MINISTRY OF AGRICULTURE, LANDS, FORESTRY AND FISHERIES

INCEPTION REPORT

(Revised)

For the

NATIONAL FOREST DEMARCATION AND BIO-PHYSICAL RESOURCE INVENTORY PROJECT

SFA2003/SLU/BIT-04/0711/EMF/LC

Project Leader **September, 2008**

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Abbreviations

BIT	Banana Industry Trust
CEHI	Caribbean Environmental Health Institute
CFO	Chief Forestry Officer
CSO	Civil Society Organisation
GoSL	Government of St Lucia
EC	European Commission
EU	European Union
FD	Forestry Department
FCG	Finnish Consulting Group
FMIS	Forest Management Information System
GIS	Geographic Information System
MAFF	Ministry of Agriculture, Forestry and Fisheries
NGO	Non-Government Organisation
OECS	Organisation of Eastern Caribbean States
PCM	Project Cycle Management
PIU	Project Implementation Unit
PSC	Project Steering Committee
PL	Project Leader
SPAW	Specially Protected Areas and Wildlife
TA	Technical Assistance
TC	Technical Committee
ToR	Terms of Reference

Executive Summary

During the Project Inception Phase the Project office was set up, and initial office equipment was purchased. Meetings were held with major stakeholders and project counterpart staff.

A revised work plan was developed which maintains the crucial milestones and planned all project outputs to be produced by the end of 2009. The revised work plan is included in Annex V.

A stakeholder's workshop was held and was attended by approximately 50 stakeholders. Full details on the workshop are included in this Inception Report, along with annexes including lists of participants and questions. Valuable feedback from the workshop is incorporated in this Inception report, and was used to modify the project Logical Framework.

A project incidentals budget was prepared and is included in this Inception Report. Some minor revisions to the work program are included based on feedback from the Forestry Department and other stakeholders.

Contact was made with all the proposed key experts during the Inception Phase and their availability to contribute to the project was confirmed. Early input material was obtained for the forest inventory and biodiversity survey and is included in this report.

A major cause of concern was identified in the boundary survey component of the project. The time and resources allocated for the boundary survey appear to have been seriously under-estimated with regard to the outputs expected. Options of stakeholders and other sources consulted indicate that one survey team will be unable to complete the boundary survey in the time available. This report includes a recommendation that the scope of the boundary survey work be adjusted to emphasis the survey of the new parcels of land to be incorporated in the forest estate.

A possible significant omission from the Project's desired outputs was identified. Discussions with stakeholders and prospective survey team members revealed that a survey such as is included in the Project should include a component for the monumentation of the survey. This was not included in the project Terms of Reference or the list of activities or outputs, and consequently was not costed or included in the Project Proposal or the work plan included in this Inception report.

Background

The Ministry of Agriculture, Lands, Fisheries and Forestry of St Lucia promotes and supports the conservation of the country's natural resource base for the benefit of the entire population. The Forestry Department, in collaboration with the Crown Lands Division of the Ministry of Physical Development and National Mobilization, has identified all the lands adjacent to the Forest Reserves and has made recommendations for their vesting/acquisition and eventual incorporation into the existing Forest Reserve Management System. However, before reaching that point, these lands have to be surveyed, demarcated on the ground with standard physical markers, vested in the Crown, or acquired, and declared legal Forest Reserves. In addition, the existing forest reserve boundaries need to be re-demarcated.

The Forestry Department is the principle agency responsible for managing forest and wildlife resources on the island of St. Lucia. The Forestry Division of St. Lucia was established in 1946, upgraded to the status of Forestry Department in 1984 and is currently supervised by a Chief Forest Officer

The objectives of the department and the basic principles of current policy seeks to advance the areas of Forest Reservation (13% of the island), Natural Resource Management, Utilization, Environmental Education, Wildlife Conservation, Co-Management, Research, Recreation, Aesthetics, and Forest Extension.

The Forestry Department also functions as the National Focal Point for the RAMSAR Convention.

This project is funded by the European Community under the Saint Lucia SFA2003 Programme Economic and Agriculture Diversification and Poverty Reduction Through Integrated National Resources Management. The Banana Industry Trust is the Grant Beneficiary and Manager of a component of the Programme "Environmental Management Fund".

The overall objective of the project is:

> "To survey and demarcate the physical parameters of the public forest reserve and conduct a comprehensive biophysical inventory/assessment and management system of forest resources to produce, inter alia, a forest resource monitoring system, obtained through ground survey, remote sensing, assessment and review of existing data that will serve as the basis for strategic sustainable planning and management of forest resources".

The purposes of the service contract are:

i. To survey and demarcate and realign the Forests Reserves boundaries, inter alia incorporating the newly acquired crown lands, in order to facilitate better protection and management;

ii. To create an updated data base of Forest Reserve boundary line (digital and hard copy data, to reside at Forestry Department and Lands and Surveys Department) and measure the quality, quantity and distribution - inclusive of yield and volume - of timber and non-timber resources, and to compile statistics of their availability at the range, watershed and national level.

iii. To assess the status of the forest ecosystem, assessment of biodiversity (species richness and diversity) and all existing vegetation type at the watershed, range, and national level.

iv. To advise on the most optimal means/measures for the sustainable management (utilization and conservation) of forest resources

v. To recommend relevant silvicultural and utilization prescriptions necessary for planning and management of forest resources

vi. To assess all existing forestry related database, and to create an updated monitoring system for producing forest resource state and change estimates;

vii. To provide spatial and statistical data for estimating the nature, magnitude, geographical scope, in relation to Timber and NTFP yield and volume, biodiversity, carbon storage, and processes

viii. To conduct a training programme to develop the capacity of a cadre of persons in forests resource assessment and inventory method and forests management system using, scientific and modern technology

ix. To recommend and implement an effective, efficient and appropriate forest management system for Saint Lucia.

Information dissemination for the public awareness and support is crucial for the successful implementation of this project. Organising consultations with and briefing sessions for key stakeholders for the presentation of the forest demarcation and biodiversity assessment work plan, and conducting meeting with major communities that are directly or indirectly linked to the forest reserves and other important forest ecosystems that will require conservation interventions, are essential for getting the community support and acceptance for the work of the project. Past experience shows that support is best generated by close involvement through a consultative and participatory management approach.

Introduction

The Project Leader/Forest Inventory Specialist, Dr Robert Tennent, who is responsible for organizing the conduct of the work, designing and implementing the new inventory and the survey and demarcation of the forest reserve boundaries, and coordinating the outputs of the various experts of the project, arrived in Saint Lucia on 16th July, 2008.

At the end of the six weeks Inception Phase the Project Leader had prepared this Inception Report for submission to the Banana Industry Trust. The purpose of the report is to review the project's components, identify any specific problems, and prepare a detailed work plan for the project Implementation Phase for consideration and approval by the Project Implementation Unit.

The Inception Phase included intensive consultations with the implementation partners, and the first visits to the field, as well as the establishment of the Project Implementation Unit. The Project Leader has met with various project stakeholders and, in addition a stakeholder meeting with approximately 50 participants was organised where each project component was reviewed. Each project component is addressed separately in this report.

On arrival the Project Leader met with Mr Bertram Clarke of the BIT, and held initial discussions on the project. Mr. Clarke emphasised the importance of the project being completed on time, at the end of 2009.

The Project Leader then met with the Chief Forest Officer, Mr. Michael Andres, his Deputy CFO, Mr Michael Bobb, and the two Assistant CFOs, Mr. Adams Toussaint and Mr. Lyndon John. The CFO described the importance of the project to the FD and St Lucia, and provided background on forestry in St Lucia.

The Project Leader and the Consultant home office Project Director met with the Permanent Secretary of the Department of Forestry to discuss the importance of the project.

A stakeholder meeting, where many local project stakeholder organisations participated, was organised on August 19, 2008. The meeting offered a good opportunity to start information sharing between the project and various organisations and individuals that have an interest in the project implementation and results. Feedback from the stakeholder meeting was used extensively in the preparation of this Inception Report. The full list of participants and a list of questions and comments from the workshop are shown in Annex III.

At the conclusion of the Inception Phase the Project Leader had established a sound and functioning working relationship with the project implementing organisation, the FD, and the BIT. The Project Leader had made contacts with the majority of the most prominent stakeholders through the workshop, and had established good links within the FD. These links will grow during

the life of the project and an emphasis will be put into broadening the links into the wider stakeholder community during the field work phase of the project.

During the Inception Phase the Project Leader commenced the analysis of institutional and technical aspects of the project. Discussions were held with key FD members, as well as with the FD GIS staff. The FD GIS staff demonstrated their capacities, and assisted in identifying some institutional weaknesses, such as a lack of a functioning printer, aging computer equipment, and obsolete GIS software. The Project Leader identified the GIS section as being in need of assistance to be able to support the project and maintain project activities on an ongoing basis.

During the Inception Phase the Project Leader held discussions with members of the surveying profession of St Lucia, and found that the profession holds the view that the surveying component of the project is seriously underfunded, and that it will not be possible to complete this component during the project's lifetime. The Project Leader also received information that this underfunding resulted in some of those organisations invited to bid on the project failing to present a bid.

A revised schedule of operations is shown in the revised work plan included in Annex V.

Inception Phase activities

Training needs review

Capacity building is a key issue for the sustainability of the project. All members of the project team are experienced and skilled trainers who are capable of transferring their skills and knowledge via formal training as well as doing on-the-job training. An early training needs analysis is being carried out among the counterpart organisation, FD, to identify the priorities of the staff for training, to establish a suitable timetable, and to find the best methods for training. At the end of the project there needs to be a sufficient cadre of trained FD staff to manage the established forest inventory and assessment environment, sustainable forest management systems, forest reserves boundaries, electronic data management systems and biodiversity assessment systems.

Forest inventory

A provisional forest inventory training needs review was conducted through a detailed interview with Assistant CFO Adams Toussaint and supporting discussions with other FD officers. Mr Toussaint has a thorough knowledge of the training needs of the forest officers who will be required to contribute to the forest inventory.

The training needs analysis identified the following training needs. Approximately 15 FD forest officers require training in the following areas.

- Basic forest mensuration
- Aim of forest inventory
- Basic inventory design
- Basic forest sampling
- Map reading
- Layout of cruise lines
- Sample plot layout
- Field data recording
- Tree identification
- Establishment of PSPs
- Safety
- Data management

These training needs can be met through a 3 day training course. A training course including a training manual will be designed and conducted in October 2008. Further on-the job training will be conducted during the course of the project and specific trainings will be organised if need arises.

Bio-diversity resource inventory

A training needs analysis for the bio-diversity resource inventory was initiated by the Conservation Specialist, Dr. Jenny Daltry, when she made her first visit to St Lucia September 2nd. Training for the bio-diversity component of the inventory will be carried out in November 08. Annex VIII contains early draft provisional details of the work to be done under the bio-diversity resource inventory.

Related programmes and other donor activities

During the Inception Phase the Project Director and Project Leader met with Mr. Warren Olding, Team Leader of the Integrated Natural Resource Management Project's Technical Assistance program. Mr Olding provided valuable background to the project's genesis, and specific advice which was incorporated in this Inception Report.

In the FCG tender document a reference is made to various programmes and projects implemented in St Lucia and Caribbean region. The key stakeholder with regard to many of the mentioned projects in St Lucia is the Forestry Department under the Ministry of Agriculture, Forestry and Fisheries. Thus, the FD is the focal point in contacting the projects and in finding possibilities for synergies between the projects.

Initial visits to forest

A familiarisation visit was taken to the forests to the north of St Lucia to acquaint the Project Leader with the nature and structure of St Lucian forests. This included visits to natural and plantation forests. The visit included a trip on the forest skyline, which enable the Project Leader to gain a strong impression of the forest structure.

The visit allowed the Project Leader to confirm his initial impressions of the forest nature. The Project Leader subsequently observed forests in the centre of St Lucia during a briefing visit with the Principal Surveyor, and subsequent travel to Vieux Fort with the FCG home office Project Director, Mr Jorma Peltonen.

Stakeholders meeting

A stakeholders meeting was arranged to launch the project, to familiarize the project stakeholders with the project objectives and results, to introduce stakeholders to members of the Project Team, and to obtain stakeholder feedback on the project. The meeting was held on August 19th at the Palm Haven Hotel, timed to coincide with the visit to St Lucia of the FCG home-office Project Director, Mr Jorma Peltonen. The meeting agenda, list of participants, and discussion notes are presented in Annex III.

Approximately 50 stakeholders attended. The meeting was opened by a representative of the FD, and the Permanent Secretary of the MAFF gave a presentation and welcome to the members. The Head of the Banana Industry Trust, Mr. Bertram Clarke, who is also the Project Manager, spoke to the meeting, giving the history of the project, outlining the aims of the project, and emphasising the importance that the project is completed by the end of 2009.

The FCG Project Director, Mr. Jorma Peltonen introduced the Consultant consortium to the stakeholders, and presented background to the meeting. He was followed by the Project Leader, Dr. Robert Tennent, who presided over the Project Team's presentation to the meeting.

The Presentation outlined the goals of the workshop, and introduced the members of the Project team. Each team member made a presentation of aspects of the work that they would be focusing on, with Dr. Tennent and Mr. Peltonen presenting for the two team members unavailable at the Workshop.

The Project Leader then provided an overview of the project Work Plan, showing the broad detail of activities planned over the coming 16 months to complete the project. The Project Leader then showed the project milestones.

The presentations were followed by a general discussion period before the lunch break. The general discussion period provided valuable feedback, which has been incorporated in this Inception Report.

Following the lunch break, the stakeholders returned for a more detailed discussion centred on the Project Logical Framework. This extremely valuable discussion period contributed directly to the revision of the Logical Framework as presented in this Inception Report.

A number of specific items were discussed during the second discussion period, reflecting the wish of some members that the underlying purposes and objectives of the project be revised. This was not done during the meeting, as certain core elements of the logical framework are incorporated in the Consultant's contract as work product, and cannot be changed without a compensating review of the financial details of the contract. However these concerns were noted in this Inception Report and comments are included in the revised logical framework.

Mobilisation of surveyor

One of the first planned actions in the Inception Phase was the mobilisation of the Principal Surveyor. After a preliminary meeting with the Project Leader, the proposed Principal Surveyor joined the Project Leader in a meeting attended by the Deputy Forest Chief, Mr. Michael Bobb, the Project Leader, and the Project Forestry Counterpart, Mr Adams Toussaint. The meeting discussed the logistics and legal details associated with the surveying component of the project. The FD officials recommended that the newly purchased parcels of land be surveyed first, followed by adjacent existing forest land.

At the end of the Inception Phase a Principal Surveyor had not been fielded. Discussions on the issue have been held with the stakeholders. The challenging scope of the work caused negotiations to move slowly. Feedback from several sources suggested that two field teams would be needed to complete the task in the allotted time, whereas the initial work plan had included only one field team. Further feedback indicated that the survey component of the project was under resourced.

Establishment of Project Implementation Unit and Technical Committee

During the Inception Phase the Project Implementation Unit (PIU) and the Project Technical Committee (TC) were established by the BIT and the FD with input from the Consultant. The PIU is to be coordinated by the BIT, meeting monthly, to coordinate project activities, and to monitor project outputs.

The members of the PIU will be:

- Mr Julius Polius, BIT, Chairman.
- Mr. G. Michel Andrew, FD
- Mr. Adams Toussaint, FD
- Mr. Hilary Regis, NAO
- Dr. Robert Tennent, FCG Project Leader
- Dr. Christopher Cox, CEHI
- Mr. Warren Olding

The BIT will service the PIU.

The Project Technical Committee will guide the project and facilitate overall implementation of the Project, including ensuring that project activities are well co-ordinated.

The TC will have the following members.

- Mr. Adams Toussaint, FD, Chairman
- Mr. G. Michel Andrew, FD
- Mr. Julius Polius, BIT
- Dr. Robert Tennent, FCG Project Leader
- Ms. Andrina Abraham, Min. of Economic Affairs
- Mr. Vincent Jn Baptiste, Min. of Physical Development & Housing
- Mr. Cornelius Isaac, IWCAM
- Mr. Warren Olding
- St. Lucia National Trust representative
- WASCO representative
- Ministry of Finance representative

The Project will service the TC through the Project secretary, seeking assistance from the FD when required.

Analysis of Project Terms of Reference relating to actual situation

No significant differences between the situation as described in the ToR and the situation as observed by the Project Leader and the Project Manager were identified. A number of minor items of stakeholder concern were identified in the Logical Framework, as noted below.

Items of stakeholder concern in the Logical Framework.

Number of local people trained in the use of forest management system

The ToR for the project required at least 2 local persons be trained in the use of the forest management system to be implemented during the project. This has been included in the Logical Framework under Purpose 8 and included in the Consultant's contract. The Consultant will meet this output, but will also train as many suitable individuals as can be trained during the time available. The Project Leader will adopt a target of training at least 5 individuals in the use of the system.

No change was made in the Logical Framework, and it is noted that 'at least 2' can certainly mean 5 or more.

Vegetative classification vs. forest types

Under Result 3 information on the vegetative classification will be reported on. There was some feeling that the works 'forest type' should be included. This was not done, as the term 'vegetative classification' can be interpreted to include 'forest types', and the focus of the result is on forest resources.

Critical habitats

Stakeholders noted that Result 5 requires identification of critical habitats for fauna, but Result 4 does not require identification of critical habitats for flora. The Result was not modified, as it is again part of the Consultant's contract, but the indicator to judge the acceptability of Result 4 output was modified to reflect this concern.

Forest management system

There was some debate over Result 11, which calls for *"A forest management system in place and functioning".* Some stakeholders said that the FD must have a forest management system in place already, as they have been managing forests for many years. The actual result desired by the FD is a forest management **information** system, which is computerised system making management information available in forms suitable for decision making.

The Consultants' responded that this was the interpretation they made from the ToR, and that the project proposal and resulting contract fully reflect this. The indicators in the Logical Framework include the term FMIS, and the Consultants know that an FMIS is required. The work plan includes details on the timing and training of the FMIS.

The Consultant's have no objection to the modification of Result 11 to include 'information', and the modified Logical Framework included in the Inception Report includes 'forest management information system' in result 11 in all places.

GIS components of the project

Discussions were held with the GIS section of the FD. The section has a license for ArcGIS 8.2, and would like this to be upgraded to the most recent version. Their version does not work with MS Vista.

There are existing forest cover maps, from FAO work in 2006. The existing satellite imagery is of limited use, due to cloud cover problems which are common in St Lucia. The GIS section has digitised the boundaries for the new land parcels, but these are of limited accuracy.

The existing information is of a high enough quality to be used for the initial forest classification to be used in designing the inventory sample framework. There is some information available on land slope classification, based on a Puerto Rico project output in 2000.

Land survey

Some participants in the stakeholders workshop expressed their concern on the short implementation period for the forest reserves demarcation work and questioned if the time allocated was sufficient to implement the work in case any unexpected alterations to plans (like boundary related conflicts with local communities, landslides, etc.) occur. Thus, the following assumptions were added to the project logical framework at the result level:

- There will be no significant conflict with local communes on the forest reserve borders
- There are no major inaccuracies in existing registered boundaries

Proposed changes to Terms of Reference

Scope of land survey component

During the Inception Phase and subsequent Implementation Phase it became apparent that the scope of work in the survey component has been underestimated. Stakeholder feedback first alerted the Project Leader and Project Director to this situation. Subsequent discussions with the candidate for Principal Surveyor, other members of the St Lucia surveying community, and feedback from prospective project bidders reinforced this concern.

Other surveyors stated that it would not be possible to complete the boundary survey during the time allocated with one survey team. Attempts to fund two survey teams resulted in a 25% over budget in the Incidentals budget.

It is apparent that there will be ongoing problems with the boundary survey component of the project.

The Project Director and Project Director strongly support the recommendation from the draft Inception Report review team that the scope of the boundary survey work be revised and restricted to the survey of the new parcels of land to be incorporated in the forest estate. The project management has decided to make the new parcels the initial and highest priority item in the boundary survey.

Forest inventory

There are no major changes required from the ToR and the project proposal. On minor clarification is that in the project proposal the FMIS development software was defined as Microsoft Access, and it was stated that the FMIS may be implemented using an open-source software such as mySQL. After review of the FD computer resources, we now recommend that implementation remain in MS Access. There is no suitable Forestry Department server, and so the use of server based software is not appropriate.

The initial visits to the forest reinforced the Project Leader's opinion that the proposed inventory sampling design should be given careful consideration. The design was describe in the Project Proposal as below.

> *The actual inventory design must be determined based on the forest definition stage. Based on information available in the ToR, supported by reviews of the forests of St Lucia using Google Earth, the most likely inventory design is assumed to be two-stage forest inventory. The two-stage inventory will based on a stratification of forest into like primary sampling units, to be selected with probability proportional to size, with those primary units selected in the first stage sampled with secondary sampling units randomly located on parallel transects. GPS technology will be used to locate the secondary sampling points, to enable all field data to be accurately geo-referenced.*

The initial stratification will depend on the forest type, terrain, forest cover and forest management class. Plantation forest is most likely to be stratified on the basis of species and age. Natural forest is to be stratified on forest cover type, terrain and forest management category. Data from previous inventories, aerial photographs, and any acquired satellite imagery will be used to make the stratification. High altitude Protection forest may be assigned to a specific stratum to be subjected to a lower sampling intensity, based on difficulty and danger of access, sampling difficulty, and erosion concerns.

Secondary forest will be stratified on the basis of remote sensing data and management category. During the inventory design phase decisions will be made on the extent to which secondary forest is to be sampled. Such sampling is more likely to be designed to estimate NTFP and wildlife frequencies. The nature of the secondary forest must be identified prior to the sampling intensity being established.

Annex VII includes early draft provisional inventory analysis materials. The final form of the inventory design is included in the revise project work plan shown in Annex V as a milestone to be achieved November 2008.

Forest demarcation

The Project ToR does not mention the monumentation (concreting) of the survey points with metal markers, nor has monumentation been taken into account in the project budget. If monumentation is required for the forest demarcation to be completed, there is a need for an additional allocation of funds to cover the increased costs of monumentation. This matter is left for discretion of the Contracting Authority and the Project financier.

Detailed action plans for each Key Expert

Introduction

This section identifies the specific activities each Key Expert will be primarily responsible for. However each person working on project is a member of a team, and will be expected to contribute to all project outputs if required. The Consultant has identified specific short term experts to support the key project team. Their availability has been confirmed and their specific inputs and tasks have been elaborated in the Work Plan.

Detailed ToR for some non-key experts are included in Annex II.

All key experts will contribute to the achievement of all project outputs. However specific project activities will be assigned to specific key experts for implementation. The following chapters identify the activities which each key expert will focus on. All key experts will be expected to contribute to other activities which their expertise relates to.

Dr. Robert Tennent, Project Leader, Forest Inventory Specialist

The Project Leader will be responsible for coordination of all activities taking place in St Lucia. He will work closely with the FCG home-office Project Director in Finland to ensure that inputs of all key experts are timed to provide the maximum impact, and will work with the CFO and other FD officials to ensure that all project activities are coordinated with FD activities.

As Forest Inventory Specialist the Project Leader will have the responsibility of implementing those activities related to traditional forest inventory, and the development and implementation of the FMIS. He will be responsible for training in traditional forest inventory, training in use of FMIS, and for development of desired silvicultural regimes.

The Forest Inventory Specialist will take primary responsibility for the following activities, relating to the Project Purposes, Results and Activities as listed in Annex I.

Purpose 2, Result 3

Activities

- Conduct forest inventory
- Establish permanent sample plots (PSPs)
- Prepare/select volume tables
- Prepare FMIS
- Prepare inventory results

Purpose 4, Result 6

Activities

- Use FMIS to develop a series of alternative management objectives
- Evaluate alternatives

- Prepare the report

Purpose 5, Result 7

Activities

- Prepare alternative silvicultural prescriptions
- Prepare alternative utilization prescriptions
- Evaluate alternatives
- Produce report

Purpose 6, Result 8

Activities

- Obtain all existing previous inventory data
- Obtain all existing volume functions etc
- Prepare FMIS linked to GIS
- Enter all suitable previous inventory data into FMIS
- Provide training in use of FMIS
- Implement FMIS

Purpose 7, Result 9

Activities

- Conduct forest inventory to collect data
- Data processing
- Preparing a report

Purpose 8 Result 10

Activities

- Conduct training needs analysis
- Conduct training workshops for a cadre of local persons, including forestry officers, which will form part of the biophysical inventory and forest boundary line surveying team,
- Provide field work experience and on-the-job training to selected local persons
- Provide training in use of FMIS to selected FD staff

Purpose 9 Result 11

Activities

- Prepare FMIS integrating GIS, inclusion of inventory data, PSPs, and yield control
- Use FMIS to prepare management plans which can be modified to include effect of inventory data which may be collected at a later date

Annex VII contains an early draft methodologies section for the inventory activities of the Inventory Specialist. Please note that the material in Annex VII is in early draft form and is presented for information only, and will change during the development of the methodologies.

Dr. Jenny Daltry, Conservation Specialist

The Conservation Specialist will be responsible for the achievement of the bio-diversity aspects of the project. She will be responsible for the activities highlighted below.

She will supervise and coordinate the training and implementation of the biodiversity survey, working closely with the Forest Inventory Specialist to coordinate the two inventory aspects, and with the GIS and Data Management specialist for the input of the biodiversity data. She will have a major role to play in the preparation of the forest cover type maps.

The Conservation Specialist will contribute 7 months working as a long term expert. Her inputs are provisionally timetabled as follows.

September 08	Fielding mission, identify equipment, planning
October 08	Staff training needs assessment. Field reconnaissance. Participatory identification of information needed and survey design.
Nov. /December 08	Staff training classes and field surveys (with invited scientists from relevant fields). Establish database. Initiate herbarium and botanical description component.
Feb. /March 09	Joint review of data gathered, and preliminary recommendations. Second round of field surveys, with emphasis on plants and stocking the herbarium. Begin interview surveys on wildlife use.
July/August 09	Complete report, maps. Conduct rapid field surveys to assess wildlife populations used by local people and prepare recommendations. Complete training in data analysis and reporting.
Nov. /December 09	Completion of last outputs, including final joint review of findings and recommendations. Final assessment of any areas newly incorporated into the Forest Reserve system.

The Conservation Specialist will take primary responsibility for the following activities, relating to the Project Purposes, Results and Activities as listed in Annex I.

Purpose 2, Result 3

Activities

- Vegetation classification and composition;
- Species list

Purpose 3, Result 4

Activities

- Planning

- Consultation with MAFF and other stakeholders.
- Flora assessment and classification
- Report preparation
- Upgrading National Herbarium

Purpose 3, Result 5

Activities

- Planning
- Consultation with MAFF and other stakeholders.
- Fauna assessment and classification, critical habitats identification

Report preparation Annex VIII contains an early draft methodologies section for the activities of the Conservation Specialist. Please note that the material in Annex VIII is presented for information only, and will change during the development of the methodologies.

Mr. Earl Cenac, Principal Surveyor

The Principal Surveyor will be responsible for the surveying aspects of the project. He will manage the surveying activities of the project, and supervise the surveying team. He will maintain close liaison with the Project Leader and the CFO, and ensure that all project surveying activities are closely coordinated with FD activities.

He will work closely with the GIS and Data Management expert to ensure that all GIS input is consistent in terms of software and standards.

The Principal Surveyor will be a locally recruited long term expert contracted for 14 months over an 18 month period.

The Principal Surveyor will take primary responsibility for the following activities, relating to Project Purposes, Results and Activities as listed in Annex I.

Purpose 1, Result 1

Activities

- Ascertain, demarcate, and maintain/restore all existing forest reserve boundaries.
- Realign and update forest reserve boundaries to incorporate recent land acquisitions and the incorporation of 117 critical forested Crown parcels (approx. 2015 acres) and the 20+ parcels of private lands earmarked for incorporation into the Forest Reserves
- Submit to the Forestry Department two copies of the lodged boundary survey plans and digitized information of the above-mentioned surveys (the survey data format/ programme AutoCAD 2005 k; compatible with the ongoing efforts at digitisation of spatial data in St. Lucia
- Demarcate the limit of all forest reserves boundaries
- To develop a national forest reserve boundary line management plan

Purpose 2, Result 2

Activities

- digitize all information from forest reserve boundary survey
- Production of plans, maps and reports on the basis of digitized information

Mr. Vijay Datadin, GIS and Data Management Specialist

The GIS and Data Management specialist will be responsible for the GIS aspects of the project. He will be required to work closely with the other three key experts, and to ensure that all GIS input is standardised. He will work closely with the Principal Surveyor to ensure all surveying data are coordinated with all forest inventory and bio-diversity data.

He will work closely with the Forest Inventory specialist in providing the links between the attribute-based FMIS and the GIS system, so that GIS queries can interrogate the FMIS and provide area-based estimates of volume and other desired variables.

The GIS and Data Management Specialist will be an internationally recruited long term expert who will provide three 2 month inputs during the course of the project.

His inputs are provisionally timetable as below.

- November/December 2008
- April/May 2009
- Mid-October/mid-December 2009

The GIS and Data Management Specialist will take primary responsibility for the following activities, relating to Project Purposes, Results and Activities as listed in Annex I.

Purpose 2, Result 3

Activities

- Prepare GIS maps

Purpose 6, Result 8

Activities

- Update GIS to include boundary data, bio-resource data.
- Prepare FMIS linked to GIS
- Produce maps

Purpose 9, Result 11

Activities

- Prepare FMIS integrating GIS, inclusion of inventory data, PSPs, and yield control

Detailed Incidentals Budget

Discussions were held with Mr. Clarke of the BIT on items which may be purchased from the XCD 300,000 Incidentals budget included in the contract. Mr. Clarke advised that equipment necessary for the sustainable operation of the FMIS was included in this budget, as was travel costs and office costs. Travel costs and subsidence costs were also to be paid from this budget. Discussions with the FD indicated that a suitable daily subsistence allowance was XCD60 for an overnight stay and XCD30 for lunch.

Based on this information a detailed incidentals budget was prepared, as attached in Annex VI.

FMIS/Office computer system

A computer is required for the combined role of FMIS development and later implementation, secretarial services, and data input. The computer should have a large screen for FMIS development. A small office printer is required, plus supporting accessories.

A copy of Microsoft Office 2007 Professional is required for the development of the FMIS. The FMIS will be developed using Microsoft Access 2007.

This computer system is required at project inception. The project office secretary cannot be recruited until this computer system is in place. The following table contains cost estimations for this system, which is budgeted at XCD6,635.

FMIS Computer	XCD 3,550	
UPS - 650	XCD 595	
Network access point	XCD 295	
Printer - office	XCD 695	
Microsoft Office 2007 Professional	XCD 1,500	
FMIS/Office computer system		**XCD 6,635**

Table 1 Estimated cost of FMIS/Office computer system

This computer was purchased and installed in the Project office during the Inception Phase. The copy of Microsoft Office 2007 Professional has not yet been purchase.

GIS computer system

A computer is required for the GIS aspects of the project, and to ensure the later sustainability of the survey boundaries and inventory GIS. The computer should have a large screen for GIS development. A map plotter printer is required, plus supporting accessories. A copy of Arc View 12 is required for the development of the GIS.

This computer system is not required until November 2008. The following table contains cost estimations for this system, which is budgeted at XCD16,909.

GIS Computer	XCD 3,550	
UPS - 650	XCD 595	
Map plotter printer	XCD 4,000	
Arc GIS Licenses	XCD 8,764	
	GIS computer system	**XCD 16,909**

Table 2 Estimated cost of GIS computer system

Inventory field equipment

The project budget does not contain an element for inventory field equipment to be purchased by the project for the ongoing use of the Forestry Department. An allowance for EC$10,000 to be used for the purchase of field equipment has been included in the incidentals budget.

Office costs

General office setup costs are estimated at XCD1689. This includes the purchase of stationary and a filing cabinet. Ongoing office costs will include provision of office materials and telephone services, estimated to cost XCD8488 during the course of the project[1]. The incidentals budget gives a breakdown of these costs.

Field operating expenses

Field operating expenses include travel and daily allowances. These are estimated to cost XCD 256,808, as detailed in the summary table below. A full breakdown of these costs estimates over the life of the project is given in the detailed incidentals budget shown in Annex VI.

Item	
Field vehicle hire	XCD 140,000
Field vehicle fuel	XCD 20,300
Per diems	XCD 84,508
Private car allowances	XCD 12,000
TOTAL	**XCD 256,808**

Table 3 Estimated field operating costs

[1] This does not cover the project office secretary's salary, which is covered by the Consultant.

Review of other projects

The project proposal included the following background information on other projects in St Lucia.

The Caribbean Natural Resources Institute (CANARI) is an independent technical and research organisation, which analyses and promotes the participatory management of natural resources in the islands of the Caribbean. The results of its research and analysis in this field have been disseminated throughout the Caribbean region through publications, technical assistance and training.

There are two projects under the ***CANARI Forests and Livelihoods*** *programme, seeking to enhance the contribution of forest goods and ecological services to sustainable livelihoods of the rural poor in the insular Caribbean. The project are: "****Participatory Forest Management: improving policy and institutional capacity****", sponsored under the FAO National Forest Programme Facility (NFPF), and "****Practices and policies that improve forest management and the livelihoods of the rural poor in the insular Caribbean****" funded by the European Commission's Programme on Tropical Forests and other Forests in Developing Countries.*

CANARI is implementing the project ***Participatory Forest Management: improving policy and institutional capacity****" in partnership with the forestry departments of the participating countries, in 7 countries of the insular Caribbean - Barbados, Dominica, Grenada, Saint Kitts & Nevis, Saint Lucia, Saint Vincent & the Grenadines, and Trinidad & Tobago, involving regional activities as well as national activities. The NFPF project aims to support the improvement of socioeconomic and environmental benefits that can be derived from forest management by analysing, promoting and building capacity for participatory planning and management of forest resources at the regional, national and local levels.*

EC Natural Resources Management Programme*. The Programme aims aid the GoSL in bringing about legal and institutional reforms as well as environmental policy developments to ensure the full integration of environmental concerns in its economic and social development policies. Specific sectors currently being identified and prioritised for possible funding are integrated watershed management and water supply/sewerage/treatment, water harvesting, coastal mapping and zone management with action plans, solid waste management, disaster reduction/environmental education and training and maximising renewable energy opportunities. The Programme is planned to end in 2011.*

The OECS Protected Areas and Associated Livelihoods (OPAAL) Project *is a 5-year project designed to improve the management of protected areas in the Participating Member States of the Organisation of Eastern Caribbean States (OECS). The OPAAL project was born out of a request by the government of St. Lucia to the World Bank to support a national Coastal /*

Wetland Ecosystem Conservation and Sustainable Livelihoods project which was subsequently converted into a regional activity to involve states of Antigua and Barbuda, St. Kitts and Nevis, the Commonwealth of Dominica, St. Lucia, St. Vincent and the Grenadines and Grenada. Project objectives include increased participation in protected areas management by private and civil society organizations, and facilitating sustainable community livelihoods for those communities traditionally dependent on protected areas resources.

*The United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) funded "**Capacity Building and Mainstreaming of Sustainable Land Management in Saint Lucia**". The long-term goal of the project is to ensure sustainable management of the land resources of St. Lucia in order to enhance ecosystem health, integrity, stability, functions and services, while contributing directly to the environmental, economic and social well being of the people of Saint Lucia.*

***IWCAM Demonstration Project**. The project site, the Fond D'or Watershed is the second largest watershed in St. Lucia. It is 10,230 acres in area, most of which is hilly. Government Forest Reserves makes up 23% of the watershed. The Project General Objectives are to develop a model approach to participatory watershed management which will capture the input and support of all stakeholders, particularly local communities, within a specific watershed complex; to capture requirements for integration with other national policies, legislation and resource management strategies; to demonstrate the use of incentives and transferred benefits within a watershed management structure; to achieve reduction in wastage and water loss; and to encourage better conservation and more long-term sustainable use of natural resources.*

A review and analysis of the results and outputs of these projects was initiated during the Inception Phase, and was ongoing at the time of presentation of this Inception Report. The project recognises recent projects that have similar objectives. In order to avoid duplication, the project will make an assessment of the similar projects that have been implemented in Saint Lucia during the Inception Phase. The information generated from this assessment will help synergize the relevant data with the project, specifically, in the development of the FMIS. The assessment of similar initiatives will help identify any forestry and biodiversity data gaps, and focus efforts in bridging these gaps. These similar projects include but are not limited to:

- Distance sampling parrot and other key bird species census, St Lucia, dry lands assessment, White breasted thrasher assessment**,** the iguana conservation project and work done on the Maria Islands on the lizards and the Racer spearheaded by Durrell Wildlife Conservation Trust (DWCT).
- The Caribbean Vegetation mapping project, funded by USDA Forest Service International Institute of Tropical Forestry (IITF) and The Nature Conservancy (TNC)
- The proposed Biodiversity inventory and status assessment for Millet nature trail, spearheaded by CEPro consultants on behalf of the Forestry Department.

Finalization of project logistics

Office

A project office was established in office space provided by the Forestry Department. The project office consists of two adjoining rooms complete with desks, chairs, air conditioners, and a telephone. Internet access is available in the project office.

The Project Leader decided to defer the recruitment of a Project Secretary until a sufficient work load had developed and necessary office equipment is purchased. Discussions were held with FD officers on likely candidates for the position of secretary, initially to be a part time position, later becoming a fulltime position. A possible candidate has been identified. The secretary is anticipated to commence work on a part time basis in September, becoming fulltime in early 2009. The secretary will be given training in the use of Microsoft Money and Microsoft Excel to enable the secretary to fulfil project functions.

Timing of input of resources

The timing of project inputs is detailed in the revised version of the project work plan shown in Annex V. The key Experts have been contacted, and their time has been allocated to ensure that the project outputs can be realised.

Further refinement will be made to the timing of the Key expert consultants during the Implementation Phase.

Annex I – Project Purposes, Results, and Activities

To successfully achieve the purposes set out in ToR	
Purposes	Related results and activities
Purpose 1. To survey and demarcate and realign the Forests Reserves boundaries, inter alia incorporating the newly acquired crown lands, in order to facilitate better protection and management;	**Result 1**. *Realigned, demarcated and updated forest reserve boundaries* Activities: 1. Ascertain, demarcate, and maintain/restore all existing forest reserve boundaries. 2. Realign and update forest reserve boundaries to incorporate recent land acquisitions and the incorporation of 117 critical forested Crown parcels (approx. 2015 acres) and the 20+ parcels of private lands earmarked for incorporation into the Forest Reserves 3. Submit to the Forestry Department two copies of the lodged boundary survey plans and digitized information of the above-mentioned surveys (the survey data format/ programme AutoCAD 2005 k; compatible with the ongoing efforts at digitisation of spatial data in St. Lucia 4. Demarcate the limit of all forest reserves boundaries 5. To develop a national forest reserve boundary line management plan
2. To create an updated data base of Forest Reserve boundary line (digital and hard copy data, to reside at Forestry Department and Lands and Surveys Department) and measure the quality, quantity and distribution - inclusive of yield and volume - of timber and non-timber resources, and to compile statistics of their	**Result 2**: *Digital and physical plans/maps, reports, data and other information on land of all forests reserves produced from surveying and demarcation of the forests reserves boundary line survey*; Activities:

To successfully achieve the purposes set out in ToR	
Purposes	Related results and activities
availability at the range, watershed and national level.	1. digitize all information from forest reserve boundary survey 2. Production of plans, maps and reports on the basis of digitized information **Result 3**: *A comprehensive report on the current state of forest resources (Timber, Non-Timber, biodiversity, wild fauna etc), with recommendations for sustainable management practices*. The report should include, but should not be limited to, the following key considerations: a. Background information; b. Previous inventories; c. Inventory Design; d. Inventory results, including area, volume, species composition; e. Accuracy of inventory results; f. Vegetation classification and composition; g. Species list; h. Summary of statistical calculations; i. Conclusions and recommendations; Activities: 1. Conduct forest inventory 2. Establish permanent sample plots (PSPs) 3. Prepare/select volume tables 4. Prepare GIS maps

To successfully achieve the purposes set out in ToR	
Purposes	Related results and activities
	5. Prepare FMIS 6. Prepare inventory results
3. To assess the status of the forest ecosystem, assessment of biodiversity (species richness and diversity) and all existing vegetation type at the watershed, range, and national level.	**Result 4:** *A botanical description of forest plants including an island wide specimen collection and identification. An upgraded and improved National Herbarium* Activities: 1. Planning 2. Consultation with MAFF and other stakeholders. 3. Flora assessment and classification 4. Report preparation 5. Upgrading National Herbarium **Result 5.** *An assessment of wildlife use attributes identifying critical habitats and recommendation for sustaining habitats of important, rare or endangered animal species,* Activities: 1. Planning 2. Consultation with MAFF and other stakeholders. 3. Fauna assessment and classification, critical habitats identification 4. Report preparation

To successfully achieve the purposes set out in ToR	
Purposes	Related results and activities
4. To advise on the most optimal means/measures for the sustainable management (utilization and conservation) of forest resources	**Result 6**: *A report on most suitable and alternative management strategies* Activities 1. Use FMIS to develop a series of alternative management objectives 2. Evaluate alternatives 3. Prepare the report
5. To recommend relevant silvicultural and utilization prescriptions necessary for planning and management of forest resources	**Result 7**: *A report on silvicultural and utilization prescriptions* Activities: 1. Prepare alternative silvicultural prescriptions 2. Prepare alternative utilization prescriptions 3. Evaluate alternatives 4. Produce report
6. To assess all existing forestry related database, and to create an updated monitoring system for producing forest resource state and change estimates;	**Result 8:** *An updated and functional forest resource monitoring system,* which should include: a. Permanent sample plots; b. Yield tables and other tools for measurements of changing variables; c. An upgraded and integrated data base, with biodiversity, wildlife, forest, botanical inventory

To successfully achieve the purposes set out in ToR	
Purposes	Related results and activities
	data; d. Capacity for effective and efficient maintenance of monitoring system, including computers, GPS, GIS, other relevant tools and human resources; e. Standard maps at a scale of 1:25,000 for the whole country using GIS data, indicating different forest zones, forest boundaries, forest cover classes, wildlife sanctuaries and important habitats for rare and endangers wild animals and other critical biodiversity conservation considerations. Activities 1. Obtain all existing previous inventory data 2. Obtain all existing volume functions etc 3. Update GIS to include boundary data, bio-resource data. 4. Prepare FMIS linked to GIS 5. Enter all suitable previous inventory data into FMIS 6. Produce maps 7. Provide training in use of FMIS 8. Implement FMIS
7. To provide spatial and statistical data for estimating the nature, magnitude, geographical scope, in relation to Timber and NTFP yield and volume, biodiversity, carbon storage, and processes	**Result 9**: *A comprehensive report on the nature, magnitude and geographical scope of forest resources (Timber and Non-Timber yield and volume, biodiversity, carbon storage and processes).* Note: this report is connected to the production of the report on result 3.

To successfully achieve the purposes set out in ToR	
Purposes	Related results and activities
	Activities: 1. Conduct forest inventory to collect data 2. Data processing 3. Preparing a report
8. To conduct a training programme to develop the capacity of a cadre of persons in forests resource assessment and inventory method and forests management system using, scientific and modern technology	**Result 10**: *A cadre of locally trained individuals with sufficient capacity and skills to function in a forest inventory/assessment environment and at least 2 local persons who can manage a forest management system.* Activities: 1. Conduct training needs analysis 2. Conduct training workshops for a cadre of local persons, including forestry officers, which will form part of the biophysical inventory and forest boundary line surveying team, 3. Provide field work experience and on-the-job training to selected local persons 4. Provide training in use of FMIS to selected FD staff
9. To recommend and implement an effective, efficient and appropriate forest management system for Saint Lucia.	**Result 11**: *A forest management information system in place and functioning;* Activities: 1. Prepare FMIS integrating GIS, inclusion of inventory data, PSPs, and yield control 2. Use FMIS to prepare management plans which can be modified to include effect of inventory data which may be collected at a later date

Annex II - Terms of Reference for specific project experts

This Annex contains Terms of Reference for specific project experts identified at the time of the Inception Report.

ToR for the Surveyor Technician

Requirements:

- The Surveyor Technician should possess at least a certificate in building technology or related field and should have at least 5 years professional experience in the field of surveying.

Duties:

The tasks of the Surveyor Technician entail Planning and implementing National Forest Demarcation, in close cooperation with the Principal Surveyor.

Survey Technician's work will be conducted in the field, as a member of the field team. The specific activities include the following:

- Ascertain, demarcate, and maintain/restore all existing forest reserve boundaries.
- Realign and update forest reserve boundaries to incorporate recent land acquisitions and the incorporation of 117 critical forested Crown parcels (approx. 2015 acres) and the 20+ parcels of private lands earmarked for incorporation into the Forest Reserves. The plan(s) should be presented in accordance with the requirements of the aforementioned agency.
- Demarcate the limit of all forest reserves boundaries.
- To contribute to a national forest reserve boundary line management plan.

Other tasks related to forest demarcation, according to the needs of the project, can be assigned to the Surveyor Technician. The Surveyor Technician shall work under the direction and supervision of the Principal Surveyor and Project Leader.

ToR for the Surveyor Draftsman

Requirements:

- The Surveyor Draftsman should possess at least a certificate in building technology or related field and should have at least 5 years professional experience in the field of surveying.

Duties:

The tasks of the Surveyor Draftsman entail Planning and implementing National Forest Demarcation, in close cooperation with the Principal Surveyor.

Survey Draftsman's work will be conducted in the office, as support to the field team and the Principal Surveyor. The specific activities include the following:

- Digitise all field data with AutoCAD
- Collect information for use by Principal Surveyor
- Ascertain, demarcate, and maintain/restore all existing forest reserve boundaries.
- Realign and update forest reserve boundaries to incorporate recent land acquisitions and the incorporation of 117 critical forested Crown parcels (approx. 2015 acres) and the 20+ parcels of private lands earmarked for incorporation into the Forest Reserves. The plan(s) should be presented in accordance with the requirements of the aforementioned agency.
- Demarcate the limit of all forest reserves boundaries.
- To contribute to a national forest reserve boundary line management plan.

Other tasks related to forest demarcation, according to the needs of the project, can be assigned to the Surveyor Draftsman. The Surveyor Draftsman shall work under the direction and supervision of the Principal Surveyor and Project Leader.

ToR for Project Botanist

Purpose

The primary purpose of this post is to deliver Result 4 and the botanical components of Results 3 and 10. This post will entail literature reviews, rapid field surveys nationwide, and herbarium-based work.

Tasks

In consultation with the Conservation Biologist, Project Leader, GIS & Data Management Specialist, MAFF and other personnel, develop a work plan and identify equipment and other resource needs to complete the following activities:-

- Develop a vegetation classification system based on existing literature supplemented with field research in representative sites nationwide. Work with the GIS specialist to map the different vegetation types.
- Compile a list of the known terrestrial plants of St Lucia, based on existing literature supplemented with field surveys.
- Prepare botanical descriptions, with photographs, of key forest plants (including dominant trees, endemic species, globally threatened species, species of commercial or domestic use, etc.).
- Work with a designated local curator to upgrade and improve the National Herbarium, and collect and deposit additional specimens.
- Identify future research and training priorities to further understanding of St Lucia's flora.
- During the course of the above, train and mentor designated national personnel in plant identification and assessment techniques.

Outputs

- An agreed work plan at the start of the assignment.
- Report detailing the proposed vegetation classification system, with a description of the structure and composition of each vegetation type.
- Report containing botanical descriptions, with photographs, of important forest plants, and a checklist of the known flora of St Lucia
- Plant specimens collected, identified and deposited in the herbarium. National herbarium upgraded and improved, with clear systems in place for curating specimens.
- End of assignment report, with recommendations for future botanical research and training on St Lucia.
- Designated national personnel gain skills and experience in botanical surveys and curation.

Qualifications

- A relevant degree
- Well-rounded knowledge of the taxonomy of Lesser Antillean flora
- Experience in collecting, preparing and curating plant specimens.
- Good writing skills

ToR for Project Ornithologist

Purpose

The primary purpose of this post is to deliver bird-related components of Results 3, 5 and 10. This post will entail literature reviews and rapid field surveys nationwide.

Tasks

In consultation with the Conservation Biologist and other personnel, develop a work plan and identify equipment and other resource needs to complete the following activities:-

- Conduct a literature review to compile a list of the known birds of St Lucia, identifying those that are resident, migratory or rare vagrants.
- Identify bird species of conservation concern, e.g., species that are globally threatened (IUCN red list), endemic, or frequently hunted. Map their distribution ranges, with technical support from the GIS and Data Management specialist, and compile a description of their status, ecology, and any known management needs.
- Conduct rapid, standardized assessments of the diversity and relative abundance of birdlife in at least five key forest sites (to be identified in advance by the project team).
- Contribute to planning meetings to identify management needs of St Lucia's forests as they pertain to the nation's birds.
- During the course of this assignment, train and mentor designated national personnel in bird identification and assessment techniques.

Outputs

- An agreed work plan at the start of the assignment.
- Checklist of the birds of St Lucia.
- Report on the birds of conservation concern, containing distribution maps and details of their status, ecology and recommended management actions.
- Contribute bird diversity and abundance information to forest biodiversity report (compiled by the Conservation Biologist).
- Designated national personnel gain skills and experience in bird survey techniques.

Qualifications

- Ability to identify the birds of Lesser Antilles
- Experience in field survey techniques to record bird species diversity and relative abundance.
- Good writing skills

ToR for Project Entomologist

Purpose

The primary purpose of this post is to deliver insect-related components of Results 3, 5 and 10. This post will entail literature reviews and rapid field surveys nationwide.

Tasks

In consultation with the Conservation Biologist and other personnel, develop a work plan and identify equipment and other resource needs to complete the following activities:-

- Conduct a literature review to compile a list of the known insects of St Lucia.
- Conduct rapid, standardized assessments of the diversity of one order of insects[2] in at least five forest types (to be identified in advance by the project team). Diversity should be calculated on the basis of morphotypes if a significant number of species are new to science.
- Identify species of special conservation interest, e.g., species that are endemic, globally threatened, or alien invasive.
- Advise on the significance and management needs of St Lucia's forests as they pertain to the nation's insects.
- During the course of this assignment, train and mentor designated national personnel in insect survey techniques.

Outputs

- An agreed work plan at the start of the assignment.
- Checklist of the known insects of St Lucia, indicating species of conservation interest and recommended management actions.
- Contribute insect diversity and abundance information to the forest biodiversity report (compiled by the Conservation Biologist).
- Designated national personnel gain skills and experience in insect survey techniques.

Qualifications

- Ability to identify insects of Lesser Antilles
- Experience in field survey techniques to record species diversity within at least one insect order.
- Good writing skills

[2] e.g., Coleoptera (beetles), Diptera (flies) or Lepidodoptera (butterflies and moths). Note that it would not be reasonable to expect one expert to address more than one order.

ToR for Project Mammalogist

Purpose

The primary purpose of this post is to deliver mammal-related components of Results 3, 5 and 10. This post will entail literature reviews and rapid field surveys nationwide.

Tasks

In consultation with the Conservation Biologist and other personnel, develop a work plan and identify equipment and other resource needs to complete the following activities:-

- Conduct a literature review to compile a list of the known mammals of St Lucia, identifying those that are native and non-native.
- Identify mammal species of conservation concern, e.g., species that are globally threatened (IUCN red list), endemic, or frequently hunted. Map their distribution ranges, with technical support from the GIS and Data Management specialist, and compile a description of their status, ecology, and any known management needs.
- Conduct rapid, standardized assessments of the diversity and, where possible, relative abundance of bats and other mammals in at least five key forest types (to be identified in advance by the project team).
- Contribute to planning meetings to identify management needs of St Lucia's forests as they pertain to the nation's mammals.
- During the course of this assignment, train and mentor designated national personnel in mammal identification and assessment techniques.

Outputs

- An agreed work plan at the start of the assignment.
- Checklist of the mammals of St Lucia.
- Report on the mammals of conservation concern, containing distribution maps and details of their status, ecology and recommended management actions.
- Contribute mammal diversity and abundance information to forest biodiversity report (compiled by the Conservation Biologist).
- Designated national personnel gain skills and experience in mammal survey techniques.

Qualifications

- Ability to identify bats and other mammals of Lesser Antilles
- Experience in field survey techniques to record mammal species diversity and relative abundance.
- Good writing skills

Annex III – Project Launch and Stakeholder Workshop

The Project Launch and Stakeholder Workshop was held on August 19th at the Palm Haven Hotel, Rodney Bay. The Agenda, List of Participants, and Discussion notes are included below.

Agenda

National Forest Demarcation & Bio-Physical Resource Inventory Project

Stakeholders Workshop, 19 August, 2008

Conference room, Palm Haven Hotel

Time	Item	Presenter
8:30 am	Registration	
9:00 am	Welcome address by CFO	Mr. Michael Bobb (for Mr. G. Michel Andrew)
9:10 am	Opening address by PS	Mr. Hubert Emmanuel
9:30 am	Statement of support by BIT	Mr. Bertram Clarke
9:40 am	Introduction to Finnish Consulting Group	Mr. Jorma Peltonen
9:50 am	Introduction of Project Team	Dr. Robert Tennent
10;00 am	Coffee break	
10:30 am	Description of project activities	
	Forest Inventory	Dr. Robert Tennent
	Biophysical Inventory	Mr. Jorma Peltonen
	Boundary survey	Mr. Earl Cenac
	GIS activities	Dr. Robert Tennent
12:00 pm	Lunch break	
1:00 pm	Discussion group	Chairman: Mr. Lyndon John
3:00 pm	Conclusion of Workshop	Mr. Lyndon John

Attendees at Project Launch/Stakeholders Workshop

NAME	ORGANIZATION/TITLE
FCG International	
Jorma Peltonen	Project Director
Robert Tennent	Project Leader
MINISTRY OF PHYSICAL DEVELOPMENT, HOUSING, URBAN RENEWAL & LOCAL GOV'T	
Peter Felix	Crown Lands
Donnalyn Charles	Sustainable Dev't & Environ
Vincent Jn Baptiste	Survey & Mapping
MINISTRY OF TOURISM	
Sherille Emmanuel	Ministry of Tourism
MINISTRY OF FINANCE	
Lisa Montoute	Ministry of Finance
ATTORNEY GENERAL'S CHAMBERS	
Dwight Lay	AG's Chambers
MINISTRY OF ECONOMIC AFFAIRS	
Andrina Abraham	Ministry of Economic Plng
Deborah Bushell	TA Team, NAO's Office
Warren Olding	INRMP - SFA 2003
Hilary Regis	NAO
MINISTRY OF AGRICULTURE, LANDS, FORESTRY & FISHERIES	
Faustinus Monero	Engineering Division
Vincent La Corbiniere	Marketing Unit
David Lewis	Northern Range
Peter Vidal	Millet Range
Ananias Verneuil	Dennery Range
Julius Georges	Quilesse Range
Donatian Gustave	Forest Mgmt
Alfred Prospere	Watershed Mgmt
Karl Augustine	Environmental Educ. Unit
Elvis Herelle	Region 1 Extension Office
Mary Louis	Region 2 Extension Office
Adeline Eudovic	Region 3 Extension Office
Hyacinth Felix	Region 4 Extension Office
Bernadine Evans	Region 4 Extension Office

NAME	ORGANIZATION/TITLE
Felix Chicot	Region 6 Extension Office & Farmer Organization Co-ordinator
Francois Henry	Region 7 Extension Office
Unice Perineau	Region 8 Extension Office
Hilary George	Research Division
Collin Paul	Tree Crop Co-ordinator, Extension Div
George Small	Root Crop Co-ord, Extension Div
Eloi Alexis	Cut Flower & Pineapple Specialist, Extension Div
Michael Bobb	Forestry Department
Lyndon John	Forestry Department
Anita James	Biodiversity Project
Dr. Charles Isaac	Corporate Planning Division
Cornelius Isaac	IWCAM
Raphael St. Mark	Banana Production Management Unit
BANANA INDUSTRY TRUST	
Bertram Clarke	BIT
Julius Polius	BIT
Bothan St. Jean	
OTHERS	
Allison Anerville	Thomazo Water catchment
Earl Cenac	Earl Cenac & Associates
Joseph Dosserie	WASCO
Hilary Regis	NAO
Kervin Stephenson	IICA

Questions and comments recorded during workshop

Some 40 participants attended the workshop. The feedback from the workshop participants was very positive. Many questions were asked and comments made during the workshop, with the Project Leader, the Forestry Department and the BIT representatives joining together to respond to the queries.

The feedback obtained from the questions and comments was incorporated into this Inception Report. The following notes record the majority of the questions and comments from the workshop.

Forest inventory

- Sampling method that has been planned for the forest inventory work (two-stage PPS sampling) might not be suitable for St Lucia as the forests are multi-storey.
- What will be the sampling intensity of the forest inventory?
- How will the forest inventory work be carried out in the future when the project has ended – what will be the frequency of the inventories?
- How many FD staff members will be participating in the actual field work (forest and biodiversity inventory)?
- To what extent the water resources will be identified and taken into account when doing the inventories?

Biodiversity assessment

- The work of Conservation Biologist will be very demanding and time consuming and will need a lot of consultation with the local experts.
- The project should do the sampling of all possible forms of life when doing the biodiversity assessment.
- The project period for the biodiversity assessment is very scarce and cannot probably be done by the end of next year so it is important the Forest Department will have the capacity to continue the work after the project has ended its work.
- What plans the project has to work together with the private forest owners with regard to biodiversity assessment?

Land survey and forest demarcation

- Areas that are prompt to landslides might cause problems with regard to boundary measurement. Also in some areas there is mining going on.
- It will be important to work with stakeholders like the agricultural sector and local communities as the boundary measurement of the forest reserves and land use related issues might cause concern and even conflicts.

- The implementation period for the forest reserve demarcation work is rather short. Is the time allocated sufficient to implement the work in case any unexpected alterations to plans occur?

Other issues

- Many times the communities feel they are not part of the processes that deal with the natural resources of the area where they are living. How the project will manage to get them involved and get support from them in the field work?
- Safety: should there be cooperation with the local police concerning the inventory work done in the forest reserves?
- How will the danger of snakes be eliminated during the field work?
- What plans for acquisition of lands to be included in the Forest reserve there are? Is any money allocated for that purpose?
- What kind of training there will be for different levels of staff of FD? Will the GIS training be available for forest rangers?
- What are the plans for the collaboration with other projects? And with the tourism sector?
- Are there any revenue collection planned as part of the project as income generation would increase the sustainability?
- One needs to increase the publicity in the project work plan. In the rural area the right media to do the publicity is radio.
- Stakeholder meetings with project beneficiaries at the community level needs to be organised to inform about the project activities and reply any queries.

Annex IV – Revised Project Logical Framework

The following table shows the revised project logical framework. It contains revisions developed during the Inception Phase including feedback from the stakeholder's workshop.

INSET LOGICAL FRAMEWORK HERE

Annex V - Revised Project Work plan

The following table shows the revised work plan for the project. Further minor revision of the timing of activities will be recorded in future reports.

INSERT WORK PLAN HERE

Annex VI – Detailed Incidentals Budget by item and month

Incidentals budget item	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09
Office consumables	XCD 759	XCD 200	XCD 300	XCD 300	XCD 300	XCD 300	XCD 300	XCD 300	XCD 300
Telephone costs/internet	XCD 29	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100
Field vehicle hire	XCD 0	XCD 0	XCD 5,000	XCD 5,000	XCD 5,000	XCD 25,000	XCD 15,000	XCD 15,000	XCD 15,000
Field vehicle fuel	XCD 0	XCD 0	XCD 700	XCD 750	XCD 750	XCD 2,400	XCD 2,400	XCD 2,400	XCD 2,400
Per diems	XCD 0	XCD 0	XCD 3,500	XCD 4,560	XCD 3,500	XCD 10,178	XCD 10,178	XCD 9,118	XCD 10,178
Private car usage	XCD 0	XCD 0	XCD 0	XCD 1,200	XCD 1,200	XCD 1,200	XCD 1,200	XCD 1,200	XCD 1,200
Office equipment	XCD 6,297	XCD 8,764	XCD 9,645	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0
Field equipment	XCD 0	XCD 0	XCD 0	XCD 10,000	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0
Project Incidentals Totals	**XCD 7,085**	**XCD 9,064**	**XCD 19,245**	**XCD 21,910**	**XCD 10,850**	**XCD 39,178**	**XCD 29,178**	**XCD 28,118**	**XCD 29,178**

Item (continued)	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Total
Office consumables	XCD 300	XCD 300	XCD 300	XCD 300	XCD 300	XCD 300	XCD 1,000	XCD 1,000	**XCD 6,859**
Telephone costs/internet	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	XCD 100	**XCD 1,629**
Field vehicle hire	XCD 15,000	XCD 15,000	XCD 5,000	XCD 5,000	XCD 5,000	XCD 5,000	XCD 5,000	XCD 0	**XCD 140,000**
Field vehicle fuel	XCD 2,400	XCD 2,400	XCD 750	XCD 750	XCD 750	XCD 750	XCD 700	XCD 0	**XCD 20,300**
Per diems	XCD 10,178	XCD 9,118	XCD 3,500	XCD 3,500	XCD 3,500	XCD 3,500	XCD 0	XCD 0	**XCD 84,508**
Private car usage	XCD 1,200	XCD 1,200	XCD 1,200	XCD 1,200	XCD 0	XCD 0	XCD 0	XCD 0	**XCD 12,000**
Office equipment	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	**XCD 24,706**
Field equipment	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	XCD 0	**XCD 10,000**
Project Incidentals Totals	**XCD 29,178**	**XCD 28,118**	**XCD 10,850**	**XCD 10,850**	**XCD 9,650**	**XCD 9,650**	**XCD 6,800**	**XCD 1,100**	**XCD 300,002**

Annex VII – Draft Inventory methodologies

This annex contains early draft inventory methodologies to be refined for use in St Lucia. The material in this annex **WILL** be modified and is presented at this early stage for information only.

Activities to be carried out in the St Lucia Forestry Inventory

Introduction

This document outlines in broad details the recurrent activities to be carried out during the St Lucia Forest Inventory. The process of inventory is cyclic and ongoing, consisting of a repeated process of redefining the forest into more specific detail. This is achieved by a gradual refining of the forest stratification described in steps 1 and 2, followed by further sampling, and repeated analysis.

Further precise detail is to be found in the two supporting documents, St Lucia Forest Service Inventory Guide, and St Lucia Forest Service Forest Management Information System User Guide, further referred to as the Inventory guide and the SLFMIS guide respectively.

Forest typing

The first step in forest inventory is to develop forest type maps. This involves the delineation of areas occupied by forest on a map, either manually or digital, using either colour shaded maps or a GIS software package. These areas are known as ***forest units***.

The forest typing should identify the forest in terms of the location of the forest unit, the area of the forest unit, the managerial classification of the forest unit, and the species composition of the forest unit.

The typing may be broad or narrow, depending on the resources available. The typing can be extended at a later date, to allow more refined inventory results to be calculated. The more narrow the typing, the more sensitive the inventory.

It is vital that the area of each forest unit is measured. The overall accuracy of the inventory estimates depends on the area measurement and the accuracy of the forest statistics calculated.

If the forest units are identified using tracing paper in the first instance, they should be digitised into the GIS at a later stage, and the area estimates updated.

See the Inventory guide for further details

Identify forest strata

The second step is to divide the forest units into forest strata. A forest stratum is a collection of similar forest units, which will be managed together.

From a forest manager's point of view, stratification gives information on management units, which the manager can use for management decision making. A forest manager may divide his forest into productive and non-productive forest, putting most of his managerial efforts into the

productive forest. The forest manager gains a better understanding of his forest through the use of a carefully thought out forest stratification.

The forest stratum is the inventory component that provides estimates of forest statistics. No estimates of forest statistics are available for any lower level inventory components. A forest unit, for example, does not provide any estimates of forest statistics.

The forest units identified above should be classified into forest strata. All forest units must be included in a forest stratum for the inventory results to be accurate.

See the Inventory guide for further details

Enter forest units in SLFMIS

The details of the forest units should be entered into the SLFMIS, with their strata definitions. This step is vital to classify the inventory to ensure that inventory results are as sensitive as possible.

The information entered in the SLFMIS will allow the forest manager to understand the nature of his forest.

See the SLFMIS guide for further details

Sample plot distribution

Most forest inventories use systematic sampling. Systematic sampling is sampling on a grid imposed over a forest. An example would be using the geo-reference grid found on many maps as a guide for sampling.

Systematic sampling can introduce bias, if there is a systematic pattern in the forest being sampled, such as a regular series of ridges and valleys. Any sampling scheme that had sample lines following a ridge or valley pattern would be likely to produce biased estimates.

In St Lucia systematic sampling is unlikely to introduce bias, due to the nature of the geography of the island.

It is important that any systematic sampling grid be established objectively. A grid line should be defined in such a manner that bias is avoided. An objective starting point should be determined.

For the forest inventory in St Lucia, sampling should be carried out by placing sample points on a gridline at 200m x 200m intervals over the forest units. The sample interval can be increased for large forest units, or decreased for small forest units.

A sample plot should be located at the intersection of each grid line. The access to the forest unit should be considered, to ensure that field team safety is protected.

See the Inventory guide for further details

Establish sample plot

Field sample points should be established at each grid point location. The sample point should be either a sample plot, or a strip plot, depending on the nature of the forest.

The field team should travel to the sample point via a compass bearing from a suitable access point, such as a road/

The measurements to be collected within the sample plot are the species and diameters of all trees, and a sample of tree heights, or species count for strip plots

See the Inventory guide for further details

Measure sample plot

The diameter of a tree is the single most important measurement that can be taken from a tree. Tree diameter is closely related to tree height and volume. Accurately measured tree diameters can allow a forest manager to estimate forest volume with a reasonable degree of accuracy.

The diameter of each tree should be measured in centimetres to one decimal point (e.g. “14.7”) with a diameter tape at a point 1.3 m from the base of the tree, measured on the uphill side of the tree

A sample of heights should be measured to enable the FMIS to calculate the mean top height of the stand.[3] The MTH is calculated from a regression equation. The FMIS needs the heights of about 10 to 12 trees to calculate this height.

The sample tree heights should include three smaller trees, three average trees, and four to six trees at the top of the range. This is to ensure that the regression be can calculated accurately.

The team leader should be careful to ensure that only representative trees are measured. He should not measure short trees with large diameters, or tall trees with small diameters.

In mixed species stands a range of species should be included in the height tree sample.

See the Inventory guide for further details

Enter sample plot information

The sample plot information should next be entered into the SLFMIS computer system, after careful checking for transcribing errors, punch errors, and obviously bad measurement errors. (For example, a tree with a dbh and a height of less than 1.3m. By definition, a tree does not have a dbh until it is over 1.3m high)

It is vital that all data entered have been collected accurately, and recorded correctly.

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[3] Mean Top Height, MTH, is the height corresponding to the quadratic mean diameter of the 100 largest diameter trees in the sample plot, calculated from a height-diameter regression curve.

If the data are not entered correctly, the inventory results will not be accurate.

See the SLFMIS guide for further details

Check sample plot information

The SLFMIS Plot details report should be run for each plot after data entry. This report lists any errors that can be found, such as zero dbh, suspect heights, low height diameter regression r^2 values, and zero plot areas.

The printouts from the SLFMIS should be compared with the field data sheets. Any incorrect or bad data should be corrected in the SLFMIS or removed from the database.

See the SLFMIS guide for further details

Examine stratum reports

After each batch of plots has been entered into the SLFMIS, the stratum summary reports should be run.

The reports present the inventory summary details for examination. These reports show see how accurate the inventory is, so that a decision can be made whether to carry out more sampling.

The examination of the summary reports will show the degree of accuracy that has been achieved in the inventory. This is the PLE[4] of the basal area estimate.

If the PLE is too high, over 10%, this indicates that either the sample intensity is too small, or that the stratum is too varied.

If the PLE is too high, either more plots need to be measured each forest unit, or the forest units need to be divided into smaller units with less variation within them.

See the SLFMIS guide for further details

Redefine forest units as necessary

If the stratum reports show that the strata are too large or poorly defined, it is necessary to redefine the forest units into more homogenous groupings, or subdivide the forest units.

This is done by remapping the forest units into smaller units, and allocating them to different strata. New strata should be defined to allow variation between strata to be excluded from the PLE estimate. After redefining the forest units, the analysis is repeated, and the process recommenced.

See the SLFMIS guide for further detail

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[4] Probable Limit of Error, the 95% confidence limit of the mean, expressed as a percentage.

St Lucia Forestry Department Inventory Guide

Introduction

This manual is a guide to conducting forest inventory for use by the St Lucia Forestry Department. It does not contain all the theory and detail necessary to fully understand forest inventory. It is intended to provide a general guide on conducting inventory, identifying aspects of forest inventory that should be considered.

The guide is designed to supplement training inventory team members have already received. The guide should serve as a reminder of important aspects of forest inventory.

The guide does not include details on the analysis of forest inventory data. These are contained in the guide to the St Lucia Forest Management Information System, which contains an inventory data analysis module[5].

Those involved in the preparation of a forest inventory should obtain comprehensive texts on the subject of inventory, and make a full study. A list of suitable texts is given in the Recommended Reading section of this guide.

Statistical terms in forest inventory

A forest inventory is a process of statistical estimation. It is worth reviewing a number of statistical terms that apply in forest inventory, as in any statistical sample.

Random

All statistical samples should be taken at random. A random sample is defined as:

"*A sample of **n** units selected from a population such that each possible combination of **n** has an equal likelihood of being selected.*"

For forest inventory, this means that every point in a forest unit must have an equal chance of being selected.

Bias

Random sampling is designed to prevent bias. Bias is defined as:

"*A systematic distortion of an estimate*"

A biased estimate is an estimate that is systematically different from the true value. An example of bias would be measuring diameters with a tape that had lost the first 2 centimetres. All the diameter measurements would be 2 cm greater than the trees in question.

Accuracy

Forest inventories are designed to provide accurate estimates. Accuracy is defined as:

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[5] See "St Lucia Forestry Department Management Information System User Guide", by R.B. Tennent

"*The closeness of an estimate to the true value*"

For a forest with a true average diameter of 45 cm, an estimated mean diameter of 44 cm would be accurate, and an estimated mean diameter of 55 cm would be inaccurate.

Precision

Precision is defined as:

"*The closeness of sample values to their true mean*"

In the case above, an inventory with sample diameter estimates of 43, 44, 45, 42, and 46 would be precise, whereas one with sample diameter estimates of 42, 46, 40, 48, 38 and 50 would be imprecise.

Probable Limit of Error

The accuracy of a forest inventory is often expressed in terms of the probable limit of error, or PLE. This is the 95% confidence limit of the mean, expressed as a percentage.

Accuracy of inventory

The St Lucia forest inventory is aimed at estimating the combined basal area of a stratum to the ±10% level at a 95% probable limit of error. The accuracy of the stocking per hectare figures will be calculated from the sampling intensity level of the basal area estimate.

Estimates of volume can only be tentative, as there are no existing tree volume tables for St Lucia. The St Lucia Forestry Department uses a log volume table for estimating tree volume. The log volume table applies to all species, and is a simple form factor table. Such a table can provide indicative volumes only, and does not allow for accurate estimates of stand volume. As such no accurate error terms can be allocated.

The accuracy of the inventory will be highly dependent on the success in dividing the forest into small homogeneous forest units. If the forest units are large, a high sampling intensity will be necessary to achieve the aimed degree of accuracy.

Forest typing

The first step in forest inventory is to develop forest type maps. This involves the delineation of areas occupied by forest on a map, either manually or digital, using either colour shaded maps or a GIS[6] software package. The areas so delineated are known as ***forest units***.[7]

The mapped forest units form the sampling frame for the inventory. The sampling frame is the reference framework for the inventory, setting out the areas to be sampled, and defining the extent of the forest.

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[6] Geographic Information System

[7] A *Forest Unit* is defined as the smallest piece of land to be considered for forest management

The forest typing should identify the forest in terms of the location of the forest unit, the area of the forest unit, the managerial classification of the forest unit, and the species composition of the forest unit.

- Location
- Area
- Management class
- Species composition

The typing may be broad or narrow, depending on the resources available. The typing can be extended at a later date, to allow more refined inventory results to be calculated.

It is vital that the area of each forest unit is measured. The overall accuracy of the inventory estimates depends on the area measurement and the accuracy of the forest statistics calculated.

Once the forest units have been defined, the inventory can be carried out. It is possible for forest units to be defined after inventory has been carried out, but this is not the most efficient method of conduction forest inventory.

Stratification

Stratification is the procedure of dividing the forest up into collections of forest units that are of managerial interest. For example, a stratum could consist of all areas of forest that contain mature *Casurina equisetifolia* or all areas planted with *Acacia nilotica* for slope stabilisation. Another definition of a stratum could be all areas with a slope greater than 20 degrees.

Reasons to stratify

Statistical

The statistical reason for stratification is to increase the between strata variance. This means that by defining strata that contain very different types of forest, variation in forest types can be limited to variation within similar forest types.

A farming example would be to measure the average weight of pigs and chickens separately, rather than the combined average weight, which is of no realistic interest. In this case the farmer has stratified his livestock into pigs and chickens.

A more realistic example is to calculate the average weight of male versus female pigs.

Managerial

From a forest manager's point of view, stratification gives information on management units, which the manager can use for management decision making. A forest manager may divide his forest into productive and non-productive forest, putting most of his managerial efforts into the productive forest. The forest manager gains a better understanding of his forest through the use of a carefully thought out forest stratification.

The forest stratum is the inventory component that provides estimates of forest statistics. No estimates of forest statistics are available for any lower level inventory components. A forest unit, for example, does not provide any estimates of forest statistics.

Allocation of forest units

The actual implementation of the process of stratification is carried out by allocating the forest units into different strata. This can be done before or after the forest units have been sampled. The process is carried out by merely selecting which stratum the forest unit belongs in. In a computer program this could consist of selecting the appropriate stratum from a list.

Each forest unit can belong in only one stratum. The forest inventory will not give any estimates for the forest unit, unless a particular forest unit is defined as a stratum as well as a forest unit. For example, a very large area of a valuable timber species may be important enough to be defined as a stratum. In this case the stratum would have only one forest unit, and a high sampling intensity would be needed for that forest unit. Separate estimates of the forest unit's forest statistics would be produced.

Most strata will have more than one forest unit in them. The number of strata can be increase as the inventory proceeds, but reallocating forest units to different strata that are defined during the inventory.[8]

Sample intensity

When an inventory is carried out, different sampling intensities can be carried out for different forest strata. The sampling intensity is the number of sample points measured in a stratum expressed as a percentage of the total area of the stratum.

The sampling intensity used in an inventory depends on a number of factors, including the following.

- Value of forest
- Cost of sampling
- Variation of forest
- Future management objectives

All forest inventories are carried out with a limited amount of funding, and as such the wise forest manager will allocate a higher proportion of his resources to the most valuable of his forests. The cost of establishing a sample point may vary between different regions in the forest, and will need to be taken into account in calculating the sample intensity.

Variation within the forest will affect the sample size. If a forest is not divided into enough strata, the inventory estimates will be less accurate. A manager may decide to allocate a smaller

[8] This process is defined as post-stratification with redistribution

sample size to a stratum that contains a number of less important forest units, and a higher sample size to a stratum that contains more important forest units.

There are statistical methods of calculating the number of sample points needed to achieve a desired level of statistical accuracy. All these methods require some prior knowledge of forest variation, which is often not available. The estimates are not particularly accurate, and act as a guide only.

With the use of a FMIS[9], the necessity to have prior estimates of sample intensity can be avoided. The inventory can be initiated with a subjective estimate of the number of sample points required. An estimate of accuracy cannot be calculated with less that 3 sample points, and will be inaccurate with less that 10 sample points. As such, inventory can be initiated with the initial aim of collecting at least 10 sample points in each stratum. After this initial data has been input into the FMIS, the FMIS will calculate the stratum estimates, along with their accuracy, allowing the forest manager to decide whether he needs increased accuracy or not.

Sample plot location

A forest inventory is a statistical sample of the forest, intended to give unbiased and accurate estimates of forest statistics. As such, the location of sample plots is critical.

Sample plots should be located randomly within the forest unit to be sampled. In theory, the sampling design should ensure that all parts of the forest are equally likely to be sampled.

In practice this is difficult in forest inventory. Problems of access often make it extremely difficult to sample certain parts of the forest. Locating a specific part of the forest can be difficult for reasons of navigation. Some steep areas of a forest may be too dangerous to sample.

Systematic sampling

For these and other reasons most forest inventories use systematic sampling. Systematic sampling is sampling on a grid imposed over a forest. An example would be using the geo-reference grid found on many maps as a guide for sampling.

Systematic sampling can introduce bias, if there is a systematic pattern in the forest being sampled, such as a regular series of ridges and valleys. Any sampling scheme that had sample lines following a ridge or valley pattern would be likely to produce biased estimates.

In St Lucia systematic sampling is unlikely to introduce bias, due to the nature of the geography of the island.

It is important that any systematic sampling grid be established objectively. A grid line should be defined in such a manner that bias is avoided. An objective starting point should be determined.

[9] Forest Management Information System

For the forest inventory in St Lucia, sampling should be carried out by placing sample points on a gridline at 200m intervals. The sample interval can be increased for large forest units, or decreased for small forest units.

Sample plot size

A further aspect of the inventor to be considered is the size of the sample unit, known as the sample plot in forest inventory. A sample plot may be of many different shapes, such as a square, rectangle, circle, hexagon, or even a star shape. In the case of the forest inventory in St Lucia a diamond plot shape has been selected.

A diamond plot is one in which a square plot is laid out on flat or sloping ground orientated up with its central axis running up and down the slope of the land the sample plot is established on. When theoretically projected horizontally, the square plot becomes a diamond shape. Diamond plots are simple to lay out, and can easily be corrected for slope, as is necessary in sloping forest ground.

Aim for 30 trees

The size of the sample plot is determined by the stocking of the forest the sample plot is established in. A sample plot should sample enough of the forest to gain a representative estimate of the nature of the forest, but should not be so large as to waste valuable manpower resources.

For statistical purposes approximately 20 trees sampled constitutes a representative sample. Due to the varied nature of most forest areas, a sample plot cannot be guaranteed to have 20 trees in most cases. It is better to have slightly more trees than 20, rather than slightly less than 20. Hence the sample plot size should be set so that approximately 30 trees will be included. This represents a slight degree of over sampling, but not to a troublesome extent.

As an example, an inventory team leader is establishing sample plots in a forest unit that he estimates has 600 stems per hectare. He calculates as follows:

Sample size = 30/Stocking = 30/600 = .05 ha.

The inventory team leader knows he should use a .05 ha sample plot for this forest unit.

It should be noted that the same sample plot size should be used within any particular forest unit.

Diamond plot establishment

A diamond plot is easy to establish on the ground, one of the reasons to use diamond plots. Figure 1 shows the general layout of a diamond plot.

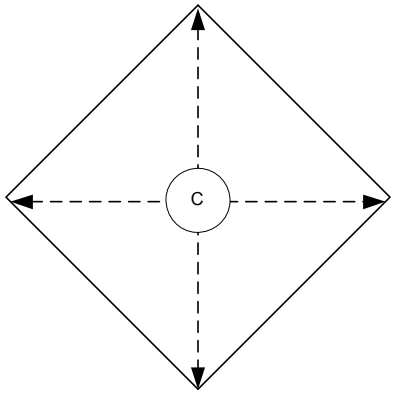

Figure 1. Diamond plot layout

Once the central point has been located, the sample plot centre should be marked with a peg. The slope should be measured both uphill and downhill, and the two measurements averaged to calculate the slope of the sample plot. The slope should be noted in the Comments section of the sample plot sheet. (See Appendix 3)

The slope should be measured with the OPTI Laser Hypsometer measurement. There are two steps, first selecting Mode 4, for Angle Measurement, and next making the measurement, as described next.

First step. Mode selection. Hold the button down for 10-12 seconds until a beep is heard. Immediately release the button. Press the button repeatedly until Mode 3 is displayed. This is the Angle measurement mode, in degrees.

Second step. Angle measurement. To determine the angle or slop, press and hold the range button, point the Red Dot at a point uphill equal to your eye height, release the button and wait for the beep before reading the angle in the LCD.

Note that you should measure the slope to a point at your eye level. Do not aim the laser at another person's face, as there is a slight risk of damage to the eye from the laser beam.

Knowing the sample plot size and the slope, the length of the diagonal arm of the sample plot can be found in the table in Appendix 1.

For our example above, where the team leader has calculated he needs to use a sample plot size of .05 ha, Appendix 1 gives a diagonal area length of 15.8 m for flat land (slope 0), and 15.9 m for land with a slope of 10 degrees.

The diamond plot is laid out by measuring uphill the distance of the diagonal arm, 15.9 m for our example plot. At the 15.9 meter point a peg is hammered into the ground. Next a peg is placed 15.9 m downhill from the central peg. All three pegs should be sighted in line.

The final two pegs are laid out to the right of the central axis, and to the left of the central axis, at distances of 15.9 m and lined up on the central peg. This second axis should be at right angles to the central axis.

The resulting plot will occupy approximately 0.05 ha of land, adjusted for slope. If the two axes are not at right angles, a slight error in area will be made. This error is not great, and is self-correcting to a degree.

Once the sample plot has been laid out, all trees should be marked with spray paint marks to indicate that they are in or out. A tree is defined as being in the sample plot if more than half of it is inside the line between two corner pegs. There is no need to number the trees, as the sample plot is a temporary sample plot, which we do not plan to revisit, except possibly for checking purposes within a week or two.

The trees in the sample plot can now be measured, sector by sector. After the sample plot has been measured, the pegs can be removed for use at the next sample plot site. The centre point should be marked in some way, such as with a temporary peg made from forest material, or perhaps a cairn of stones, so that the sample plot can be relocated should that be necessary.

The measurements to be collected within the sample plot are the species and diameters of all trees, and a sample of tree heights.

Diameter measurement

The diameter of a tree is the single most important measurement that can be taken from a tree. Tree diameter is closely related to tree height and volume. Accurately measured tree diameters can allow a forest manager to estimate forest volume with a reasonable degree of accuracy.

The diameter of each tree should be measured in centimetres to one decimal point (e.g. “14.7”) with a diameter tape at a point 1.3 m from the base of the tree, measured on the uphill side of the tree. This is defined as ‘diameter breast height’, or dbh.

It is sometimes necessary to move the measurement point up or down from 1.3 m to avoid unrepresentative measurements if there is a stem irregularity or significant stem buttress. It is better to make a true measurement than to attempt to make an averaged measurement, as averaged measurements are often calculated incorrectly.

Diameters should be recorded on the sample plot sheet to one decimal place, e.g. “11.3”.

Height measurement

A sample of heights should be measured to enable the FMIS to calculate the mean top height of the stand.[10] The MTH is calculated from a regression equation. The FMIS needs the heights of about 10 to 12 trees to calculate this height.

The sample tree heights should include three smaller trees, three average trees, and four to six trees at the top of the range. This is to ensure that the regression be can calculated accurately.

The team leader should be careful to ensure that only representative trees are measured. He should not measure short trees with large diameters, or tall trees with small diameters.

In mixed species stands a range of species should be included in the height tree sample.

The height should be measured with the OPTI Laser Hypsometer. The instructions for measurement are as follows.[11]

> First step. Mode selection. Hold the button down for 10-12 seconds until a beep is heard. Immediately release the button. Press the button approximately 10 times until Mode 3 M is displayed. This is the Height measurement mode, in metres.
>
> Second Step. Measure the Height. To measure a height requires three measurements. First, find a point somewhere near the middle of the trunk of the tree to be measured. Press the button and "CEN" appears on the LCD. Aim the Red Dot at the Target, release the button, and wait for the beep. The LCD will then display "TOP". Aim the unit at the top of the object to be measured; press and release the button, wait for the beep. The LCD will then display "BOT". Aim the unit at the bottom of the obje3ct to be measured; press and release the button; wait for a double beep. The LCD will then display the height measurement of the object. It is not necessary to be able to see either the top or the bottom of the object being measured, since the TOP and BOT measurements are angle measurements, not the distance measurement.

The height should be recorded on the sample plot sheet in metres to one decimal place, e.g. "11.2".

The OPTI Laser Hypsometer can also be used to collect other measurements which may be required, such as the length of the tree bole, or height to crown break.

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[10] Mean Top Height, MTH, is the height corresponding to the quadratic mean diameter of the 100 largest diameter trees in the sample plot, calculated from a height-diameter regression curve.

[11] Abstracted from the OPTI manual.

Strip plot establishment

Some forest units may not be suited to the establishment of a diamond plot. These would include the following:

- Forest units with trees below 1.3m e.g. newly planted areas
- Forest units with non-forest species e.g. scrubland
- Dangerously steep areas
- Areas of low economic value
- Areas of natural forest with a high density and variety of trees.[12]

In these areas a strip plot should be established. A strip plot is simply a plot running along the line of travel, where all trees within a fixed distance of the centre line are counted by species. Figure 2 shows the layout of a strip plot.

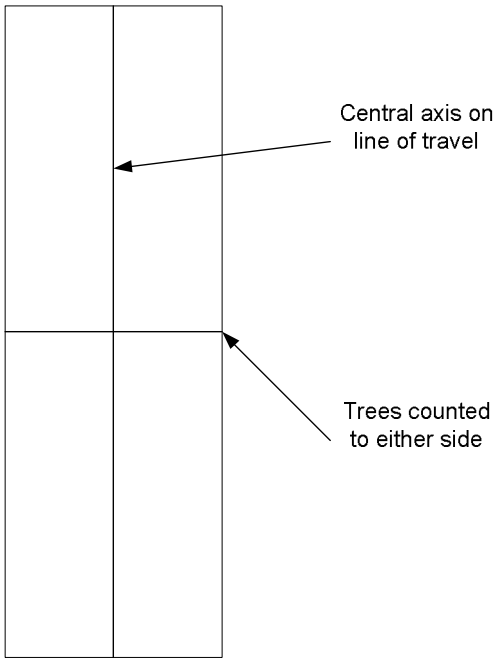

Figure 2 Example of strip plot. (Not to scale)

Strip plots should be put in in the direction of any slope, with the length adjusted for slope. Appendix 2 contains lengths and widths for a variety of strip plots at a range of slopes.

Appendix 3 includes a strip plot data sheet for your use.

[12] Such areas are not typically subject to forest inventory, but to ecological survey, which is out of the range of this guide.

Volume estimation

The volume of a tree may be measured directly, through the application of sectionally measurement techniques, or may be estimated from volume functions. In most cases tree volumes are estimated rather than measured, due to the considerable time necessary to collect the measurements required, and the frequent necessity to fell the tree to obtain accurate measurements.

Volume functions are derived from sectional measurements collected from a sample of fallen trees. The preparation of volume functions requires the collection of data from a large number of trees. Separate volume functions are required for different species, and for differently managed trees of the same species.

The volume of a sample plot can be estimated either directly from the summation of the estimated volumes of the individual trees within the sample plot, or by indirect estimation from the sample plot estimates.

In the absence of tree volume functions for St Lucia forest species, the indirect estimation of plot volume will be applied to the St Lucia forest inventory.

Volume can be estimated using the following equation.

$V/B = a + bH$

where

V = stand volume per hectare

B = basal area per hectare

H = mean top height

a, b = coefficients

This general equation applies to a wide range of species. It is based on the volume of a cone, the simplest estimate of volume.

In the absence of St Lucia specific coefficients, values of 0.9 and 0.3 are used. These general values have been found to provide acceptable estimates of volume for a wide range of trees.

Conclusion

This guide to forest inventory has been produced as an aid to forest inventory in St Lucia. It contains all of the material necessary to conduct a forest inventory in St Lucia.

Further information can be found in the texts suggested below. A more full explanation for forest inventory sampling and statistical procedures can also be found in the various recommended texts.

This guide does not contain information on the analysis of the inventory data. This is described in the companion guide to the St Lucia Forest Management Information System.

No information on the collection of volume data has been included. At some future point volume functions may need to be developed for St Lucia forest species.

Armed with this guide and the RFMIS guide, St Lucia Forestry Department Staff will have the tools to carry out a successful forest inventory.

Recommended Reading

Avery, T.E., & Burkhart, H.E.	1994	Forest measurements, Fourth edition, McGraw-Hill, New York
Cochran, W.G.	1953	Sampling techniques, Wiley Publications, New York.
Freese, F.	1962	Elementary Forest Sampling. US Department of Agriculture, Handbook no. 232
Freese, F.	1963	Statistical Methods for Foresters. US Department of Agriculture Handbook
Hammond, D	1995	Forestry Handbook. NZ Institute of Forestry, Christchurch, New Zealand.
Spurr, S. H.	1966	Forest Inventory. Ronald Press Co.
Spurr, S. H.	1960	Photogrammetry and Photo-reinterpretation, second edition, Ronald Press Co.

Appendix 1. Diamond Plot Sizes

The following table includes diamond sample plot diagonal lengths for a range of plot sizes, including slope corrected diagonal lengths. The table also gives the expected number of trees in the plot for given stockings.

Slope (degrees)	Plot Size (ha.)							
	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.10
0	7.1	10.0	12.2	14.1	15.8	17.3	20.0	22.4
5	7.1	10.0	12.3	14.2	15.8	17.4	20.0	22.4
10	7.1	10.1	12.3	14.3	15.9	17.5	20.2	22.5
15	7.2	10.2	12.5	14.4	16.1	17.6	20.3	22.8
20	7.3	10.3	12.6	14.6	16.3	17.9	20.6	23.1
25	7.4	10.5	12.9	14.9	16.6	18.2	21.0	23.5
30	7.6	10.7	13.2	15.2	17.0	18.6	21.5	24.0
35	7.8	11.0	13.5	15.6	17.5	19.1	22.1	24.7
40	8.1	11.4	14.0	16.2	18.1	19.8	22.9	25.5
Stocking (s/ha.)	Number of trees in sample plot							
1500	15	30	45	60	75	90	120	150
1400	14	28	42	56	70	84	112	140
1200	12	24	36	48	60	72	96	120
1000	10	20	30	40	50	60	80	100
800	8	16	24	32	40	48	64	80
600	6	12	18	24	30	36	48	60
400	4	8	12	16	20	24	32	40
200	2	4	6	8	10	12	16	20
100	1	2	3	4	5	6	8	10

Table 4 Length of diamond plot diagonal and numbers of trees in plot for given plot size

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Appendix 2. Strip Plot Sizes

The following table includes strip plot widths and lengths for a range of strip plots, including slope corrected lengths. The table also gives the expected number of trees in the strip plot for given stockings.

Strip width (m)	2	2	2	3	3	4	4	5
Slope (degrees)	Plot Size (ha.)							
	0.005	0.01	0.02	0.02	0.03	0.03	0.04	0.05
0	25.0	50.0	100.0	66.7	100.0	75.0	100.0	100.0
5	25.1	50.2	100.4	66.9	100.4	75.3	100.4	100.4
10	25.4	50.8	101.5	67.7	101.5	76.2	101.5	101.5
15	25.9	51.8	103.5	69.0	103.5	77.6	103.5	103.5
20	26.6	53.2	106.4	70.9	106.4	79.8	106.4	106.4
25	27.6	55.2	110.3	73.6	110.3	82.8	110.3	110.3
30	28.9	57.7	115.5	77.0	115.5	86.6	115.5	115.5
35	30.5	61.0	122.1	81.4	122.1	91.6	122.1	122.1
40	32.6	65.3	130.5	87.0	130.5	97.9	130.5	130.5
Stocking (s/ha.)	Number of trees in sample plot							
5000	25	50	100	100	150	150	200	250
3000	15	30	60	60	90	90	120	150
2500	13	25	50	50	75	75	100	125
2000	10	20	40	40	60	60	80	100
1500	8	15	30	30	45	45	60	75
1200	6	12	24	24	36	36	48	60
1000	5	10	20	20	30	30	40	50
800	4	8	16	16	24	24	32	40
600	3	6	12	12	18	18	24	30
500	3	5	10	10	15	15	20	25
400	2	4	8	8	12	12	16	20
300	2	3	6	6	9	9	12	15
200	1	2	4	4	6	6	8	10
100	1	1	2	2	3	3	4	5

Table 5 Length of strip plot and numbers of trees in plot for given plot size

Annex VIII – Draft Biodiversity methodologies

These methodologies are presented in early draft form and changes will be made.

The Conservation Biologist will head a small team of biologists, including a Botanist (5 months) and three zoologists (2 months each). The activities of this team can be broken down into the following six components:

Identification, Description and Mapping of Forest Types/ Ecosystem Units

This component is directly warranted as part of Result 3 (f) *Vegetation classification and composition*. Importantly, this component will also provide the necessary design framework for sampling biodiversity [see 0 Biodiversity Inventory, below] and determining where to establish permanent sampling plots for forest inventory (Result 3 (d)). This component will also support analyses of the critical habitats of species (Result 5) and enable calculation of carbon storage (Result 9).

Key outputs:

- A forest ecosystem classification system for St Lucia that can be understood and used by botanists and non-botanists alike. The recognised forest types will be mapped and described in a technical report (Result 3).
- Calculations of the area of each forest type and hence their carbon content, which will be included in the main technical report (Result 9).

Personnel

This component will require input from the Conservation Biologist, GIS and Data Management Specialist, Botanist and his assistant(s), Project Leader and participating FD staff.

Timing

This component is urgent, because other components depend up the findings. It should therefore commence as soon as the GIS and Data Management Specialist is in place, i.e., before the end of 2008.

Methods

Identify and map ecosystem units nationwide, including forest types.

The GIS and Data Management Specialist should be tasked to obtain or generate the following nationwide GIS maps:-

- Major forest types throughout the island, using satellite images and aerial photographs if available (with guidance from the Conservation Biologist and Botanist, and due consideration of existing vegetation classification systems).
- Land cover, showing the current distribution of natural forest, tree plantations, agricultural land, settlements, etc.
- Contours, slopes and aspect
- Rivers and watersheds (drainage basins)
- Major geological landforms, surface geology and soils, if sufficient data exist.
- Rainfall, if sufficient data exist.

These maps should be overlaid to identify the key forest ecosystem (macrohabitat) units that will provide the framework for the forest management information system.

The entire mapping process is likely to take the GIS and Data Management Specialist several months to complete, but a *draft* forest ecosystem map will be required by the Conservation Biologist's team before the end of December 2008.

Ground-truth and describe the forest types

Using the draft forest ecosystem maps prepared in (i), the Botanist will visit and assess sites that fall within the identified forest types as well as transition boundaries. At least six[13] sites of up to 1 hectare in size should be visited and analysed within each forest type, and their location recorded using GPS.

The Botanist will prepare data sheets and conduct the following assessments to prepare a comprehensive description of each vegetation type. The sampling strategy will be discussed with the Conservation Biologist and Project Leader in advance.

Botanical (taxonomical) assessment

Dominant and other diagnostic species will be identified within each vegetation type, and samples collected for the herbarium [see also 0

[13] More sites should be assessed if the vegetation type shows a high level of internal variation (heterogeneity). If time permits, the Botanist should sample sub-sets within each forest type (e.g., sites on windward versus leeward slopes) to obtain an even more sophisticated understanding of forest diversity and composition.

Upgrading the Herbarium, below]. To help non-botanists to recognise the named species, photographs should be provided in the report and Botanical Description [see 0]

Assessment of structural form

This will include standardized measures of physical characters, including canopy height, tree diameter distribution, presence of lianas, density and composition of understory vegetation, etc. This will result in a very simple, physical description that even non-botanists can use to recognise the different vegetation types.

The essential survey equipment for this activity includes diameter tapes, clinometer or hypsometer to measure height, GPS, equipment for collecting specimens, and camera. Photographs should be taken showing each vegetation type and its defining features.

These data will be supplemented with additional data from the forest inventories using Permanent Sampling Plots, which will also record tree diameter, etc. (Note that it is important that all fieldworkers follow the same, agreed criteria for, for example, recording tree diameter, canopy height and species nomenclature).

Revise and complete the nationwide forest type map

Using feedback from 0 (Ground-truth and describe the forest types), the GIS and Data Management Specialist will be requested to refine and finalize the vegetation/ ecosystem map before the end of the project.

The area of each forest type should be measured to allow for calculation of carbon content (Result 9) using existing data for comparable types of tropical forests.[14]

Biodiversity Inventory

This component focuses on the diversity, distribution and, to a lesser extent, abundance of forest animals and plants. This will achieve multiple results, *inter alia*, Result 3 (g) (*Species list*); Result 4 (*a botanical description of forest plants including an island wide specimen collection and identification*), and Result 5 (*An assessment of wildlife use attributes identifying critical habitats and recommendation for sustaining habitats of important, rare or endangered animal species*). It will also contribute towards other results including Result 9, Result 10.

Because different forest types support different communities of plants and animals, the Conservation Biologist's team will use the forest type (ecosystem) maps from 0 (Identification, Description and Mapping of Forest Types/ Ecosystem Units) to provide a framework for stratified sampling. In other words, species will be systematically sampled within each forest

[14] Fauna & Flora International holds an extensive database of carbon measurements from tropical forests, which the Conservation Biologist can draw on, using the nearest analogies to the forest types we identify in St Lucia.

type to build up a more complete species list and to allow comparison of the relative importance and management needs of each type.

The inventory will include higher plants (and ferns, time permitting), mammals, birds, reptiles and amphibians. One or more invertebrate groups (snails, butterflies and/or beetles) will be included if a suitable expert is identified and available.

Key outputs:

- Checklists of forest species on St Lucia, cross-referenced to the main forest types they occupy (Result 3).
- Series of illustrated technical reports detailing the survey methods and findings, and recommendations for managing important elements of St Lucia's forest plants and animals (re Results 4, 5 and 9).
- Georeferenced data to populate the '*upgraded and integrated data base, with biodiversity, wildlife, forest, botanical inventory data*' (Result 8).
- Designated national personnel gain skills and experience in surveys (see 0 Training, below).

Personnel

Conservation Biologist, Botanist and his assistant(s) and up to three expert Zoologists, to sample a wide range of species and locations. At least two FD or other personnel are needed to assist this team and to receive on-the-job training.

The forest inventory team will also be asked to assist with recording certain species within their Permanent Sampling Plots, notably Non-Timber Forest Products and feral pigs.

This component will also require close collaboration with the Project Leader and GIS and Data Management Specialist to develop maps and feed the resulting data into the database.

Timing

All of the desk-based reviews and botanical fieldwork should commence before the end of 2008. This component is complex but should be completed by mid 2009.

Methods:

For each taxonomic group, the main steps and methods are:-

Consultations and desk-based reviews of published and grey literature to collate existing data on the diversity and distribution of terrestrial fauna and flora in St Lucia

FD staff will be interviewed to provide recent sightings and observations.

Stratified sampling of the species diversity and distribution in key forest areas

Using the forest type (ecosystem) map, sampling site nodes will be semi-randomly selected within each forest type, paying particular attention to areas within or adjacent to the state-owned forest. Each node will be recorded using a GPS and the biologists' Standard Sampling Units (quadrats, transect, point counts, timed surveys) will commence from here. The methods will be standardized to facilitate comparisons between the diversity of species in different habitats and to potentially allow FD staff or other scientists to replicate them in the future.

The precise methods for each taxonomic group are to be confirmed pending further discussions with the additional experts, but are likely to comprise:-

Standard survey techniques for higher plants

Forest angiosperms and gymnosperms will be systematically sampled within non-permanent plots of fixed size (up to 1 hectare) within each forest type. A species list will be compiled for every plot that is surveyed. Specimens of fertile plants (in flower or fruit) will be collected if they are not already represented in the herbarium. Multiple copies of each collection will be made where possible to allow duplicates to be deposited in other herbaria. Specimens will be sterilized (frozen), dried and pressed at the herbarium and identified by the Botanist before being catalogued. Equipment required includes pruners, machete, plastic bags and newspaper.

Standard survey techniques for birds

Point counts will be conducted in the survey sites, whereby the expert will remain in one place for a fixed period of time (e.g., 20 minutes) and record all birds seen and heard within a fixed radius during that time. No birds are to be caught or collected. Additional data for the parrot will be collected in collaboration with the Durrell Wildlife survey, which will take place in early 2009. Equipment required includes bird field guides and binoculars.

Standard survey techniques for mammals

Bats will be sampled using mist nets or harp traps set for a predefined number of nights in each forest type. All bats will be identified on site and released promptly. Equipment required include mist net and poles (or harp trap for small insectivorous bats), gloves, headlamps and net repair kit.

Feral pigs – potentially a key factor for the management of St Lucia's forests – will be recorded as simple indices based on the presence of sign (e.g., tracks, wallows, rubbing posts) by the Conservation Biologist's team and the team conducting PSPs.

Time permitting, other smaller mammals (rodents, opossum, mongoose) will be surveyed using a fixed number of live traps in each survey area. Mongooses are of particular interest because of their severe impact on native forest wildlife. Equipment required includes a large number of traps (e.g., Sherman, Havahart or local designs). Bait food, cloth handling bags, leather gloves, and flagging tape to mark trap locations.

Standard survey techniques for reptiles and amphibians

These will be assessed using standardized visual encounter surveys for a predefined period in each forest type and area. The researcher(s) will follow existing trails where possible and record the route taken using GPS. Equipment required to catch specimens for identification or documentation purposes will include a snake hook or grab stick, plastic bags, head lamps, noose materials for lizards (e.g., dental floss or cotton thread). All specimens caught will be released unharmed.

Standard survey techniques for invertebrates

Butterflies can be sampled using a similar point count method to birds, during peak flying periods, but some voucher specimens will need to be captured with a net for identification purposes. Equipment required includes a butterfly hand net and identification materials. A butterfly fruit trap may also be used.

Snails can be systematically sampled by hand within small fixed plots. Equipment required is minimal but may include a suitable preservative.

Beetles would be sampled using a fixed placement of small pitfall traps. Equipment required include a trowel, plastic or paper cups and a preservative e.g., 70% ethanol).

Additional non-standardized sampling

To increase the chances of recording locally rare or nocturnal species that may be missed during normal systematic sampling (above), the experts may also choose to conduct spot searches for additional species. For example, the bird expert may conduct additional rapid searches at night to identify nocturnal birds.

Identification of priority species and areas for special management

Using a combination of literature searches, interviews and field observations (above), the team will identify species of management importance and the specific forest habitats they depend upon. These areas will be mapped using GIS. The priority species should include those that are 'important, rare or endangered', specifically:-

- Any indigenous (native) species listed as globally threatened by IUCN and/ or listed as nationally threatened with extinction.
- Any non-Red Listed indigenous (native) species that appear to be: scarce, rapidly declining, endemic to a restricted area, known or suspected to have highly specialised needs, or are vulnerable to hybridisation with introduced species.
- Non-indigenous species that are known or suspected to be invasive.
- Species that are heavily used or persecuted by people.
- Species that perform a keystone role in the forest ecosystem.
- Indigenous species that serve as indicators for ecosystems or certain conditions.
- Species that are o could be used as flagships for forest conservation

Management recommendations will be formulated based on the best available information, and discussed with FD and other stakeholders before the end of the project.

Database, reporting, and the Botanical Description

Geo-referenced data from the biodiversity surveys, including the location of survey sites and recorded species, will be entered into the forest management database, under guidance from the Project Leader. Every expert will produce a technical report detailing their methods, findings and management recommendations, with maps and other illustrations as appropriate.

The Botanist will also prepare a concise illustrated, electronic guide to some of St Lucia's most important forest plants, including species that are diagnostic of the key forest types (re 0).

Assessment of Wildlife Use

This component is directly required as part of Result 5 (*An assessment of wildlife use attributes*) and will focus on both wild forest animals and plants (i.e., Non-Timber Forest Products).

Key outputs:

- A report on the most important forest animals and plants that are used by local people, indicating critical habitats and management needs (Result 5).

Personnel

This component will require input from the Conservation Biologist, Botanist, Zoologists and participating FD staff.

Timing

This component will overlap heavily with the biodiversity survey (II).

Methods

Consultations, interviews and desk-based reviews

A standard interview template on the types, quantities and sources of wildlife use will be designed that should take no more than 30 minutes for interviewees to complete. Interviews will be conducted with at least 30 persons known to collect or consume wild forest animals and plants.

Because interviewees may be reluctant to discuss illegal hunting of wildlife, the interviews will focus on species that are either still legal now or were legal in the recent past. FD staff will be interviewed on their knowledge of the current forms and extent of illegal activities.

The scientists will also draw upon any previous literature that refers to wildlife use in St Lucia.

Field assessments of key species

From the findings of III a (above), a list will be compiled of forest plants and animals, indicating those considered to be of special management importance, i.e., species that are very heavily used by people and/or species that are endangered by such use. The distribution and critical habitats of these species will be assessed during the Biodiversity Inventory (0, above).

Upgrading the Herbarium

Result 4 requires *An upgraded and improved National Herbarium*.

Key outputs:

- An enlarged Herbarium collection with more experienced personnel (Result 4).

Personnel

This component will be led by the Botanist and his assistant.

Timing

The above will be achieved by the project Botanist while implementing the botanical research as part of 0 (Ground-truth and describe the forest types) and 0 (Biodiversity Inventory) above.

Methods

Following a site visit and discussions with the Herbarium staff in September 2008, it appears that the Herbarium is already well equipped and functioning to a high standard: the existing specimens are well labelled and managed, there are clear protocols in place for the curation of specimens and facilities to accommodate additional specimens. The curators would like to seal off the main area where the collection is housed to protect it from insects or other damage, but such major structural work is undoubtedly beyond the scope or budget of the present project.

We therefore propose to meet the requirements of this contract to improve the Herbarium with the following actions:-

Deposition of additional specimens

With priority given to species that are current missing or poorly represented in the herbarium. All new specimens should be correctly sterilized, labelled, identified and stored.

Building the skills and experience of at least one Herbarium curator

The curator will accompany the Botanist on collecting trips to improve his field skills and ability to identify and collect new specimens.

Training

This component will contribute partially towards Result 10 (*A cadre of locally trained individuals with sufficient capacity and skills to function in a forest inventory/assessment environment and at least 2 local persons who can manage a forest management system*). Note that the Project Leader and other key experts will also provide training during this project.

Key outputs:

- Training reports, including training needs analysis and subsequent trainee evaluations.
- Designated national personnel gain skills and experience in biological survey techniques.

Personnel

Training in biological survey techniques will be led by the Conservation Botanist with input from the rest of the scientific team.

Timing

Training needs analysis should take place in October, with training integrated into all subsequent biological research activities.

Methods

Training needs analysis

This analysis will focus primarily on national personnel who will be directly involved in fieldwork as part of the 0 Biodiversity Inventory, 0 Assessment of Wildlife Use and 0

Upgrading the Herbarium, to identify gaps in their skills or experience with regard to field craft (including health and safety), conservation biology, and biological research techniques.

The needs analysis can be broadened to include other FD personnel who require improved biological field skills to implement the forest management system.

Training and mentoring

From the findings of V a (above), a training plan will be devised, which is likely to include:-

- Formal training workshop(s) to teach trainees the theory of field survey design, data analysis and conservation biology.
- On-the-job training and mentoring in a diverse range of practical field skills and conservation biology.
- Final evaluation of the trainees by the Conservation Biologist and other scientists providing trainer.

Other General Technical Inputs

The Conservation Biologist will also assist the Project Leader with preparing and reviewing other technical outputs from the project, with particular attention to ensuring that the forest management system reflects good forest and wildlife conservation practice.

The Conservation Biologist can also assist the Project Leader with other technical tasks on request, as long as they fit within the agreed contract period.