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Introduction

The National Forest Demarcation and Bio-Physical Resource Inventory Project continued with its implementation phase during the period January 1st to June 30th. The second implementation period focused on field data collection, during which intensive field data collection efforts were made.

A major focus during the second implementation period was starting the boundary survey component of the project. After protracted difficulties contracts were signed with a new Principal Surveyor and two Survey Technicians in early May. The survey field work commenced in May, with a second field team starting work in June. The report includes details of progress in the survey component.

This interim report describes the project activities from January to the end of June 2009. The report focuses on providing a summary of activities. Background detail is provided in Annexes.

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

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.

The project commenced in July 2008, and a revised Inception Report was accepted in October. The project is now in the Implementation Phase, and has been carrying out intensive field work operations. The bulk of the timber and biodiversity inventory field work was completed during the period report on. Data analysis and report preparation will take place over the final six months of the project. Boundary survey work will be ongoing until the end of November 2009.

Major Project Activities

The main activities during the period from January to June 30th were field data collection activities, and recruitment of boundary survey staff. These activities are also described in detail below, cross referenced to the project documentation to show how the activities contribute to the project outputs.

Timber inventory field work

A major achievement made during the period reported was the implementation and completion of the timber inventory field work. The field work started ahead of schedule on January 12th, and finished ahead of schedule on May 29th. Over twenty people took part in the inventory, consisting of staff hired by the project supplemented by Forestry Department staff. This ensured that at the end of the 5 month period St. Lucia had a high number of individuals skilled and experienced in modern natural forest timber inventory procedures. The field work supplemented the training activities carried out in 2008, and strengthened the outputs achieve in 2008 contributing to the training purpose, result, and specific activities as shown below.

The timber inventory ultimately resulted in the measurement of 416 sample plots, distributed through the forest as shown in the following table.

Stratum	Hectares	No. of plots established	Plot area sampled	Sampling rate	BA Precision achieved
Castries Waterworks	1397	111	7.43	0.53%	8.10%
Barre D'Isle	1213	58	2.88	0.24%	10.10%
Dennery	392	20	0.99	0.25%	19.70%
Central Forest B	1959	73	3.65	0.19%	11.50%
Quilesse	1809	97	4.85	0.27%	8.70%
Central Forest A	2037	50	2.50	0.12%	15.40%
Marquis	133	7	0.35	0.26%	39.00%
Total sampled area	8940	416	22.64	0.25%	4.40%

Table 1 Timber inventory sampling data

Preliminary analysis of the inventory data shows the following estimates of timber volume in St. Lucia.

Region	Area (ha.)	Number of sample plots	Average volume per hectare	Volume (cubic m.)	Precision of estimate
Castries Waterworks	1425	111	381	542971	8.1%
Barre de l'Isl	1213	58	360	436616	10.1%
Central Forest A	2069	50	201	415937	15.4%
Central Forest B	1959	73	324	634764	11.5%
Dennery Ridge, Waterworks	392	20	357	140111	19.7%
Marquis	194	7	212	41096	39.0%
Quilesse	1925	97	299	575674	8.7%
Total forest estate	**9178**	**416**	**304**	**2787168**	

Table 2 Preliminary timber inventory statistics

Detailed analysis of the timber inventory field data and preparation of reports will be carried out during the final six months of 2009.

The timber inventory field work contributed to the following aspects of the project ToR and work plan.

2.2 Purpose

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.

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

2.3 Results to be achieved by the Consultant

v. A comprehensive report on the current state of forest resources (Timber, NonTimber, biodiversity, wild fauna etc), with recommendations for sustainable management practices. The report should include, but should not be limited to, the following key considerations:

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;

x. 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.

4.2 Specific Activities

i. The inventory framework should be universally applicable irrespective of the forests type and geographical location and the design of the framework should be cost effective and flexible enough to permit adaptability to changing trends.

ii. The inventory must be scientifically defensible, be based on internationally acceptable methodology and presented in a form that demonstrates a logical progression in the conduct of the assignment.

iii. The inventory process must be replicable.

iv. The forest inventory must employ standard terminology and quantifiable field sampling and data analysis methods, so levels of confidence can be documented.

v. The inventory methods employed should be widely accepted both nationally and internationally.

vi. The inventory design should take advantage of the information available from previous inventories,

vii. The inventory must classify existing biological associations that repeat across the landscape.

viii. The inventory units must be ecologically meaningful (relating to watershed boundaries wherever possible).

ix. The inventory units must be mappable from polygons that are discernable oil imagery.

x. The system of assessment must be hierarchically organized such that it can be applied at different spatial scales.

xi. This system must identify units at an appropriate scale to meet the objectives for resource management and biodiversity conservation,

xii. The system must be flexible and open ended such that it will allow for additions, modifications, and continuous refinement.

xx. 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.

Work Plan Milestones due during period

Forest resource inventory field work commences by February 2009 - achieved

Forest resource inventory field work completed by June 2009 - achieved

Biodiversity survey field work

This period was one of intensive field research by the project's extensive team of more than 20 biologists under the direction of the Conservation Biologist. The main activities, with some key preliminary findings, are as follows:

Mammal survey

Project Mammalogist Dr Frank Clarke and forestry staff conducted a successful mammal survey in St Lucia for 12 weeks from 16 January to 8 April 2009. The team completed standardized assessments of the diversity and relative abundance of mammals at more than 20 sites representing the major forest types. Working both day and night, more than 370 mongooses, opossum, rats, and agouti were recorded, including 316 specimens caught in live traps and released. Dr Clarke observed that the most widespread and most commonly trapped mammal was the small Asian mongoose, a non-native species that threatens St Lucia's native wildlife. More than 400 bats were captured with mist nets and released, representing eight species and four families of bats, and a ninth species was observed. The most commonly captured bats were the Jamaican fruit bat and the blossom bat, both of which probably have an important role in pollinating and distributing forest trees. The mammal data set has proved large enough to quantify and compare the abundance of mongoose, opossum, rats and the various bat species in different forest types. No signs of the St Lucian Muskrat (Giant Rice Rat) were found, supporting fears that this endemic species may be extinct. The final technical report will be circulated early in the next quarter. Annex 1 contains Dr Clarke's draft report.

Herpetological survey

The project Conservation Biologist, Dr Jenny Daltry, conducted two visits to St Lucia in February and May, and completed standardized assessments of the diversity and relative abundance of reptiles and amphibians in 33 sites, representing the major forest types from sea level to more than 800 metres. The herpetological field surveys are to be completed in July, with a target of 45 sites completed. Dr Daltry has already found 13 of the 16-18 extant terrestrial species recorded in St Lucia, and obtained valuable additional data from other members of the team. When the final phase of the fieldwork is completed in July, she will have sufficient geo-referenced data to develop simple distribution maps for least half of the forest species, including the endemic fer de lance, pygmy gecko and worm snake. The preliminary findings show that many of the endemic species appear to be abnormally scarce, probably mainly due to the spread of alien invasive species. Their conservation management needs will be integrated into the forthcoming forest management system.

Entomological survey

The project Entomologist, Prof. Mike Ivie, has been working in St Lucia since 26 April, with a rotating team of more than 20 entomologists from the USA. At the time of writing, the team has collected 69 families of insects, comprising several hundred species, most of which are new records for St Lucia. A large number of species may be new to science and preliminary findings indicate the team has discovered four new genera of beetles, but these await confirmation when Prof Ivie returns to his laboratory. The survey is proving very significant in advancing knowledge of the animal biodiversity of St

Lucia, and will enable the project to evaluate the relative diversity of different forest types. Dr. Ivie has been providing weekly updates on this field work, which are contained in Annex 2.

Botanical survey

Project Botanist Roger Graveson, assisted by Melvin Smith and others, conducted more than 179 standardized plots between 12 January and 20 June, recording all tree and understory species and relevant physiological variables within a fixed radius. These detailed plot data will form the basis for the new forest classification system, which will be developed in the next quarter using multivariate ordination. During the reporting period, approximately 70 plant specimens were collected and deposited in the herbarium, and added to the herbarium database accordingly. The data set includes six new plant species records for St Lucia, and will enable more accurate assessments of the distribution, status and forest associations of important plants. Mr Graveson's study has also highlighted the impact of feral pigs on the forests. The botanical description and vegetation data analysis are currently being prepared in line with the revised work plan.

Wildlife Use Survey

Critical Habitats Specialist Matthew Morton began coordinating the wildlife use survey in April, devising and testing questionnaires for forestry department staff, hunters/ collectors and traders, and the general public. The questionnaires are being delivered by forestry department staff and volunteers. To date 213 people have been interviewed with the data entered into Excel.

More than a dozen Forestry Department staff participated in the design or execution of the surveys above, gaining new skills and knowledge and thereby supplementing the biological survey training activities carried out by the Conservation Biologist in 2008.

The biodiversity survey field work contributed to the following aspects of the project ToR and work plan.

2.2 Purpose

The purposes of this contract are as follows:

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.

2.3 Results to be achieved by the Consultant

The key output (s) of the Inventory/Assessment of Forest Resources shall include inter alia:

v. A comprehensive report on the current state of forest resources (Timber, NonTimber, biodiversity, wild fauna etc), with recommendations for sustainable management practices. The report should include, but should not be limited to, the following key considerations:

vi. An updated and functional forest resource monitoring system which should include:

c. An upgraded and integrated data base, with biodiversity, wildlife, forest, botanical inventory data;

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.

vii. A botanical description of forest plants including an island wide specimen collection and identification. An upgraded and improved National Herbarium.

viii. An assessment of wildlife use attributes identifying critical habitats and recommendation for sustaining habitats of important, rare or endangered animal species,

Work Plan Milestones due during period

A botanical description of forest plants (due March 09)

The original date of this milestone did not take into account two factors: (i) The 6-month botanical field survey did not commence until January 2009. (ii) The botanical description is intrinsically linked to the vegetation classification system, which is pending the completion of the botanical field surveys in July 2009. The Botanist has started writing the botanical description and will work with the Conservation Biologist to complete it during the next reporting phase.

Assessment report on wildlife use attributes (due May 09)

The original date of this milestone did not consider two factors: (i) The Forestry Department staff required for the questionnaire survey work were occupied with a survey of parrots from January to April 2009. The questionnaire survey therefore could not commence until May. (ii) In addition to interviewing wildlife traders and regulators, the wildlife use assessment must also draw on empirical data from the mammal, plant and herpetological surveys. Because of the timeframe on completing these field surveys, this report has been postponed to the end of September.

Preparation of FMIS

During the period covered in this report work continued out on the development of the St. Lucia FMIS. A prototype FMIS was prepared in January 2009, with an initial focus on the components covering the processing of inventory data, as this will be the first task to be implement with the FMIS. The prototype FMIS included an inventory data processing component, prototype inventory analysis reports, a prototype PSP module, as well as prototype forest harvesting and forest growth modules.

The prototype has been further developed to enable analysis of the inventory data to proceed, and later to be available for management planning.

The continued development of the FMIS contributes to the following aspects of the project ToR and work plan.

2.2 Purpose

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

2.3 Results to be achieved by the Consultant

vi. 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 data;

ix. A forest management system in place and functioning;

1.2 Specific Activities

xiii. The results should be analyzed, maintained and presented in the form of a GIS and geo-reference database linked specifically to other inventories,

Work Plan Milestones due during period

Prototype FMIS released in January 2009 - achieved

GIS and Data Management

The project GIS and Data Management Specialist, Mr Vijay Datadin, made two visits to St Lucia to provide input during the period reported. During his missions he continued the development of the project GIS system on the computer purchased for the system, with an emphasis on training of FD staff in data collection from aerial photographs purchased during the period.

Mr. Datadin also spend a considerable amount of time in assisting with the Timber Inventory, producing maps for use by the field teams, summary maps showing the location of sample plots, and developing the link to the FMIS. He also coordinated data collation of the Biophysical survey field work.

After the commencement of the boundary survey, Mr. Datadin liaised with the survey team to ensure that the survey team's outputs were compatible with the project GIS. As survey data become available, they will be entered in the project GIS. The components related to the production of maps using AutoCAD will be covered during the next period.

A detailed mission report on the activities of the GIS and Data Management Specialist is contained in Annex 3.

The establishment of the project GIS system contributed to the following aspects of the project ToR and work plan.

2.2 Purpose

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.

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

2.3 Results to be achieved by the Consultant

iii. 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;

vi. An updated and functional forest resource monitoring system which should include:

c. An upgraded and integrated data base, with biodiversity, wildlife, forest, botanical inventory 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.

4.2 Specific Activities

ix. The inventory units must be mappable from polygons that are discernable oil imagery

xiii. The results should be analyzed, maintained and presented in the form of a GIS and geo-reference database linked specifically to other inventories,

No Work Plan Milestones due during period

Forest reserves boundary survey

Problems with the appointment of a Principle Surveyor continued into this period. After investigation of a series of different options, a contract was signed with a new Principle Surveyor and two Survey technicians in April. Survey field work commenced in May, with two field teams being fielded instead of the one team initially proposed, to make up time lost during the negotiations.

The boundary survey team consists of the Principal Surveyor, Mr. Johnson Volney, assisted by two Survey Technicians, Mr. Alphaeus Fadlien and Mr. Baxter Bushell, the latter two each leading a field team composed of an additional three chainmen assisted by a cutlass man. This totals 11 people devoted to the boundary survey, assisted by one permanent Forestry Department officer and additional forest officers as required.

The following table shows the progress of the survey teams up to the end of June. The table shows the distances surveyed of actual forest boundaries, as well as the associated distances surveyed to tie in the forest boundaries to the national survey system.

Week ended	A team		B team		Total (tie in)	Total Forest (m)	Cumulative Total Forest (m)	Cumulative total survey (m)
	Tie in	Forest	Tie in	Forest				
29 May	1,542	2,635	0	0	1,542	2,635	2,635	4,177
5 June	0	1,205	0	0	0	1,205	3,840	5,382
12 June	0	785	1,096	0	1,096	785	4,625	7,263
19 June	0	538	0	0	0	538	5,163	7,801
26 June	0	600	0	256	0	856	6,019	8,657

Table 3 Boundary survey progress

The forest reserves boundary survey contributes to the following aspects of the project ToR and work plan.

2.2 Purpose

The purposes of this contract are as follows:

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.

2.3 Results to be achieved by the Consultant

The key output (s) of the Inventory/Assessment of Forest Resources shall include inter alia:

ii. Realigned, demarcated and updated forest reserve boundaries incorporating the 117 critical forested Crown parcels (approx. 2015 acres) and the 20+ parcels of private lands acquired for the purpose of amalgamating into the official Forest Reserves;

iii. 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;

iv. A national forest reserve boundary maintenance plan;

No Work Plan Milestones due during period

Other Project activities

Meetings

The Project Leader attended numerous informal meetings with the BIT, Forestry Department, and other stakeholders to coordinate project activities. The Project Leader also attended all Project Implementation Unit and Project Technical Committee meetings held during the period.

Visits to support the project

Over the last six months there have been eight visits to St Lucia by Key Experts and the Project Manager, Mr. Jorma Peltonen, who visited in April. Three visits were made by the project Conservation Biologist, Dr. Jenny Daltry, to plan and conduct field data collection. A three month visit was made by the project mammalogist, Dr. Frank Clarke. Two 2 month visits were made by the project GIS and Data Management Specialist, Mr. Vijay Datadin, to develop the GIS system and to prepare of maps. Further details of the work produced during these visits are contained above. The project entomologist, Dr. Mike Ivie arrived in May for a three month mission, and was due to leave on July 18th.

Annexes

The following annexes are included below.

Annex 1 Draft report by project mammalogist

This is a preliminary report on the activities of project mammalogist Dr Frank Clarke in St Lucia from 11th January to 9th April 2009. A previous report by Dr Clarke, in the form of an oral presentation, was made to the BIT technical committee on 12th February 2009. The surveys and other work were successful and analysis of data is underway and the final technical report on St Lucia's mammals will follow shortly.

Mammal Survey

The project mammalogist and forestry staff assistants (mammal survey team) conducted fieldwork for 12 weeks from 16th January to 08th April 2009. The team conducted rapid, standardized assessments of the diversity and relative abundance of mammals at more than 20 sites among key forest types identified by the project botanist and critical habitat specialist as occurring on St Lucia.

The main forest types were dry forest, dry hilltop forest, mesic (transitional) forest, and wet (rain) forest. Five sites in each forest types were surveyed with sites being selected so as to have good coverage of the entire island. For example, dry forests were surveyed in the NW of St Lucia near Rodney Bay, NE near Monchy, SE at Prasline, and SW at Belvedere. Two stands of mangrove forests between Micoud and View Fort were also surveyed.

Because mammals are difficult to survey compared to other wildlife, the team used a combination of observational and capture methods to survey St Lucia's mammal fauna, allowing the team to obtain an accurate and relatively complete representation of St Lucia's mammal fauna given the considerable time constraints. To detect non-flying mammals the team used the following methods.

Observational methods

The team conducted repeated timed searches of forest sites using Visual Encounter Surveys and recorded the location of agouti, opossum, mongoose, rats, and feral pigs, observed. Because many of St Lucia's mammals are nocturnal and cryptic, very few animals were observed (e.g. only 3 agouti observed) and their presence at many sites was often only inferred indirectly by recording faeces (droppings), scratch marks on trees, wallows (pigs), hair, tracks, and other mammal signs. Recording of opportunistic observations was used to establish the presence of rarely encountered species, specifically feral pigs and agouti, that were not to be surveyed easily by other mean, and the team also recorded road kills.

Live animal trapping

Live animal trapping was highly effective at surveying mammals. At key forest sites, 1 km long trap lines were established with a live trap (an enclosure where the doors are held open by a trigger mechanism that is connected to a treadle on the floor of the trap) stationed every 100m. Trap lines were baited and opened for 5 days to measure the abundance of opossum, mongoose, feral cats, agouti and rodents e.g. rats.

Trapping proved highly effective at surveying mammals with a total of 316 individuals being trapped. The most commonly trapped was the small Asian mongoose (*Herpestes auropunctatus*), followed by rats

(*Rattus* spp.), and opossums (*Didelphis marsupialis*). Two feral cats were trapped but no agouti, even though the captures of adult cats indicate that traps were large enough to trap agouti. However, for all other species a sufficient number were trapped to compare their abundances in different forest types and map distributions.

The St Lucian Muskrat (St Lucian Giant Rice Rat) *Megalomys luciae* was not found despite intensive trapping throughout St Lucia, especially in the NE and near the Sorciere River. This endemic species is thought to have become extinct in the 19th century, though people farming dry forest around the Sorciere River report an unusual looking rat eating their crops.

Summary of non-flying mammal surveys

To summarise, more than 370 mongoose, opossum, rats, and agouti were recorded (observed directly, indirectly observed, trapped or captured). Live animal trapping was an especially effective method at surveying non-flying mammals and will the sample size (number of individuals trapped) is large enough to compare the abundances of mongoose, opossum, and rats among different forest types. The most widely-distributed and most commonly observed and trapped mammal is the small Asian mongoose, an introduced species that is a major threat to St Lucia's native birds, reptiles, and amphibians.

Bat fauna

To survey bats the team erected two or three mist-nets at ground level at sites. Nets were positioned to sample all micro-habitats present at sites: flat well-drained ground, across streams, in swampy areas, under closed canopy or in the open. The team opened nets just before sunset and left open catching bats until around 21:00 hours.

More than 400 bats were captured representing eight species and four families of bats. The dominant species in the community (most commonly captured) were the Jamaican Fruit Bat (*Artibeus jaimaicensis*) and the Blossom Bat (*Monophyllus plethodon*). The former, a large fruit-eating bat, is very widely distributed, whereas the nectar-feeding blossom bat is a regional endemic – only found in the Lesser Antilles.

Two other fruit-eating bats captured were *Ardops nichollsi* (regionally endemic) and *Sturnira lilium*. Three insect eating species, the naked-backed bat *Pteronotus davyi* (only recently discovered on St Lucia), *Molossus molossus,* and *Tadarida brasiliensis*, were captured. A fishing bat *Noctiolio leporinus* was also captured. This species, which catches small fish along slow moving streams, rivers, and calm coastal waters, is more common in St Lucia than our single capture suggests (observed feeding along Trumassee River and the coast). Thousands of a ninth species, *Brachyphylla cavernarum,* were observed roosting in a sea cave at Soufriere, though none were captured.

Although nets are effective at capturing most of St Lucia's bats, the exception is *Tadarida brasliniensis* and *Molossus molossus*, which often commute and feed high above the ground, and even when they fly close to nets, they easily detect and avoid them. Fortunately they (and *Pteronotus davyi*) produce loud echolocation calls (high frequency sounds produced by bats to navigate their way around the landscape and locate insects) that are easily detected by bat detectors, and their calls appear to be species-specific allowing identification.

To (acoustically) survey these bats the team used a bat detector to listen for bat calls and identify which species occur at each site. The results of this work suggest that bat detectors are effective as a tool for surveying the distributions of a third of St Lucia's bat fauna, *P. davyi* has a very distinct call, and *M. molossus* and *P. davyi* are probably more commonly and widely distributed in habitats than the results of mist netting surveys suggest.

To summarise, nine bat species have been recorded from St Lucia. All are native. Two are regional endemics (*Monophylus plethodon, Ardops nicholsi*) of conservation importance.

Training

On-the-job training was given to Forestry Officers Mary James (53), Nereus Mitchel (12), Timothy Jn Baptiste (9), Alwin Dornelly (2), Canice Peterson (5), as well as Forestry Assistants Stephen Lesmond (8) and Randall Marius (5), and Zoo Staff George Antione (4). Numbers in parenthesis refer to the number of days of training staff received on the job training while assisting with fieldwork. Because of other staffing commitments by Forestry (parrot survey, timber inventory etc) only Mary James was assigned to assist with the mammal survey for the full duration of the survey.

Training included how to identify mammal species and their signs (tracks, faeces etc) and training in a wide variety of mammal survey methods i.e. mist netting for bats, live animal trapping for non-flying mammals, Timed Searches using Visual Encounter Surveys for mammals that are rare and/or difficult to detect, and acoustic surveys with bat detectors. In particular, Timothy Jn Baptiste and Nereus Mitchel excelled at the work showed particular interest in working with mammals and learning new skills.

Interviews

Interviews with Forestry Staff, including Range Officers, have commenced with the aim of documenting the considerable local knowledge that forestry staff have on wildlife. Range officers have been interviewed to obtain data on the abundance and distribution of agouti and wild pigs in their ranges, perceived changes in population abundances over time, and information on hunting activities, and wildlife management.

Next steps

The information obtained with be analysed and technical report will follow shortly. This will include a checklist of the mammals of St Lucia identifying which species are native and non-native, information on the mammals of conservation concern, distribution maps for mammal species, relative abundance, and details of the status and ecology of St Lucia's mammals with recommended management actions for managing mammals in St Lucia's forests.

Annex 2 Entomological field updates

Update 1, 05 May 2009

Today is our 10th day on island, and a good time to update you on our progress. The entomology program is now well established, with results pouring in from hand collecting in dry, mesic and mangrove forest, with short-term trapping sites established at Savannes (mangrove), Escap (dry) and La Porte (mesic). We have now exceeded the number of beetle and fly species and families recorded from St. Lucia in the last 150 years (1758-2008). But, most importantly, we have the full outline of our sampling plan awaiting arrival of our final equipment from Customs.

To date, in addition to the first five team members who arrived on 26 April to lead the Coleoptera work, we have been joined by Drs. Runyon and Delphia on 02 May, who are initiating the Diptera inventory, and we are preparing to welcome Dr. and Mrs. Sibley next week, who will conduct the Odonata inventory.

Meetings and discussions with Mr. Toussaint, Mr. Graveson, Mr. Smith, Mr. Morton, Dr. Daltry and others, have allowed us to identify our 14 trapping localities, to be run for 6 weeks each (7 sites at a time, with rotation). These are scaled to represent all of St. Lucia's forest types in proportion to their geographic extent (i.e. large in area = more sites, small in area = less sites), and chosen to coordinate with the activities of other inventory groups and Project goals. In the absence of an established/agreed upon forest type classification, we agreed to the following temporary classification used by Mr. Graveson: Dry Forest, Mesic Forest, Submontane Forest, Montane Forest and Cloud Forest (including *Podocarpus* Subtype, Elfin Subtype, Palm Brake Subtype).

Our trapping sites are distributed as follows (priority order within a type indicated in parentheses):

Dry Forest

1. Mont Gaiac [La Borne] (#5)
2. Grande Anse [Des Barre] (#2)
3. Louvet (#1)
4. Caille Des (#3)
5. Bordelais [Prison] (#4)

Mesic Forest

1. Chassin [Mr. Toussaint's land] (#2)
2. Gros Piton, top (#1)
3. River Dore ravine (#3, tie)
4. River Dugard (#3, tie)

Submontane Forest

1. Des Cartiers at big shady area (#1), established Tuesday, 05 May
2. Mont Lacomb
3. Piton Flore summit

Montane Forest

1. Lower Troumassée

Cloud Forest

1. Upper Piton Troumassée, to be established Wednesday, 06 May

Other priorities identified are hand collecting in the special biodiversity hot spot on Petit Piton (Mr. Smith to facilitate and guide ascent), a visit to the cave at Vieux Fort (contact info needed for Mr. Stephen Lesmond), a visit with Guy Mathurin (contact info needed) to discuss past work on the fauna (including obtaining a copy of his book), and determine the possibility of use of Ministry of Health fogging equipment.

Many hand-collecting sites will be visited on an ad hoc basis.

Update 2, 11 May 2009

It is time for a second update on our work. Clearance of our last bits of field equipment through Customs last Friday allowed us to have a full complement of 5 trapping sites established (LaPorte, Parrot Hill, Grande Anse, Chassin, and River Dorée), with 2 more identified that will be established this week when 2 more 12 volt batteries become available. Our collections are rapidly expanding, with the mounting soon to be slowed by the problems of getting our 2 crates of specimen boxes through Customs. We hope this will be resolved this week by those most useful helpers Patience and Time, as well as the continued efforts of Dr. Tennent and Mr. Toussaint.

We will now turn our efforts toward finding a 240v portable generator that we can borrow to deploy our mercury vapor lights during our night collecting efforts, and developing discussions with the Ministry of Health about having access to one of their fogging units. If any of you have any ideas on these items, we would be happy to hear them. We only need a small generator -- a 500Watt unit would be great.

Our first set of collaborators left on Sunday (Drs. Runyon and Delphia), and another one will leave on Tuesday (Mr. Foley).

Although our contracted project is focused on beetles, we are using the unique opportunity of this Biodiversity Inventory Project to extend the knowledge produced of many other groups as well.

As an example, among the long-legged fly family Dolichopodidae, a single species has been reported from St. Lucia, now known as *Thrypticus minutus* Parent (Pollet et al. 2004:59). In contrast, Dominica has 113 and Montserrat 46 species. Dipterist (a specialist on the Diptera, the Order that contains the true flies) Dr. Justin B. Runyon left St. Lucia on Sunday, after a week of collecting, and has a tentative list of 40 species of this family, with the possibility of that number growing considerably when the collections are studied – a 40-fold increase in species known from St. Lucia!. Some of these species are so specific that they are only found on the shady side of native palm tree trunks, others only in the spray zone alongside waterfalls. The endemic/native/introduced status of all these species will require much more study, once the material is back in the laboratory.

Why would we worry about little flies? The Dolichopodidae are an important component of St. Lucia's biodiversity both taxonomically and ecologically. As predators in both their larval and adult stages, their large biomass, high diversity and abundance indicates that massive numbers of other arthropods are controlled by their heavily specific niche partitions, as well themselves providing food for other animals such as the birds, reptiles and amphibians. Without them, there could be huge outbreaks of such groups as sand flies (fed upon by some of the beach and marine rock species), mosquitoes; and many

groups that are obscure simply because their numbers are maintained at a low level by these voracious, diverse and abundant predators. Dr. Runyon commented that, surprisingly, they are the most abundant flies he saw on the island.

Dr. Runyon also sampled many other beneficial groups of flies, including the predaceous flower flies (Syrphidae, 7 species recorded from St. Lucia, compared with 23 from Dominica and 22 from Montserrat), and parasitic Tachinidae. He collected shore flies to forward to Dr. Wayne Mathis at the Smithsonian Institution.

We will collect many more specimens of these families in Malaise traps at each of our trapping localities, and a second Dipterist will join us next week to continue expanding that part of the inventory. Study of these specimens will continue for years to come, with a snapshot of what we know in our final report.

Tomorrow (Tuesday, 12 May 2009), Dr. and Mrs. Fred Sibley of Yale University (retired) will arrive for work concentrating on the Odonata (dragonflies and damselflies). Then on Sunday, May 16, Dr. Andrew Cline and Dr. Stephen Gamari of California Department of Food and Agriculture will arrive to continue the work on beetles and flies, respectively.

As a highlight, I will include this photo of *Chloronia* taken last week near LaPorte. This beautiful and rarely seen animal belongs to a species previously only known from Dominica, and it the only member of the ancient group Megaloptera known from the Lesser Antilles, and one of only 2 known from all the West Indies (the other is from Cuba). The Megaloptera are excellent indicators of high water quality. We hope to find its larva in the next few months. Even though it is not a beetle, its addition to St. Lucia's fauna is a significant find, testament to the high quality of environmental stewardship in her mountain forests.

Update 3, 18 May 2009

Time for another update on our progress. Drs. Andrew Cline and Stephen Gamari of California Department of Food and Agriculture arrived Saturday. Dr. Cline is a beetle specialist, and Dr. Gamari a fly expert. They immediately began establishing new trap types around our existing sites to increase the number of species taken.

We established another trap locality this week on Gros Piton, but are sad to report the theft of our traps at the River Dorée site, including destruction of all the samples in the traps. This is a setback, but will not deter us. The other traps sites are producing samples at a rapid rate.

As promised last week, Fred Sibley has been working hard on the inventory of the dragonflies and damselflies. [I would like to know the local names for these groups, if someone could provide them?] Here is a summary of progress on this interesting group of animals.

The small insect Order Odonata includes the familiar dragonflies and damselflies. In number of world species (ca. 6,500), it ranks between the mammals and birds. It is perhaps the best known of all insect Orders globally, and has emerged as a frequently used biodiversity metric, allowing comparison at the alpha and beta levels because of relative ease of inventory and identification. They have also emerged as a tourist attraction, with an ever-growing and devoted following of Odonata watchers, often drawn from birders looking for a new challenge. As with birds, the first step in developing such tourist interest is in having a list and an identification guide.

The weak point for over-reliance on Odonata as a biodiversity metric is that they are all aquatic as larvae, and all belong to the same trophic level as both adults and larvae – predators. However, this is balanced by other characteristics. The species range from highly tolerant of pollution to highly dependent on pristine water quality. Larvae of different species occur in ponds, lakes, high-order streams, rivers, estuaries and even phytotelmata (water holding plants like bromeliads). And, species range from some of the most widely distributed of animals to very localized endemics. The total list for all of the Lesser Antilles (Sombrero to Grenada) is 49 species. Thus, this group is a useful part of the picture, but only one of the several groups on which we will be reporting.

The history of St. Lucian Odonata exploration begins with a mystery. In 1842 Rambur (1842) described a tiny species of damselfly from what was thought to be the Cape of Good Hope in southern Africa. However, when it was discovered to actually be a New World species known only from Guadeloupe and Dominca, the label was reexamined and discovered to say only “Cap.” Could this be Le Cap of northern St. Lucia? We hope to test the idea of its occurrence on St. Lucia during our team’s work on the island, especially while Sibley is with us.

The first fully reported visit by an odonate collector is when Thomas W. “Nick” Donnelly of the USA collected during visits in the 1950’s and 60’s, which resulted in 10 species, one of which he described as new in a 1961 paper (repeated in Donnelly 1970). No subsequent reports have been published for St. Lucia. This formed our starting point – 10 known species and one suspect.

Insect inventory team member Fred Sibley is now half-way through his visit, and has dramatically changed this view of St. Lucia’s fauna (Table 1). By the time he arrived, our group had collected 7 species of Odonata, adding 2 species to the list, but Sibley has more than doubled the total number of species known from St. Lucia to 22, rapidly approaching ½ of the total species known from all the Lesser Antilles.

Remember that one mystery/questionable record known from "Cap?" It has still not been confirmed from St. Lucia, but a visit to the golf course at LeCap is a high priority for Sibley's remaining time on-island, to see if it can be found in the ponds there -- a natural choice for its habitat.

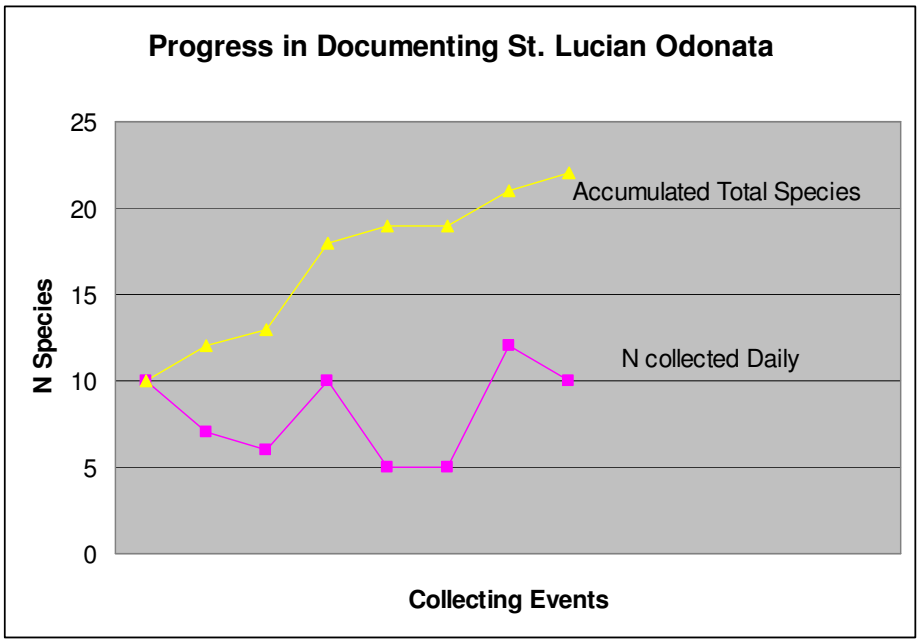


Table A1. Odonata numbers in St. Lucia. X axis represents collecting events as follows: Donnelly collections, Inventory Team collections pre-Sibley, and Sibley days 1-6.

Update 4, 25 May 2009

How quickly a month has gone by. The past week was very busy, with Fred Sibley, our dragonfly expert, leaving on Friday, and Drs. Andrew Cline and Stephen Gamari leaving Saturday. Sibley has reported from New York that after a full accounting, we have managed to collect 21 St. Lucian Odonata species – the last one taken by Mr. Adams Toussaint. Add to that one previously documented species we have not yet recollected, and the suspect Cap species, and the list is 22-23 species. That elusive damselfly species from Cap has not yet been found, but at least 2 Lucians have given credible, accurate descriptions from memory that match it, so we hope to find it eventually. Before he left, Sibley directed others in the team in how to find several suspected missing species.

In a major surprise, Dr. Gaimari, a fly specialist surrounded by beetle people, netted 2 tiger beetles in Escap that did not look familiar. It has been more than a hundred years since the last tiger beetle species was first recorded from the Eastern Caribbean region, yet here was something totally different from all previous records (attached photo no.1). The tiger beetles are the best known group of beetles world-wide, and such a discovery here was totally unexpected. As expected, *Cicindela suturalis* has been found to be common here (attached photo no. 2), even though it is a new island record. Conversely, the other expected tiger beetle species has not yet been found, perhaps because our people do not spend time on beaches, the habitat of that widespread species. A third nocturnal species is considered possible here, but is rarely seen. Yet, jumping over these 2 know Eastern Caribbean tiger

beetles, we now have a first-discovery, not just for St. Lucia, but for the region. Just what it is will require more study, but photos sent to tiger beetle specialist Michael Kippenhan have already been compared with the collections and literature at the Field Museum of Natural History in Chicago, and they defy easy identification.

This week we also heard from Dr. Runyon, who is back in his laboratory in the USA and has finished a fast pass through the material he collected by hand. From what he estimated upon departure was about 40 species of Dolichopodidae flies, he has now identified 55 species. Sixteen of these are undescribed species (see attached photo no. 3) – nearly 30% of the total. Yet, the single member of the family actually recorded from St. Lucia is not among them! Mathematical models of species discovery show that to take a sample that included 55 species without finding a single representative of those found in an earlier sample (in this case of only 1 species) is indicative of a truly huge total number yet to be discovered. Runyon has yet to examine the trap samples he took back with neither him, nor the members of that family from Dr. Gaimari's work, nor our other trap samples, so this number is bound to rise.

Showing the unwashed face of biodiversity, Mr. Roger Graveson provided a photo of the catch in one of the traps on Gros Piton, which clearly showed one of the largest longhorn beetles recorded from St. Lucia – our first recovery of that species (attached photo no. 4, thanks Roger). This single trap sample provided several new island beetle records.

Other happenings this week included a very productive meeting on Tuesday with Mr. Lyndon John and Mr. Alwin Dornelly of Forestry. That meeting produced a plan of work for the next 2 weeks. Weekly follow-up meetings are scheduled. Later, in the day on Tuesday, Mr. Adams Toussaint accompanied a film crew from Agriculture to interview members of the team for a program on the inventory project.

To end the week, Ms Crystal Maier, a beetle systematics graduate student at Montana State University, has joined us (on Saturday) and will spend the next 2 months here. She will be responsible for, along with trapping and normal forest collecting, sampling the aquatic beetles on the island. And, at the end of the upcoming week, our largest group will arrive from Utah, under the direction of leaf beetle specialist Dr. Shawn Clark of BYU.

Photo 1. *Cicindela suturalis*

Photo 2. *Cicindela* (*Brasiella*) sp.

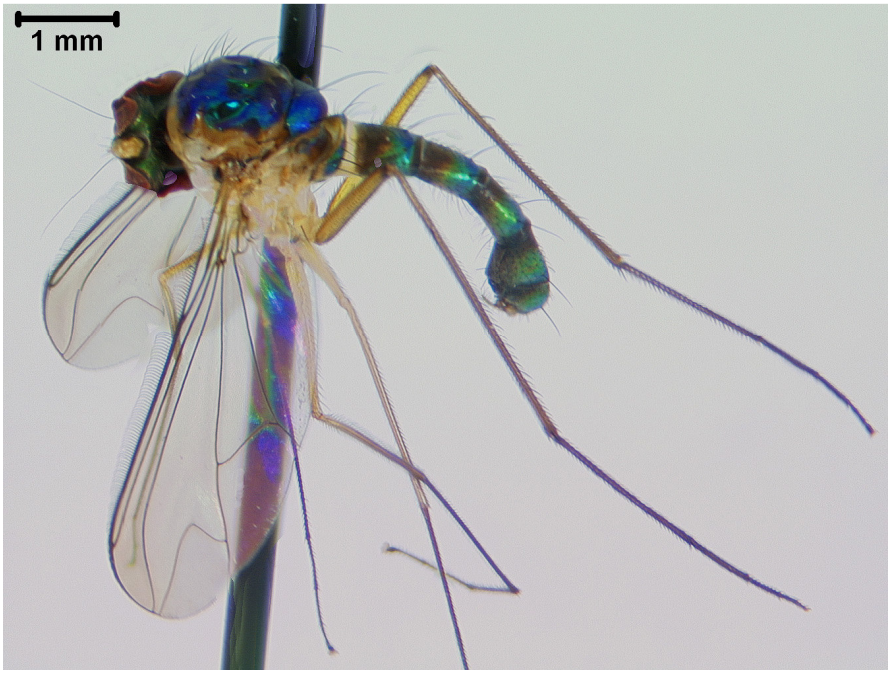


Photo 3. *Amblypsilopus* n.sp.

Photo 4. Inside of Ultraviolet Light Trap on Gros Piton.

Update 5, 01 June 2009

This will mark the last week of the first half of our field work. Although the team was only 5 people strong during the week, progress was rapid. With the assistance of Mr. Melvin Smith of Mon Repos, the Troumassee Cloud Forest trap site was successfully established. This will be our most inaccessible and highest trap locality, but also the most unique. The hand-collected material from the area yielded species not yet seen from other areas.

With a full complement of trap sites operating, the sheer volume of material coming in has overwhelmed my ability to keep up with sorting and mounting. When our running total of beetle species collected passed 300, representing 62 families, with no sign of slowing, I began to have trouble keeping the list current. The most interesting tidbit of information has been that Ross Winton has discovered the larval habitat of the mystery tiger beetle mentioned in last week's update, obtaining a larva and several more adults, as well as beginning characterization of the habitat in Escap. It occurs in very un-tiger-beetle-like habitat where scattered dry forest plants occur on undisturbed soil covered with an algal crust.

I have also spent some time with one of my own favorite groups, the longhorn woodboring beetles (Cerambycidae). This group includes several invasive pests and species of importance to forest production, as well as some very unique endemics. Because of the work of a pair of French cerambycidologists in the 1990's who were preparing a book on the Longhorn Beetles of the Lesser Antilles, this group is one of the best documented beetle families on St. Lucia. There were 29 species recorded from here before our arrival, including 4 single-island endemics. One of the 2 Lucian endemic

beetle genera (*Paraclytemnestra*) belongs to this group. Although a piece of a dead specimen was found in the second week of our visit, it was not until this week that we took an intact specimen of this genus in an ultraviolet light trap on Piton St. Esprit. The 2 previously known specimens -- one taken before 1925 and now in the Smithsonian, and the other, an old specimen in the Paris Museum -- were both broken and incomplete. The fact that the species still exists in St. Lucia's protected areas is excellent news, and our ability to fill in gaps in science's knowledge about its form is a further bonus.

Not yet recorded, but known, was a 30th as-yet undescribed species, known from a single specimen collected by Mr. Guy Mathurin. This specimen is now in the Natural History Museum in London, where it is being described by Mr. Max Barclay of that museum. Mr. Winton collected a second specimen near Barre de L'Isle, and has twice seen (and missed) a third. In addition, we have taken 3 more undescribed new species during our time on-island, as well as adding 11 more species not previously recorded from the island, for a total of 44 species so far. This compares with 34 species known from Dominica, 28 from St. Vincent and 56 from Martinique.

All 4 of the undescribed longhorn species are, interestingly, beautiful animals, with very spectacular colors and forms. One mimics an ant, another a firefly, the third has a series of spots that look like ivory, and the one also in London is black with a series of yellow bands running across its body. Images of these species would make a very nice block of postage stamps celebrating the biodiversity of St. Lucia!

On Wednesday, we hosted a meeting with Robert Tennent and Vijay Datadin where GIS data needs by the parties was discussed, and on Friday, at a meeting with Tim Jean-Baptiste of Forestry, we mapped out the coming 2 week's activities.

Rounding our week, on Saturday, Dr. Shawn Clark of Brigham Young University arrived with 4 students to give us more hands to conduct direct collections. That group will be with us for 2 weeks.

Update 6, 08 June 2009

We are now at the stage of our work that we are pulling traps from the first set of sites and moving them to the second series. This begins this week, and continues through next week.

We still have the BYU group here, and Dr. Clark has greatly increased the number of leaf beetles (his specialty, the family Chrysomelidae). All of the 6 previously recorded species in this group have been recollected, and the new number has surpassed 30 species. Montserrat has 36 recorded, and Dominica 51, so we hope to at least surpass 40 during our visit. However, many of these species are tiny and cryptic, so a real number will have to wait until after Dr. Clark can study our material in the lab after we finish the collecting.

We are beginning to zero in on species that we have so far failed to recollect. Foremost among these are 2 tiny ground beetles known only from a single collection by 2 Italian tourists collecting in Ravine Chabot in 1984. One of these species was made the basis of a new genus, one of 2 genera known only from St. Lucia. The technique they used is called soil washing, something I was taught to do when visiting Italy in 2006 and 2008. It involves putting soil in a bucket, pouring water in and mixing, then

letting the organic matter, including insects, float to the surface where they are skimmed off, dried on newspapers, and then put in a Berlese funnel to extract the insects. Since these beetles are 1.0-2.2mm long, they can only be found when examining concentrated debris under the microscope.

Finding these 2 tiny endemic species is important because all but a single specimen are in private collections, where access by scientists is limited. Once we have seen the original habitat, perhaps we will have an easier time finding other populations.

Additional species we have not taken include the 2 largest species of beetles, *Dynastes hercules reidi* and the longhorn *Mallodon spinibarbis*, both of which have larvae that live in large, dead logs in forests, habitats that have generated dozens of species already. Species that live in soil and leaf litter are still underrepresented in what we have so far, and at least 4 previously recorded species from this habitat (beyond the Ravine Chabot species) have eluded us. Lastly, several aquatic species are still not among our samples, and another habitat that shows some gaps are beach inhabitants. These last 2 groups are not targets for our forest inventory work, so are of lower interest.

So, the main message is that we keep on sampling and adding species. It is like shoveling sand on the beach.

Update 7, 15 June 16, 2009

This was a busy week, with 9 people living in the house at Escap and going out collecting every day. More than 20 new sites were examined for beetles during this time, in addition to the regular trap site visits. The volume of material that came in is simply amazing. Ross and Crystal each had a day during the week that I pulled them from the field to help at the scopes to keep up with material before it spoiled. We worked 7 days a week, and into the evening after dinner every night to keep up.

Last Thursday (Corpus Christi), we visited Ravine Chabot to try to figure out where a pair of Italian amateur beetle enthusiasts might have done some soil washing some 24 years ago that yielded 2 tiny-but-spectacular species endemic to St. Lucia. After scouting around and talking to locals, we believe they must have worked in the area along the Castries River, near or above the old water pump house. We are making plans to return and work on testing that hypothesis this coming week. The test will involve repeating their methods in that area, in hopes of rediscovering the animals. A side benefit of this trip was that some examination of a few dead mango logs turned into an impromptu education session, with several Ravine Chabot youth and children joining us and enthusiastically learning about what lives under the bark of dead logs. This was apparently as greatly enjoyed by them as it was by us.

The BYU group left today, taking with them a very large number of mounted specimens. Indeed, virtually all of the labeled material went with Dr. Clark, so that we do not run out of room for people to hand carry the material. This will allow us a bit of a breather until the next group of helpers arrive next week.

We are still adding species to the list of St. Lucian beetles every day. Obviously, this is now going less rapidly than during the first few weeks, but the rate of discovery is still surprisingly good. No *Dynastes*,

nor *Mallodon* yet. At this point we cannot even approximate the number of species taken so far -- the numbers are too large and the labeling cannot keep up. I have to devote my time to cleaning, sorting and mounting the material so I can deal with identifications rapidly when I return to my laboratory.

So, how do we assess the level of progress at this point? There are 2 ways, and the one I will talk about this week is the number of families represented.

Among the Coleoptera (beetles), there are 165 lineages recognized as families. These represent important, more-or-less equivalently old, groups that are important biodiversity representatives. Some of these are huge, with more than 50,000 species world-wide, while others have only a single species. Most have a few hundred to several thousand species in the world. Some occur all over the world, and some are limited to a small region, such as New Zealand or Chile, so no one place has all families occurring there.

The West Indian Biogeographic Region (Greater Antilles, Lesser Antilles as far south as Grenada, and the islands of the Bahamas and Turks & Caicos), is very rich in biodiversity at this level, with 98 families known from the region (60% of the world number -- for comparison, all of North America north of Mexico has only 130). Again, some are very speciose in the region (have many species), while others are known from only a single species. At the extreme, one is known from a single specimen from one of my traps in the Dominican Republic, and another from only a single fossil specimen in amber. Of the remaining 67 families not (yet) known from the West Indies, only 9 have a serious chance of ever being found here.

The entire Lesser Antilles Sub region (Sombrero to Grenada) has some 80+ known families, with another 7 or so expected. We have collected 66 of these families on St. Lucia, to which we add one more family that is recorded-but-not-recollected, to make a known total of 67. Three families were added to our collections in the last week, one a few minutes before I began writing this update! We fully expect to add a few more before we leave. We realistically could make it to 70 families, maybe even more, because still lacking from our list are 12 families that almost certainly occur here. Some of these are far more common and speciose than things we have already found. Less likely to be here, but still possible are another 5 families. Thus, we expect the total actually on-island to be approaching the 80-families range, roughly equivalent to the entire Sub region! We will not find all the families here on this visit, but we will get close to a full picture.

How does this compare to other Eastern Caribbean islands? We have now passed second-place Montserrat's 63 families, and have tied the previous record-holder Guadeloupe's (I think) 67 families, which would make St. Lucia's recorded biodiversity regionally very high. Of course, pride goeth before destruction, and a haughty spirit before a fall, so keep in mind that only Montserrat and Guadeloupe have had this level of attention paid to their beetles. Never-the-less, St. Lucia will remain among the region's most biodiverse nations.

Update 8, 22 June 2009

What a week! Remembering to remain flexible was critical to us this week.

The planned work at Ravine Chabot and Millet was rained out, and Eli and Crystal had our first flat tyre. Of course, this could not happen on a paved road with a nice flat shoulder, but they never happen there, do they? A problem with the battery charger and a failed ultraviolet light were issues that required a work-around, and several other small issues cased some grief. Still, all-in-all, we managed to keep the traps running full-tilt, with only a day's adjustment here and there. With the moon in the 3rd quarter and the rainy season species starting to emerge, it is a critical time for our trapping efforts. Such small set backs just make us appreciate how well the overall project has been going.

Our site on the top of Gros Piton was retired this week, having reached its allotted number of weeks, and the traps moved to a new one established north of Barre de L'Isle. We continued to increase our targeted collecting aimed at increasing the series of a few very special finds, including a new genus of flea beetle from mosses on Troumassee and Piton de St. Esprit. This tiny, almost spherical animal has lost its flight wings, and has spring-like hind legs longer than the body. Troumassee yields very few species and specimens, but they all seem to be special, many new. Another find from there this week is a new species of darkling beetle that is the first of its genus known from the Lesser Antilles, and a nearly blind weevil that looks very unfamiliar.

A night spent with lights on the beach filled in some of our more obvious holes from previously recorded species (apparently previous visitors liked to spend more time on the beach than we do).

We added another family to our list this week, with our current 68 families bringing us to within striking distance of our predicted goal of 70. Interestingly, we did not add this family by adding a single species that belongs to it, but by adding 2 species, one each of both genera known to occur in the West Indies.

Ending the week, it was a sad day Saturday when we said goodbye to Ross Winton, who has been with us since the first day we arrived. Ross has been the backbone of our efforts so far, and we will miss him greatly, but he had to get back in time to do the sampling required for his own Master's Thesis. He carried 16 boxes of specimens back to the lab, and will start working on them with Ian Foley in anticipation of our return. We are grateful to Ross' wife, Danielle, for doing without him for the last 2 months so that the St. Lucia project could benefit from his work here.

This leaves only 4 of us here for most of the coming week, our nadir, but our numbers will increase again with the arrival of 3 more on Friday.

How many beetles are there on St. Lucia?

Last week I mentioned that there are various ways to estimate how many species are in a place, and that I would discuss one of them this week. There are about 180 species recorded in the scientific literature from St. Lucia, but based on the size of the island, and comparison to other better-known islands like Montserrat and Guadeloupe, I expect the real total to be somewhere in the 1,400 to 1,600

species range. I do not know how many we have collected so far, but our goal is to pass 700, or 50%, in the time we have here.

Why so few? Some species may not be out at this time of year; some live in tiny, specialized niches that we will miss; some are so rare that we will not cross their paths; and some of what is and isn't found is just luck. It has been 2 months of collecting every day, and we have not yet seen the island's largest beetle! So, how to estimate the total from what we have so far, i.e. "How do we know what we do not know?"

Let's say we want to know how many first names there are in Dennery. Let's say we do not have the resources to find everyone and ask them their name, and there is no list, so we have to find a way to estimate it. We can assume that some names are very common, such as David and Michael, while others will be less so, and a few so rare that we will never run into the one person who has it. So, we keep track of the names we find, and how many times they repeat. At first, we will add new names very often, but soon we will find repeats more often than new names, and before long, a new name will be a rare event. By graphing this relationship between number of people encountered and number of new names discovered, we will have a curve that starts very steep, and then curves off to a lower and lower angle. Before we get to the end of the curve, we will have an idea of where the curve is headed, and can use this to estimate the point at which all names will have been found, and how many names there are at that point.

Another way of looking at it is suppose there is a jar of jelly beans, and each color is represented by a different number of beans. If there are 100 colors, and the most abundant one is the color of 1000 beans, and the 5 rarest colors are only represented by a single one, with the other 97 colors scaled between them, how many beans must you sample to find all 100? The answer is "up to 1000." However, if you draw out 20, replace them, mix the jar and draw again 20 times, and keep track of the number of each color seen in each sample, you can get a pretty good estimate of the total using the same ideas as we discussed about for names. The answer will be something like "96 plus or minus 8" meaning there is a 90% likelihood that the actual total is somewhere between 88 and 104.

We have not even recollected all of the first 180 beetle records, which is the equivalent of not re-sampling a color of jelly bean in the first handful. Clearly, if we collect 700 species of beetles, but do not recollect some of those collected by others on less extensive efforts, the total species pool is very large, with a significant number remaining to be discovered.

This technique is mathematically far more sophisticated than I have made it sound, but was developed by a statistician who used the pattern of spotting the unique numbers on taxis in Edinburgh, Scotland, to find a technique to estimate the total number of taxis in the city (which was known because of records on licenses given). So, using simple repeated measures, we can get a pretty good estimate of what is out there.

We will use this type of estimator on the data we are collecting to get a better idea of how many species of beetles really inhabit this island with us. Each specimen will be considered a collecting event, and the distribution of number of specimens per species will give us the data we need for an estimate.

29 June 2009, Update #9 on Insect Project

Barre de L'Isle and Louvet Yield Families 69 and 70, Fond Bay Goes into Bonus Round.

Although there is nothing scientifically important about round numbers, we humans like them anyway. We had a target of documenting 70 families of beetles on St. Lucia during our work here, and, if we count one water beetle family recorded from the island already (that we have not found yet ourselves), 2 discoveries this week took us to that lofty number. At Barre de L'Isle, a flight intercept trap yielded a single minute marsh-loving beetle (family Limnichidae) that we expected to find commonly at a light trap in a river bottom, and an ultraviolet light trap at Louvet produced a rare palmetto beetle (family Smicripidae) that we expected to find in our Berlese funnels. In an expansion of the strangeness of this, 2 days later I found 2 more examples of this second species in a Lindgren Funnel trap a couple meters out our back door at Escap! So much for experts knowing what to expect! Both families were expected here, but finding these 4 individual representatives has required examining hundreds of thousands of insects under a microscope. That numbers game has paid off, and we have justified the seemingly too-optimistic goals we set for ourselves. Now, just like in video games or TV shows, we move into the bonus round.

On Friday, Dr. Matthew Gimmel, a graduate student at Louisiana State University and specialist on tiny obscure beetles arrived, and promptly on Saturday found Family 71 on the Fond Bay Beach (he went there to collect beetles, really!). The ant-like flower beetles (family Anthicidae) he found were larger and more numerous than the previous 2 additions, and with help from Crystal Maier, several specimens of this species were collected under beach wrack. At least they were where they were expected to be.

Anyone want to bet on 72, 73, or 74 families?

Meetings and other comings and goings.

A brief overview of work this very busy week. On Monday, Mr. Melvin Smith accompanied our crew up Piton Troumasse, where more moss was collected to find more of our new flea beetle. On Tuesday and Wednesday, the project vehicle got new tires (Tuesday) and brakes (Wednesday) so Crystal worked at the scopes to help me catch up, while Eli serviced the traps at Barre de L'Isle.

On Wednesday afternoon Mrs. Hana Romain of Agriculture visited to check on our lab setup and get an overview of what we are doing. Then on Thursday morning she and Mr. Steven Lesmond accompanied our crew to field sites, while I had a meeting with Dr. Tennent. In the afternoon Mrs. Romain returned to the Escap house with specimens from the insect collection at Union, which we identified and recorded. Friday morning saw a meeting with Mr. Alwin Dornelly to sketch out the schedule for the next few weeks, and in the afternoon, we had airport arrivals to meet and further work with Mrs. Romain.

The following is another in my series of background on why we approach things as we do.

Why go High?

Someone might ask why are we so concerned with reaching high elevations for some of our trap sites? We spend a great deal of time and effort to get our traps to the top of such places as Troumassee and Piton de St. Esprit. Why bother? To find the answer we go back to a young entomology student at Harvard in the early 20th century -- Philip Darlington. He was paying for his beetle collecting trips to

Cuba, Haiti and Jamaica by collecting amphibians for a professor (Thomas Barbour) back home, and was finding that the better specimens (which brought a bonus) were found as far from human villages as he could get. This pushed him to walk far into the mountains, and as he climbed, he noticed that the familiar widespread ground beetle species of the lowlands were often replaced by flightless, endemic species new to science. Reflecting on this over the years, he developed what he eventually called his Theory of Islands and Mountains.

What he explained was that when a species crossed an ocean barrier to colonize a new island, it would first hit the beach area, whether it floated or flew. If it could survive there, it would produce a population. The species that were best able to cross these gaps would be those that could most successfully live at the beach or lowlands. If they crossed often enough, they would be represented by widespread species common to an entire archipelago. When a new invasive species arrived on an island, the species already there would probably have spread into the inland areas through natural selection, and the pressure of competition from the new invader would "push" them farther inland and up the mountains. This push would pressure the older species that occurred inland of the lowland one to be pushed even higher, and so on. Over time, this repeated process would result in the phenomenon Darlington and those of us who have followed him find so often – common, widespread species on the beach, a few endemics that are similar to those on other islands in the lowlands, a higher percentage of more differentiated endemics in the uplands, and mostly endemic, highly modified flightless species near the tops of high mountains.

Why flightless? Surely flight is one of the most desirable traits for any species? Not always. While for an insect species adapted to lowlands, wings were an advantage, a mountain-top species would have little use for them, and even find them fatal. The mountain top area is small, subject to high winds, and often very wet. If an individual who is adapted to mountain tops takes off in flight, it would often be blown away from its habitat, and be unable to return or find a new one before dying. There is nothing better than certain death to result in very strong natural selection. Successfully moving between islands is very unlikely for a mountain topper, because the suitable habitat for these cool-wet-loving species is orders of magnitude smaller than for the lowland-adapted species. Plus, even after successfully arriving on the beach, they still have to find their way up a mountain to reach proper habitat. Thus, evolution would quickly favour any individuals that lost the power of flight, and in doing so, produce new, endemic species. Given enough time, the tops of mountains on small islands would accumulate many unique, often bizarre species found nowhere else on earth.

This is why we spend so little time on beaches, and so much time climbing Pitons, Monts and Massifs.

Now, not everything on mountaintops is endemic, nor are all the species there flightless, but the percentage of the total is greater for both.

One factor is that the older the island and higher the mountain, the higher this percentage gets. St. Lucia is far younger than islands like Hispaniola and Puerto Rico, and her mountains have started out as desolate volcanic cones, so the expectation is less. However, St. Lucia's peaks have produced a very odd, undescribed flightless flea beetle that lives in moss (and may be a new genus!), a flightless darkling beetle (also undescribed), and a whole group of flightless weevils. Many other species remain unstudied in this regard, but the pattern holds, and our focus has been vindicated.

Annex 3 GIS and Data Management Specialist mission report

Introduction/Background

The Saint Lucia Ministry of Agriculture, Lands, Fisheries and Forestry promotes and supports the management and conservation of the country's natural resource base for the benefit of the entire population. The National Forest Demarcation & Bio-Physical Resource Inventory Project has land survey (forest demarcation), and timber and biodiversity inventory (bio-physical resource inventory) components; and data are generated in each of these areas of activity. The GIS provides an integrated view of these data and combines them to produce:

(i) A comprehensive presentation/ understanding of the project data for forest management and conservation purposes and
(ii) A base for integrating additional data, surveys and analyses in the future.

As per the Project Inception Report and individual Terms of Reference, the GIS and Data Management Specialist took primary responsibility for the following activities, relating to Project Purposes, Results and Activities:

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

This report addresses work accomplished by the GIS Specialist in the first two phases of scheduled activity. Phase one took place from 17th Nov – 19th Dec 2008. Phase 2 lasted mainly from 2nd Feb – 20th Mar 2009, with additional days in April and early May 2009. Timesheets have been submitted via the Project Team Leader.

Phase 3 began on 18th May 2009 and a mission report for Phase 3 will be submitted at its conclusion.

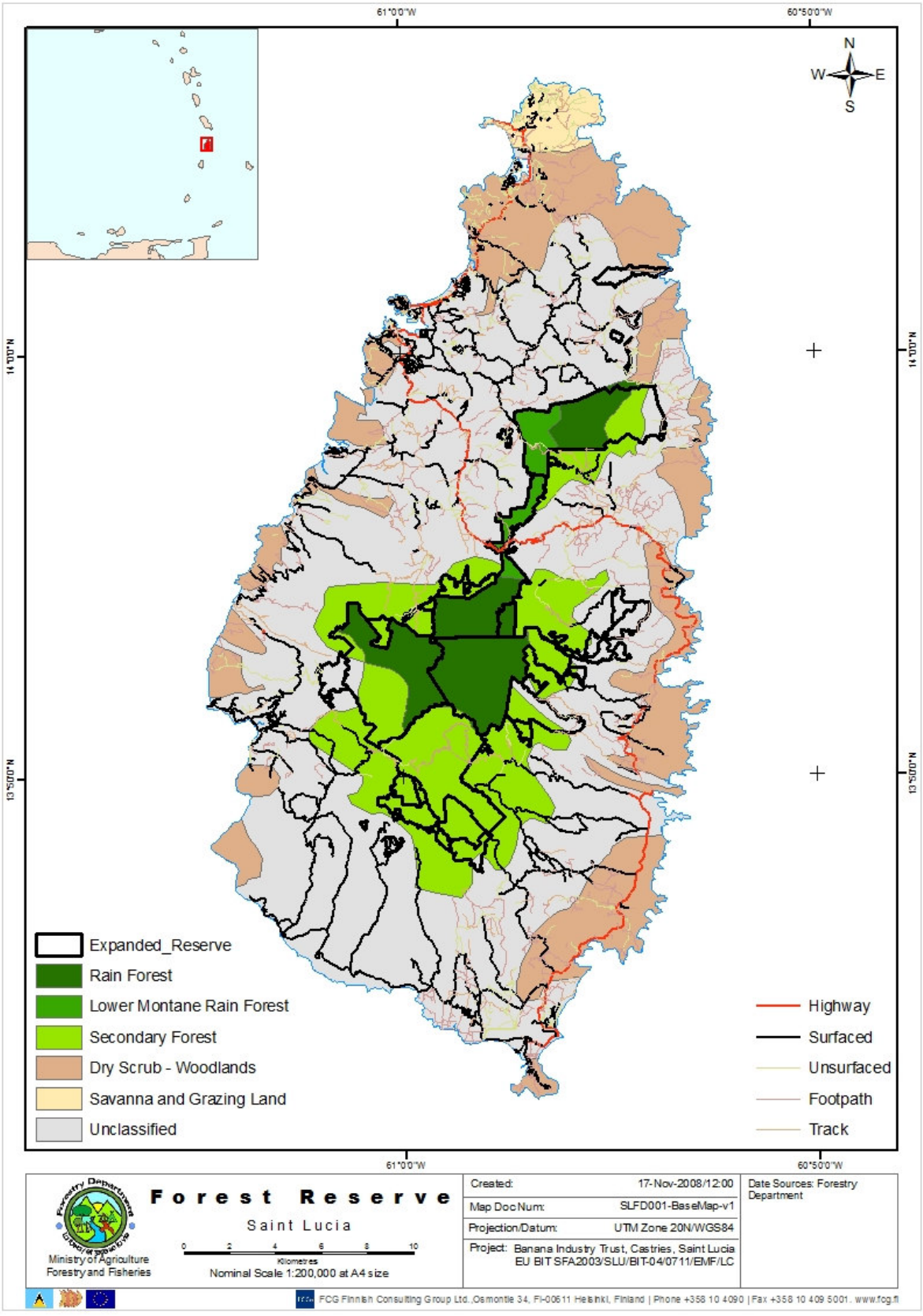
Activities

Phase 1 – 17th Nov – 19th Dec 2008 – 5 weeks

In this first phase the GIS Specialist settled in generally, familiarised himself with the work environment, equipment, existing datasets, coordinate systems, Forestry Department and other personnel and began establishing the GIS and producing maps. As part of this effort:

- The GIS desktop PC, ArcGIS software, GPS software and printer were updated/ patched/ configured
- Existing spatial data were examined, coordinate systems deduced where none were stated, and data were projected using ArcGIS
- Map templates were developed
- Maps were produced for/of:
    - Initial base data
    - Biodiversity Training Workshop
    - Timber Inventory planning
    - Ad hoc maps for the Forestry Department
- Discussions were had with the Project Team Leader/ Forest Inventory Specialist, Conservation Biologist, Ornithologist, Botanist and other project personnel regarding:
    - Data collection and recording (so that the data that they would generate could be included in the GIS)
    - Classification/ stratification systems (e.g. Vegetation Types)
    - Other data needs (e.g. satellite imagery)
    - Mapping needs
- Discussions were had with the Head and staff members of the Forestry Department GIS/ Cartography Unit with the aim of beginning close working contact with this Unit, understanding various data sources and issues (e.g. multiple projection systems in use), understanding existing needs, getting institutional and other advice and learning of the SLFD's expectations.
- The Technical Committee was briefed on progress on 15th Dec 2008

Copies of two of the maps produced in this Phase are reproduced below.


61°0'0"W
60°50'0"W
14°0'0"N
13°50'0"N
N
W
E
S
Expanded_Reserve
Rain Forest
Lower Montane Rain Forest
Secondary Forest
Dry Scrub - Woodlands
Savanna and Grazing Land
Unclassified
Highway
Surfaced
Unsurfaced
Footpath
Track
Forest Reserve
Saint Lucia
0 2 4 6 8 10
Kilometres
Nominal Scale 1:200,000 at A4 size
Ministry of Agriculture
Forestry and Fisheries
Created: 17-Nov-2008/12:00
Map Doc Num: SLFD001-BaseMap-v1
Projection/Datum: UTM Zone 20N/WGS84
Project: Banana Industry Trust, Castries, Saint Lucia
EU BIT SFA2003/SLU/BIT-04/0711/EMF/LC
Date Sources: Forestry Department
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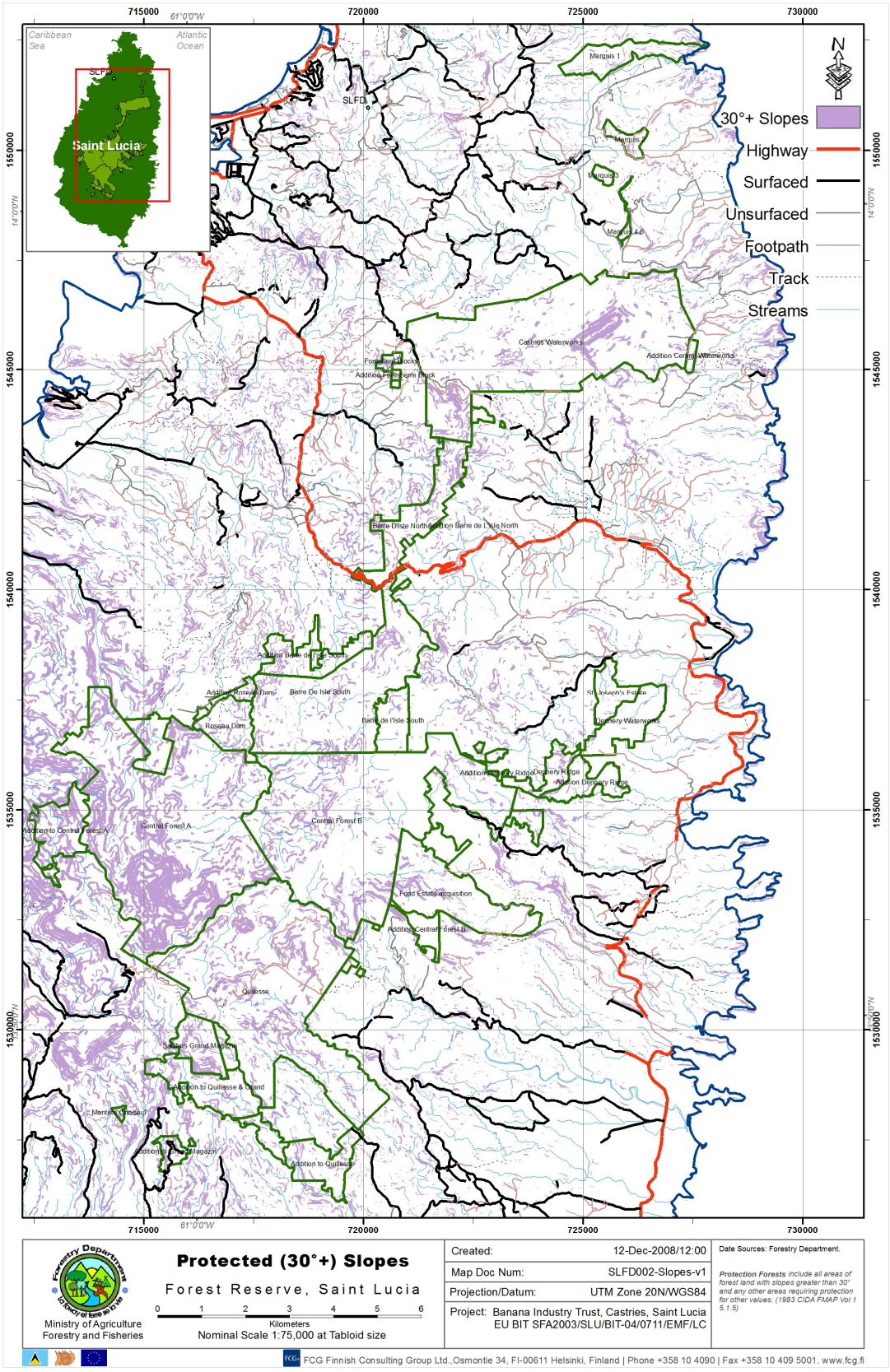
715000
720000
725000
730000
61°0'0"W
1550000
1545000
1540000
1535000
1530000
14°0'0"N
13°55'0"N
Caribbean Sea
Atlantic Ocean
Saint Lucia
SLFD
N
30°+ Slopes
Highway
Surfaced
Unsurfaced
Footpath
Track
Streams
Marquis 1
Marquis 3
Marquis 4 a
Castries Waterworks
Addition Castries Waterworks
Forestiere Rock
Addition Forestiere Rock
Barre D'Isle North
Addition Barre de L'Isle North
Addition Barre de l'Isle South
Addition Roseau Dam
Barre De Isle South
Roseau Dam
Barre de l'Isle South
St Joseph's Estate
Dennery Waterworks
Addition Dennery Ridge
Dennery Ridge
Addition Dennery Ridge
Addition to Central Forest A
Central Forest A
Central Forest B
Fond Estate acquisition
Addition Central Forest B
Quilesse
Addition to Quilesse & Grand
Addition to Quilesse
Protected (30°+) Slopes
Forest Reserve, Saint Lucia
0 1 2 3 4 5 6
Kilometers
Nominal Scale 1:75,000 at Tabloid size
Ministry of Agriculture
Forestry and Fisheries
Created: 12-Dec-2008/12:00
Map Doc Num: SLFD002-Slopes-v1
Projection/Datum: UTM Zone 20N/WGS84
Project: Banana Industry Trust, Castries, Saint Lucia
EU BIT SFA2003/SLU/BIT-04/0711/EMF/LC
Date Sources: Forestry Department.
Protection Forests include all areas of forest land with slopes greater than 30° and any other areas requiring protection for other values. (1983 CIDA FMAP Vol 1 5.1.5)
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Phase 2 – 2nd Feb – 20th Mar 2009 – 7 weeks; and additional days in April and early May 2009

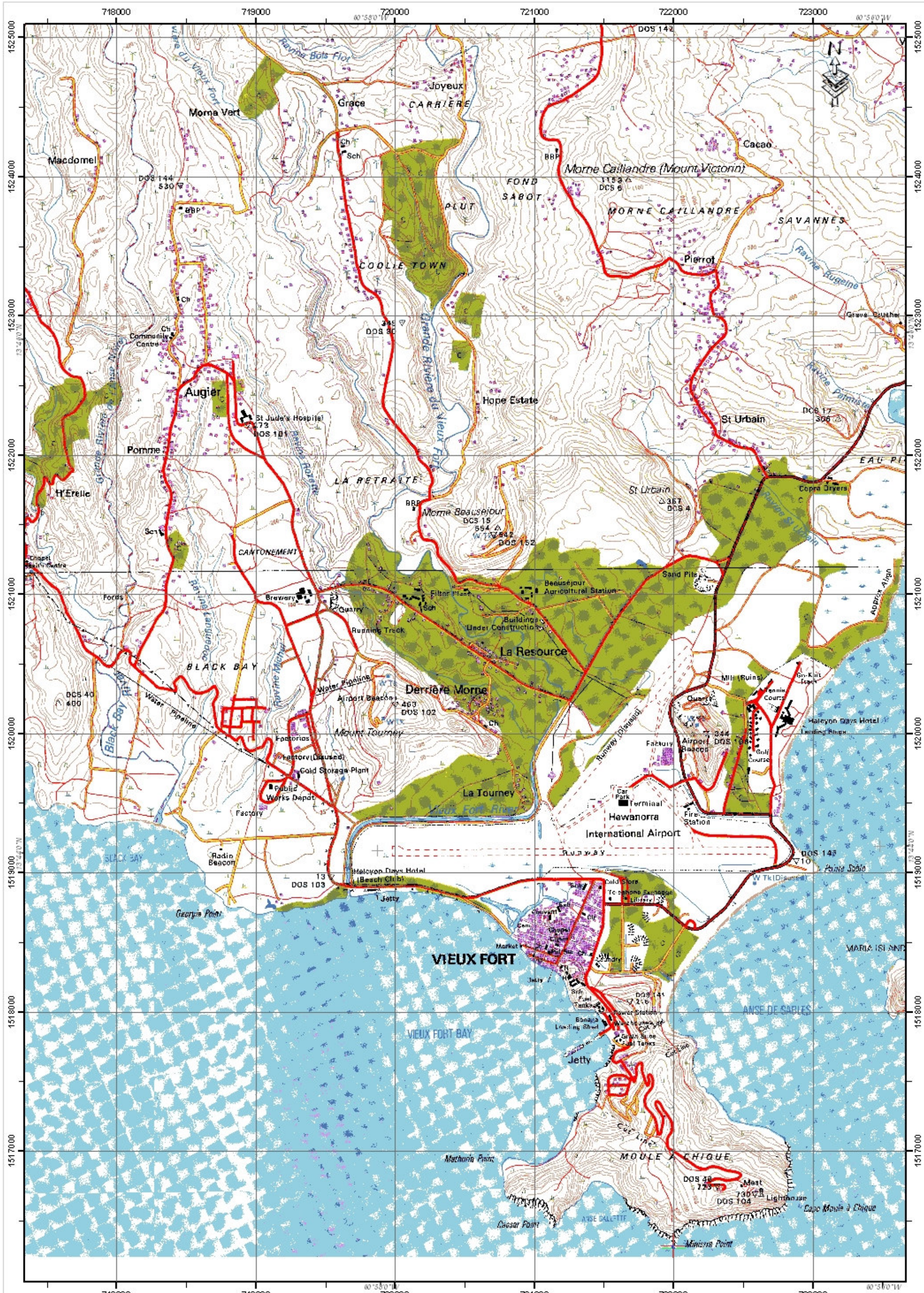
In this second phase the GIS Specialist continued the establishment of the GIS, by refining templates and producing more maps, sometimes updated in a day(s) to suit the intended user - to plan surveys, guide teams in the field and finally visualise results returned from the field. Most of the maps were produced at 1:20,000 Tabloid size (11"x17"), providing a balance between space for data and convenient size of map sheet especially for field teams - using the printer purchased by the project. The use of Global Positioning Systems (GPS) receivers by field teams improved during this period and the process (es) of transferring data from the timber, floral and faunal diversity inventories/ surveys into the GIS were developed into routines.

In addition, high resolution satellite imagery was sourced and purchased, and deeper attention was paid to the technical issue arising from the various projection/ coordinate systems in use with Saint Lucia data. Other actions in support of the team were carried out.

As part of this effort:

- A short field visit with the timber inventory team was made to clarify GPS usage
- Map templates were refined and additional ones developed
- Maps were produced:
    - A series of 1:20,000 base maps using scans of the existing topographic base map of Saint Lucia for orientation/planning fieldwork by the Mammal Specialist and others
    - A series of 1:20,000 maps of Forest Reserves (Barre De L'Isle North and South, Dennery, Central Forest 'B', Addition to Central Forest 'B', Quilesse, Addition to Quilesse, Roseau Dam Lands, Saltibus Grand Magazin, etc.) using scans of existing topographic base map of Saint Lucia, derived slopes and suggested survey lines, nearest roads and closest access points were produced for the Timber Inventory Teams. The suggested survey lines were done in concert with the Project Team Leader and the maps also listed the starting coordinates and compass bearings for the field teams.
    - A series of 1:20,000 maps showing the study sites and/or the results (e.g. Plot Basal Area) of field work by the Timber, Mammal, Plant and Herpetological Surveys.
    - 1:25,000 Summary maps
    - Ad hoc orientation maps
- Discussions continued with the Project Team Leader/ Forest Inventory Specialist, Conservation Biologist, Ornithologist, Botanist, Forestry Department GIS Unit and other project personnel in pursuit of the project purpose.
- Introductory briefings were held with CEHI, visiting researchers and EU personnel in pursuit of the general purpose of engaging Target Groups as suggested by the Overall Project ToR

Copies of two of the maps produced in this Phase are reproduced below.



Inventory

Field Orientation Map Series

0 1 2 Kilometres

Nominal Scale 1:25,000 at A4 size

Ministry of Agriculture Forestry and Fisheries

Created: 30-Apr-2009 | Projection/Datum: UTM Zone 20P/WGS84

Map Doc Num: SLFD007-InventoryPlanning-v2

Project: Banana Industry Trust, Castries, Saint Lucia
EU BIT SFA2003/SLU/BIT-04/0711/EMF/LC

Data Sources: 1:25,000 Map of Saint Lucia - OS Series E803 (DOS 345) 1981; SLFD; Durrell Wildlife Conservation Trust; FCG Project 2008-2009.

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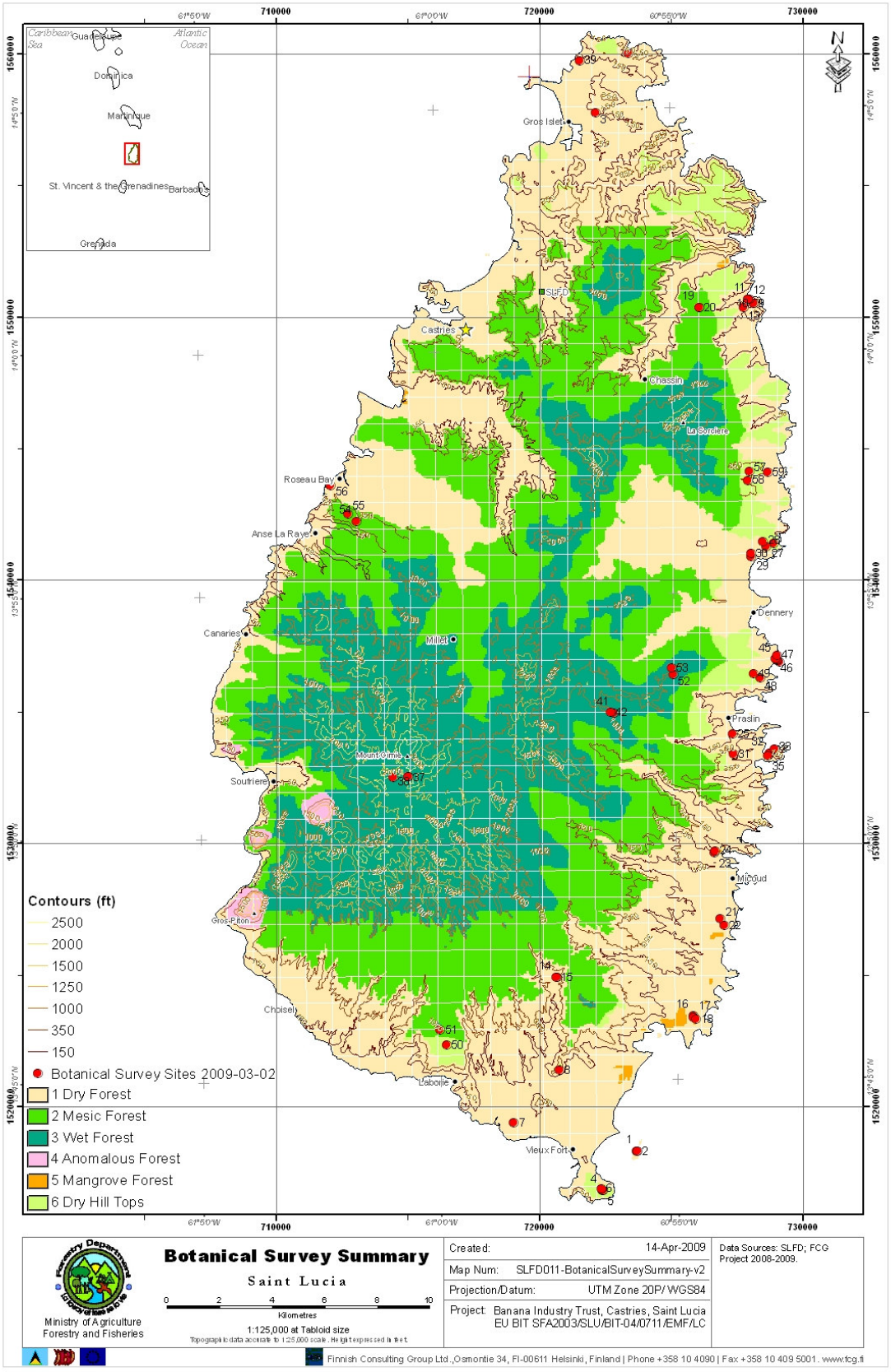
Caribbean Sea
Atlantic Ocean
Guadeloupe
Dominica
Martinique
St. Vincent & the Grenadines
Barbados
Grenada
Gros Islet
Castries
SLFD
Chassin
La Soufriere
Roseau Bay
Anse La Raye
Canaries
Micoud
Dennery
Praslin
Soufriere
Mount Gimie
Gros Piton
Choiseul
Laborie
Vieux Fort
Contours (ft)
2500
2000
1500
1250
1000
350
150
Botanical Survey Sites 2009-03-02
1 Dry Forest
2 Mesic Forest
3 Wet Forest
4 Anomalous Forest
5 Mangrove Forest
6 Dry Hill Tops
Botanical Survey Summary
Saint Lucia
Kilometres
1:125,000 at Tabloid size
Topographic data accurate to 1:25,000 scale. Height expressed in feet.
Ministry of Agriculture Forestry and Fisheries
Created: 14-Apr-2009
Map Num: SLFD011-BotanicalSurveySummary-v2
Projection/Datum: UTM Zone 20P/ WGS84
Project: Banana Industry Trust, Castries, Saint Lucia
EU BIT SFA2003/SLU/BIT-04/0711/EMF/LC
Data Sources: SLFD; FCG
Project 2008-2009.
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Summary

The main purpose of the GIS Specialist may be summarised as putting in place a GIS that combines and displays data gathered during the project, and other data, to support the resource management planning and conservation activities of the Saint Lucia Forest Department, and further, the objectives of the Agricultural Sector Policy of the Ministry of Agriculture, Forestry and Fisheries.

Guided by previous experience, the consultant has addressed and continues to build on four components of an effective GIS: (i) hardware (ii) software (iii) highly-skilled human resources and (iv) processes, to integrate data, conduct analyses, generate statistics, and advise or institute change in management of the forest resource. This main purpose has progressed well in the first two phases of the GIS Specialist's mission. The hardware and software are in place. In the coming phase more/deliberate interaction with the Forestry Department GIS Unit will be continued to develop the human resource and emplace appropriate processes to develop an effective GIS at the Forestry Department. In addition, interaction will be increased with the Forestry Department as a whole and other target groups of the project as a whole, including the Ministry of Agriculture, Forestry and Fisheries, with the purpose and in the spirit of the overall project ToR.

At the end of Phase 1 the GIS was operational and producing maps from base data. By the end of Phase 2, activity had expanded so that GPS and computed attribute data of bio-resource survey locations were being included in mapping products in an ongoing manner. Data from the Timber Inventory is systematically extracted from the Forest Management Information System and mapped – satisfying the expected routine linkage between the FMIS and the GIS.

By the end of Phase 2 the SLFD GIS had itself acquired/ repaired computers, so SLFD GIS staff could begin to observe, participate and practice actions currently being carried out by the GIS Specialist. This technology transfer aspect can now be fully instituted to achieve the seamless handover to the Forest Department GIS anticipated at the end of the project.