to establish an organic oil palm plantation on portions of the concession.

Natural Habitats is registered in Sierra Leone, and is part of Natural Habitats Group. The Group has a longstanding track record of producing organic agro-products in South America, from where products are transported to Europe and the United States of America (USA). The Natural Habitats Group is fully committed to the sustainable production of organic and fairly-traded products.

Natural Habitats Sierra Leone Project (the 'Project') involves the following key aspects:

- Palm oil nursery development with associated infrastructure (seedlings are prepared for planting in the plantation);
- Palm oil plantation development; and
- Palm oil mill (POM) installation and operation.

In March 2017, Montrose Environmental (ME) was commissioned by Natural Habitats to conduct a High Carbon Stock (HCS) assessment as part of Roundtable for Sustainable Palm Oil (RSPO) certification. The HCS assessment will enable Natural Habitats to reduce greenhouse gas emissions, where possible, to work with communities in protecting and conserving viable remnant natural forest patches in the concession, and to fulfill the "no deforestation" requirement as part of the company's commitment to sustainable palm oil production.

Natural Habitats is committed to:

- Not developing areas that have High Conservation Value (HCV);
- Not developing areas in forests that are identified as being High Carbon Stock (HCS);
- Engaging with local communities so they are fully aware of the Project and phases of development;
- Complying with all relevant Sierra Leonean laws and regulations; and
- Conforming with applicable, internationally accepted certification principles and criteria.

Areas that are HCS and / or have HCV status have been identified and mapped as part of the HCS assessment, which will enable Natural Habitats to avoid developing such areas.

The HCS follows on from an HCV assessment that was completed in January 2016. The field investigations for the HCS assessment took place from the 8th to the 14th of March 2017. Additional information for the HCS assessment was obtained from the Project's Environmental and Social Impact Assessment (ESIA) (Integems, 2016).

Reference documents used to inform, measure and confirm HCS forest patches within the concession include:

- The HCS Approach Toolkit: The High Carbon Stock Approach: No Deforestation in Practice;
- HCV-HCS Assessment Manual Factsheet; and
- ZSL, 2011. A Practical Handbook for Conserving High Conservation Value (HCV) Species and Habitats within Oil Palm Landscapes in West and Central Africa.

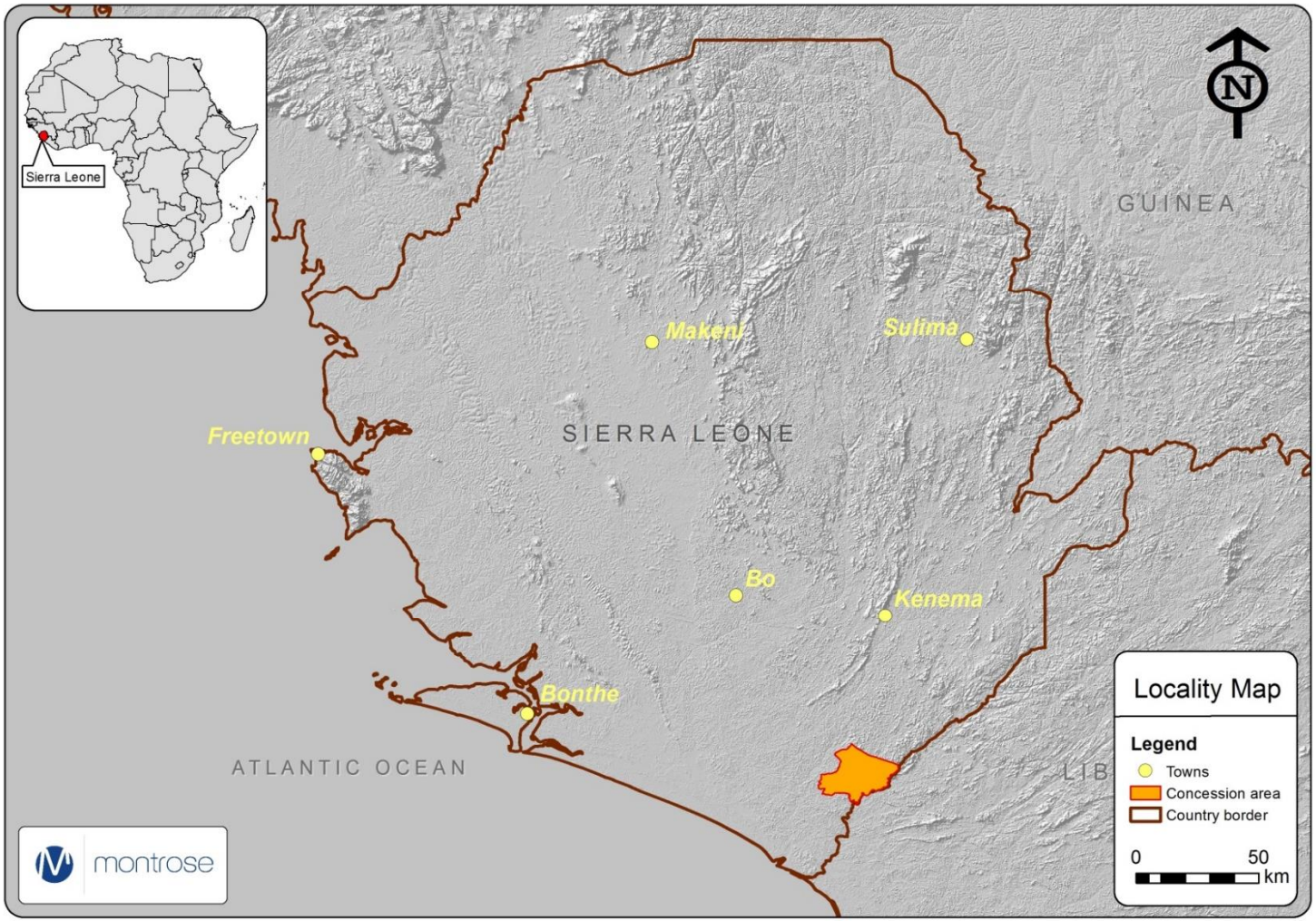

Figure 1: Locality Map, showing the Natural Habitats concession in Sierra Leone

The concession is in an area that has a number of global, regional, and local-scale classifications:

- On a global and regional scale, the Natural Habitats concession is in a biodiversity hotspot, namely, the Upper Guinean Rainforest which places conservation in international perspective.
- The concession is in a global ecoregion that has been identified by the World Wildlife Fund (WWF), namely the Tropical and Subtropical Moist Broadleaf Forests. The ecoregion status highlights the ecological sensitivity of the site for large vertebrates, water resources and forest flora.
- The site is adjacent to the Gola Forest Reserve Important Bird Area (IBA), which highlights the conservation significance from an avifaunal perspective.

On a national scale, the Gola Rainforest National Park (GRNP) serves as a critical biodiversity resource for Sierra Leone, conserving numerous endemic and Red Data species and supporting exceptional biodiversity. The GRNP has also been identified as a Key Biodiversity Area (KBA) by the IUCN – the International Union for Conservation of Nature. On a local scale, the forest and associated habitat provides immeasurable ecosystem services to the local communities on the forest edge that are dependent on the forest for basic needs and to help sustain their livelihoods.

For this assessment, the concession is considered as part of the wider landscape, as per HCS requirements. As such, protected areas, regional biogeography and other aspects have been considered in developing the HCS methodology and assessment.

The area of influence is the area that may be affected by the Project, including direct effects (e.g. development of the plantations, nurseries, access roads), and indirect effects (e.g. loss of access to areas where local communities harvest / use natural resources). The concession includes the southern boundary of the GRNP and the "leakage belt". The so-called leakage belt is a buffer area stretching over 4km around each block of the GRNP and includes forested and non-forested areas, excluding the eastern border where the Mano River flows and forms the Sierra Leone – Liberian border.

1.1. Definition of HCS and its Background and Approach

Carbon in forests is stored in biomass and soil. The amounts of carbon can be large, but can rapidly decrease following disturbance from activities such as deforestation, logging, fire, or drainage of organic soils. The loss of forest carbon stocks contributes to carbon emissions (mainly as carbon dioxide, CO_2) which in turn contributes to climate change (Sime Darby HCS Study Overview, 2015).

Forest biomass is made up of living and dead trees. This biomass stores a large amount of carbon – approximately 50% of its dry weight is carbon, and forest biomass can store up to several hundred tonnes of carbon per hectare. Forest biomass has two components (i.e. above-ground and below-ground). The larger component (about 75%) is above-ground (e.g., tree trunks, branches and leaves). The rest is below ground (e.g., coarse and fine roots (about 25%). Woody debris (mainly dead and fallen trees and branches, as well as the remnants of logging) can make up a significant amount of the biomass. As forests grow, both above-ground and below-ground biomass increases. When forests are cleared the biomass oxidises and the carbon it contains is released to the atmosphere as carbon dioxide.

In the context of forests, carbon stocks refers to the amount of carbon stored in the forest ecosystems, mainly in living biomass and soil, but to a lesser extent also in dead wood and litter.

Greenpeace, the Forest Trust (TFT) and Golden Agri-Resources (GAR), the largest Indonesian palm oil producer, started work on an HCS definition in 2011, which has evolved into what is now known as the "HCS Approach". The HCS approach is based on the premise that high levels of carbon dioxide are locked up in tropical forests, and are linked with abundant biodiversity. This approach is not just a methodology for identifying areas of HCS but is a strategy for no deforestation, and for defining and protecting 'viable forest areas' (Greenpeace, March 2014).

The HCS approach represents the first practical methodology that has been tested and developed in active concessions in Asia and Africa with input from a variety of stakeholders. HCS forests are those identified through the HCS Approach, as forested areas to be prioritised for protection from conversion by agriculture.

It is designed to protect viable HCV and HCS areas, and community lands. The HCS approach thus goes hand-in-hand with the undertaking of HCV assessments. The approach, however, does not include peatlands, with the reasoning that these should be covered by separate 'no peat conversion' policies. It is not a tool for carbon accounting (Proforest, 2014).

With the increasing number of companies committing to no-deforestation and protection of HCS forests, a multi-stakeholder steering group was set up to oversee HCS assessments, culminating in publication of a toolkit, the HCS Approach Toolkit (April 2015); this HCS assessment has been completed largely based on guidance provided in the HCS Approach Toolkit

The HCS Approach Toolkit provides a methodology and toolkit to help land managers define forest types and make decisions about what land can be developed and what land/forest areas should be conserved. It aims to balance ecological and environmental values with the customary rights of indigenous peoples and benefits of the environment, to local communities (Goldenagri.com)

The focus of the HCS Approach, field tested over several years, is on identifying viable areas of forest for protection in order to take a practical approach to implement no deforestation. This approach does not have a fixed carbon threshold (above which forest cannot be converted to palm oil plantation). Thus, the HCS Approach Toolkit does not specify carbon ranges, but uses vegetation stratification to identify 'viable' forest which is then prioritised for conservation.

Broadly, the HCS Approach stratifies the vegetation on an area of land into different classes. Each vegetation class is validated through calibrating it with carbon stock estimates for the above-ground tree biomass. The HCS methodology uses satellite imagery to stratify land cover, after which a forest inventory is developed to generate above-ground biomass carbon values per land cover class and identify potential HCS areas.

The novelty of the HCS approach is its methodology for separating HCS areas (natural forest) from non-HCS areas (degraded land). The HCS approach defines a threshold between natural forest and degraded land using six vegetation classifications that can be identified using satellite imagery and field plot measurements. The classifications are:

- High Density Forest;
- Medium Density Forest;
- Low Density Forest;
- Young Regenerating Forest;

- Scrub; and
- Cleared/Open Land.

The (provisional) HCS threshold falls between young regenerating forest and scrub (Figure 2). Regenerating forest is described as mostly young re-growth forest, but with occasional patches of older forest. Scrub is described as recently cleared areas, some woody re-growth and grass-like ground cover.

This threshold was used by Greenpeace for trials in Indonesia (Kalimantan) and Liberia. Greenpeace state that the vegetation stratification method, but not necessarily a carbon threshold approach, should be widely applicable across the humid tropics. However, the methods have yet to be widely field-tested (Proforest, 2014).

Estimating the carbon stock of an area can be achieved by taking a representative sample rather than measuring the carbon in all components over the whole area. A small, but carefully chosen sample can be used to represent the population. The sample reflects the characteristics of the population from which it is drawn. Carbon sampling measurements should be accurate (close to reality for the entire population) and precise (short confidence intervals, implying low uncertainty).

The approach uses a combination of high quality satellite pictures of a forest concession and ground plots that measure the trees for a first assessment of what is, potentially, HCS forest. These potential forest areas are then analysed and sorted to create a plan of HCS forest for conservation, including areas set aside for community food cultivation, and incorporating peat land and areas of HCV into one conservation plan. At the same time, it identifies degraded areas that can be developed to balance out economic needs. The community needs to give their consent for the HCS conservation, just as they do for any areas that are planted.

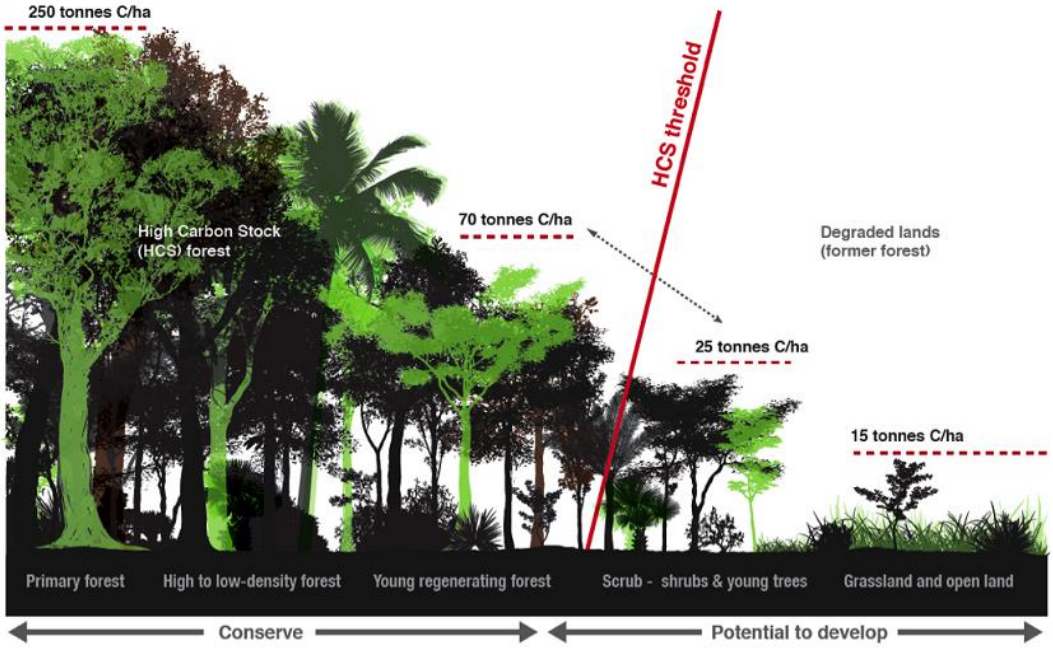

Figure 2: The HCS threshold (boundary between conservation areas and those for potential development) (HCS Approach Toolkit, 2015)

The HCS approach combines carbon and biodiversity conservation, as well as community rights and livelihoods. Only areas that contain low carbon, such as shrub and grassland could be considered for

conversion into plantations. This means that areas with young regenerating forest and secondary forest, which contain more carbon and biodiversity, are tagged for conservation.

1.2. Applicable National Legislation and International Standards

1.2.1 Sierra Leonean Policies and Legislation

Natural Habitats is required to comply with Sierra Leonean national legislation for the Project that includes:

- Environment Protection Agency (EPA) Act (Act No. 8 of 2008);
- The National Environmental Policy 1994;
- The Draft Forestry and Wildlife Sector Policy for Sierra Leone 2003;
- National Lands Policy 2005;
- Forestry Act 1988;
- Local Government Act 2004; and
- The Wildlife Act 1972.

1.2.2 International Standards, Guidelines and Conventions

Natural Habitats has committed to conforming with the general requirements of International Financial Institutions (IFIs) as generally defined in the World Bank Group Environmental, Health and Safety (EHS) Guidelines (2007) and Performance Standards for Environmental and Social Sustainability (2012) of the International Finance Corporation (IFC); the Roundtable on Sustainable Palm Oil (RSPO, 2013); High Conservation Value Resource Network (HCVRN 2013); and International Labour Organisation (ILO) conventions covering core labour standards (1998) and the basic terms and conditions of employment.

1.2.1.1. International Finance Corporation (IFC) Performance Standards

The IFC has a Sustainability Policy and set of Performance Standards on Social and Environmental Sustainability. These came into force in July 2006 and were revised and updated in January 2012. The revised Performance Standards are as follows:

- PS 1: Assessment and Management of Social and Environmental Risks and Impacts;
- PS 2: Labour and Working Conditions;
- PS 3: Resource Efficiency and Pollution Prevention;
- PS 4: Community Health, Safety and Security;
- PS 5: Land Acquisition and Involuntary Resettlement;
- PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- PS 7: Indigenous Peoples; and
- PS 8: Cultural Heritage.

1.2.1.2. IFC Environmental, Health and Safety (EHS) Guidelines

The EHS Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of projects. This information supports actions aimed at avoiding, minimizing, and controlling environmental, health, and safety (EHS) impacts during the construction, operation, and decommissioning phase of a project or facility.

For this Project, the EHS Guidelines (April 2007) that apply are:

- IFC Environmental, Health, and Safety General Guidelines;
- IFC Environmental, Health, and Safety Guidelines for Plantation Crop Production; and

- IFC Environmental, Health, and Safety Guidelines for Vegetable Oil Processing.

1.2.1.3. Equator Principles (EP)

The Equator Principles (2013), developed to serve as a common minimum framework, are a set of voluntary standards that international financing institutions adopt to determine, assess and manage environmental and social risks related to funding of projects in emerging markets. The Equator principles have its basis in the IFC's environmental and social sustainability Performance Standard and the World Bank's Environment, Health and Safety general guidelines. Institutions that adopt the EP, known as the Equator Principle s Financial Institutions (EPFIs) commit to not financing projects where the borrower will not or is unable to comply with their respective environmental and social policies and procedures that implement the EPs. EPs apply only to new project financing across many sectors though, it could be applied to upgrades or extension of existing projects where changes in scope may cause significant environmental and/or social impacts or substantially change the degree of an existing impact. The EP is made up of 10 principles, as follows:

- Principle 1: Review and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Environmental Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

1.2.1.4. Roundtable on Sustainable Palm Oil (RSPO)

The RSPO, an association for the sustainable palm oil production, was formally established with the overall objective to promote the growth and use of sustainable palm oil through cooperation within the supply chain and open dialogue with stakeholders. It has adopted and published a set of principles and criteria to help oil palm producers to be more sustainable. Within the overall framework of the document, practical advice is given to assist plantation mangers to develop operational procedures towards identifying impacts and also to measure and monitor appropriate indicators that demonstrates a reduction of impacts over time.

The RSPO acknowledges that a key aspect of achieving sustainability is to identify the significant impacts especially those that are negative on the environment. The RSPO request producers to prepare:

- Documentation of the impacts and assessment of their relative importance;
- Development of strategic management plans which includes the results of such assessments;
- Development of operational procedures which identify impacts and the required changes in current practices to mitigate their negative effects; and
- Production of improvement plans, including a time table for change.

The RSPO undertakes the following principle tasks towards the fulfilment of its own objectives:

- Research and develop definitions and criteria for sustainable production and use of palm oil;
- Undertake practical projects designed to facilitate implementation of sustainable best practices;
- Develop solutions to practical problems related to the adoption and verification of best practices for plantation establishment and management, procurement, trade and logistics;

- Acquire financial resources from private and public funds to finance projects under the auspices of RSPO; and
- Communicate RSPO's work to all stakeholders and to the broader public.

The RSPO concerns have been stipulated as a set of principles and criteria for sustainable oil palm; and are as follows:

Principle 1: Commitment to transparency

Criterion 1.1: Oil palm growers and millers provide adequate information to other stakeholders on environmental, social and legal issues relevant to RSPO Criteria, in appropriate languages and forms to allow for effective participation in decision-making.

Criterion 1.2: Management documents are publicly available, except where this is prevented by commercial confidentiality or where disclosure of information would result in negative environmental or social outcomes.

Principle 2: Compliance with applicable laws and regulations

Criterion 2.1: There is compliance with all applicable local, national and ratified international laws and regulations.

Criterion 2.2: The right to use the land can be demonstrated, and is not legitimately contested by local communities with demonstrable rights.

Criterion 2.3: Use of the land for oil palm does not diminish the legal rights, or customary rights, of other users, without their free, prior and informed consent.

Principle 3: Commitment of long-term economic and financial viability

Criterion 3.1: There is an implemented management plan that aims to achieve long-term economic and financial viability.

Principle 4: Use of appropriate best practices by growers and millers

Criterion 4.1: Operating procedures are appropriately documented and consistently implemented and monitored.

Criterion 4.2: Practices maintain soil fertility at, or where possible improve soil fertility to a level that ensures optimal and sustained yield.

Criterion 4.3 Practices minimize and control erosion and degradation of soils.

Criterion 4.4: Practices maintain the quality and availability of surface and ground water.

Criterion 4.5: Pests, diseases, weeds and invasive introduced species are effectively managed using appropriate integrated Pest Management (IPM) techniques.

Criterion 4.6: Agrochemicals are used in a way that does not endanger health or the environment. There is no prophylactic use, and where agrochemicals are used that is categorized as world.

Health Organisation Type 1A or 1B, or are listed by the Stockholm or Rotterdam Conventions, growers are actively seeking to identify alternatives, and this is documented.

Criterion 4.7: An occupational health and safety plan is documented effectively communicated and implemented.

Criterion 4.8: All staff, workers, smallholders and contractors are appropriately trained.

Principle 5: Environmental responsibility and conservation of natural resources and biodiversity

Criterion 5.1: Aspects of plantation and mill management that have environmental impacts are identified, and plans to mitigate the negative impacts and promote the positive ones are made, implemented and monitored, to demonstrate continuous improvement.

Criterion 5.2: The status of rare, threatened or endangered species and high conservation value habitats, if any, that exist in the plantation or that could be affected by plantation or mill management, shall be identified and their conservation taken into account in management plans and operations.

Criterion 5.3: Waste is reduced, recycled, re-used and disposed of in an environmentally and socially responsible manner.

Criterion 5.4: Efficiency of energy use and use of renewable energy is maximised.
Criterion 5.5: Use of fire for waste disposal and for preparing land for replanting is avoided except in specific situations, as identified in the ASEAN guidelines or other regional best practice.

Criterion 5.6: Plans to reduce pollution and emissions, including greenhouse gases, are developed, implemented and monitored.

Principle 6: Responsible consideration if employees and of individuals and communities affected by growers and mills.

Criterion 6.1: Aspects of plantation and mill management that have social impacts are identified in a participatory way and plans to mitigate the negative impacts and promote the positive ones are made, implemented and monitored, to demonstrate continuous improvement.

Criterion 6.2: There are open and transparent methods for communication and consultation between growers and/or millers, local communities and other affected or interested parties.

Criterion 6.3: There is a mutually agreed and documented system for dealing with complaints and grievances, which is implemented and accepted by all parties

Criterion 6.4: Any negotiations concerning compensation for loss of legal or customary rights are dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions.

Criterion 6.5: Pay and conditions for employee and for employees of contractors always meet at least legal or industry minimum standards and are sufficient to meet basic needs of personnel and to provide some discretionary income

Criterion 6.6: The employer respects the right of all personnel to form and join trade unions of their choice and to bargain collectively. Where the right to freedom of association and collective bargaining

are restricted under law, the employer facilitates parallel means of independent and free association and bargaining for all such personnel.

Criterion 6.7: Child labour is not used. Children are not exposed to hazardous working conditions. Work by children is acceptable on family farms, under adult supervision, and when not interfering with education programmes.

Criterion 6.8: The employer shall not engage in or support discrimination based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership, political affiliation, or age.

Criterion 6.9: A policy to prevent sexual harassment and all other forms of violence against women and to protect their reproductive rights is developed and applied.

Criterion 6.10: Growers and millers deal fairly and transparently with smallholders and other local businesses.

Criterion 6.11: Growers and millers contribute to local sustainable development wherever appropriate.

Principle 7: Responsible development of new plantings

Criterion 7.1: A comprehensive and participatory independent social and environmental impact assessment is undertaken prior to establishing new plantings or operations, or expanding existing ones, and the results incorporated into planning, management and operations.

Criterion 7.2: Soil surveys and topographic information are used for site planning in the establishment of new plantings, and the results are incorporated into plans and operations.

Criterion 7.3: New plantings since November 2005 (which is the expected date of adoption of these criteria by the (RSPO membership), have not replaced primary forest or any area containing one or more High Conservation Values.

Criterion 7.4: Extensive planting on steep terrain, and/or on marginal and fragile soils, is avoided.

Criterion 7.5: No new plantings are established on local peoples land without their free, prior and informed consent, dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions.

Criterion 7.6: Local people are compensated for any agreed land acquisitions and relinquishment of rights, subject to their free, prior and informed consent and negotiated agreements

Criterion 7.7: Use of fire in the preparation of new plantings is avoided other than in specific situations, as identified in the ASEAN guidelines or other regional best practice.

Principle 8: Commitment to continuous improvement in key areas of activity

Criterion 8.1: Growers and millers regularly monitor and review their activities and develop and implement action plans that allow demonstrable continuous improvement in key operations.

1.2.1.5. High Conservation Value Forest (HCVF)

High Conservation Value Forest (HCVF): The forest necessary to maintain or enhance one or more High Conservation Values (HCVs):

- HCV1. Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species);
- HCV2. Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance;
- HCV3. Forest areas that are in or contain rare, threatened or endangered ecosystems;
- HCV4. Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control);
- HCV5. Forest areas fundamental to meeting basic needs of local communities (e.g., subsistence, health); and
- HCV6. Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

2. HCS STUDY APPROACH AND METHODOLOGY

The tropical forests of Africa hold large stores of carbon, harbour important biodiversity, and are critical for the livelihoods of thousands of local communities. The conversion of these forests to other uses including agriculture or plantations, has caused an increase in the emission of greenhouse gases.

The ME HCS assessment is aimed at developing a practical, scientifically robust and cost-effective methodology to define and identify areas of HCS for conservation and protection from conversion by agriculture. Thus, the conserved HCS areas can retain their natural ecological functions as forests.

The methodology was based on the premise that there is a level of correlation between vegetation density and above-ground living wood volume in trees greater than or equal to 10 cm DBH (diameter above breast height). Thus, field data collected from random selected plots in remnant forest patches during fieldwork can be converted to tonnes of carbon per hectare (tC/ha). The methodology followed the recommendation of studies that combine remote sensing data analysis with ground-based field data. It was seen that this was likely to provide an effective approach to the HCS.

The approach and methodology used by ME followed the approach and methodology detailed in the HCS Approach Toolkit (2015), and included two key phases, as follows:

1) Preliminary vegetation identification and stratification to identify potential HCS forest areas:

- HCS areas identified by vegetation classification using satellite imagery, the ESIA Report, the HCV report and historic field data; and
- Land used for meeting communities' basic needs are excised from development plans.

2) Identification of ecologically viable forest areas to protect and restore:

- Overlay areas of HCS, and HCV, then identify viable areas (i.e., those that can potentially revert to their natural ecological function as a forest); and
- Viability defined using:
    1. Patch analysis of shape, size, connectivity, habitat quality and threats (patch size especially important); and
    2. Ground verification by undertaking field surveys, including taking tree measurements in random plots within selected forest patches, community consultation/stakeholder engagement (in part to obtain consent from local communities to align with the

principles of Free Prior and Informed Consent (FPIC)) and rapid biodiversity assessment of remnant natural forest patches within the study area/concession.

3. Using the tree measurement data collected from the random plots to determine the Above Ground Live Biomass (AGLB) of trees with a Diameter at Breast Height (DBH) >10cm.
4. Using a locally appropriate generic allometric equation, the carbon stock in the form of tonnes of carbon per hectare was estimated for each tree measured and then for each plot.
5. Based on the above, vegetation classes were stratified and the forest patches were then divided into HCS (HK3, HK2, HK1, BT) to be protected, and Low Carbon Stock (BM, LT), potentially suitable for oil palm plantation development (definitions of HK3, HK2, HK1, BT, BM and LT are presented in Section 2.2).

The key outcome of the HCS assessment was that vegetation cover (forest patches) in the concession were stratified into different HCS classes.

2.1. Preliminary Identification/Stratification of HCS Forest Patch Focus Areas

Using available Natural Habitats satellite imagery as well as Google maps, the HCS assessment team undertook a preliminary/initial desktop HCS forest patch focus area identification and stratification exercise. This was undertaken prior to going to site to undertake the field surveys. The aim of this preliminary exercise was to identify remnant forest patches within the NH concession that could be focussed upon and visited during the HCS field trip, and where random plots could be located so as to obtain the necessary HCS field data for each plot.

Key factors that were used in the preliminary identification of remnant forest patch focus areas included the following:

- Habitat quality (in terms of the colour and thus the potential density) of the forest patch;
- Forest patch shape;
- Forest patch size;
- Forest patch connectivity; and
- Accessibility of the forest patch.

Figure 3 below shows the preliminary identification and stratification of forest patches within the Natural Habitats concession.

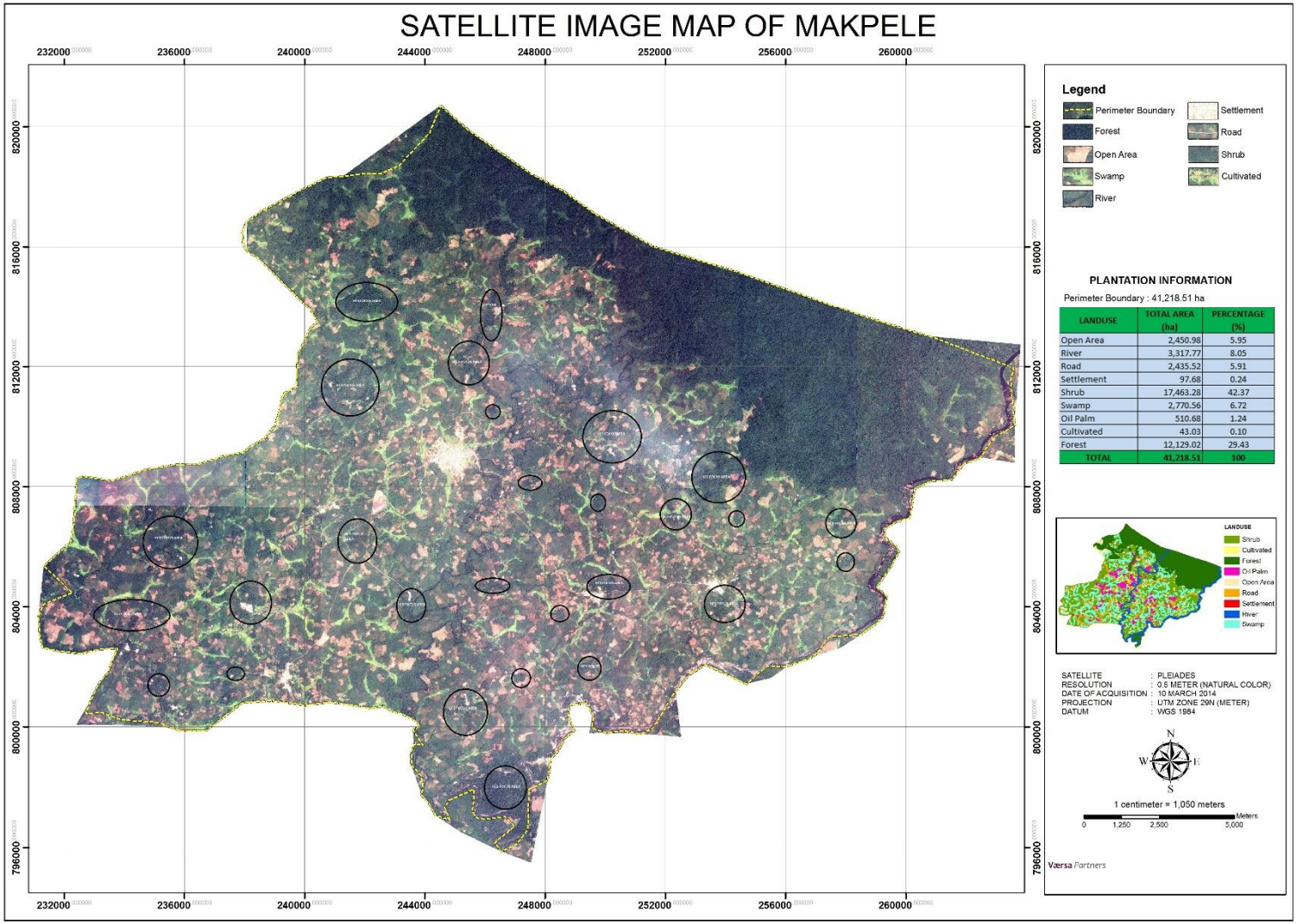

Figure 3: Preliminary HCS Forest Patch Focus Areas

2.2. HCS Field Surveys

ME HCS fieldwork involved collecting HCS-related data from random plots within the remnant forest patches of the Natural Habitats concession. As noted in the section above, the remnant forest patches to be surveyed were selected prior to undertaking the field work by making use of the available satellite images. The size, shape, and connectivity to other patches and (as applicable) riparian zones and HCV areas were also taken into account in selecting forest patches to be surveyed.

Accessibility of the forest patches was also considered when initially selecting plot locations, as some of the areas within the concession are difficult to access because there are no roads or tracks and there are large swamps in places.

The HCS plots were selected randomly whilst walking through the forest patches throughout the concession. The plot size selected was 20m x 20m, as this was seen to be a representative and manageable area, and allowed the ME and Natural Habitats team to complete the plots relatively quickly, thus completing more plots and, overall, greater areas within the concession. A hand-held Global Positioning System (GPS) was used to navigate to the plots.

The key team members involved in collecting data for each plot included:

- Phil Patton (ME) – HCS Leader and licensed High Conservation Value Assessor;
- Chris Fell (ME);
- Jusufu Moiwa (Natural Habitats);
- Alie Bao (Natural Habitats); and
- Mohamed Mansaray (Natural Habitats).

Key HCS information that was collected per plot, included the following for each tree within the plot with a diameter at base height (DBH) over 10cm:

- The coordinates of the tree;
- The circumference of the tree (in metres);
- The diameter of the tree (in metres) – diameter at breast height (DBH) = 1.3m;
- The actual height at which the circumference and diameter of the tree were measured (in metres);
- The approximate height of the tree (in metres) – estimated by looking at the tree; and
- The species of tree (if known).

It was concluded that most of the carbon in these forest areas is in larger trees. Measuring smaller trees less than 10 cm in diameter at breast height (DBH) is laborious and the carbon they contain was not significant enough to either alter the outcome of the stratification greatly, or justify the time and effort that would be required to survey them. Based on this, only trees of 10cm DBH or greater within a plot were measured.

Figure 4 shows the location of all of the HCS field survey plots within the Natural Habitats concession.

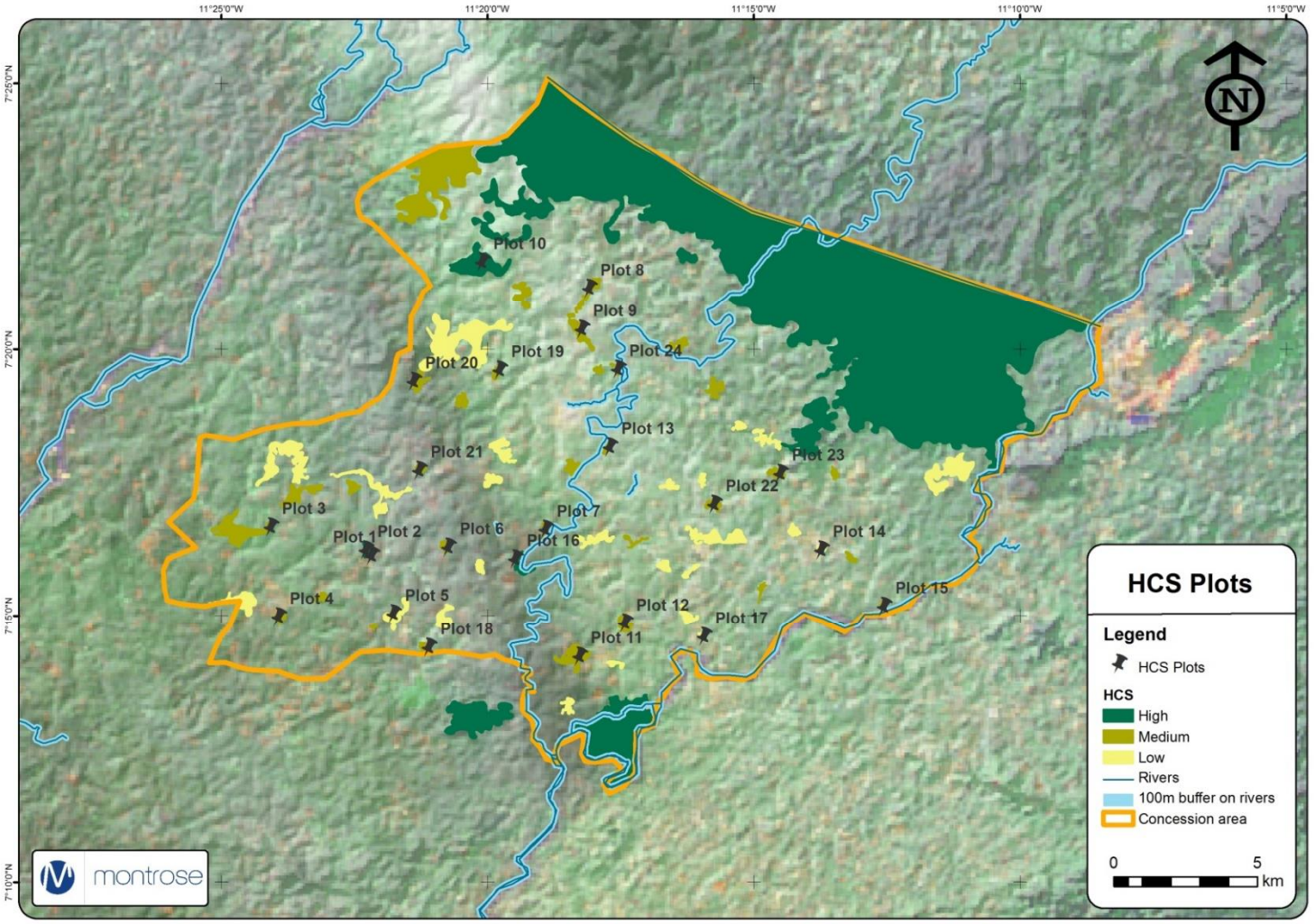

Figure 4: Field survey plot locations within the Natural Habitats concession

The data from the HCS plots was then used to determine the strata of vegetation cover for each of the forest patches. The six strata of vegetation cover include, as per the HCS Approach Toolkit: High Density Forest (HK3), Medium Density, Forest (HK2), Low Density Forest (HK1), Old Scrub (BT), Young Scrub (BM), and Cleared/Open Land (LT) and these correlated with different average carbon stocks.

The HCS vegetation cover definitions are as follows:

- High Density Forest (HK3) – Remnant forest or advanced secondary forest close to primary condition.
- Medium Density Forest (HK2) – Remnant forest but more disturbed than High Density Forest.
- Low Density Forest (HK1) – Appears to be remnant forest but highly disturbed and in process of recovering (may contain plantation/mixed garden).
- Old Scrub (BT) – Mostly young re-growth forest, but with occasional patches of older forest within the stratum.
- Young Scrub (BM) – Recently cleared areas, some woody regrowth and grass-like ground cover.

2.3. Vegetation/Forest Surveys

A rapid vegetation survey was conducted during the HCS assessment for each plot and for all forest patches surveyed, (in conjunction with rapid fauna/biodiversity surveys). Owing to the brevity of the site visit, target areas were identified and field survey forest patch locations selected from aerial imagery prior to the site visit for representative random sampling. The forest patch focus areas were chosen based on their accessibility, and based on the presence of intact forest habitat and the propensity to harbour species diversity. The focus areas for the HCS random sample plots included the following:

- Areas of fragmented natural forest within the Natural Habitats concession; and
- Riparian forest zones.

Random plots (shown in Figure 3) were taken throughout the forest patch focus areas to record species encountered, vegetation composition, species dominance, and the presence of alien plant species. The purpose of the vegetation assessment was to ascertain the presence of high or medium HCS triggers.

The following literature was used to identify plants (HCV Assessment 2016):

- Botanical training and investigation of a botanical survey in Gola for Gola Forest Project/RSPB (Hawthorne, 2011);
- Trees of Sierra Leone (Saville and Fox, 1967); and
- Woody plants of Western African forests: A guide to the forest trees, shrubs and lianes from Senegal to Ghana (Hawthorne and Jongkind, 2006).

2.4. Rapid Biodiversity Surveys

During the HCS assessment, whilst working in each plot to take measurements of the applicable trees, a rapid biodiversity survey was undertaken within the wider forest patch/remnant. A precautionary approach was followed whilst undertaking the rapid biodiversity surveys. Species encountered were identified, recorded and listed; this mostly included bird species, as they are most common in the forest and could be identified based on sight and call. The HCS team had meeting with local community members before entering a village's forest patch; faunal species encountered by local people in their

forest and farm areas, within the Natural Habitats concession, were noted. Photographs of fauna species were taken where possible.

To undertake the HCS assessment for fauna, several steps were undertaken during the desktop survey including:

- Analysis of aerial photography with regards to habitat types with an emphasis on intact forest patches;
- Review of the ESIA and HCV studies (2016); and
- Species lists were obtained using the following resources:
  - World Wildlife Fund (WWF), the IUCN, Gola Red Project and African Bird Club online species distribution maps were used to obtain data for the distribution of mammals and birds within the greater study area;
  - The potential occurrence of mammals was supplemented by the species distribution maps in the IUCN and the Field Guide to African Mammals (Jonathan Kingdom, 2007); and
  - Lists of birds found in the study area were determined by an experienced ornithologist and confirmed using several field guide publications, including Birds of Western Africa (Demey and Barrow, 2006), Birds of Western and Central Africa (Van Perlo, 2002), and Birds of Africa South of the Sahara (Sinclair and Ryan, 2012).

2.5. Stakeholder Engagement and Community Consultation

As part of the HCS approach and in line with Natural Habitats on-going and transparent engagement with stakeholders living within the concession, the HCS team met with village chiefs, elders and community representatives prior to undertaking the HCS surveys in each of the forest patches near the villages. Stakeholder engagement was carried out to obtain consent/permission from the local people to enter their forest patches, to enable communities to understand and support the fieldwork, and to obtain relevant information for the HCS from local people (local knowledge). In all cases, a number of community representatives (between one and three people) from each village accompanied the HCS team into their respective forest patches whilst surveys were undertaken.

The stakeholder engagement meetings included the following:

- Wednesday 8th March 2017 – Meeting with the Paramount Chief in Zimmi.
- Wednesday 8th March 2017 – Tuasu Village.
- Wednesday 8th March 2017 – Jabima Village.
- Thursday 9th March 2017 – Gene Village.
- Thursday 9th March 2017 – Giehun Village.
- Friday 10th March 2017 – Joborwahun Village.
- Saturday 11th March 2017 – Jaluhun Village.
- Saturday 11th March 2017 – Bopoo Village.
- Saturday 11th March 2017 – Jagbwema Village.
- Monday 13th March 2017 – Gbaa Village.
- Monday 13th March 2017 – Gangama Village.
- Monday 13th March 2017 – Manjama Village.
- Monday 13th March 2017 – Dassalam Village.
- Monday 13th March 2017 – Gofor Village.
- Monday 13th March 2017 – Senbehun Village.
- Tuesday 14th March 2017 – Gokpoma Village.
- Tuesday 14th March 2017 – Gbahama Village.
- Tuesday 14th March 2017 – Gissiwulo Village.
- Tuesday 14th March 2017 – Giewumba Village.

Note: ME was not present at the HCS stakeholder engagement meetings and associated field work undertaken on Monday 13th March and Tuesday 14th March; this work was undertaken by the Natural Habitats staff.

Key issues discussed during the HCS stakeholder engagement meetings with local communities included:

- Introductions of the HCS team (i.e., both ME and Natural Habitats team members).
- The scope of fieldwork in terms of accessing remnant forest patches near the village, measuring trees, noting tree species, looking for fauna species (i.e., rapid biodiversity surveys).
- Consent/permission from the community to undertake the field.
- Forest protection and forest use/ecosystem services.
- At a broad level, the importance of forest conservation.
- Areas where logging takes place.
- Fauna species seen by locals in their greater forest and farm areas.
- Attitudes to, and perceptions of Natural Habitats and the Project.

Natural Habitats has a dedicated Community Affairs Manager (Mr. Alie Bao) based on site. He has a team of assistants who are charged with undertaking on-going community consultation and stakeholder engagement within the concession.

2.6. Forest and Tree Biomass

Biomass of forests is relevant to issues related to global change. For example, the role of tropical forests in global biogeochemical cycles, especially the carbon cycle and its relation to the greenhouse effect, has heightened interest in estimating the biomass density of tropical forests. The biomass of forests provides estimates of the carbon pools in forest vegetation because about 50% of it is carbon. Consequently, biomass represents the potential amount of carbon, which can be added to the atmosphere as carbon dioxide when forest is cleared and/or burned. Attempts to estimate the biomass density of tropical forests have been made by the scientific community for use in models that assess the contribution of tropical deforestation and biomass burning to the increase in atmospheric carbon dioxide and other trace gases (Brown, 1997).

Biomass is defined as the total amount of above-ground living organic matter in trees expressed as oven-dry tons per unit area (tree, hectare, region, or country). It is referred to as biomass density when expressed as mass per unit area, e.g., tons per hectare. The total biomass for a region or country is obtained from the product of biomass density and the corresponding area of forests. For most forests or tree formations, biomass density estimates will be based only on the biomass in trees with diameters greater than or equal to 10 cm, which is the usual minimum diameter measured in most inventories of closed forests (Brown, 1997).

Above Ground Live Biomass (AGLB) was calculated and then used to determine the Total Carbon (ton/hectare) for each plot, which was then used for comparison purposes in determining and delineating high HCS forest, medium HCS forest, and low HCS forest. It must be noted that the HCS team's observations on the quality and density of trees within a particular plot (and associated forest patch), were also used as an important factor when classifying high, medium or low HCS forest.

3. HCS STUDY LIMITATIONS

There were some limitations to the HCS study, including:

- The fieldwork took longer than initially envisaged, owing to lengthy meetings with communities to explain the nature and reasons for the field work, and to gain their permission to undertake the fieldwork in their forest patches. Based on this, 13 plots were completed while the ME team members were on site, and the remaining 10 plots were completed by the Natural Habitats team (after the ME had left site);
- The guidance information provided in the HCS Approach Toolkit on allmotetric equations and associated calculations was relatively limited (regarding the AGLB and estimated total carbon (ton/ha)). ME referred to www.golballometree.org for different allometric equations; there are thousands of equations from which to choose, and none apparently focussed solely on Sierra Leone or Upper Guinean forest. Thus, generic/general allometric equations were used, such as the equation for wet tropical forests (Chave, et. al. 2005);
- The methodology did not account for all AGLB (e.g., by excluding trees with DBH less than 10 cm, and AGB dead matter such as logs and branches) and below-ground biomass, meaning carbon was potentially underestimated;
- Field surveys were limited only to areas where permission was obtained from the local communities;
- Field survey areas/forest patches surveyed were partly based on their accessibility. Some of the remnant forest patches within the concession are remote and have no roads or tracks nearby. More remote forest patches within the NH concession where thus not surveyed.
- Satellite images were of low to medium resolution and were two years old at the time of the HCS assessment.

4. DESCRIPTION OF THE NATURAL HABITATS CONCESSION

This section is a summary description of the Natural Habitats and is partly based on existing reports for the concession (the Natural Habitats ESIA Report, and High Conservation Value Report).

4.1. Site Description

The Project is in the Makpele Chiefdom, Pujehun District, Southern Province, Sierra Leone (Figure 3.2-1 and Figure 3.2-2). The four Administrative Sections are: the Samagbe, Selimeh, Seitua and Kengo Sections (Figure 3.2-2). Zimmi Town, the administrative headquarter town, is in Selimeh Section. The total area of the Natural Habitats concession is approximately 41,218.4 ha.

The concession is approximately 351 km southeast of Freetown; the journey takes approximately 5-8 hours by road. Road conditions from Freetown to Bo Town are generally good and surfaced (tarmac) while the roads from Bo Town to Makpele Chiefdom are laterite and need extensive repairs (INTEGEMS ESIA, 2016). Currently, the Monrovia (Liberia) to Freetown highway is being upgraded, and this will greatly improve conditions and travel time from Bo to Zimmi.

The dominant landuse in the area is subsistence agriculture, which is the basis for the livelihoods of the majority of forest-edge communities (Bulte *et al.* 2013).

The concession/Project area is a contiguous parcel of shrub-land. About 20% of Makpele Chiefdom is covered by the Gola Rainforest National Park (7,925 ha) in the north and northeast of the Chiefdom.

Total plantable area (excluding the GRNP leakage belt, HCV areas, and buffers) is approximately 15,680.65ha. Natural Habitats is planning to develop a 10,000 ha nucleus plantation; with up to another 5,000 ha being farmed through an outgrowers scheme. Natural Habitats plans to plant up to a total of 15,000 ha within its concession.

4.1.1 The Concession and Important Aspects for the HCS Assessment

For an HCS assessment, different scales of information and data sources are required, broadly classified as: global, regional, national, local and site-specific (Brown *et al.,* 2013). Scales used can be global (such as IUCN Red Data lists, Ramsar sites, IBAs and Alliance for Zero Extinction sites), regional (such as the WWF Ecoregions and associated data, CARPE landscapes), national (such as the presence of national protected areas). Additional, local-scale data includes the site surveys and fieldwork, and available literature.

Global and Regional Scale Information for the Concession:

The Natural Habitats concession is in a biodiversity hotspot (Myers, 2000), namely, the Upper Guinean Rainforest; which places conservation significance of the site from an international perspective.

The concession is in a global ecoregion (WWF), namely, the Tropical and Subtropical Moist Broadleaf Forests. This indicates the ecological sensitivity of the site for large vertebrates, water resources and forest flora.

The site is in the Gola Forest Reserve IBA, which places conservation significance on the site from an avifaunal perspective.

National Scale Information for the Concession:

The GRNP serves as a critical biodiversity resource for Sierra Leone, conserving numerous endemic and Red Data species and supporting exceptional biodiversity. The GRNP has been identified as a Key Biodiversity Area (KBA) by the IUCN (Kouame *et al.* 2012).

Local Information for the Concession:

On a local-scale, the forest and associated habitat provides significant ecosystem services to the local communities on the forest edge that are dependent on the forest for basic needs.

The concession is considered as part of the wider landscape as per HCS and HCV requirements (Brown *et al.,* 2013). As such, protected areas, regional biogeography and other aspects have been considered.

Although the HCS survey focused on the concession, the area of influence was deemed to be the concession area and immediately adjacent area including the southern boundary of the GRNP and the leakage belt. Where natural forest has been cleared in the leakage belt, the land is typically used for intercrop subsistence farming of rice and vegetables for 1-2 years before being left unplanted for an average of 7 years (RSPB, 2013).

4.2. Climate

The climate of the area of interest is wet and tropical, with a mean monthly temperature of 26^{o}C (CBD, 2003; RSPB, 2015), with a mean annual precipitation reported by White (1972) to be between 2576mm and 2770mm between Daru and Kenema. The dryer season is from December to March and the rainy season is between July and August (over 550mm/month). Figure 5 shows the monthly precipitation trends for the area.

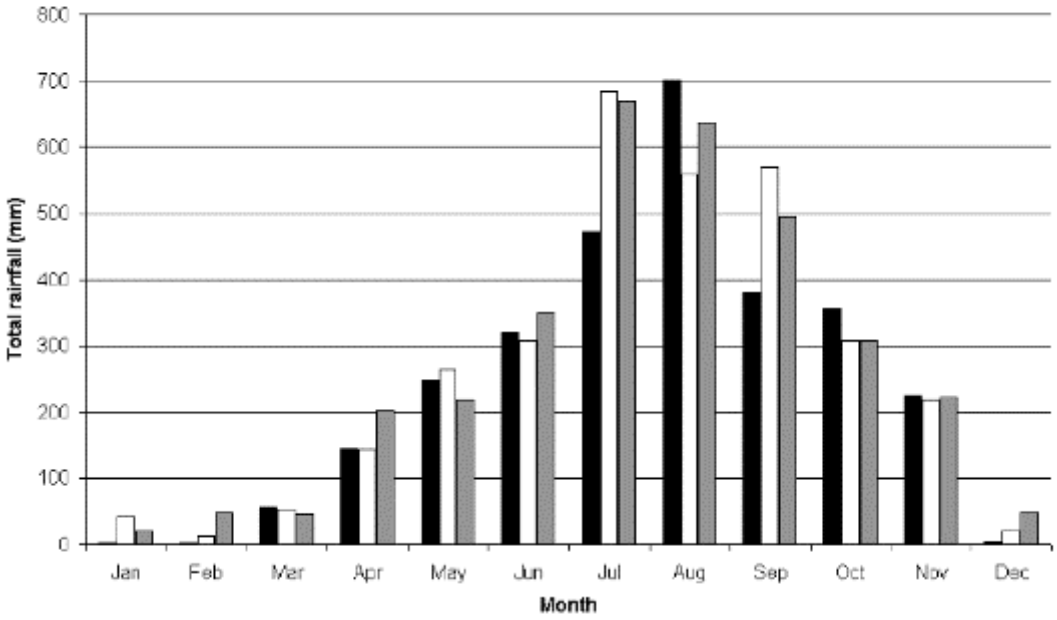

Figure 5: Annual rainfall data for the GRNP region (RSPB, 2013)

4.3. Hydrology

The area of influence includes important catchments of the Moro, Mano, Mahoi and Moa Rivers; these are important sources of water to the local people (RSPB, 2015).

The Makpele Chiefdom, like most parts of Pujehun District, is drained by two major rivers (the Moa River to the west, and the Mano River to the east). About 75% of Samagbe Section is drained by the Mano River, which forms the boundary with the Republic of Liberia, and a major tributary (Mahoi) is found to the west flowing in the north-south direction close to Zimmi Town. A tributary of the Mahoi River also passes south of Kengo Section. Selimeh, Seitua and Kengo are drained largely by tributaries (e.g., Majei, Yambase, Golia, Yebo, Konjajei, Mosakpa) from the Moa River and Mahoi River. Because of the forest cover most of the large rivers are perennial and the streams are ephemeral and tend to break up in some areas. There are a number of inland valley swamps and wetlands within the concession (INTEGEMS, 2016).

Figure 6 and 7 show the Mahoi River in the concession, south-east of Zimmi.

Figure 6 and Figure 7: The Mahoi River flowing through the Natural Habitats concession

4.4. Land use

The main land uses include agriculture practiced by local communities, artisanal alluvial diamond mining (in the south-east of the concession, closer to the Mano River), oil palm plantations (owned by local people and by Natural Habitats), small rubber tree plantations, and natural forest (used by local communities (e.g., for timber, medicinal plants, and hunting).

Local communities generally use slash-and-burn agricultural methods, whereby trees and larger plants are cut down/slashed. The brush is then burnt and cleared, paving the way for planting crops. The main crop/fruit species planted include cassava, oil palm, rice, banana, coffee, plantain, yam, groundnuts and sorghum. Slash-and-burn agriculture is the dominant land-use in the concession.

Figure 8: A local farm is cleared in preparation for planting

Figure 9: Slash-and-burn agriculture in the concession

Figure 10: Local villagers' oil palm plantation near Jabima Village

Figure 11: Natural Habitats oil palm plantation west of Zimmi.

4.5. Regional Biodiversity

Located on the edge of the Upper Guinean Forest ecosystem and listed on the WWF's critical regions for conservation, Sierra Leone supports a variety of important biodiversity landscapes and features and is globally significant (Brown and Crawford, 2012). Only four percent of the total landmass is under statutory protection, 48 forest reserves and conservation areas, covering an area of 284 591ha. Priority ecosystems include the Western Area Peninsula Forest Reserve, the Gola Rainforest, Loma Mountains, Tingi Hills and the Kangari Hills. Pressures that exist for biodiversity in Sierra Leone include population growth, mining, agriculture, logging and fisheries.

The Upper Guinean forests is a tropical seasonal forest region of West Africa. These forests extend from Guinea and Sierra Leone in the west through Liberia, Côte d'Ivoire and Ghana to Togo in the east, and a few hundred kilometres inland from the Atlantic coast.

These Upper Guinean moist forests are much affected by winds from the hot dry area to the north and the cool Atlantic currents. This gives the region a very seasonal climate with over 80 in (203 cm)

of rain falling in some areas in the wet season. Over 2000 species of vascular plant have been recorded in the ecoregion, and mammals found here include the chimpanzee (*Pan troglodytes*), leopard (*Panthera pardus*), pygmy hippopotamus (*Hexaprotodon liberiensis*), Ogilby's duiker (*Cephalophus ogilbyi*), Nimba otter shrew (*Micropotamogale lamottei*) and the African golden cat (*Profelis aurata*).

The WWF divides the Upper Guinean forests into three ecoregions:

- The Western Guinean lowland forests extend from Guinea and Sierra Leone through Liberia and south eastern Côte d'Ivoire as far as the Sassandra River;
- The Eastern Guinean forests extend east from the Sassandra River through Côte d'Ivoire and Ghana to western Togo, with a few isolated enclaves further inland in the highlands of central Togo and Benin; and
- The Guinean montane forests are found at higher elevations in the Guinea Highlands, which extend through central and south eastern Guinea, northern Sierra Leone, and eastern Côte d'Ivoire.

The poor state of vegetation in Sierra Leone is, almost everywhere, the result of the heavy pressure exerted by a very dense population. Only few, very limited areas of the country carry a climax vegetation (FAO, 1984).

In terms of the key vegetation types in Sierra Leone, three major vegetation zones occur from the southwest coast to the interior, namely coastal mangrove, forest and savanna. The forest and savanna zones have a less dense drainage pattern than the mangrove zone and tend to have fairly flat and narrow inland valleys which are seasonally flooded. The following describes the key vegetation types in south eastern Sierra Leone (where the Natural Habitats concession is located):

- Closed broadleaved forests (NHC) – Closed forests on dry lands are either moist evergreen or semi-deciduous forests and are mostly located in forest reserves on hill slopes (Gola, Kambui, Nimini, Dodo Hills, Freetown Peninsula, Tama-Tonkoli, Kasewe, Loma and Tingi Hills). They have a closed canopy and trees over 30 m high and are generally nature secondary forests, with a large number of species and a very uneven distribution. The moist semi-deciduous forests are found on the Loma Mountains and the Tingi Hills forest reserves, and also in Kasewe, Tonkoli, Golama North and Golama South forest reserves and in extension 1 of Gola East forest reserve. The former ones gradually change into sub-montane gallery forests reaching 1 700 m altitude. In such situations epiphytes are abundant. Patches of degraded forest occur, where large trees have been removed for timber or with an undergrowth of cocoa or coffee, often on the fringes of cultivated areas or in the more accessible locations of the forest areas. Typical moist evergreen forest trees are: *Lophira alata, Heritiera utilis, Klainedoxa gabonensis, Uapaoa guineensis, Oldfieldia africana, Erythrophleum ivoransis, Brachystegia leonensis and Piptadeniastrum africanum*. Common semi-deciduous forest trees are *Daniallia thurifera, Terminalia ivorensis, T. superba, Parkia bicolor and Anthonotha flagrans*, which are associated with evergreen trees such as: *Parinari excelsa, Bridelia grandis, Treculia africana* and *Pycnanthus angolenais*. Logging has been going on for several decades and there is practically no virgin forest left (FAO, 1984).

- Young secondary forests deriving from former clearing by agriculture of the forests on dry land are mainly found in the south eastern part of the country on hill slopes. They have a closed canopy and trees range in height from 10 to 30 m. The majority of the tree species are fast-growing and more or less even-aged with distinctive small crowns. They are replaced by slow-growing typical high forest species as the forest matures. Tree-crop species and a few large forest trees left standing after farming are also common. Secondary forest trees include *Musanga cecropioides, Carapa procera, Macaranga barteri, Anthocleista nobilis, Bridelia*

micrantha, Myrianthus arboreus, Phyllanthus discoideus and *Sterculia tragacantha*. These species are confined to the lowest tree stratum. They are overtopped by typical mature forest species such as *Afzelia africana, Albizia zygia, Uapaca guineensis, Daniellia thurifera, Terminalia superba, Parkia bicolor* and *Entandrophragma utile*. Associated tree-crop species are *Wangifera indica, Elaeis guineensis* and *Cola nitida* (FAO, 1984).

- Secondary forests are a locally exploited as a source of timber and firewood. Near villages, they provide a suitable habitat for an undergrowth of cocoa and coffee. A large proportion of this type occurs outside forest reserves and is thus the object of further degradation where population pressure is high (FAO, 1984).

The purpose of National Parks is to secure an area for propagating, conserving and managing wildlife and natural vegetation; as well as protecting sites, landscapes or geographic formations from damage or loss. National legislation that limits land use in National Parks in Sierra Leone include: The Forestry Act of 1988, the Forest Regulations of 1990 and the Wildlife Act of 1992.

The GRNP covers an area of over 71, 070ha in the Kailahun, Kenema and Pujehun Districts, south-east Sierra Leone (Brown and Crawford, 2012) (Figure 12). In addition to surrounding forests, this represents the largest remaining Upper Guinean Tropical Forest in Sierra Leone (RSPB, 2015). The Upper Guinean Tropical Forest is a recognised global Biodiversity Hotspot (Myers, 2000). The GRNP supports exceptional biodiversity, including more than 330 bird species, over 40 mammal species (Lindsell et al. 2011), 600 butterfly species and 1000 plant species. The area supports 60 threatened species, 8 of which are endangered and 1 of which is critically endangered (Klop et al. 2008 in RSPB, 205).

Figure 12: The entrance to the Gola Rainforest National Park

Figure 13: The road going through the Gola Rainforest National Park

4.6. Vegetation of the Natural Habitats concession

The forest of the GRNP comprises Upper Guinean Forest vegetation (RSPB, 2013) and is regarded as a centre of diversity and endemism (Klop *et al.* 2008). Due to a history of logging, much of the forest is regarded as regenerated secondary forest; although primary patches do occur. Vegetation of the GRNP is typified by dominant upper canopy species: *Hertiera utilis* and *Cryptocepalum tetraphyllum* and lower strata species: *Erythrophleum ivorens, Lophira alata, Brachystegia leonensis* and *Didelotia idae.*

Although the IUCN Red List is incomplete, 33 threatened plant species are listed for the GRNP (Klop *et al*. 2008). Of the 599 forest plant species that are endemic to the Upper Guinea Forest, 120 have been recorded in the GRNP. Red Data listed species that are found in the National Park are found in similar forest habitat within the concession area, particularly along the riparian fringe vegetation that follows rivers and streams. Disturbed areas such as villages and cultivated swamps, however, are not likely to have the propensity to support Red Data-listed plants. Threatened and endemic plant taxa that are typical of the GRNP are listed in Table 1 below. The figures below are photographs of vegetation types and flora species within the concession.

Table 1: Threatened and endemic plant species of the GRNP

Scientific Name	Threat Status
*Albizia ferruginea**	Vulnerable
Cola acuminata	Regionally endemic
Eribroma oblonga	Vulnerable
Gilbertiondendron ivorense	Regionally endemic
*Tieghemella heckelii**	Endangered
*Terminalia ivorensis**	Vulnerable

Key: * denotes species recorded during site investigations for the HCS (2017) and HCV (2016) assessments

Figure 14: Old farm land (i.e. previously cleared forest) with a remnant forest patch in the background, within the concession

Figure 15: Bambusoideae.sp

Figure 16: African Satinwood (Zanthoxylum gilletii)

Figure 17: The large buttress of a Hertiera utilis species within a remnant forest patch

Figure 18: View from the road between Zimmi and the GRNP, looking east

4.7. Fauna of the Natural Habitats Concession and Gola Forest

4.7.1 Mammals

Of the over 40 large mammal species that occur in the GRNP, the RSPB (2015) and GRNP staff have reported four listed species as Endangered (i.e. Western Red Colobus (*Piliocolobus badius)*, Western Chimpanzee *(Pan troglodytes verus)*, Pygmy Hippopotamus *(Choeropsis liberiensis)* and Jentink's Duiker *(Cephalophus jentinki)),* and seven are Vulnerable (Table 2). Additional Red Data-listed species have been recorded and attached in Appendix 3.

According to the Gola Red Project (2013), recent surveys of small terrestrial mammals in the Gola Forest within the National Park identified 26 species of shrews and rodents. Three of these species are Upper Guinea endemics and two species are restricted to the Gulf of Guinea and are classified as Near-threatened.

Several of the Red Data Mammals that are known to occur within the forested areas within the concession were directly observed during the HCV assessment. The majority were close to the boundary of the GRNP but also within the remnant forest patches of the leakage belt and along the river systems. The larger species seem to prefer pristine forest, secondary forest and at times venture into the farmlands according to villagers that were interviewed during the survey. These RTE species are prone to impacts and disturbance such as hunting, forest degradation and expansive subsistence farming.

Examples of observed species during the HCS and HCV assessment include the vulnerable Western Pied Colobus *(Colobus polykomos)* and Diana Monkey *(Cercopithecus diana*), which were both observed within the boundary area of the GRNP, with the near threatened Olive Colobus *(Procolobus verus)* and Sooty Mangabey *(Cercocebus atys)* observed within the leakage belt and the town of Salaam located in the east of the concession. These primates are not only indicators for the status of the forest habitat and for the pressure from hunting. They are also very important seed dispersers thus playing an important role in forest ecology. They are a diverse group with some species being dependent on relatively undisturbed forest, making them valuable indicators of forest conditions.

Table 2: Threatened mammals recorded in the GRNP (RSPB, 2015)

English Name	Scientific Name	Threat Status (IUCN)
Western Pied Colobus	***Colobus polykomos***	**Vulnerable**
Western Red Colobus	*Piliocolobus badius*	Endangered
Olive Colobus	***Procolobus verus***	**Near Threatened**
Sooty Mangabey	***Cercocebus atys***	**Vulnerable**
Diana Monkey	***Cercopithecus diana***	**Vulnerable**
Western Chimpanzee	***Pan troglodytes verus***	**Endangered**
Pygmy Hippopotamus	*Choeropsis liberiensis*	Endangered
Jentink's Duiker	*Cephalophus jentinki*	Endangered
Zebra Duiker	*Cephalophus zebra*	Vulnerable
African Forest Elephant	*Loxodonta cyclotis*	Vulnerable
Golden Cat	*Felis aurata*	Vulnerable
Long-tailed Pangolin	*Uromanis tetradactyla*	Vulnerable
Obscure White-toothed Shrew	*Crocidura obscurior*	Endemic
Cansdale's Swamp Rat	*Malacomys cansdalei*	Endemic
Large-headed Forest Shrew	*Crocidura grandiceps*	Near Threatened
Buettikofer's Shrew	*Crocidura. buettikoferi*	Near Threatened

4.7.1.1. Hunting for bush meat

The bush meat and hunting trade within the concession and the Makpele Chiefdom is relatively large and would be considered a priority to address in order to conserve and sustain a number of different mammal and avifaunal species located within the concession. The majority of local villages located within the concession are involved in utilising the surrounding forest habitat as a resource for meat. It is recommended that Natural Habitats management adopt an education programme with suggestions for possible alternatives to hunting wildlife within the concession. The majority of mammal species observed were either caught in traps or already killed through hunting. Examples of the species that were observed to have been killed or caught included: Sooty Mangabay *(Cercocebus atys)*, Campbell's Monkey *(Cercopithecus campbelli)* and a juvenile Bushbuck *(Tragelaphus scriptus)*, as shown in the figure below.

Figure 19: Examples of animals caught for bushmeat purposes A):Campbells Monkey (Cercopithecus campbelli), *B: Sooty Mangabay* (Cercocebus atys) *C: Maxwells Duiker* (Philantomba maxwelli)

4.7.2 Avifauna

The GRNP falls within the Important Bird Area (IBA) and, therefore, is regarded as ornithologically sensitive on a landscape level (www.birdlife.org).

A total of 327 bird species have been recorded within the GRNP and immediate vicinity. Within the region of the Gola Rainforest, where the Natural Habitats Concession is located, 23 species of global conservation concern are known to occur.

One species, the Hooded Vulture *(Necrosyrtes monachus)*, is now considered Critically Endangered and was observed flying over the town of Zimmi. Although this is a trigger for HCV 1, its wide range, and the fact it travels large distances in the search of food does not indicate that the area within the town of Zimmi needs to be classified as such.

The Gola Malimbe (*Malimbus ballmanni*) is regarded as both endemic to the Gola Rainforest and Endangered although it was not recorded during this survey.

Species that have been observed in the GRNP and may occur within the concession of close to the boundary include nine species that are regarded as Vulnerable and ten species that are regarded as Near Threatened. Sixteen of the species of global conservation significance are dependent on forest or forest-edge habitat both of which occur within the Makpele Chiefdom specifically, but not limited to the GRNP. Due to the leakage belt being in place and the corridors that are proposed the impact to these species is regarded as medium to low. Table 3 lists the threatened avifaunal species recorded for the GRNP (RSPB, 2015); although additional species were recorded in the field surveys (see section 6).

Table 3: Threatened birds recorded in the GRNP (IUCN Red List, 2015; RSPB, 2015)

Common Name	Scientific Name	Global Status
Hooded Vulture	***Necrosyrtes monachus***	**Critically Endangered**
Gola Malimbe	*Malimbus ballmanni*	Endangered
Lagden's Bush-shrike	*Malaconotus lagdeni*	Near Threatened
African Skimmer	*Rynchops flavirostris*	Near Threatened
Shelley's Eagle-owl	*Bubo shelleyi*	Near Threatened
Copper-tailed Glossy-starling	*Lamprotornis cupreocauda*	Near Threatened
Green-tailed Bristlebill	*Bleda eximius*	Near Threatened
Black-headed Rufous Warbler	*Bathmocercus cerviniventris*	Near Threatened
Rufous-winged Illadopsis	*Illadopsis rufescens*	Near Threatened
Red-fronted Antpecker	***Parmoptila rubrifrons***	**Near Threatened**
Blue-moustached Bee-eater	*Merops mentalis*	Near Threatened
Crowned Eagle	*Stephanoaetus coronatus*	Near Threatened
Western Wattled Cuckooshrike	*Campephaga lobata*	Vulnerable
Yellow-casqued Hornbill	***Ceratogymna elata***	**Vulnerable**
Nimba Flycatcher	*Melaenornis annamarulae*	Vulnerable

Common Name	Scientific Name	Global Status
Rufous Fishing-owl	*Scotopelia ussheri*	Vulnerable
White-breasted Guineafowl	*Agelastes meleagrides*	Vulnerable
White-eyed Prinia	*Prinia leontica*	Vulnerable
Yellow-bearded Greenbul	*Criniger olivaceus*	Vulnerable
Brown-cheeked Hornbill	*Bycanistes cylindricus*	Vulnerable
White-necked Picathartes	*Picathartes gymnocephalus*	Vulnerable
Yellow-footed Honeyguide	*Melignomon eisentrauti*	Data deficient

Figure 20: A) White-throated Bee-eater (Merops albicollis)*; B) Palmnut Vulture* (Gypohierax angolensis)*; C) Red Vented Malimbe* (Malimbus statatus)*; D) African Harrier Hawk* (Polyboroides typus)

4.8. Socio-Economic Context

The area of direct socio-economic influence was considered to be 5km around the plantable area based on a review of the population and economic assets likely to be influenced by the Project. This zone covers the Sorogbema Chiefdom in the south, Gallinasperi Chiefdom in the west, the Barri Chiefdom in the north-west, the Tunkia Chiefdom in the North, and the Republic of Liberia in the east.

Women are under-represented in almost all non-agricultural employment fields. Gender parity in senior positions is particularly low. Children and women are the most vulnerable and constitute the most powerless and poorest groups in the rural communities and in the Chiefdom, especially as these bear the heaviest burden of acute poverty and deprivation.

The communities in the Project area are underdeveloped with poor access to improved water sources, limited sanitation services, and limited provision of power for lighting or cooking. The access and provision of basic health services are major concerns in most of the communities covered by the

Scoping site visit and a requisite condition for a healthy work force. Significant health threats include HIV/AIDS, malaria, cholera, intestinal worms, typhoid and dysentery. The recent outbreak of Ebola virus has also impacted on the Project area (and the entire Sierra Leone) affecting both people and health service provision.

Agriculture is the main livelihood occupation within the concession, as was revealed by the community members met with during the HCS stakeholder engagement. Areas cultivated range from about 1 acre to 100 acres in size, depending on the type of crops cultivated. Poultry (chicken and ducks), sheep and goats are the livestock reared within the Project area. These livestock are mostly reared by free-range feeding, being let loose in the morning and confined late in the evening. Fishing is mainly carried out in the Mahoi, Yebo, Mano, Majei, Konjajei, Yambase and Mosakpa rivers, and in streams in close proximity to the different settlements. Hunting is limited to the use of traps and dogs rather than guns (gun use is prohibited).

Artisanal mining is not a common activity but is undertaken in the Project area. Alluvial diamond mining locations are inland valley swamps, the beds of the Mahoi River and Mano River, river terraces (i.e. alluvial mining), and uplands. Recreational facilities in most of the settlements/villages mainly comprise football fields, and athletics tracks. Craft persons were evident (e.g., carpenters, masons, tailors, weavers of fishing nets (Baimbay), country clothes, winnowers, baskets, hammocks and mats).

Figure 21: Typical houses in the villages of the concession

Figure 22: Village borehole in Tuasu Village

Figure 23: The main road through Zimmi town

Figure 24: A farmer on the way to his farm to collect coconuts from the indigenous palm trees

5. HCS STUDY RESULTS

Based on the HCS Approach Toolkit (2015), the ME HCS calculations included the following:

1) The tree density (or stocking rate) of a forest is described as the number of trees per hectare. This was calculated for each plot as follows: Tree density (stems/ha) = Trees in plot / Plot area (ha). Thus, tree density was calculated for each plot.

2) An estimation of tree density for all the random forest plots surveyed in the Natural Habitats concession was undertaken as follows: Tree Density per hectare = Average number of trees in all plots * 10, 000 sq. meter/1000 sq. meter

   Where: Ave. no. of measured trees per plot for the ME HCS assessment = 9.9 individual trees.

   - 1 ha = 10,000 sq. metres.
   - Plot size = 20 by 20 m = 400 sq. metres = 0,04ha
   - 0.04 x 25 = 1 hectare

An average of 10 individual trees was obtained per quadrant of 20 by 20 m during the tree inventory. **Thus, tree density/concentration per hectare in the study area is an average of 250 trees/ha**. The forest was not very dense in terms of tree density per hectare, notably because of the different logging and associated activities that occurred in this area in the past.

3) The carbon stock was estimated for all living trees with DBH larger or equal to 10cm using the Allometric Equations method. The following equation for wet tropical forests (Chave, *et. al*. 2005) was applied. This widely used equation relates DBH, total tree height and species specific wood density (ρ) to estimate Above Ground Live Biomass (AGLB) per tree measured in the forest plots.

   The resulting AGLB is the total biomass of the stem, crown, and leaves for trees in kilograms.

   $$\mathbf{AGLB_i = 0.0776[\rho_i D^2_i H_i]^{0.940}}$$

   Where: AGLB = Above ground live biomass in **kilograms.**

   ρ_i = density of tree (i) in **grams per cubic cm**.

   D_i = diameter of tree (i) in **cm**.

   H_i = height of tree (i) in **meters.**

   Note: A key assumption regarding the calculation of AGLB:
   ρ (i.e. Specific gravity in grams per cubic centimetre) was taken to be **0.55 ton / green m^3** for tropical tree species, as per the HCS Approach Toolkit (2015).

   Note: Metric tonnes were used for calculation purposes.

4) Calculation of Tree Carbon (i.e. Carbon per tree)

   The equation used for estimating Tree Carbon Content is:

   Carbon Mass (tonne) = Biomass * (Carbon conversion factor)

   The carbon conversion factor estimates the carbon component of the vegetation biomass. This can be derived for specific forest types or the IPCC standard value of 0.47 can be used. In this analysis the IPCC standard value of **0.47** was used.

   Thus, the carbon released *per tree* is given by

   $c_i = 0{,}47 * AGBL_i$ (**in kilograms**)

5) Calculation of Carbon per Plot

   The carbon released *per plot* is obtained by summing the carbon released per tree in the plot over all the measured trees:

   $C_p = \Sigma\, C_i$

   This gives the carbon released *per plot in **kilograms***.

6) Calculation of Carbon Mass in **Tonnes per Hectare**

Each plot will be analysed to provide estimates of tree carbon mass per ha. The equation for estimating tree carbon mass per hectare in each plot is:

Total Carbon (tonne/ha) = Σ ([Tree Carbon]) / [Plot size in hectares]

Since the plots are 20m x 20m in size, the carbon released *per plot* in **tonnes per hectare** is given by:

$C_p/(20x20)(kg/m^2)x(1/1000)(ton/kg)x10000(m^2/ha)$ = **C_p/40 (ton/ha)**.

(Thus, in the case of this HCS assessment, the value given by equation 5 above (i.e. $C_p = \Sigma C_i$) is simply divided by 40 to give the carbon released in **metric tonnes per hectare**).

5.1. HCS Random Plots – Descriptions and Results

The following sections summarise the data for each plot that was obtained by means of the field surveys. Each plot and associated forest patch are briefly described, the AGLB and Tree Carbon per tree are provided, as well as the tonnes of carbon per hectare for each plot. A few photographs of each plot (where available) are also provided.

5.1.1 Plot 1

Date: Wednesday 8th March 2017

Village: Tuasu

Plot 1	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.99	0.9	30	5108.25	2400.88
Tree 2	0.68	0.22	20	246.90	116.04
Tree 3	1.4	0.34	25	690.31	324.45
Tree 4	0.6	0.22	20	246.90	116.04
Tree 5	0.9	0.27	20	362.86	170.54
Tree 6	1	0.29	20	415.03	195.06
Tree 7	0.5	0.2	20	206.40	97.01
Tree 8	0.46	0.14	20	105.56	49.61
Tree 9	0.45	0.14	20	105.56	49.61
Total	----	----	----	----	**3519.25**

Average tonnes of Tree Carbon per hectare = 87.98

Brief Description of Forest Patch and Plot 1:

Plot 1 is in the forest patch adjacent to Tuasu Village. This forest patch is protected by the local people of Tuasu (and has been protected historically). The forest patch is thus relatively unmodified and contains large trees, most notably those of the *Fabaceae* and *Combretaceae* species. The HCS of this patch was relatively low.

Tree Density of Plot 1:

Tree density (stems/ha) = Trees in plot / Plot area (ha).

For Plot 1: 9/0.04 = 225.

Figure 25: The edge of the Tuasu forest patch, looking towards it from farm land. Plot 1 was located within the forest seen in this photograph

Figure 26: Measuring a tree in Plot 1

Figure 27: Measuring a tree in Plot 1

Figure 28: Forest in Plot 1

Figure 29: Forest in Plot 1

Figure 30: Forest in Plot 1

Figure 31: Measuring a tree in Plot 1

5.1.2 Plot 2

Date: Wednesday 8th March 2017

Village: Tuasu Graveyard

Plot 2	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	6.55	1.3	40	13364.49	6281.31
Tree 2	0.7	0.4	25	937.00	440.39
Tree 3	0.7	0.22	20	246.90	116.04
Tree 4	1.1	0.3	25	545.57	256.42
Tree 5	0.85	0.29	25	511.89	240.59
Tree 6	0.9	0.32	20	499.40	234.72
Tree 7	1.4	0.45	20	948.00	445.56
Tree 8	0.8	0.26	20	338.00	158.86
Total	----	----	----	----	**8173.90**

Average tonnes of Tree Carbon per hectare = 204.35

Brief Description of Plot 2:

Plot 2 is in the same forest patch as Plot 1, near Tuasu Village. This plot is more central in the forest patch, and locals said that the plot is within the old Tuasu Graveyard. This plot has larger trees as compared to Plot 1, notably large *Hertiera utilis* trees, with large diameters.

Figure 32: Measuring a large Hertiera utilis tree in Plot 2.

Figure 33: The buttress of a large Hertiera utilis tree in Plot 2

Figure 34: Smaller Hertiera utilis tree in Plot 2

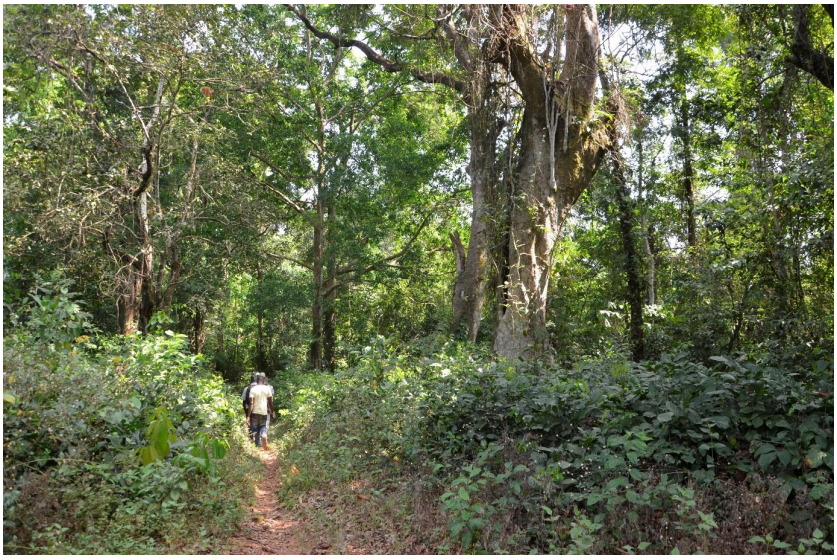

Figure 35: Path through the forest patch were Plots 1 and 2 are located

Figure 36: Forest in Plot 2

Figure 37: Forest in Plot 2

Figure 38: Measuring a tree in Plot 2

Figure 39: Forest in Plot 2

Figure 40: Forest in Plot 2

5.1.3 Plot 3

Date: Wednesday 8th March 2017

Village: Jabima

Plot 3	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	9.5	1.25	45	13867.98	6517.95
Tree 2	1.4	0.43	15	664.12	312.14
Tree 3	0.65	0.2	15	157.49	74.02
Tree 4	0.7	0.24	15	221.88	104.29
Tree 5	1.1	0.35	25	728.98	342.62
Tree 6	0.5	0.17	15	116.03	54.53
Tree 7	0.6	0.2	15	157.49	74.02
Tree 8	6.6	2.2	35	31694.31	14896.32
Total	----	----	----	----	**22375.90**

Average tonnes of Tree Carbon per hectare = 559.40

Brief Description of Plot 3:

Plot 3 is described as degraded secondary forest with several larger *Hertiera utilis* trees that have not been logged or removed. The biodiversity was low during the time of the survey and this is likely to be due to the close proximity of human activity, including subsistence farming.

Figure 41: HCS survey team in Plot 3

Figure 42: Village path connecting farming plots

Figure 43: Forest in Plot 3

Figure 44: Plot 3 on the right of the forest path

Figure 45: Forest in Plot 3

Figure 46: Measuring a tree in Plot 3

Figure 47: A butterfly in Plot 3

5.1.4 Plot 4

Date: Thursday 9th March 2017

Village: Gene

Plot 4	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	1.37	0.39	20	724.39	340.46
Tree 2	1.66	0.74	25	2978.67	1399.97
Tree 3	1.34	0.4	20	759.70	357.06
Tree 4	6.4	2.3	35	34456.80	16194.70
Tree 5	0.93	0.37	15	500.67	235.31
Tree 6	0.97	0.33	15	403.77	189.77
Tree 7	2.1	0.71	25	2755.70	1295.18
Tree 8	0.84	0.3	20	442.34	207.90
Tree 9	0.79	0.29	20	415.03	195.06
Tree 10	0.55	0.18	15	129.19	60.72
Total	----	----	----	----	**20476.14**

Average tonnes of Tree Carbon per hectare = 511.90

Brief Description of Plot 4:

Plot 4 of the HCS survey is on the south-western boundary of the concession. The forest is close to an unnamed stream and was therefore considered to be of relatively high HCS due to the density of species and the size of the individuals.

Figure 48: Measuring a Hertiera utilis tree

Figure 49: Fairly common within the concession – Zanthoxylum gilletii

Figure 50: Forest path with Plot 4 on the left

Figure 51: Accessing Plot 4

Figure 52: Hertiera utilis tree in Plot 4

Figure 53: Plot 4 on the left of the path

5.1.5 Plot 5

Date: Thursday 9th March 2017

Village: Giehun

Plot 5	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	0.49	0.16	15	103.53	48.66
Tree 2	2.55	0.82	30	4288.12	2015.42
Tree 3	1.12	0.39	20	724.39	340.46
Tree 4	1.29	0.45	25	1169.25	549.55
Tree 5	0.49	0.12	15	60.28	28.33
Tree 6	1.09	0.34	20	559.69	263.06
Tree 7	1	0.37	15	500.67	235.31
Tree 8	0.52	0.2	15	157.49	74.02
Tree 9	1.1	0.4	15	579.70	272.46
Tree 10	1.17	0.37	20	656.13	308.38
Tree 11	1.7	0.6	25	2008.12	943.82
Total	----	----	----	----	**5079.47**

Average tonnes of Tree Carbon per hectare = 126.99

Brief Description of Plot 5:

Plot 5 consists of low HCS forest as it is an extremely small patch adjacent to a road near the village Gofo. This forest patch is considered an area of spiritual importance by the local villagers and one is not allowed to enter the area without consent from the local headman.

Figure 54: The forest patch of Plot 5 – relatively low HCS due to size of trees in forest patch

Figure 55: Forest in Plot 5

Figure 56: Plot 5 – young Hertiera utilis tree

Figure 57: Forest in Plot 5

Figure 58: Forest in Plot 5

Figure 59: Forest in Plot 5

5.1.6 Plot 6

Date: Thursday 9th March 2017

Location: Forest patch next to road by NH plantation

Plot 6	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.51	0.84	25	3780.17	1776.68
Tree 2	0.88	0.33	15	403.77	189.77
Tree 3	0.75	0.27	20	362.86	170.54
Tree 4	0.87	0.33	20	529.15	248.70
Tree 5	1.54	0.49	30	1628.79	765.53
Tree 6	0.93	0.35	20	591.04	277.79
Tree 7	0.59	0.21	15	172.62	81.13
Tree 8	0.87	0.26	20	338.00	158.86
Tree 9	1.28	0.48	25	1320.08	620.44
Tree 10	0.8	0.23	30	392.96	184.69
Tree 11	0.63	0.25	15	239.58	112.60
Tree 12	0.8	0.32	25	615.95	289.50
Tree 13	0.84	0.31	15	359.00	168.73
Tree 14	0.7	0.3	25	545.57	256.42
Tree 15	0.64	0.2	20	206.40	97.01
Tree 16	0.64	0.23	15	204.82	96.27
Tree 17	0.66	0.24	25	358.64	168.56
Total	----	----	----	----	**5663.22**

Average tonnes of Tree Carbon per hectare = 141.58

Brief Description of Plot 6:

Plot 6 is adjacent to the main Zimmi – Liberia road system and the forest is regarded as low HCS and is heavily impacted by human activity. Chainsaw-cut timber next to the road was evidence of timber harvesting in this forest patch (Photo 66). Access to the forest was by the road but community consent was required before using the road. The proposed plantations are on the eastern side of the road.

Figure 60: Plot 6 adjacent to the road. Dominant species included Brachystegia sp.

Figure 61: HCS field survey team measuring a tree in Plot 6

Figure 62: Plot 6 on the right, adjacent to the road

Figure 63: Palm tree in Plot 6

Figure 64: Forest in Plot 6

Figure 65: Forest in Plot 6

Figure 66: Harvested timber on the road adjacent to Plot 6

5.1.7 Plot 7

Date: Thursday 9th March 2017

Location: Forest patch adjacent to NH nursery (near Mahoi)

Plot 7	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	0.85	0.32	15	381.07	179.11
Tree 2	1.92	0.58	20	1527.62	717.98
Tree 3	1.9	0.6	25	2008.12	943.82
Tree 4	0.7	0.22	25	304.52	143.13
Tree 5	0.8	0.24	25	358.64	168.56
Tree 6	2.82	1.19	30	8636.24	4059.03
Tree 7	1.09	0.32	25	615.95	289.50
Tree 8	0.68	0.22	25	304.52	143.13
Tree 9	1.84	0.84	25	3780.17	1776.68
Tree 10	0.46	0.13	15	70.07	32.93
Tree 11	1.6	0.5	25	1425.38	669.93
Tree 12	1.25	0.39	25	893.44	419.92
Tree 13	1.37	0.49	25	1372.26	644.96
Tree 14	0.98	0.33	25	652.64	306.74
Tree 15	1.2	0.31	25	580.26	272.72
Total	----	----	----	----	**10768.14**

Average tonnes of Tree Carbon per hectare = 269.20

Brief Description of Plot 7:

Plot 7 is considered to be medium HCS due to its close proximity the Mahoi River system and the diversity of both riparian and normal forest species. This area is close to the plantation nursery and the river buffer of 100m needs to be managed accordingly.

Figure 67: The riparian area adjacent to the Mahoi River

Figure 68: HCS Field Survey Team measuring a tree in Plot 7

Figure 69: Young Hertiera utilis tree in Plot 7

Figure 70: Measuring a Hertiera utilis tree in Plot 7

Figure 71: Forest in Plot 7

Figure 72: View of the forest patch in which Plot 7 is located, from the NH nursery

5.1.8 Plot 8

Date: Friday 10th March 2017

Location: Between Zimmi & Gola Forest

Plot 8	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	7.9	2.5	30	34867.74	16387.84
Tree 2	0.52	0.18	15	129.19	60.72
Tree 3	1.2	0.4	15	579.70	272.46
Tree 4	1.3	0.4	30	1112.17	522.72
Tree 5	0.8	0.29	15	316.69	148.85
Tree 6	2.1	0.78	30	3903.32	1834.56
Tree 7	0.9	0.33	15	403.77	189.77
Tree 8	2.6	0.88	30	4896.93	2301.56
Tree 9	1.3	0.39	25	893.44	419.92
Tree 10	4.5	0.93	30	5433.06	2553.54
Tree 11	0.75	0.32	15	381.07	179.11
Total	----	----	----	----	**24871.04**

Average tonnes of Tree Carbon per hectare = 621.78

Brief Description of Plot 8:

Plot 8 includes a low HCS forest patch adjacent to the road leading to the GRNP. The forest patches adjacent to the main road systems were all extremely small and fragmented.

5.1.9 Plot 9

Date: Friday 10th March 2017

Location: Between Zimmi & Gola Forest

Plot 9	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	7.2	2.3	30	29808.83	14010.15
Tree 2	2.4	0.93	25	4577.35	2151.35
Tree 3	0.71	0.24	15	221.88	104.29
Tree 4	2.4	0.82	30	4288.12	2015.42
Tree 5	0.5	0.19	15	143.02	67.22
Tree 6	1	0.41	15	607.24	285.40
Tree 7	1.7	0.51	15	915.29	430.19
Tree 8	3.9	1.1	30	7449.29	3501.17
Total	----	----	----	----	**22565.18**

Average tonnes of Tree Carbon per hectare = 564.13

Brief Description of Plot 9:

Similarly to Plot 8, Plot 9 includes a low HCS forest patch adjacent to the road leading from Zimmi to the GRNP. The forest patches adjacent to the main road systems are all relatively small and fragmented, and frequently near swamp vegetation.

Figure 73: Swamp vegetation adjacent to forest patches near the road from Zimmi to the GRNP

5.1.10 Plot 10

Date: Friday 10th March 2017

Village: Joborwahun (Chimp. Forest)

Plot 10	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.9	1	30	6227.25	2926.81
Tree 2	1.4	0.5	15	881.84	414.47
Tree 3	0.85	0.3	15	337.53	158.64
Tree 4	1.3	0.44	30	1330.42	625.30
Tree 5	1.06	0.35	25	728.98	342.62
Tree 6	3.05	1.03	30	6583.10	3094.06
Tree 7	0.43	0.16	15	103.53	48.66
Tree 8	0.98	0.35	15	451.00	211.97
Tree 9	0.93	0.4	15	579.70	272.46
Tree 10	0.68	0.24	15	221.88	104.29
Tree 11	1.16	0.36	15	475.53	223.50
Total	----	----	----	----	**8422.76**

Average tonnes of Tree Carbon per hectare = 210.57

Brief Description of Plot 10:

Plot 10 is located within an isolated but extensive patch of high HCS and HCV 1 forest in the leakage belt and therefore will not be impacted. Illegal logging is taking place in this forested area where a family of Western chimpanzees live (HCV Survey 2016). This species uses the fragmented forest as a corridor to the Gola Rainforest National Park and farm land. If this area is not conserved or managed it is likely these primate species will recede into the GRNP and may disappear altogether.

Figure 74: The intact high HCS forest patch near Joborwahun

Figure 75: The HCS field survey team in the Plot 10 forest patch

Figure 76: Relatively dense forest – High HCS forest patch near Joborwahun

Figure 77: Hertiera utilis tree in Plot 10

Figure 78: Subsistence agriculture next to the forest patch in which Plot 10 is located

5.1.11 Plot 11

Date: Saturday 11th March 2017

Village: Jaluhun

Plot 11	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.2	0.76	30	3717.29	1747.13
Tree 2	0.58	0.18	15	129.19	60.72
Tree 3	0.8	0.29	25	511.89	240.59
Tree 4	1.45	0.4	30	1112.17	522.72
Tree 5	0.65	0.25	15	239.58	112.60
Tree 6	1.87	0.78	30	3903.32	1834.56
Tree 7	0.95	0.33	15	403.77	189.77
Tree 8	1.1	0.38	25	850.86	399.91
Tree 9	1.2	0.38	25	850.86	399.91
Tree 10	1.4	0.45	25	1169.25	549.55
Tree 11	15.4	4.4	35	116658.84	54829.65
Tree 12	4	1.3	25	8591.71	4038.11
Tree 13	1.5	0.6	15	1242.38	583.92
Total	----	----	----	----	**65509.12**

Average tonnes of Tree Carbon per hectare = 1,637.73

Brief Description of Plot 11:

Plot 11 is considered medium HCS and is a relatively small forest patch adjacent to the local village, Jaluhun. The biodiversity of this forest patch was high and several primate species were observed from the village (during the meetings with the village elders).

Figure 79: The buttress of a large Hertiera utilis tree in Plot 11

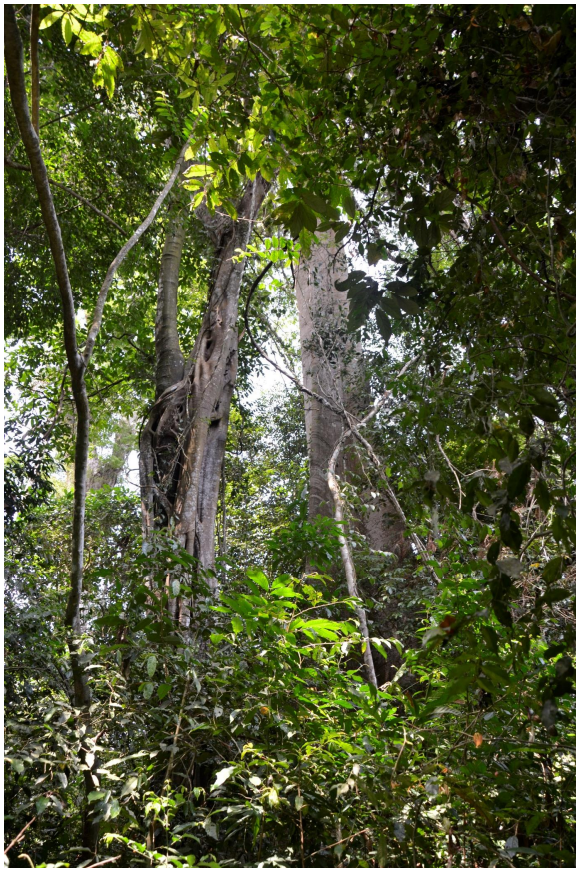

Figure 80: Forest in Plot 11

Figure 81: Measuring a tree in Plot 11

Figure 82: Forest in Plot 11

5.1.12 Plot 12

Date: Saturday 11th March 2017

Village: Bopoo

Plot 12	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.44	0.85	30	4587.80	2156.26
Tree 2	1.5	0.46	25	1218.57	572.73
Tree 3	0.73	0.27	15	276.88	130.13
Tree 4	0.8	0.29	15	316.69	148.85
Tree 5	2.7	0.9	25	4303.70	2022.74
Tree 6	0.82	0.32	15	381.07	179.11

Plot 12	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 7	1.43	0.54	15	1019.13	478.99
Tree 8	1.2	0.44	25	1120.88	526.81
Tree 9	1.04	0.035	15	5.95	2.79
Total	----	----	----	----	**6218.41**

Average tonnes of Tree Carbon per hectare = 155.46

Brief Description of Plot 12:

Plot 12 is considered a medium density forest with a low HCS due to its fragmented nature and ongoing clearing by the local community. This forest patch is adjacent to the Bopoo village and consequently has fairly low biodiversity (during the survey period).

Figure 83: Forest patch within which Plot 12 was located

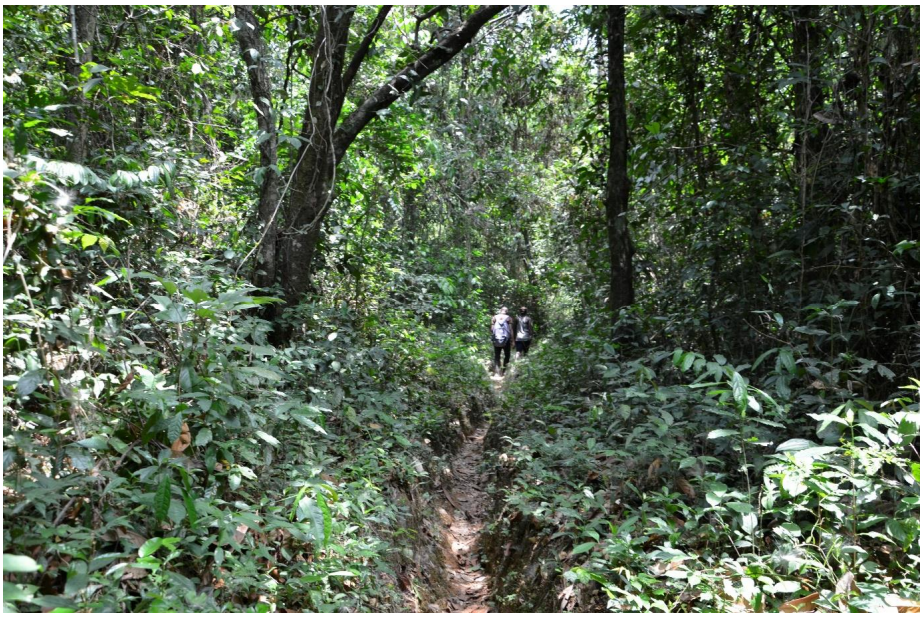

Figure 84: Path with Plot 12 on the left

Figure 85: Butterfly seen in Plot 12

Figure 86: Recording tree measurements in Plot 12

Figure 87: Forest in Plot 12

5.1.13 Plot 13

Date: Saturday 11th March 2017

Village: Jagbwema

Plot 13	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	0.7	0.24	15	221.88	104.29
Tree 2	2.4	1	15	3245.85	1525.55
Tree 3	1.65	0.56	25	1763.84	829.01
Tree 4	1.4	0.49	25	1372.26	644.96
Tree 5	1.76	0.6	25	2008.12	943.82
Tree 6	1.05	0.34	25	690.31	324.45
Tree 7	1.25	0.5	15	881.84	414.47
Tree 8	1.6	0.5	25	1425.38	669.93
Tree 9	1.53	0.53	15	983.94	462.45
Tree 10	1.23	0.39	25	893.44	419.92
Total	----	----	----	----	**6338.83**

Average tonnes of Tree Carbon per hectare = 158.47

Brief Description of Plot 13:

Plot 13 is a degraded and low density forest near the road to Zimmi east of the Mahoi River. Due to its close proximity to the river, the density of forest increases and has a variety of species.

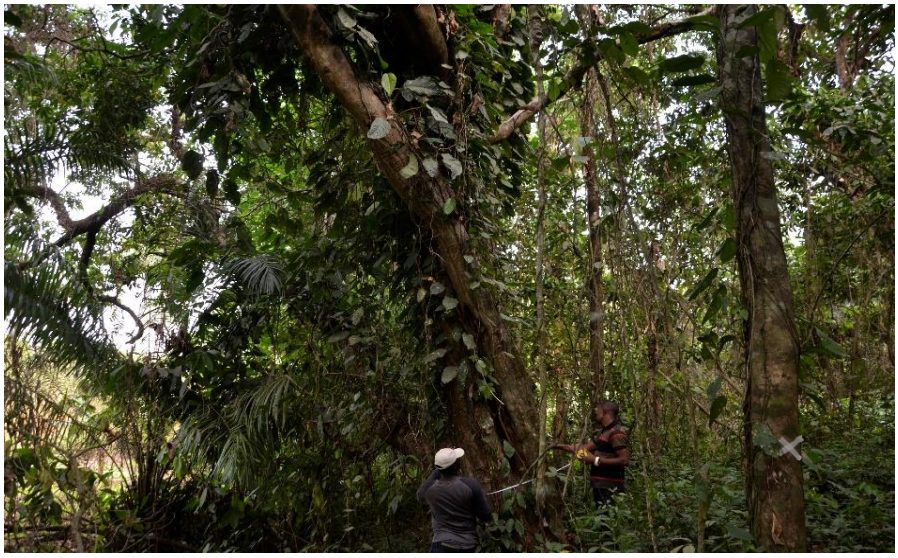

Figure 88: The HCS field survey team measuring a tree in Plot 13

Figure 89: Local farms in the swampy area next to the forest patch where Plot 13 is located

Figure 90: Plot 13 located in the forest on the left of the path

Figure 91: Plot 13 forest

5.1.14 Plot 14

Date: Monday 13th March 2017

Village: Gbaa

Plot 14	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	0.8	0.3	15	337.53	158.64
Tree 2	1.7	0.6	25	2008.12	943.82
Tree 3	1.2	0.4	25	937.00	440.39
Tree 4	1.16	0.44	25	1120.88	526.81
Tree 5	1	0.36	15	475.53	223.50
Tree 6	5.5	2.3	25	25113.92	11803.54
Tree 7	1	0.4	15	579.70	272.46
Tree 8	2.6	1.1	20	5088.49	2391.59
Tree 9	3.1	1.9	25	17535.70	8241.78
Tree 10	1.3	0.53	20	1289.46	606.05
Tree 11	2.6	1.2	20	5992.82	2816.63
Total	----	----	----	----	**28266.57**

Average tonnes of Tree Carbon per hectare = 706.66

Brief Description of Plot 14:

Plot 14 is located adjacent to the village Gba within the central eastern area of the concession. Although heavily impacted upon by anthropogenic activity the trees within this forest patch are large and well established giving a relatively high HCS value.

5.1.15 Plot 15

Date: Monday 13th March 2017

Village: Gangama

Plot 15	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	3	1.3	25	8591.71	4038.11
Tree 2	2.3	1.1	20	5088.49	2391.59
Tree 3	1.8	0.67	20	2003.51	941.65
Tree 4	1.6	0.5	20	1155.67	543.17
Tree 5	1.6	1	20	4253.74	1999.26
Tree 6	1.7	0.8	15	2133.72	1002.85
Tree 7	1.3	0.5	20	1155.67	543.17
Tree 8	2.4	1.1	20	5088.49	2391.59
Tree 9	1	0.35	15	451.00	211.97
Tree 10	1.3	0.5	20	1155.67	543.17

Total	----	----	----	----	**14606.51**

Average tonnes of Tree Carbon per hectare = 365.16

Brief Description of Plot 15:

Plot 15 is adjacent to the Mano River system and is within the riparian forest zone with a moderately high HCS value. The riparian forest areas are all within the buffer zones and considered HCV 1 and 2 priority areas.

5.1.16 Plot 16

Date: Monday 13th March 2017

Village: Manjama

Plot 16	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.5	1	20	4253.74	1999.26
Tree 2	3.28	1.2	25	7391.41	3473.96
Tree 3	1.43	0.7	20	2175.48	1022.48
Tree 4	2	0.73	15	1796.29	844.25
Tree 5	0.88	0.34	15	427.08	200.73
Tree 6	2.41	0.75	20	2476.77	1164.08
Tree 7	0.65	0.29	15	316.69	148.85
Tree 8	1.86	0.72	20	2293.80	1078.09
Tree 9	2.06	0.9	20	3489.37	1640.00
Tree 10	0.5	0.28	15	296.47	139.34
Tree 11	0.61	0.25	15	239.58	112.60
Total	----	----	----	----	**11823.64**

Average tonnes of Tree Carbon per hectare = 295.59

Brief Description of Plot 16:

Similarly to Plot 15, Plot 16 is located adjacent to a major river system, the Mahoi River. It falls within the riparian forest zone with a moderately high HCS value. The riparian forest areas are all within the buffer zones and considered HCV 1 and 2 priority areas as they are the ideal natural corridors for the movement of many species of fauna.

5.1.17 Plot 17

Date: Monday 13th March 2017

Village: Dassalam

Plot 17	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.3	1.1	20	5088.49	2391.59
Tree 2	3.4	1.3	25	8591.71	4038.11
Tree 3	1.5	0.6	20	1628.15	765.23
Tree 4	0.9	0.4	15	579.70	272.46
Tree 5	2.1	0.7	15	1660.02	780.21
Tree 6	1.6	0.6	20	1628.15	765.23
Tree 7	2	0.7	20	2175.48	1022.48
Tree 8	1	0.4	15	579.70	272.46
Tree 9	2	0.8	20	2796.28	1314.25
Tree 10	1.7	0.7	20	2175.48	1022.48
Total	----	----	----	----	**12644.49**

Average tonnes of Tree Carbon per hectare = 316.11

Brief Description of Plot 17:

Plot 17 is located in a relatively small and isolated forest patch in the south eastern region of the concession on the road to the village Disalmi. The region is relatively void of forest and the results were of a low to medium HCS value.

5.1.18 Plot 18

Date: Monday 13th March 2017

Village: Gofor

Plot 18	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	2.5	0.8	20	2796.28	1314.25
Tree 2	1.2	0.47	20	1028.76	483.52
Tree 3	0.85	0.3	15	337.53	158.64
Tree 4	1.15	0.45	20	948.00	445.56
Tree 5	1.37	0.58	20	1527.62	717.98
Tree 6	1	0.4	15	579.70	272.46
Tree 7	0.63	0.25	15	239.58	112.60
Tree 8	1.5	0.37	15	500.67	235.31
Tree 9	1.54	0.55	20	1382.46	649.76

Tree 10	1.39	0.68	20	2060.10	968.25
Total	----	----	----	----	**5358.33**

Average tonnes of Tree Carbon per hectare = 133.96

Brief Description of Plot 18:

Plot 18 is located on the southern boundary of the concession and near the village Gofo. Due to the anthropogenic activity, this forest patch is relatively disturbed. However, the larger trees are intact and the HCS value was considered moderate.

5.1.19 Plot 19

Date: Monday 13th March 2017

Village: Senbehun

Plot 19	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	1.88	0.85	20	3133.85	1472.91
Tree 2	0.66	0.26	15	257.92	121.22
Tree 3	1.33	0.49	20	1112.60	522.92
Tree 4	0.9	0.32	15	381.07	179.11
Tree 5	0.63	0.26	15	257.92	121.22
Tree 6	1.7	0.54	20	1335.58	627.72
Tree 7	0.46	0.2	15	157.49	74.02
Tree 8	0.96	0.38	20	689.86	324.24
Tree 9	1.1	0.44	20	908.79	427.13
Total	----	----	----	----	**3870.49**

Average tonnes of Tree Carbon per hectare = 96.76

Brief Description of Plot 19:

Plot 19 was a small forest patch located approximately 2km west of Zimmi town. Forest clearing is noticeable in this region due to subsistence farming practices. The biodiversity within the patches seems to reduce in density and species variety the closer one gets to the larger villages. This is likely to be because of the bushmeat trade and general increase in human activity.

5.1.20 Plot 20

Date: Tuesday 14th March 2017

Village: Gokpoma

Plot 20	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	3.7	1.1	25	6276.02	2949.73
Tree 2	1.22	0.45	20	948.00	445.56

Tree 3	1.21	0.44	20	908.79	427.13
Tree 4	1.75	0.7	20	2175.48	1022.48
Tree 5	0.45	0.19	15	143.02	67.22
Tree 6	1.15	0.4	20	759.70	357.06
Tree 7	1.1	0.46	20	988.00	464.36
Tree 8	1.29	0.5	20	1155.67	543.17
Tree 9	0.65	0.21	15	172.62	81.13
Tree 10	0.78	0.3	20	442.34	207.90
Total	----	----	----	----	**6565.73**

Average tonnes of Tree Carbon per hectare = 164.14

Brief Description of Plot 20:

Plot 20 is on the eastern boundary of the concession. These forest patches would form a natural corridor with the forest remnants that are connected to the Gola Rainforest National Park and are considered high in HCS value.

5.1.21 Plot 21

Date: Tuesday 14th March 2017

Village: Gbahama

Plot 21	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	1.9	0.69	25	2611.58	1227.44
Tree 2	0.98	0.31	20	470.47	221.12
Tree 3	0.81	0.38	20	689.86	324.24
Tree 4	0.51	0.22	20	246.90	116.04
Tree 5	1.63	0.67	20	2003.51	941.65
Tree 6	1.22	0.4	20	759.70	357.06
Tree 7	0.53	0.25	20	313.98	147.57
Tree 8	1.28	0.45	20	948.00	445.56
Tree 9	2.28	0.9	25	4303.70	2022.74
Tree 10	0.71	0.3	20	442.34	207.90
Total	----	----	----	----	**6011.32**

Average tonnes of Tree Carbon per hectare = 150.28

Brief Description of Plot 21:

Plot 21 is adjacent to the village of Gbahama in the western section of the concession. The forest patches in this area are heavily disturbed and fragmented due to the subsistence farming practices.

5.1.22 Plot 22

Date: Tuesday 14th March 2017

Village: Gissiwulo

Plot 22	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	1.2	0.42	20	832.68	391.36
Tree 2	0.6	0.22	15	188.40	88.55
Tree 3	0.8	0.28	15	296.47	139.34
Tree 4	1	0.34	15	427.08	200.73
Tree 5	1.5	0.58	25	1884.13	885.54
Tree 6	0.9	0.3	15	337.53	158.64
Tree 7	1.3	0.4	20	759.70	357.06
Tree 8	1.6	0.4	15	579.70	272.46
Tree 9	1.1	0.37	20	656.13	308.38
Total	----	----	----	----	**2802.06**

Average tonnes of Tree Carbon per hectare = 70.05

Brief Description of Plot 22:

Plot 22 is adjacent to a small village (Gissiwulo) within the central eastern section of the concession. The forest patches are interspersed with swamp areas and will yield a relatively high HCS and biodiversity.

5.1. 23 Plot 23

Date: Tuesday 14th March 2017

Village: Giewumba

Plot 23	Circumference (m)	Diameter (m)	Approx. tree height (m)	AGLB (kg)	Tree Carbon (kg of C per tree)
Tree 1	1.2	0.5	20	1155.67	543.17
Tree 2	0.9	0.3	20	442.34	207.90
Tree 3	1.5	0.6	20	1628.15	765.23
Tree 4	2.3	0.76	25	3131.81	1471.95
Tree 5	1.2	0.4	15	579.70	272.46
Tree 6	3.1	0.98	25	5050.93	2373.94
Tree 7	3.6	1.3	25	8591.71	4038.11
Tree 8	1.2	0.5	20	1155.67	543.17
Tree 9	3.3	1.2	25	7391.41	3473.96
Total	----	----	----	----	**13689.88**

Average tonnes of Tree Carbon per hectare = 342.25

Brief Description of Plot 23:

Plot 23 is in the eastern section of the concession and is in a remote area being close to the leakage belt area. The HCS value is relatively high in this region and the patches of forest quite large forming potential corridors with the southern region of the GRNP. The local village of Giewumba is extremely small with fewer than 12 households and limited clearing for agricultural practices was recorded.

5.2. HCS Summary Table & Map

The following table summarises the Total Tree Carbon and Total Carbon figures for each plot, as shown in the previous section.

Table 4: Summary of the Total Tree Carbon (Mg C) and Total Carbon (tonnes/hectare) per plot

Plot Number	Total Tree Carbon (kg of C) per plot	Average Tree Carbon (tonnes/hectare) for each plot
1	3519.25	87.98
2	8173.90	204.35
3	22375.90	559.3974
4	20476.14	511.90
5	5079.47	126.99
6	5663.22	141.58
7	10768.14	269.20
8	24871.04	621.78
9	22565.18	564.13
10	8422.76	210.57
11	65509.12	1637.73
12	6218.41	155.46
13	6338.83	158.47
14	28266.57	706.66
15	14606.51	365.16
16	11823.64	295.59
17	12644.49	316.11
18	5358.33	133.96
19	3870.49	96.76
20	6565.73	164.14
21	6011.32	150.28
22	2802.06	70.05
23	13689.88	342.25

It is important to note that in order to determine High, Medium and Low HCS areas within the concession, the ME team mainly used the analysis of satellite imagery, and physical observations of forest patches during the field trip.

The data presented in the tables (above) were derived using allometric equations and were regarded as secondary evidence because results apply to the plots only, and not necessarily to the greater forest patch (within which the plot(s) are located).

In places, the presence of a few large trees within a plot would mean that the subsequent Average Tree Carbon (in tonnes/hectare) per plot would be high. Thus, even though a particular plot received a low Average Tree Carbon amount, the greater forest patch could be judged to be of High HCS value, due to the health, structure and density of the trees and vegetation, and based on the findings of the rapid biodiversity assessment.

The findings from the imagery, field observations and equations were reviewed by the team to finalise the results as presented in this section.

Table 5 shows the approximate areas (in hectares) of High, Medium and Low HCS area, as determined from the HCS assessment. Based on this, the total HCS area (i.e. High, Medium and Low) is 10,185 ha. It must be noted that High HCS forms the largest proportion of the HCS areas because part of the GRNP, which is a High HCS area, falls within the Natural Habitats concession, and was thus included in the delineation of HCS areas.

Table 5: Approximate areas of High, Medium and Low HCS within the concession

HCS Level	Area (ha)
High HCS	8,445
Medium HCS	877
Low HCS	863
TOTAL	**10,185**

Figure 92 is the map showing the High, Medium and Low HCS forest patches, and is based on the study of the satellite imagery for the concession, the field survey results and observations, and the allometric equation calculation results. Natural Habitats will need to work with local communities and other stakeholders to protect and conserve the High HCS, Medium HCS and Low HCS forest patches in the concession.

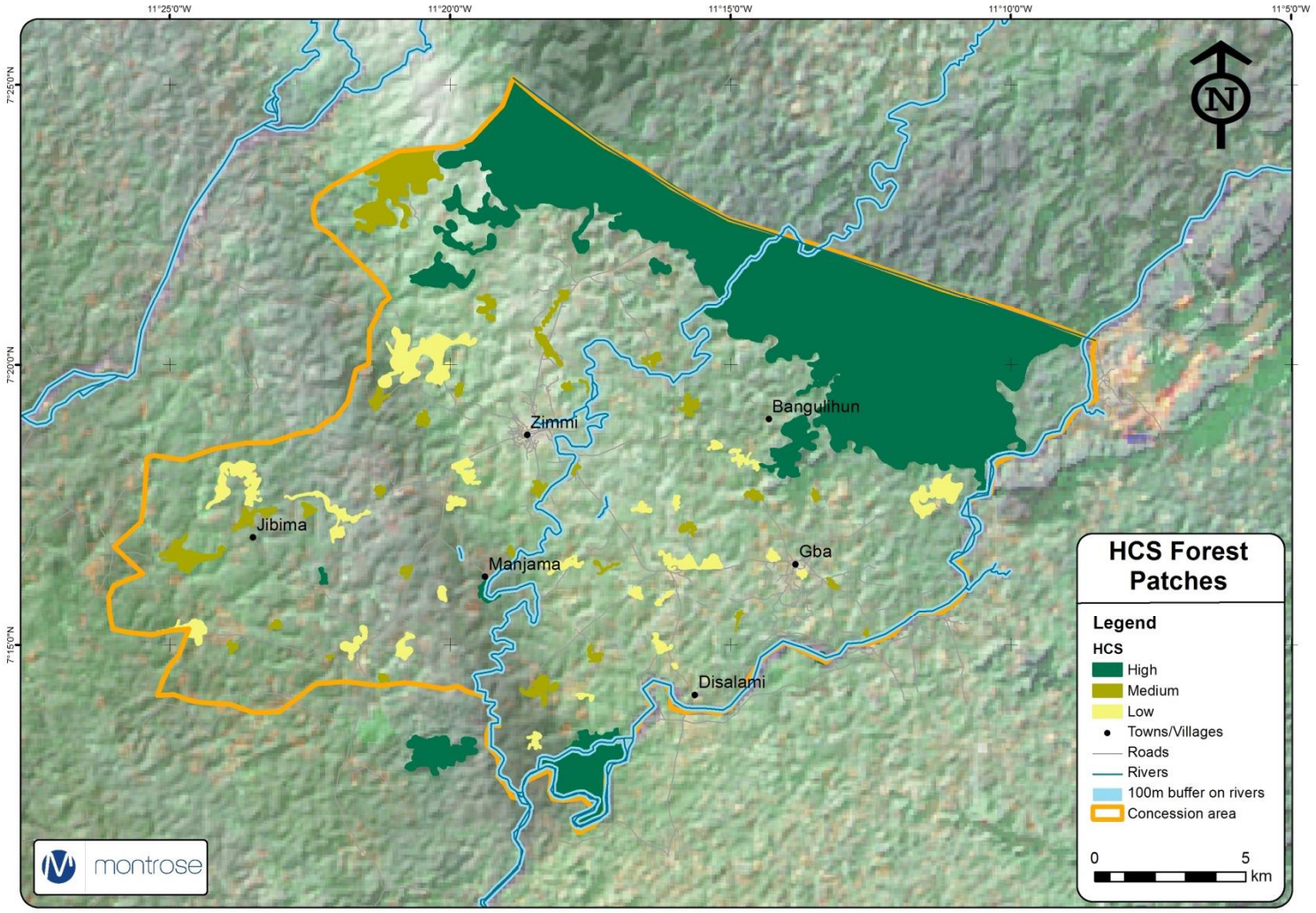

Figure 92: Map showing the High HCS, Medium HCS and Low HCS areas within the Natural Habitats concession

5.3. Combined HCS and HCV Areas

A map showing the combined HCS areas and HCV areas for the Natural Habitats concession is important for managing the forests with reference to priorities for no deforestation, future protection and conservation efforts (Figure 93).

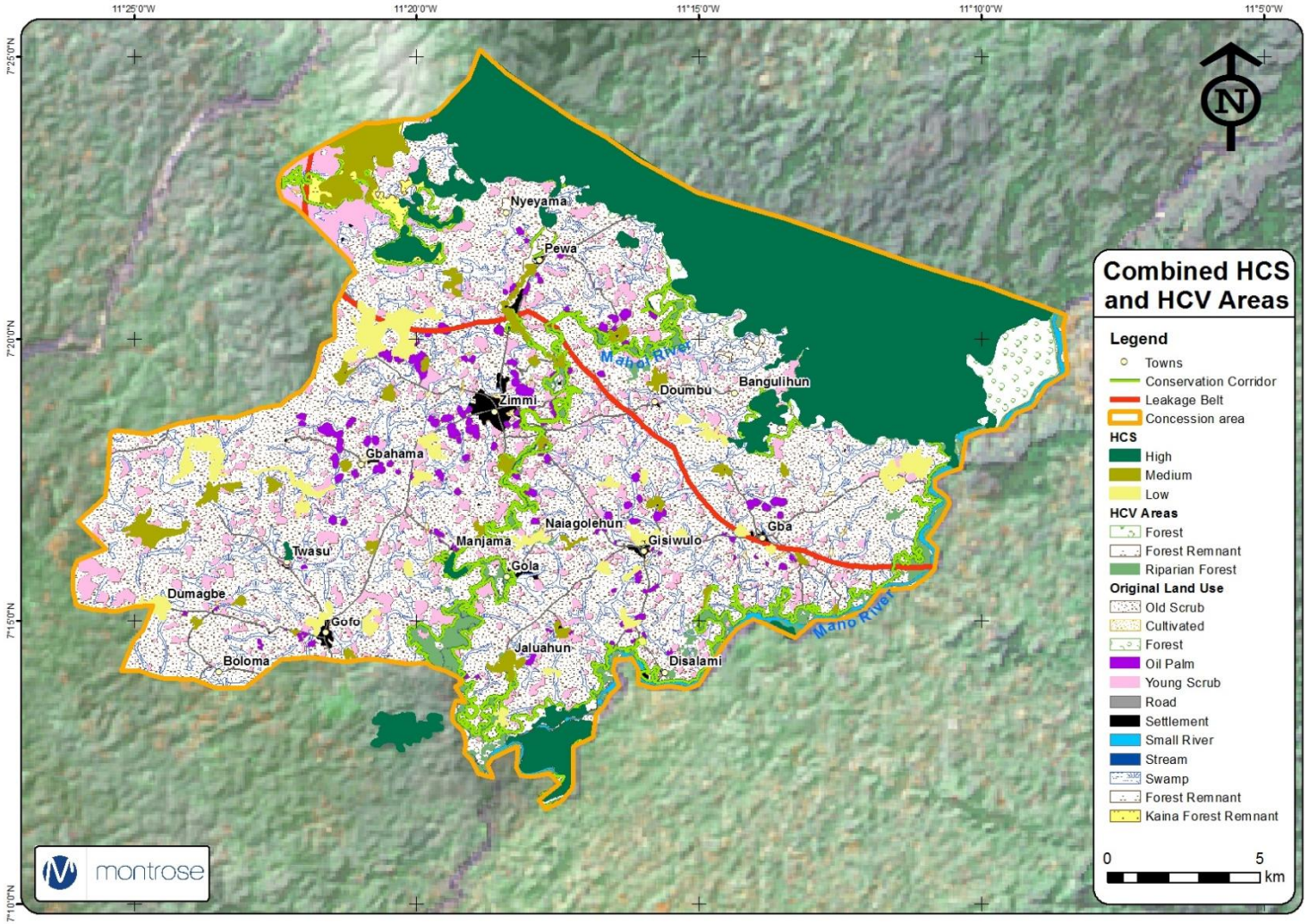

Figure 93: Combined HCS and HCV Priority Areas Map

5.4. Stakeholder Engagement

Key notes and findings from the stakeholder engagement/community consultation meetings undertaken as part of the HCS assessment are as follows:

- The large majority of the community members that the HCS team met with during the HCS field surveys were welcoming. They were ready to engage with the team and interactions with the communities indicated they know about Natural Habitats and the Project;
- One community initially prevented the HCS team from entering their forest, as they were suspicious of the team's motives and what the team was doing. After lengthy discussions with the Natural Habitats team members, when the objectives and nature of the HCS field surveys was explained to them, they approved access to their forest;
- Local people often protect a single forest patch next to their village. Historically these forest patches were protected, and this protection thus continues today. These forest patches are harvested for certain natural resources, such as bamboo for construction, and hunting purposes.
- Local people said that logging does take place in the forest patches within the concession. (This was confirmed by the HCS team when undertaking the field surveys, where chain saws were heard, and recently cut timber was seen next to the road).
- In the southeast of the concession, near the Mano River, local people and in-migrants undertake artisanal alluvial diamond mining.
- It is good that Natural Habitats has a dedicated community consultation team on site, led by Mr. Alie Bao. It is of the utmost importance that this team continues with efforts to consult and engage with local villagers in the concession on a continuous basis. With greater information sharing about Natural Habitats and the Project, capacity building and training, relationships between Natural Habitats and local communities will be strengthened.
- Natural Habitats will need to work with local communities (and relevant government departments) going forward, to protect and conserve the high HCV forests within the concession.

The figures below show photographs of community consultation meetings undertaken before the HCS assessment field surveys.

Figure 94: Stakeholder engagement meeting in Bopoo Village, prior to undertaking the HCS field survey

Figure 95: Stakeholder engagement meeting as part of the HCS assessment, March 2017

6. RECOMMENDATIONS

When an area has been identified as having high, medium or low importance by the HCS assessment, management measures should be implemented to secure its value, and to protect and conserve these areas from deforestation. The three primary management options are prescribed (Jennings, 2004):

- Protection of the area (through reserves, buffer zones);
- Modifications or constraints on operations (mitigation measures to reduce the overall impact on natural areas); and
- Restoration activities (forest integrity can be restored with rehabilitation interventions or removal of alien plants).

Section 6.1 provides recommendations for the management of HCS areas (i.e. high, medium and low HCS), including mitigation and measures to minimise impacts to biodiversity.

6.1. Training, education and capacity building

ME recommends that an environmental education programme is initiated by Natural Habitats as a contribution to the local communities and to promote the conservation of the GRNP for its critical biodiversity value. Key issues to be conveyed in this programme include:

- The importance of forest habitat for the maintenance of biodiversity;
- The negative impacts of deforestation by means of logging and clearing for agriculture;
- The identification of Red Data plant and animal species; and
- The negative impacts of bush meat harvesting.

A farming education program with a focus on reducing the reliance on bushmeat and increasing the reliance on domestic animals, which would reduce the hunting pressure on these animals. It is unlikely that hunting for bushmeat would be entirely stopped, but it could be reduced over time.

6.2. Measures for Natural Forest Remnants

The following recommendations have been made for the natural forests patches/remnants within the Natural Habitats concession:

- The natural forest remnant areas identified in this report should be incorporated into the chimpanzee monitoring plan for the GRNP in collaboration with the GRNP staff;
- Sustainable logging should be promoted in villages adjacent to these forest patches by Natural Habitats, as recommended for riparian forests; and
- Natural Habitats should actively engage with and work with relevant stakeholders such as local communities and their leaders, local government agencies and NGOs' to promote the protection and conservation of forest patches of high, medium and low HCS value within the concession.

6.3. Measures for Riparian Forests and Rivers

The following management measures are recommended for riparian forests and rivers:

- A buffer of 100m has been placed around the Mahoi and Mano rivers and it is strongly recommended that this area, and the riparian forest is excluded from the plantable area;
- Sustainable logging should be promoted on site. Natural habitats should establish a small nursery on site with timber species (as listed in Appendix 2) for replanting in logged areas. The project should be guided by a qualified botanist and species that are fast-growing should be selected. Planted areas should be managed to allow for trees to reach maturity before they can be logged;
- Engage consistently with local communities early in future HCS assessment processes to capture information on landuse needs. and
- Additional freshwater ecological surveys are required to determine the presence of cryptic, migratory and elusive species.

6.4. Bushmeat

Recommendations to manage illegal bushmeat hunting include the following:

- Consultation with local communities to discuss the trade and options to reduce hunting:
- Strong measures to limit bushmeat hunting, particularly in the concession and Project areas of influence:
- Dissemination of information and education about the most endangered species;
- Working with government Wildlife Departments and the GRNP to report incidents and help reduce, and ultimately, eradicate, unlawful hunting;
- Erecting signs warning against illegal activities (in graphics and local languages);
- Erect gates or booms on forest roads where people enter with vehicles;
- Use forest guards to patrol the area; and
- Form a network of stakeholders that can work together to limit the bushmeat trade.

6.5. General Recommendations

Following on from the HCS assessment and its findings, ME makes the following general recommendations to Natural Habitats:

- Maintain and manage the buffer (leakage belt) at the interface between the Natural Habitats concession and the GRNP. The decision by Natural Habitats to establish a 4km buffer zone across the northern boundary bordering the GRNP is commendable and should offset any direct and indirect ecological impact on the GRNP;

- The Mano River represents the border between Sierra Leone and Liberia and the 100m buffer along the banks of the river needs to be managed;
- More people are expected to move into the Makpele Chiefdom as news of the Project spreads. An influx management plan would help manage aspects of in-migration that are within the control of Natural Habitats (e.g., draft an employment policy that includes a clear message that all jobs will be advertised and appointments will be managed through a clearly defined process. It is helpful to have an office away from the concession such as in Zimmi so that jobseekers do not set up home in or near the concession);
- Appropriate educational programmes should be defined with local government authorities, to plan for social infrastructure and services to make people less dependent on the natural resources;
- All remnant forest patches such as the pocket of forest adjacent to Kaina village and other ecologically sensitive areas such as wetlands and riparian vegetation should be left untouched within the concession;
- Those areas that are not suitable for the planting of oil palm must remain undeveloped to serve as biodiversity plots, must be managed as an integral part of the plantation. Biodiversity corridors serve as suitable habitat for remnant fauna and flora and are important for local biodiversity on the concession. All forms of habitat degrading activities such as hunting, farming and logging must be prohibited from the biodiversity management areas and corridors;
- It is recommended that fauna and flora monitoring with a focus on habitat, vegetation, large and small mammals, birds, reptiles, fish and amphibians be facilitated on, at least, an annual basis. Results of these studies will provide site-specific mitigation and management for the biodiversity within the concession; and
- It is recommended that roads be carefully maintained with appropriate drainage ditches. Gabions and other erosion mitigation measures may be applied wherever necessary.

In terms of meeting RSPO requirements, Natural Habitats is required to adhere to the following:

- Identify specific MAs within the concession area;
- Develop and implement a management plan with maps for each of the MAs that can be easily used by staff working on the ground;
- Develop and implement a monitoring plan for each of the MAs; and
- Do not expand into areas of natural forest, as per RSPO requirements.

ME strongly recommends that Natural Habitats acquires high-resolution satellite data, such as the World View image used for the assessment. Such high-resolution imagery greatly helps to identify the land cover strata and aids the HCS assessment process.

When the site is audited for RSPO accreditation, this HCS assessment report is required along with associated maps and plans.

ME recommends that Natural Habitats develops an HCS and HCV workplan, which summarises the key actions and associated timelines. Thereafter, in line with the RSPO requirements, annual audits should take place to measure performance and progress regarding the HCS and HCV actions, including conducting further field work to determine the status of the HCS and HCS areas within the concession in an on-going manner.

7. CONCLUSION

Sierra Leone is party to several international treaties that directly relate to the fauna and flora of the country. These include Biodiversity, Desertification, Endangered Species, Tropical Timber, Rivers and Wetlands (WWF, 2008). With these treaties and general environmental best practices, Natural Habitats is in a strong position to be a leader in the field of conservation within its concession.

The poorly-managed expansion of oil palm plantations in Africa will lead to further losses of biodiversity through forest habitat, loss and fragmentation, and increased hunting off-take in the remaining forest areas (Abernathy et al., 2013). This survey for the Natural Habitats' concession, will assist by providing a sustainable and ecologically sensitive management approach that is required throughout the oil palm industry in Sierra Leone and the African continent.

The HCS approach is relatively simple, practical, quick and cost-effective, and is a technically sound basis on which to make land-use decisions that support carbon and biodiversity management / protection. However, it is important to note that it was never intended to be rigorous enough, or technically sufficient, to be used for carbon accounting. It does not account for all Above Ground Biomass (AGB), as it just focuses on trees >10cm diameter), or any Below Ground Biomass (BGB). So in practice, this HCS assessment underestimates total biomass carbon (Greenpeace, Identifying High Carbon Stock (HCS) Forest for Protection (2013)).

Planting in disturbed habitat addresses concerns about the logging/clearing of HCS forests for agricultural developments. Commercial bush meat hunting and illegal logging in the concession remains a factor that will hinder any conservation efforts that Natural Habitats initiates, and will need to be addressed with education campaigns and help from other parties (e.g., the authorities, local communities and NGOs etc.).

Natural Habitat needs to continue with HCS assessments using the methodology used for this assessment, for areas that are targeted for expansion.

HCS and HCV methodologies have predominantly been developed through a top-down approach, with limited input from government, the private sector and local community stakeholders in forested areas. For the long-term management of HCVs and HCS areas, incentives are needed to develop ownership and promote protection of these areas. Natural Habitats, with its on-going stakeholder engagement efforts on site, is in a good position to work with local communities, local government agencies, and NGOs' at protecting and conserving the HCS and HCV areas within the concession.

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APPENDICES

Appendix 1: Curriculum Vitae of the HCS Assessment Team

Philip David Patton

High Conservation Value and High Carbon Stock (HCV / HCS) licensed assessor

Education

- 1994 A-Levels (Matric); Woodridge College, Eastern Cape
- 1997 B.Sc. (Geology and Botany): University of Port Elizabeth
- 1998 B.Sc. (Honours) (Environmental and Geographical Science): University of Cape Town

Language Skills

English

Employment

- 2016 – Present: Montrose Environmental: Director
- 2007 – Present: ESS (Pty) Ltd.: Contracted Environmental Auditor and Biodiversity Specialist
- 2013 – 2016: Digby Wells Environmental: Associate
- 2007 – 2017: Gauteng Asphalt: Contracted Environmental Auditor
- Sep 2007 – Sep 2012 Islands in Africa: Managing Director (Safari Lodge operator in Namibia)
- Dec 2004 – 2007 Mahlatini LTD – Proprietor and Managing Director (Ireland)
- May 2002 – May 2004 ENSR International (RSK ENSR Group), London - UK, Senior Environmental Consultant / Auditor
- December 1998 – March 2002 Groundwater Consulting Services (GCS), RSA Environmental Consultant, Staff Hydrogeologist

Experience

- High Conservation Value Assessments
- High Carbon Stock Assessments
- HCV training
- Environmental Auditing (Due Diligence, Compliance), IEMA London.
- Environmental Management (EMP's, EIA's, EMPR's)
- Terrestrial Ecology: Fauna and Flora Specialist – Southern and East Africa

Selected Project Experience

- EIA/EMP/Biodiversity assessments:
  - 2016, HCV Assessment for Camenix, Cameroon
  - 2016, HCV Assessment for Natural Habitats, Sierra Leone
  - 2015, HCV Assessment for Feronia PHC, Lukuto Plantation, DRC
  - 2015, HCV Assessment for Feronia PHC, Yaligimba Plantation, DRC
  - 2015, HCV Assessment for Feronia PHC, Boteka Plantation, DRC
- International Environmental Due Diligence Audits:
  - Jan, 2003: SLI, Glasgow (Light bulb manufacturing), **Scotland**
  - July, 2003: Beach Profiling and oil damage remediation, **Kuwait**
  - Dec, 2003 Framatome Building (Commercial high-rise), Paris, **France**
  - Nov, 2003 Schoellar Plast, Gyor (Injection molding), **Hungary**
  - Oct, 2003, Adams, Beirut (confectionary factory), **Lebanon**
  - Sep, 2003, Formy Tachov (manufacturing company), **Czech Republic**
  - June, 2004, Liffe (TIAA) Financial building, London, **UK**
  - Dec, 2004 Kimberly Clarke and Cobra Watertech, **South Africa**, (with ENSR UK)

Professional affiliations

2002 – 2004 EARA (Environmental Auditor – UK)

Professional Registration

Pr. Sci. Nat. (SACNASP 2012)

ALS – Licensed HCV Assessor

Christopher Mahlon Fell

Senior Environmental and Social Consultant

Education

- 1999 Bachelor of Science in Forestry, University of Stellenbosch (South Africa)
- 2001 Master of Philosophy in Environment and Development: University of Cambridge (United Kingdom)

Language Skills

English and Afrikaans

Employment

- 2017: Present: Montrose Associate – Environmental Consultant
- 2013 – 2016: Anadarko Mozambique Gas Development Project, Senior Environmental Consultant and Biodiversity Manager
- 2010 – 2012: Golder Associates Ghana, Regional Manager for West Africa and Senior Environmental and Social Consultant
- 2006 – 2010: Golder Associates Africa (Pty) Ltd, Environmental Consultant
- 2003 – 2005: IUCN (The World Conservation Union), Community Conservation Advisor
- 2002 – 2003: ResourceAfrica, Project Manager

Experience

- Environmental and Social Impact Assessments
- Environmental and Social Management Plans
- Environmental and Social Due Diligence
- High Carbon Stock Assessments
- Biodiversity Strategies and Management Plans
- Ecosystem Services Assessment
- Social Impact Assessment
- Community-based Natural Resource Management
- Stakeholder Engagement

Selected Project Experience

- ESIA/ESMP:
  - 2016 & 2017, ESIA for the Ngualla Mining Project, Tanzania
  - 2013 – 2016, ESMP for the Mozambique Gas Development Project, Mozambique
  - 2012, Tarkwa Expansion Phase 6/7: Tailings Storage Facility 4, Ghana
  - 2012, Prestea Underground Mine EIA, Ghana
  - 2012, Medinandi Project Environmental and Social Scoping Study, Mali
  - 2012, New Liberty Gold Mine ESIA, Liberia
  - 2009 & 2010, Bakouma Mining Project ESIA, Central African Republic
  - 2009, Foskor's Pyroxenite Expansion Project (PEP) Phase 3 EIA, South Africa
- International Environmental Due Diligence Audits:
  - 2010, Accugas Pipeline Project Due Diligence, Nigeria
  - 2010, Independent Environmental and Social Due Diligence of the Boseto Copper Project, Botswana

- Tarkwa and Damang Gold Mines Environmental & Social Due Diligence, Ghana

Professional affiliations

International Association of Impact Assessment (IAIA) South Africa

Appendix 2: Flora and Vegetation Findings

Site visits were conducted from the 18th to the 22nd of November 2015 to gain an understanding of the ecological sensitivity of the Natural Habitats concession area and to determine the presence of HCV's. A detailed description of flora will be provided in the ESIA report (Integems, 2016) but broad vegetation classification and species listing is presented in this report. The forested areas are characterised by a mosaic of evergreen semi-deciduous forest with varying degrees of disturbance due to logging, slash and burn and subsistence farming practices.

Vegetation Habitats

Broad habitats were identified based on aerial imagery analysis, as well as ground-truthing in the field. Figure 1 represents the distribution of these habitats within the concession area along with the delineation of the leakage belt. Species such as *Brachystegia* and *Uapaca* were typical of the riparian habitat.

Swamps covered a large majority of the concession area and were comprised of permanent freshwater wetlands on inorganic soils; with emergent vegetation; water-logged for at least most of the growing season. These wetlands experience temporary to permanent inundation over soils with poor drainage capacity. *Uapaca* spp. and *Voacanga* sp. represented the dominant woody component, whereas ferns*, Cyperus* spp. and *Lasimorpha senegalensis* covered the majority of this habitat.

The list of expected plant species for the area is presented in Figure 1 and the species recorded during the HCV and HCS site visits are listed in Table 1. Six species of Red Data status were recorded during the field visits for the ESIA (Integems, 2016) and include the following: *Afzelia africana, Copaifera salikunda, Fleroya stipulosa, Lophira alata, Nauclea diderrichii* and *Terminalia ivorensis;* all of which are Vulnerable.

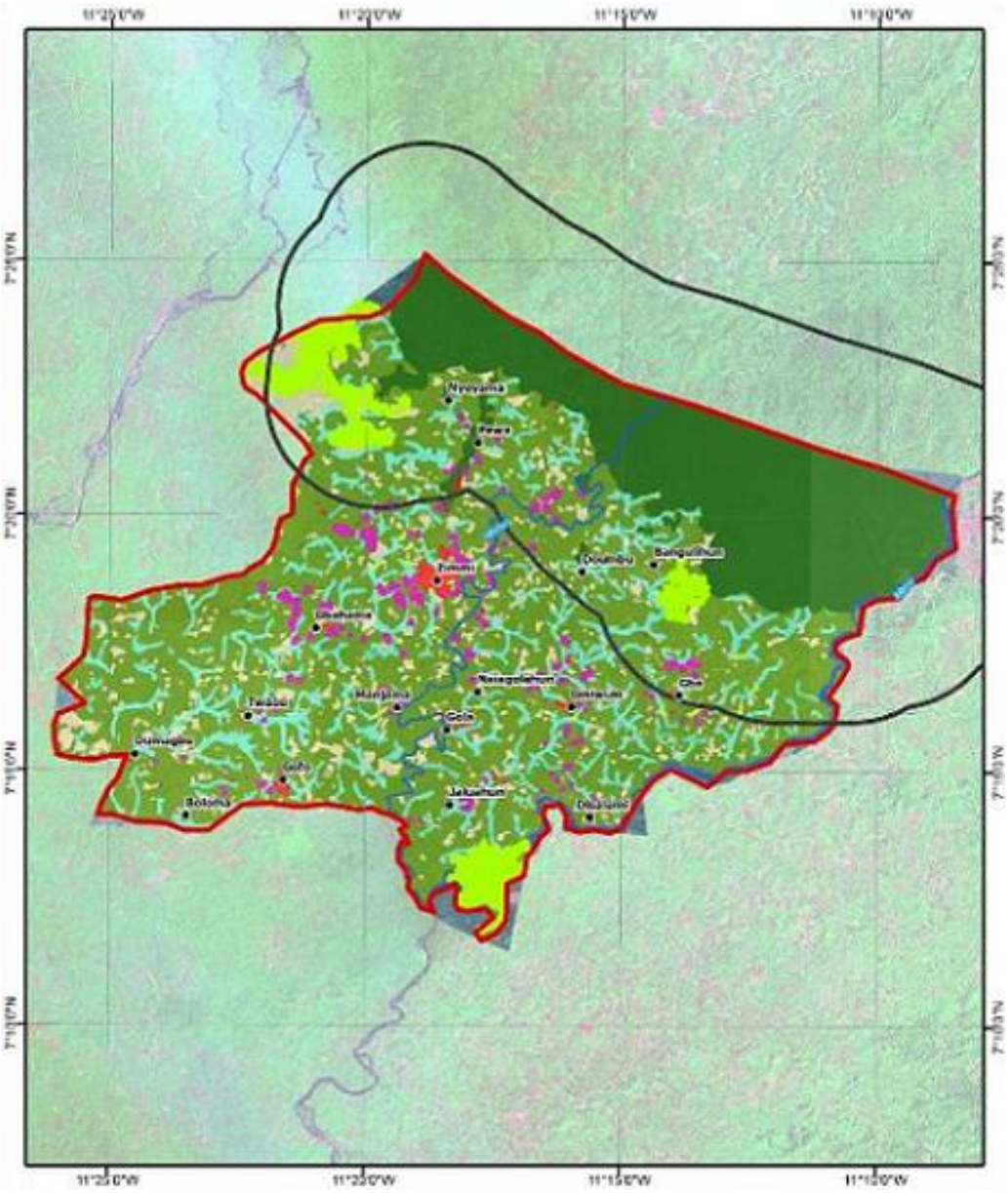

Figure 1: HCV habitats identified

Table 1: List of plant species recorded during the HCV and HCS site visits

Family	Species	Threat Status	GRNP	Riparian Fringe	Swamps	Villages/dryland disturbed areas
Acanthaceae	*Asystasia calycina*	No status				x
Acanthaceae	*Lankesteria brevior*	No status	x			
Anacardiaceae	*Mangifera indica*	Crop				x
Apocynaceae	*Funtumia elastica*	No status	x			
Apocynaceae	*Rauvolfia vomitoria*	No status				
Apocynaceae	*Tabernaemontana crassa*	No status		x		x
Apocynaceae	*Voacanga sp.*			x	x	
Aracaceae	*Elaeis guineensis*	No status	x	x		x
Aracaceae	*Lasimorpha senegalensis*	Least Concern			x	
Arecaceae	*Laccosperma secundiflorum*	No status		x		
Arecaceae	*Phoenix sp.*		x			
Arececeae	*Raphia hookeri*		x	x		
Asteraceae	*Ageratum conyzoides*	Exotic				x
Asteraceae	*Aspilia africana*	No status				x
Bombacaceae	*Bombax buonopozense*	No status		x		
Bombacaceae	*Ceiba pentandra*	No status	x	x		
Burseraceae	*Canarium schweinfurthii*	No status		x		
Callophyllaceae	*Mammea africana*	No status	x			
Combretaceae	*Combretum grandiflorum*	No status	x	x		x
Combretaceae	*Combretum sp.*			x		x
Combretaceae	*Terminalia ivorensis*	Vulnerable	x	x		
Convolvulaceae	*Aniseia martinicensis*	Least Concern	x	x		
Convolvulaceae	*Ipomoea grandifolia*	No status				x
Costaceae	*Costus lucanusianus*	No status	x	x		
Cucurbitaceae	*Momordica sp.*					
Cyperaceae	*Cyperus sp.*				x	
Dilleniaceae	*Tetracera sp.*					
Ebenaceae	*Diospyros sp.*		x			
Euphorbiaceae	*Bridelia ferruginea*			x		x
Euphorbiaceae	*Drypetes chevalieri*	No status	x	x		
Euphorbiaceae	*Hymenocardia lyrata*	No status		x		
Euphorbiaceae	*Macaranga heterophylla*	No status	x	x		

Family	Species	Threat Status	GRNP	Riparian Fringe	Swamps	Villages/dryland disturbed areas
Euphorbiaceae	*Uapaca esculenta*	No status		x		
Fabaceae	*Albizia adianthifolia*	Least Concern				
Fabaceae	*Albizia ferruginea*	Vulnerable	x	x		
Fabaceae	*Berlinia confusa*	No status	x	x		
Fabaceae	*Berlinia tomentella*	No status	x			
Fabaceae	*Brachystegia leonensis*	No status	x			
Fabaceae	*Cathormion altissimum*	No status				
Fabaceae	*Mimosa pudica*	Exotic				x
Fabaceae	*Pentaclethra macrophylla*	No status	x			
Fabaceae	*Senna alata*	Exotic				x
Flacouritaceae	*Caloncoba echinata*	No status	x			
Irvingaceae	*Klainodoxa gabonensis*		x			
Loganiaceae	*Anthocleista nobilis*	No status			x	
Loganiaceae	*Anthocleista procera*	No status			x	
Loganiaceae	*Anthocleista sp.*					
Loganiaceae	*Strychnos aculeata*	No status		x		
Loganiaceae	*Strychnos sp.*			x		
Malvaceae	*Clappertonia ficifolia*	No status		x		x
Moraceae	*Artocarpus altilis*	No status				x
Moraceae	*Ficus exasperata*	No status		x		
Myristicaceae	*Pycnanthus anglolensis*		x	x		
Ochnaceae	*Lophira alata*	Vulnerable				
Olacaceae	*Heisteria parvifolia*	No status	x	x		
Orchidaceae	*Bulbophyllum sp.*					
Papilionaceae	*Calopogonium mucunoides*	No status				x
Poaceae	*Bambusa vulgaris*	Naturalised Exotic		x		
Poaceae	*Centotheca lappacea*	No status	x	x		
Poaceae	*Digitaria longiflora*	No status		x	x	x
Poaceae	*Olyra latifolia*	No status	x	x		
Poaceae	*Pennesetum purpureum*	Exotic				x
Rubiaceae	*Geophila obvallata*	No status				
Rubiaceae	*Mussaenda chippii*	No status			x	x
Rubiaceae	*Nauclea latifolia*	No status				x
Rutaceae	*Zanthoxylum gilletii*	No status	x	x		

Family	Species	Threat Status	GRNP	Riparian Fringe	Swamps	Villages/dryland disturbed areas
Sapotaceae	*Tieghemella heckelii*	Endangered	x			
Selaginellaceae	*Selaginella versicolor*	No status		x		
Sterculiaceae	*Cola caricaefolia*	No status	x			
Thelypteridaceae	*Cyclosaurus sp.*		x	x	x	
Urticaceae	*Musanga cecropioides*	No status	x	x		
Violaceae	*Rinorea sp.*		x	x		x
Zingiberaceae	*Aframomum danielii*		x			
	Bush chilli		x			

Ecosystem Services

In addition to regulatory services (such as climate regulation and erosion control), cultural services (not assessed for this report), the local communities use plants in particular for provisioning services. Ethnobotany is a branch of botany that focuses on the use of plants for medicines and other practical purposes. The use of native plants for ethnobotanical uses can be detrimental to populations that are overexploited. Interviews with members of the forest edge communities in the GRNP leakage belt, as well as data collected from the local market were used to determine what species are being used for ethnobotanical purposes. The dominant uses of plant species are described in this section, including for subsistence agriculture, logging for timber and medicinal plant species (examples in Figure 2).

Figure 2: Examples of ethnobotanical plant uses (A: market vegetables; B: timber along a road adjacent to a palm oil plantation in the concession (potentially Tieghemella heckelii*)*

Subsistence Agriculture

Table 2 lists the crop species identified on site for subsistence agriculture. These are regarded as provisioning services, since this includes the primary use of resources. Additional crop species may occur, however, but the entire concession area was not assessed for this HCS report.

Table 2: Crop species recorded during the HCS assessment

Species	Common Name
Musa acuminata	Banana
Manihot esculenta	Cassava
Coffea liberica	Coffee
Mangifera indica	Mango
Oryza spp.	Rice (two hybrids identified)
Elaies guineensis	Oil Palm
Carica papaya	Papaya
Musa paradisiaca	Plantain
Sorghum bicolor	Sorghum

Timber

The harvesting of timber species was observed to a limited extent in the GRNP; resulting in varying degrees of disturbance in the forest. The forest edge, however, showed more evidence of logging with the most significant clearing observed at the forest fragment adjacent to Kaina village on the edge of the leakage belt (Latitude: 7°21'35.40"N; Longitude: 11°20'5.55"W). An example of this is represented in Figure 3.

Figure 3: Logging of the forest adjacent to planted area

Timber species expected to occur in the area, as well as those observed during the site visit, are listed in Table 3.

Table 3: Timber species found in the HCS Plots

Species	Recorded during site visit
Brachystegia leonensis	x
Cathormion altissimum	x
Klainedoxa gabonensis	x
Lophira alata	x
Pentaclethra microphylla	x
Ricinodendron heudelotii	x
Terminalia sueprba	x
Tieghemella heckelii	x

Medicinal Plants

Over 450 medicinal plants are recorded in West Africa, approximately 30% of which are exotic and cultivated by traditional healers (Leipzig, 1996). Whilst the effectiveness of many of the so-called medicinal plants listed in Table 4 has not always been proven, these species are regarded as useful by the local communities.

Table 4: Plants with reported medicinal uses

Species	Ailment
Albizia adianthifolia	Convulsions, Fever (Macfoy, 2013)
Anthocleista nobilis	Closure of frontal suture (Macfoy, 2013)
Argeratum conyzoides	Used as an insecticide (Leipzig, 1996; Macfoy, 2013)
Carica papaya	Headaches, rheumatism, worms (Macfoy, 2013)
Cola caricaefolia	Toothache (Macfoy, 2013)
Combretum sp.	Hemorroids (Macfoy, 2013)
Elaies guineensis	Hiccups, inflammation, toothache (Macfoy, 2013)
Ficus exasperata	Abortifacient, convulsions, worms (Macfoy, 2013)
Macaranga heterophylla	Gonorrhea (Macfoy, 2013)
Manihot esculenta	Eye complaints, wounds (Macfoy, 2013)
Mimosa pudica	Headaches (Macfoy, 2013)
Musa paradisiaca	Headache (Macfoy, 2013)
Momordica sp.	Constipation (Macfoy, 2013)
Nauclea latifolia	Fever, laxative, vaginal infection (Leipzig, 1996; Macfoy, 2013)
Pennesetum purpureum	Asthma; throat infection (Macfoy, 2013)
Rauvolfia vomitoria	Pain (Leipzig, 1996; Macfoy, 2013)
Senna alata	Laxative (Leipzig 1996; Macfoy, 2013)

Appendix 3: Mammal Survey Findings

The natural forest to the north of the Makpele Chiefdom includes the southern boundary of the GRNP and is home to many mammal species including Red Data species. Species of Special Concern (SSC) include Forest Elephant *(Loxodonta africana)*, Leopard *(Panthere pardus)*, Western Chimpanzee *(Pan troglodytes versus)*, Pygmy Hippopotamus *(Hexaprotodon liberensis)*, Monkeys *(Colobus polykomos, Philiocolobus badius, Cereopithecus Diana, Procolobus versus)* and Antelopes *(Cephalaphus zebra, Cephalaphus jentinkii)*. The following are Endangered: *P troglodytes versus, H liberiensis, L. africana, P. badius, C. diana* and *P. pardus.* The Vulnerable species include: *C. polykomos, A. africanus, A. zebra, and E baettikoferi.* The Endangered species include: the Pygmy Hippopotamus, Bongo and Banded Duiker and Jentinks Duiker. A list of species likely to occur on site is represented in the table below.

Expected and possible Mammal Species for the Makpele Chiefdom

Common Name	*Scientific name*	IUCN Status
Western Chimpanzee*	*Pan troglodytes*	Endangered
Olive Colobus *	*Procolobus verus*	Near threatened
Western Red Colobus	*Piliocolobus badius*	Endangered
Western Pied Colobus*	*Colobus polykomos*	Near threatened
Sooty Mangabey *	*Cercocebus atys*	Near threatened
Green Monkey	*Chlorocebus sabaeus*	Least concern
Diana Monkey *	*Cercopithecus Diana*	Endangered
Campbell's Monkey *	*Cercopithecus campbelli*	Least concern
Lesser Spot-nosed Monkey *	*Cercopithecus petaurista*	Least concern
Potto	*Perodicticus potto*	Least concern
Demidoff's Galago Galago demidoff	*Galago demidoff*	Least concern
Thomas's Galago	*Galago thomasi*	Least concern
Western Tree Hyrax	*Dendrohyrax dorsalis*	Least concern
African Forest Elephant	*Loxodonta (africana) cyclotis*	Vulnerable
Pygmy hippopotamus	*Hexaprotodon liberiensis*	Endangered
Red River Hog	*Potamochoerus porcus*	Least concern
Water Chevrotain	*Hyemoschus aquaticus*	Least concern
African Buffalo	*Syncerus caffer*	Conservation dependent
Bongo	*Boocercus euryceros*	Near threatened
Bushbuck*	*Tragelaphus scriptus*	Least concern
Maxwell's Duiker	*Cephalophus maxwellii*	Near threatened
Zebra Duiker	*Cephalophus zebra*	Vulnerable
Black Duiker	*Cephalophus niger*	Near threatened
Jentink's duiker	*Cephalophus jentinki*	Vulnerable
Yellow-backed Duiker	*Cephalophus silvicultor*	Near threatened
Ogilby's Duiker	*Cephalophus ogilbyi*	Near threatened
Bay Duiker	*Cephalophus dorsalis*	Near threatened
Royal Antelope	*Neotragus pygmaeus*	Near threatened
Striped Ground Squirrel	*Xerus erythropus*	Least concern
Fire-footed Rope-Squirrel *	*Funisciurus pyrropus*	Least concern
Green Bush Squirrel	*Paraxerus poensis*	Least concern
Red-legged Sun Squirrel	*Heliosciurus rufobrachium*	Least concern
Forest Giant Squirrel	*Protoxerus stangeri*	Least concern

Common Name	*Scientific name*	IUCN Status
Slender-tailed Squirrel	*Protoxerus aubinnii*	Data deficient
Temminck's Squirrel	*Epixerus ebii*	Data deficient
Lord Derby's Flying Squirrel	*Anomalurus derbianus*	Least concern
African Clawless Otter *	*Aonyx capensis*	Least concern
Spotted-necked Otter	*Lutra maculicollis*	Least concern
Common Slender Mongoose*	*Herpestes sanguineus*	Least concern
Long-nosed Cusimanse*	*Crossarchus obscurus*	Least concern
Marsh Mongoose*	*Atilax paludinosus*	Least concern
African Civet*	*Civettictis civetta*	Least concern
African Palm Civet*	*Nandinia binotata*	Least concern
Leopard	*Panthera pardus*	Least concern
Tree Pangolin	*Phataginus tricuspis*	Least concern
Crested Porcupine	*Hystrix cristata*	Least concern
Brush-tailed Porcupine	*Atherus africanus*	Least concern
Giant Pouched Rat*	*Cricetomys emini*	Least concern
Rusty-bellied Brush-furred Rat	*Lophuromys sikapusi*	Least concern
Greater Cane Rat	*Thryonomys swinderianus*	Least concern
Hammer-headed Fruit Bat	*Hypsignathus monstrosus*	Least concern
African Straw-coloured Fruit-bat*	*Eidolon helvum*	Near threatened
Slender-tailed Squirrel	*Protoxerus aubinnii*	Data deficient
Forest Genet	*Genetta pardina*	Least concern
Large Grey Mongoose	*Herpestes ichneumon*	Least concern
White-tailed Mongoose	*Ichneumia albicauda*	Least concern
Golden Cat	*Felis aurata*	Vulnerable
Long-tailed Pangolin	*Uromanis tetradactyla*	Vulnerable
Milne-Edwards' Swamp Rat	*Malacomys edwardsi*	Least concern
Temminck's Striped Mouse	*Hybomys trivirgatus*	Least concern
Typical Striped Grass Mouse*	*Lemniscomys striatus*	Least concern
Common House Rat*	*Rattus rattus*	Alien
African Wading Rat	*Colomys goslingi*	Least concern
Isabelline Red-legged Sun Squirrel	*Heliosciurus rufobrachium*	Least concern
Jouvenet's Shrew	*Crocidura jouvenetae*	Least concern
Guinea Multimammate Mouse	*Mastomys erythroleucus*	Least concern
Upland Horseshoe Bat	*Rhinolophus hillorum*	Near threatened
Western Palm Squirrel	*Epixerus ebii*	Least concern

Key: * denotes species that were recorded during the field visit for the HCV assessment

Bushmeat hunting rivals habitat loss as a major threat to the survival of mammals in Africa (Bakarr *et al.,* 2001 and Rose et al., 2003). Bushmeat is a critical protein source for many people in the region and a large number of species are hunted. Antelopes, bats, pigs, primates and large rats dominate the bushmeat trade. The extent of bushmeat hunting has prompted governments to enact hunting bans, though the legislation to date has often been impractical and/or poorly enforced (Sayer *et al.,* 2005). If bushmeat hunting is not controlled, Africa's larger endemic mammalian species will be exterminated from vast areas and, possibly, driven to extinction.

The bushmeat and hunting trade within the Makpele Chiefdom is relatively high and would be considered a priority to address in order to conserve and sustain a number of different mammal and avifaunal species located within the concession. The majority of local villages located within the concession are involved in utilising the surrounding forest habitat as a resource for meat. It is recommended that Natural Habitats management adopt an education programme with suggestions for possible alternatives to hunting wildlife within the concession. The majority of mammal species observed were either caught in traps or already killed through hunting. Species that were observed to have been killed or caught included: Sooty Mangabay *(Cercocebus atys),* Campbell's Monkey *(Cercopithecus campbelli)* and a juvenile Bushbuck *(Tragelaphus scriptus)*.

Motion sensitive night cameras were deployed at positions throughout the concession and the boundary areas between the concession and the GRNP.

Red Data Mammals

A total of six Red Data mammals species were recorded on site.

Appendix 4: Avifauna Survey Findings

Habitat and Ecology

In quantifying the status of the avifaunal density and diversity within the Natural Habitats Concession, a combination of scientific field methods and a desktop assessment were conducted to provide an understanding of the species and activity that may occur in the different habitats available within the concession.

An extensive and broad literature review on the GRNP was initiated including published articles, papers or any similar surveys that were undertaken prior to the field survey; the field survey was conducted between the 18th to the 22nd November 2015. The timing of the survey coincided with start of the dry season although extremely hot and humid, a number of the intra-African migrants were not present during the survey. It is recommended that a second-season survey is conducted in due course through the HCV monitoring programme. The avifaunal survey was undertaken using standard internationally accepted methods to understand bird habitat, interaction and distribution in relation to existing subsistence farming areas and forested areas located within the Concession. Of particular relevance is the "leakage belt" between the GRNP and the proposed project plantable boundary (covering a 4km buffer area) does harbour a number of HCV habitats and individual species. The concession has isolated patches of both natural and secondary forests within its boundaries.

The project area, including the Makpele Chiefdom and the southern portion of the GRNP, is located close to an International IBA (Fishpool & Evans 2001) and holds a high number of the threatened and endemic species of the region. Many of these species are also present in the fragmented forests and riparian zones of the proposed project area. Recent bird surveys (Klop et al 2010, Demey 2011) recorded 294 species in the GRNP bringing the total to 327, which is amongst the highest of the Upper Guinean Forests.

Observations were made of past and current logging activities, the conversion of forests to subsistence farming plantations, and ongoing hunting pressure. The findings indicate that the Makpele Chiefdom area, in general, is of relatively high value as a site for the conservation of birds especially in those habitat areas including forest, swamp and riparian areas. The generally low value within the concession area around the villages is due to factors such as a decline in the bird species richness as a result of forest degradation, fragmentation, and clearance and unsustainable levels of hunting of many of the larger species such as hornbills, turacos, parrots and birds of prey.

132 species of birds were found within the Makpele Chiefdom area (including the southern boundary of the GRNP), of which 6 species are Afro-Palearctic migrants. One bird species, the Timneh Grey Parrot *(Psittacus timneh)*, recently split from African Grey Parrot *(P. erithacus),* was observed in a small flock within the pocket of primarily forest located within the concession. Bird species recorded during the HCV assessment are listed in the table below.

Species of interest observed during the HCS survey within the concession

Common Name	*Scientific name*	IUCN Status	Observed
Woolly-necked Stork	*Ciconia episcopus*	Least concern	Flying in groups throughout concession
Palm-nut Vulture	*Gypohierax angolensis*	Least concern	A number of single species in forested areas
Hooded Vulture	*Necrosyrtes monachus*	Endangered	Single species flying over Zimmi
Congo Serpent Eagle	*Dryotriorchis spectabilis*	Least concern	Single species flying over farmland

Common Name	*Scientific name*	IUCN Status	Observed
African Hawk Eagle	*Hieraaetus spilogaster*	Least concern	Breeding pair observed over hillock
Gymnogene	*Polyboroides typus*	Least concern	Common throughout concession
White-spotted Flufftail	*Sarothrura pulchra*	Least concern	Calling in forest area in buffer zone
Buff-spotted Flufftail	*Sarothrura elegans*	Least concern	Calling at bridge over Mahoi River in Concession.
Rock Pratincole	*Glareola nuchalis*	Least concern	Common on river systems roosting on bare rocks
Timneh Grey Parrot	*Psittacus timneh*	Vulnerable	Small flock flying over forest area west of Zimmi
Green Pigeon	*Treron calvus*	Least concern	Fairly common throughout forested areas
Verreaux's Turaco	*Tauraco macrorhynchus*	Least concern	Single species observed on Gola boundary
Great Blue Turaco	*Corythaeola cristata*	Least concern	Fairly common throughout forested areas
Sabine's Spinetail	*Rhaphidura sabini*	Least concern	Flocks observed in evening west of Zimmi
Cassin's Spinetail	*Neafrapus cassini*	Least concern	Flying with other spinetails and swifts
Shining-blue Kingfisher	*Alcedo quadribrachys*	Least concern	Observed in swamp area adjacent to Zimmi town
Chocolatebacked Kingfisher	*Halcyon badia*	Least concern	Single species observed in swamp in buffer zone
White-throated Bee-eater	*Merops albicollis*	Least concern	Common throughout concession
Broad-billed Roller	*Eurystomus glaucurus*	Least concern	Breeding pair observed on Mahoi near nursary
Red-billed Dwarf Hornbill	*Lophoceros camurus*	Least concern	Observed within large bird party in GRNP boundary
Pied Hornbill	*Tockus fasciatus*	Least concern	Common throughout concession
White-tailed Hornbill	*Bycanistes fistulator*	Least concern	Common throughout concession
Black-wattled Hornbill	*Ceratogymna atrata*	Least concern	Common in the forested areas
Yellow-casqued Hornbill	*Ceratogymna elata*	Vulnerable	A number of single species in forested areas
Black-wattled Hornbill	*Ceratogymna atrata*	Least concern	Common in the forested areas
Yellow-throated Tinkerbird	*Pogoniulus subsulphureus*	Least concern	Common in the forested areas
Yellow-spotted Barbet	*Buccanodon duchaillui*	Least concern	Common in buffer zone forest
Least Honeyguide	*Indicator exilis*	Least concern	Observed within large bird party in GRNP boundary
Fire-bellied Woodpecker	*Dendropicos pyrrhogaster*	Least concern	Single species west of Zimmi in secondary forest
Rufous-sided Broadbill	*Smithornis rufolateralis*	Least concern	Displaying pair in Gola Rainforest close to boundary
Whitethroat Blue Swallow	*Hirundo nigrita*	Least concern	Single species on Mahoi River
Spotted Greenbul	*Ixonotus guttatus*	Least concern	Breeding pair on the Mahoi River - riparian forest
Simple Greenbul	*Chlorocichla simplex*	Least concern	Common throughout concession
White-throated Greenbul	*Phyllastrephus albigularis*	Least concern	Observed within large bird party in GRNP boundary
Red Tailed Leaf-love	*Pyrrhurus scandens*	Least concern	Calling in forest area in buffer zone
Western Nicator	*Nicator chloris*	Least concern	Common throughout concession
Forest Robin	*Stiphrornis erythrothorax*	Least concern	Common throughout forested areas
Kemp's Longbill	*Macrosphenus kempi*	Least concern	Riparian forest on the Mano River

Common Name	*Scientific name*	IUCN Status	Observed
Willow Warbler	*Phylloscopus trochilus*	Least concern	Common in forest fringe areas
Moustached Grass Warbler	*Melocichlamentalis*	Least concern	Single species in swamp in buffer zone
Green Hylia	*Hylia prasina*	Least concern	Observed within large bird party in GRNP boundary
Sharpe's Apalis	*Apalis sharpii*	Least concern	Breeding pair in buffer zone forest - near endemic
Green-backed Camaroptera	*Camaroptera brachyura*	Least concern	Single species in Zimmi garden
White-browed Flycatcher	*Fraseria cinerascens*	Least concern	Breeding pair in riparian forest at Mano River
African Blue Flycatcher	*Elminia longicauda*	Least concern	Single species in buffer zone
Cassins Flycatcher	*Muscicapa cannina*	Least concern	Single species in swamp in buffer zone
African Paradise Flycatcher	*Terpsiphone viridis*	Least concern	Common throughout concession
Senegal Batis	*Batis senegalensis*	Least concern	Observed within bird party in Gola forest boundary
Chestnut Wattle-eye	*Dyaphorophyia castanea*	Least concern	Observed within large bird party in GRNP boundary
Tit-hylia	*Pholidornis rushiae*	Least concern	Single species observed near Mano River
W. Violet-backed Sunbird	*Anthreptes longuemarei*	Least concern	Breeding pair in Zimmi garden
Buff-throated Sunbird	*Chalcomitra adelberti*	Least concern	Single species in local village
Collared Sunbird	*Hedydipna collaris*	Least concern	Common throughout concession
Variable Sunbird	*Cinnyris venustus*	Least concern	Common in forest areas
Tiny Sunbird	*Cinnyris minullus*	Least concern	Common in forest areas
Splendid Sunbird	*Cinnyris coccinigastrus*	Least concern	Single species observed in forest edge in buffer zone
Black-winged Oriole	*Oriolus nigripennis*	Least concern	Breeding pair in the Gola forest boundary
Westrn Blackheaded Oriole	*Oriolus brachyrhynchus*	Least concern	Common throughout the concession
Shining Drongo	*Dicrurus atripennis*	Least concern	Common throughout the concession
Chestnut-winged Starling	*Onychognathus fulgidus*	Least concern	Common throughout concession
Common Fiscal	*Lanius collaris*	Least concern	Single species in Zimmi garden
Grey-headed Sparrow	*Passer griseus*	Least concern	common in villages throughout concession
Red-vented Malimbe	*Malimbus scutatus*	Least concern	Single species in forest in buffer zone
Red-headed Malimbe	*Malimbus rubricollis*	Least concern	Breeding pair adjacent to swamp in buffer zone
Blue-billed Malimbe	*Malimbus nitens*	Least concern	single species observed in buffer zone
Pied Crow	*Corvus albus*	Least concern	Common in Zimmi and villages
Village Weaver	*Ploceus cucullatus*	Least concern	Breeding throughout concession
Compact Weaver	*Ploceus superciliosus*	Least concern	Common thoughout concession
Yellow-mantled Widowbird	*Euplectes macroura*	Least concern	Observed in swamp area adjacent to Zimmi town
Grey-headed Negrofinch	*Nigrita canicapillus*	Least concern	Observed within large bird party in GRNP boundary
Chestnut -breasted Nigrita	*Nigrita bicolor*	Least concern	Observed within large bird party in GRNP boundary
Red-fronted Antpecker	*Parmoptila rubrifrons*	Near threaten	Observed within large bird party in GRNP boundary