Darwin Initiative – Final Report

Darwin project information

Project Reference	14-004
Project Title	A Biodiversity Monitoring System for Trinidad and Tobago
Host country(ies)	Trinidad and Tobago
UK Contract Holder Institution	Oxford University
UK Partner Institution(s)	
Host Country Partner Institution(s)	National Herbarium, University of West Indies, Forestry Division, Asa Wright Nature Centre
Darwin Grant Value	£264,500
Start/End dates of Project	July 2005 to December 2008
Project Leader Name	Dr Nick Brown
Project Website	http://dps.plants.ox.ac.uk/bol/TRIN
Report Author(s) and date	Nick Brown (Oxford), Yasmin Baksh-Comeau (UWI)

1 Project Background

Trinidad and Tobago (T&T) have the richest biodiversity in the southern Caribbean but some of the most rapid rates of habitat loss. A lack of basic habitat assessments and baseline data, combined with a lack of capacity compromised the ability to develop conservation strategies.

The purpose of this project was to build and maintain capacity in T&T to monitor habitats, detect changes in plant populations and measure the effects of management. We sought to do this through the following outputs:

- 239 sample plots enumerated and over 20,000 plant specimens collected and identified.
- Expansion and complete refurbishment of National Herbarium. Collections catalogued on herbarium database.
- Annotated and illustrated checklist of T&T flora in production.
- Updated vegetation map and an assessment of changes since 1984.
- Biodiversity MSc established at UWI
- Vegetation survey and identification training for Forestry Division staff.

2 Project support to the Convention on Biological Diversity (CBD)

2.1 CBD Objectives

The project has supported the following CBD objectives:

Article 7: This project has provided up-to-date information on the distribution of plant species and habitats to highlight those under particular threat. The Environmental Management Authority – the CBD focal point for T&T, will be able to access, for the first time, to detailed distribution maps for all plant species found on the two islands, plus information on their conservation status – of particular importance in the on-going process of identifying areas for conservation and restoration. We have assisted the National Herbarium to database its

collections and publish the catalogue on-line thus meeting the CBD commitment to maintain and organise relevant biodiversity data.

Article 12: A primary contribution of our project to meeting CBD commitments has been to provide scientific and technical training in herbarium management, particularly in the development and maintenance of an on-line, networked database. We have also established an MSc in Biodiversity and Conservation involving universities in four countries in the Caribbean in which the identification, conservation and sustainable use of plant resources will be a key component.

Article 14: An important use that will be made of on-line information on species distributions is in the preparation and appraisal of Environmental Impact Assessments that are required for development in T&T. Our conservation check-list will enable the Environmental Management Authority to assess whether programmes and policies are likely to have significant adverse impacts on plant biological diversity.

Article 17: We have created a BRAHMS database of the entire National Herbarium collection (including high resolution digital images of all specimens) and new voucher specimens collected during this project. The entire database can be viewed and searched on-line making these data available to anyone with internet access. We have also been able to repatriate important historical herbarium data. Many scientifically important Caribbean plant specimens are held in herbaria in the UK and are not accessible to researchers in the countries from which they were taken. We have digitized these (including high resolution digital photographs) and added them to the our Caribbean BRAHMS database.

Article 18: Our project has been extremely successful in promoting cooperation in the training of personnel and exchange of experts. We have been able to develop and strengthen capacity in plant taxonomy, vegetation inventory, herbarium curation and the teaching of biodiversity conservation. We have contributed to building institution capacity in the University of the West Indies (and other regional universities), the National Herbarium and the T&T Forestry Division.

2.2 2010 Biodiversity Target Themes

Our project has assisted in meeting the 2010 Biodiversity Target of mobilizing technical resources for developing countries, and especially small island developing States. Island biodiversity was also identified as a global conservation priority and was made a CBD Thematic Programme (COP 8 Decision VIII/1). Our project assisted with the achievement of a key target in this Thematic Programme, namely the development of the capacity for a national and regional biodiversity monitoring programme. It has also strengthened regional co-operation through the development of an MSc in Biodiversity Conservation taught co-operatively through a network of Caribbean regional universities.

2.3 Cross-cutting Issues

Climate Change and Biological Diversity. One of the highest priority actions identified under this CBD Cross-cutting Issue is to identify and conserve biodiversity components that are especially sensitive to climate change. This is the focus of Ms Shobha Maharaj's doctoral research, using the data on plant distributions and habitat associations collected during this project.

3 Project Partnerships

The idea for this project was proposed by the University of the West Indies. Senior staff at UWI had identified the need to upgrade the National Herbarium and improve biodiversity training and sought assistance from Oxford University. Dr Nick Brown (Oxford, NDB) proposed making an application to the Darwin Initiative for financial support for these activities.

UWI and Oxford University received pre-project funding to hold a planning workshop in Trinidad from 12th – 17th June 2004 in order to develop the full proposal. Many local organisations, including all of the project partners and the Environmental Management Authority (EMA), participated in this workshop and helped define the research priorities. Both the Stage 1 and Stage 2 applications were jointly written by staff from Oxford, the National Herbarium and the Business Development Unit at UWI with contributions from the T&T Forestry Division.

The first project activity was to draw up a MoU. NDB had previous experience of a Darwin Initiative project in Laos which suggested that this was important in order to confirm partner responsibilities and expectations. The MoU was signed in Oxford by the Head of the Life Sciences Division on behalf of OU and by the Director of Development on behalf of UWI on 5th May 2005.

A major achievement of this project has been the very central involvement of the **Forestry Division**, despite their initial scepticism about its value. A key issue which came to the surface at the project planning workshop was the lack of previous productive collaboration between UWI and the Forestry Division. There had also been public criticism of the Division for the lack of capacity and involvement in biodiversity conservation.

This project would not have been logistically possible without the wholehearted commitment of the Forestry Division. They seconded two teams of eight and fourteen field staff to the project – including paying additional salary allowances whilst they were in the field. They loaned two 4W drive vehicles and donated their fuel - a considerable investment of their divisional resources which signalled the importance that they attached to this work. The Forestry Division team became extremely skilled at botanical inventory and a close working relationship has now been forged with UWI. We view this as a major achievement of the project.

The project benefitted greatly when the Acting Director of the Forestry Division, Mr Seepersad Ramnerine, was awarded a Darwin Fellowship to come to Oxford for one month in October 2007 to carry out analysis of data from 170 Forestry Division permanent sample plots. This gave us an unrivalled opportunity to closely involve a member of the senior management team in the work and enthuse him about the value of the work.

The National Herbarium proved to be ideal partners. Our project stretched them to the limit through the demands that it placed on staff and resources. The University invested far more in the refurbishment of the Herbarium than had initially been agreed – creating as a result the best herbaria in the Caribbean. Project administration in Trinidad was handled with efficiency and transparency. Yasmin Baksh-Comeau, the Curator of the National Herbarium and her team proved to be knowledgeable, committed and very hard working.

There have continued to be internal tensions at UWI between the National Herbarium and the Department of Life Sciences. These tensions pre-date the Darwin project but were exacerbated by conflict over project resources and collaborations. These were resolved when we were awarded a major EU grant for the development of an international MSc course in Biodiversity Conservation to be based in the Department of Life Sciences through the EDULINK programme (http://www.acp-edulink.eu/). The Department have signalled their long-term commitment to this area by the appointment of a new chair in Biodiversity Conservation (Professor Andrew Lawrence) who has been keen to foster a new working relationship.

Our partnership with the **Asa Wright Nature Centre** did not prove to be successful. It was very dependent on a single individual who left for alternative employment in the second year of the project. Thereafter the centre has had no involvement with the project work. The lesson we learned from this is that a successful partnership is built on institutional commitment rather than individual enthusiasm.

In summary, the tripartite project worked particularly well because of the complimentary skills of the three partners.

4 Project Achievements

4.1 Impact: achievement of positive impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

This project was not designed to have a direct impact on biodiversity. Rather it was intended to provide an instrument for informing and enabling a transition to a system of sustainable management and conservation in Trinidad and Tobago. We anticipate that improved conservation management based on clear and authoritative evidence will help to slow the rates of habitat loss in the islands. Our project has help to meet several crucial research and training needs identified in the National Biodiversity Strategy and Action Plan (NBSAP).

The impact of the project is not restricted to T&T. Our partner organisation, UWI serves 15 countries in the Commonwealth Caribbean. These countries all draw on the botanical expertise in the National Herbarium and will benefit from the knowledge gained from the project and the expansion of the TRIN facilities. The development of an MSc in Biodiversity Conservation and Sustainable Development for the Caribbean will lead directly to increased capacity at UWI and in the Universities of Guyana, Suriname and Belize. Graduates of this course will support biodiversity conservation projects and policy developments in the region.

4.2 Outcomes: achievement of the project purpose and outcomes

The purpose of this project was to build and maintain capacity in Trinidad and Tobago to monitor habitats, detect changes in plant populations and measure the effects of management.

We propose to carry out a national vegetation inventory so that we can 1) assess the conservation status of habitats and key species 2) expand and enhance the National Herbarium 3) produce two user-friendly field guides 4) train staff in collections and information management in the herbarium 5) provide training in plant survey and identification for students at two HE institutions, staff in the state forestry service and local nature reserve guides.

1. A significant increase in institutional capacity:

(i.) It had been our original intention to employ a post-doctoral research assistant to co-ordinate the programme of rapid biodiversity surveys. In the event it proved impossible to find a T&T national with appropriate qualifications (a telling reflection of the lack of indigenous capacity). We decided, rather than employ an expatriate we would train a national masters-level student. There were no young plant taxonomists in T&T and we felt it was important to secure a succession for future years. We agreed with UWI that the post-doctoral position should be re-graded as a post graduate research assistantship. Ms Shobha Maharaj was appointed to this post from October 2005. Shobha proved to be the perfect appointment. She demonstrated strong leadership ability, organising long and arduous field campaigns where she directed two large teams of male foresters. She was hard-working, well organised and learned very fast. We were sufficiently impressed by her abilities that we encouraged her to apply for position as a doctoral research student at Oxford University, supervised by NDB and SH. She was offered both a place and a £6,000 p.a. University scholarship. She began her doctoral research – investigating the likely impacts of climate change on the flora of T&T in October 2008 . Mr Seepersad Ramnerine (acting director of the T&T Forestry Division), Mrs Yasmin Baksh-Comeau (Curator of the National Herbarium) and Dr John Agard (Chairman, Environmental Management Authority) have agreed to form Shobha's supervisory committee.

(ii.) A new Herbarium Assistant, Ms Kisha Manaure was appointed in January 2008 following the resignation of Mr. Jaumark Pierre, originally hired as the technical assistant to Ms. Maharaj.. Now that the project has ended her salary costs will be met from UWI funds. She is able to carry out many of the routine maintenance and curating tasks, allowing the Curator to devote more of her time to plant identification, education and research. Kisha has been trained to prepare and catalogue specimens and is also being trained in plant identification. Ms. Manaure has exceeded our expectations with her ability to identify plants and she is now being trained as a potential candidate for succession planning in the herbarium. The Herbarium now has two extra, well-trained members of staff as a direct result of this project. This represents a major capacity building outcome of the project.

(iii.) Twenty foresters from the T&T Forestry Division took part in the field surveys. They were trained in Rapid Botanical Survey (RBS) techniques and are now competent to carry out these surveys independently. The National Herbarium and Forestry Division intend to continue the programme of rapid botanical surveys in those parts of the islands that have not yet been extensively sampled.

(iv.) Mrs. Yasmin Baksh-Comeau and Miss Kisha Manaure will travel to Oxford on 12 July 2009 to join Shobha Maharaj on an 4-week training course in the use of the BRAHMS database that we have created for the National Herbarium. They will learn how to

digitize species and collection data, curate herbaria. This will enable the Herbarium to provide information on the distribution and conservation status of species in order to inform conservation decision-making and facilitate the publication of floras, checklists and monographic accounts.

(v.) Mr Seepersad Ramnerine, Acting Conservator of Forests visited Oxford for one month on a Darwin Fellowship (Sept-Oct 2007) to work on Forestry Division permanent sample plot data. We were able to clean and organise the data so that they could be incorporated into our overall biodiversity survey. We trained Mr Ramnerine in PSP data analysis methods and we are in the process of using this long-term data set for analysis of climate change influences on forest composition and dynamics for publication. Since returning to Trinidad Mr Ramnerine has trained junior staff in his section in analysis methods and collected voucher specimens from >200 unidentified individuals in his PSPs in order to establish their identities in the National Herbarium. He has used basic forest modelling techniques to examine the consequences of exploitation and fire for forest dynamics. This work is still in progress but is likely to feed directly into management strategies for Trinidad's forests. Another important outcome from this work will be a reclassification of Trinidad's forests for management purposes on the basis of complete plant biodiversity data rather than simply their timber production potential.

(vi.) A series of plant identification workshops were conducted by the Curator, Mrs. Yasmin Baksh-Comeau, for volunteers from the Trinidad and Tobago Field Naturalists' Club, Friends of the Botanic Gardens, technical staff from the Dept. of Life Sciences and Forest Officers from the Forestry Division, who participated in the survey. A register of the participants was kept. Following the field survey a group of selected Forest officers were assigned to the herbarium to assist with the plant identification phase. They continue to receive training in this area.

(vii.) In November 2007, the Herbarium hosted the International Herbarium Techniques Course which was delivered by a team of presenters from the Royal Botanic Gardens, Kew, England. This course attracted local participants from the Forestry Division and the Ministry of Agriculture (Horticultural Services) responsible for our Botanic Gardens. It attracted regional participants from Jamaica, Guyana, Antigua and Barbuda. As a follow-up from this course one participant (Chris Pratt) from Antigua and Barbuda and also a member of their local NGO (Environmental Awareness Group) will soon publish a "Field guide to the native and naturalized plants of Antigua and Barbuda" with support from USAID. Voucher specimens from Antigua and Barbuda collected for the publication of this guide book are now lodged with the TRIN herbarium as part of an agreement between the Government of Antigua and the National Herbarium of T&T to help with the preservation of their local flora. The Herbarium facilitated Mr. Pratt's visit in April 2009 to consult the library and herbarium collections.

(viii.) As a result of the DI project the University of the West Indies has increased its support for the Herbarium by funding the appointment of a Library Assistant post and bursaries for student internships in the Herbarium. This has improved access to the library collections both for UWI students and staff and the general public.

2. New facilities

Shortly into the start of the first phase of the project, approval was given by the University of the West Indies to undertake extensive refurbishment and expansion of the Herbarium. 200 new purpose-built steel herbarium cabinets were installed along with a new air-conditioning system. These have provided secure, air-tight, moisture and insect-resistant storage for botanical specimens. Storage capacity has increased from 30,000 to approximately 200,000 herbarium specimens.

A pre-installation structural survey revealed that the National Herbarium building was not strong enough to support the weight of the new cabinets. The necessary structural reinforcements work required the entire Herbarium to be crated and moved to another location. This Herculean task was carried out efficiently by the herbarium staff but as a consequence the

collections were unavailable for five months of the project causing unexpected delay. Structural work was completed and the collections returned to the Herbarium by December 2006. The move afforded the opportunity to re-order the collections into a sequence corresponding to our Conservation Check-list, which is alphabetic, within ferns/monocots/dicots.

BRAHMS (Botanical Research And Herbarium Management Software) was installed on all of the Herbarium computers, including two new computers purchased for this project.

The Herbarium library was relocated to an adjacent room and was completely reorganized and upgraded by the newly-appointed full-time Library Assistant, Mrs. Beverly Adams-Baptiste who joined the staff on 1st March 2009.

The Herbarium now has the equipment necessary to carry out field work, including a 4-wheel drive vehicle, a digital camera, a GPS, a plant drier, presses, secateurs etc.

The expansion and major refurbishment of the Herbarium has transformed it from a small and deteriorating collection into a world-class facility, linked through BRAHMS to other international collections. This is reflected in the development of new international collaborations including the International Institute of Tropical Forestry, Montgomery Botanic Gardens, Florida and RGB Kew.

3. Base-line data and collections

(i.) Complete digitisation of TRIN Herbarium. Digital photographs of the entire herbarium collection of flowering plants (17,259 high resolution images) were completed in January 2008. The Herbarium hired a Student Intern, Ms. Uta Rampersad, with their own resources in order to complete the photographing of these specimens on time. The information on the herbarium labels of these specimens has now been data based in BRAHMS and linked to the digital images. This work was carried out by a team of Oxford University students in order to ensure the timely completion of the complete digitization project. http://dps.plants.ox.ac.uk/bol/TRIN

(ii.) We have now completed enumeration of more than double the original number of sample plots proposed. Figure 1 shows a distribution map of these plots. We have now collected 21,944 voucher specimens.

During the RBS survey we made 22,467 species records of which 21,944 were vouchered. More than 82% are currently identified to species, which has given us a robust dataset for species distribution mapping and analysis of habitat types. We anticipate that a further 3-5% of these voucher specimens will ultimately be identified and we are in the process of seeking assistance with this task from experts on particular groups, across the globe. However, c 10-15% are likely to remain unidentified as the specimens either rotted (before they could be adequately dried on long field expeditions), were lost, were immature seedlings, bark or sterile grasses and Cyperaceae.

The large numbers of sterile, dimorphic, juvenile or incomplete specimens collected during the survey proved challenging for the herbarium staff. The standard procedure of using flora keys along with fertile herbarium specimens or very old specimens rendered identification incomplete or doubtful in many cases. Therefore the staff had to rely on the use of vegetative characters and resorted to designing vegetative keys suitable for identifying sterile material in some of the smaller families. We are collating these keys in order to develop field identification guides for sterile material which will also enhance the virtual field herbarium.

The identification and databasing in BRAHMS of the plants identified and the field data were finally completed at the end of February 2009. The identifications were done principally by Drs William Hawthorne and Stephen Harris (OU), Winston Johnson, Yasmin S. Baksh-Comeau and Victor Quesnel from TRIN.

4.3 Outputs (and activities)

The project achieved almost all of its outputs (plus many others that were not specified in the original proposal). Some important outputs have not yet been completed but all project partners remain committed to achieving them in the near future. The project evolved significantly over the three years of funding and this meant that we had to adapt some of our proposed outputs to meet new aspirations and demands from our project partners.

1. Network of vegetation sample plots enumerated: Achieved.

We originally proposed to enumerate 70 vegetation sample plots. A final total of 239 rapid botanical surveys (RBS) were carried out. We substantially increased the number of samples that we took as it became clear that our original sampling framework was inadequate to characterise the variation that currently exists and that we were revealing important new information on the range of many species of high conservation value. We decided to use the RBS methodology as it haas a number of advantages over plot-based sampling. It allows a more complete inventory of the vegetation and does not restrict collections to an arbitrarily selected and often relatively small area. It is a more efficient sampling technique allowing more samples to be taken in a given time.

The Forestry Division and UWI continue to collaborate on the enumeration of further RBS samples, focussing on the poorly sampled Northern Range.

2. Updated vegetation map of T&T. Assessment of changes in habitat structure, composition and distribution since 1984. In progress.

This has become a major focus for SM's D.Phil thesis. Progress with this output was delayed by the greater-than-anticipated effort we devoted to vegetation sampling. However, we feel that although the output has been delayed, the analysis will now be carried out by a member of the T&T National Herbarium staff, rather than an Oxford academic. This has great value, in terms of capacity building and the legacy that it will leave. SM is receiving training in GIS and remote sensing techniques and in the ordination of vegetation data. In addition to preparing a new vegetation map of T&T she will examine the climatic controls on the distribution of plants of high conservation value and predict the consequences for them of climate change.

Forestry Division is participating in a detailed forest mapping project, organized by the US Forest Service (International Institute of Tropical Forestry) as part of their Caribbean Forest Mapping Project. IITF have obtained a full set of 2008 IKONOS satellite photographs for T&T which they are using to produce high resolution images of forest cover. We have very detailed biodiversity survey data. In order to avoid duplication of effort and the production of two forest maps we are now collaborating with IITF to produce a much higher quality product.

3. Taxonomy training courses provided for tertiary level students. Achieved

We encountered a number of practical and personnel problems with offering taxonomy training courses for UWI students. In particular, there was resistance from some members of staff in the Life Sciences Department, to incorporating taxonomy training into existing degree programmes. In order to overcome these problems we agreed to co-ordinate an application to the African Caribbean and Pacific Group of State - EU Partnerships in Higher Education, EDULINK programme for funds to support a new degree. We applied for a grant to support the development of a one year full-time (2 year part-time) taught an MSc in Biodiversity Conservation and Sustainable Development for the Caribbean. EDULINK's overall objective is to foster capacity building and regional integration in the field of higher education through institutional networking and this was a good match for our Darwin Project objectives. Dr David Rampersad, Director of the Business Development Unit at UWI, visited Oxford in April 2008 for one week during which he and NDB co-wrote an application. Although our application was not approved at this first attempt we were invited to submit a modified proposal which was awarded a €400,000 grant in January 2009. The three-year project involves the following HE institutions:

- The University of the West Indies
- The Universities of Oxford

- The University of Belize
- The University of Guyana
- The Anton De Kom University of Suriname
- Institute for Advanced Teacher Training of Suriname

The specific aims of the project are as follows:

i) Develop a network of trained academics and professionals in the region committed to biodiversity conservation and sustainable development and the delivery of a high calibre, joint MSc in this discipline;

ii) Develop a network of HEIs committed to and capable of the joint management and delivery of the MSc at a regional level;

iii) Development and delivery of a one year full-time (2 year part-time) taught MSc in Biodiversity Conservation and Sustainable Development;

iv) Develop, within the framework of the MSc, of stand alone modules and/or courses delivered as Continued Professional Development courses to existing professionals within the environmental sector;

v) Develop a web based delivery system of training for professionals within the Caribbean which will mean that students do not have to move between islands or leave work to participate in the programme.

The first meeting of the Academic Management Board will take place in Trinidad from 24-27th September 2009.

4. Expand and enhance the National Herbarium. Achieved

(i.) **Repatriation of historical herbarium data:** many important Caribbean plant specimens are held in herbaria in the UK and are not accessible to researchers in the countries from which they were taken. We have taken high-resolution digital images of 9,000 of these held in the Oxford University Herbarium (including 3,600 collected in Trinidad) and data-based their collection information.

(ii.) **Refurbishment of National Herbarium:** Full details are given in Section 4.2.2

Nation Herbarium before refurbishment

Refurbished Herbarium, July 2008

5. Field guide to the trees of T&T and Asa Wright Nature Centre published. In Progress

We requested, and were given permission to broaden the scope of this output to produce an illustrated and annotated Conservation Checklist for T&T, a more coherent vehicle for all project outputs. (Also, another UWI staff member began work on updating the Manual of Dendrology and we did not wish to duplicate his effort).

We have written short notes on all species summarising their physiognomy and ecology e.g. “small weedy tree common along roadsides”; with much more detail for species of conservation concern. We have largely resolved taxonomic problems. We have incorporated information on the local names and traditional usage of many species. We have taken several thousand colour photographs of plants during our vegetation survey. All of these images will be incorporated into the BRAHMS database, and we have included selected images in the Checklist. We have also inherited C.D. Adams’ entire 35mm slide collection, taken over a 15 year period as a botanist in T&T. 212 of these images have been digitised and will also be used. Fifty six drawings have been completed by the Oxford University botanical artist Rosemary Wise.

We are now in the process of finalising the manuscript of this publication. This has involved a great deal of checking and proof reading for our T&T counterparts, and this stage has taken rather longer than we had hoped or anticipated. We have discussed accelerating this stage by taking over authorship and management of the text but we feel that it is crucial that our T&T counterparts remain centrally involved in the production of this book if it is to be acceptable to policy-makers in T&T.

In order to facilitate completion of the manuscript we have arranged for YBC and KM to come to Oxford at the beginning of July for a four week training workshop. They will receive one-to-one tuition in using the BRAHMS database to format and output the species descriptions and distribution maps. Our major aim is to have a complete manuscript ready for production by 14th August 2009.

A Plant Conservation Checklist of Trinidad and Tobago

Front Matter

The Darwin project

Acknowledgements

Botanical exploration and the herbarium in Trinidad

The vegetation and its conservation

A brief account of previous classifications of vegetation types.

Current protected areas and forest reserves, real and proposed

The Darwin RBS and conservation assessment

Summary of survey; results, maps etc

IUCN listings for species

Star ratings: criteria and listings

- List of Black Star species

Bioquality of samples

- Ordination results and how they relate to past vegetation types
- Genetic Heat Index patterns and how they relate to protected areas

The check-list

Introduction

I. Pteridophytes,

2. Monocots,

3. 'Dicots', palaeo-herbs and eudicots

Layout: Families will be arranged alphabetically in sections. Genera will be arranged alphabetically within families and species alphabetically within genera.

The level of detail provided in species accounts will depend on their conservation importance:

Common Species:

***Genus species* author** **Local names....**

Recent synonyms (since existing TT flora account; or to assist with translation of important works e.g. Beard species)

Star, IUCN rating

Short description (e.g. Small herb to 30cm with red flowers. Differs from the rarer *xx pp* by its larger flowers, >3 cm long). A small picture may be included if available, photogenic and suitable for the layout.

Global distribution

Local Distribution TRINIDAD Area 1, Area2, Area5. TOBAGO Area1

Ecology: Common along streams and in swamps.

Usage and Folkore if any.

Other notes and references.

High conservation value species (Black and Gold Star species)

***Genus species* author** **Local names....**

Recent synonyms (since existing T&T flora account; or to assist with translation of important works)

Star, IUCN rating

Medium sized description; (e.g. Small herb to 30cm with red flowers. Leaves serrated, glossy, 5-15cm long. Differs from the rarer *xx pp* by its longer leaves). *Key included if critical to identification.*

Pictures of live plants, specimens, line drawing as available

Global distribution

Local Distribution TRINIDAD Area 1, Area2, Area5. TOBAGO Area1.

Ecology: (e.g. Common along streams and in swamps).

Usage, folklore etc.

Discussion of local distribution and notes of interest: (e.g. discovered in Tobago in 1897. Beard recorded it all over the place, but it seems to be rarer today).

Other notes and references.

Distribution map.

Index of local names

Index of families and the (first) page number for each genus

4.4 Project standard measures and publications

A full list of project standard measures is provided in Annex 4.

Our major publication – the Conservation Checklist of Trinidad and Tobago is still in production.

At present we have two scientific papers in production. The first focuses on the relationship between epiphytes and forest disturbance and the second is the product of Seepersad Ramnerine's Darwin Fellowship. He is examining the effects of forest fire on growth of timber species. It is likely that a significant number of further papers will be produced, particularly relating to the work being undertaken by SM for her D.Phil. project.

4.5 Technical and Scientific achievements and co-operation

4.5.1 Staff

YBC Mrs Yasmin Baksh-Comeau, Curator, National Herbarium UWI

SM Miss Shobha Maharaj, Darwin Project Research Assistant, UWI

KM Keisha Mauare, Herbarium Technician, UWI

NB Dr Nick Brown, Oxford University

WH Dr William Hawthorne, Oxford University

SH Dr Stephen Harris, Curator, Oxford University Herbarium

4.5.2 Methodology

The method used was an adaptation of that described by Hawthorne & Abu-Juam (1995).

The method used plotless sampling of a defined landscape unit. The area of forest to be sampled was defined, usually by position in the landscape (e.g. ridge top, steep slope, gully side etc). The field team agreed the area within which they would collect. A detailed field description of the site was taken, including its soil type, topography, aspect altitude and exact location.

Field teams comprised at least six members (mostly Forestry Division staff with one UWI/Oxford team leader). One member of the team booked specimens. A second member was responsible for numbering, labelling and pressing. All other members of the team collected specimens. Each collector specialised on a specific life-form (trees, herbs, climbers etc). Collectors took voucher specimens of as many species of vascular plant as possible. No plants were excluded that could be named or collected with reasonable effort. Mosses, lichens, fungi and dead trees were excluded. No special effort was made to collect epiphytes. A specific epiphyte collection was made during August 2006 by a team of Oxford and UWI tree climbers (including NB and SM). Leaf collections were made from canopy trees using a catapult and line. When this proved impossible, dead leaves were collected from beneath the tree, taking care to ensure that they matched the leaves that could be seen in the canopy, through binoculars. A full description of the bark and slash of trees was made.

Most specimens were sterile. From time to time a species was found in flower or fruit. High quality, duplicated voucher specimens were collected from these individuals and most were photographed.

All voucher specimens were recorded, numbered and pressed in the field. A 'field name' was given to those that the field team recognized. Notes were made on the physiognomy of the whole plant and where it was growing. Every specimen was given a unique number that was attached to it on a card tag. The number is also written on a leaf and on the newspaper in

which the specimen was pressed. The number was prefixed by a unique four character code that identified the field location.

A record was kept of the number of stems of each species (or morphotype) of canopy tree in the collection area. This information provides an index of relative abundance and a simple link with tree inventory data collected by the Forestry Division in their permanent sample plots. It also provided a discipline by which the identity of all trees was checked, rather than dismissed from afar as the same as one already seen.

All specimens were dried and securely stored in the Herbarium within 24 hours of being collected (except during long field expeditions in remote parts of the country) Field data was transcribed to the Herbarium database as soon as possible.

Our field work generated thousands of sterile specimens of plants. Many of these were not recognized by the field team during collection. Identification of these samples is a major component of the survey work. Once a substantial collection of specimens had accumulated they were sorted first into families and then into progressively smaller taxonomic units. This job was supervised by an experienced botanist (YBC, WH and SH) but assistants with limited taxonomic knowledge very quickly acquired the skills needed to sort specimens into unique taxa. This proved to be a very useful method for teaching field botany and many members of the project team are now able to recognize a very substantial number of species from sterile specimens. The final checking and naming of specimens was carried out by SH, WH and YBC.

Every species has been given both an IUCN Red List category and a conservation star rating determined by their geographical distribution.

Black	Local (country endemics)
Gold	Regional (biogeographical zone endemics)
Blue	Widespread but locally uncommon
Green	Ubiquitous

We have used these rankings in order to calculate both the Genetic Heat Index (*sensu* Hawthorne 1996) of sites across the island. GHIs reflect the proportion of restricted range species in a sample and permit the comparison of samples with different numbers of species.

4.5.3 Findings

Prior to the Darwin Project most collections held by the National Herbarium came from a very restricted number of locations (mostly in the north-west of the island). We now have botanical collections from all areas of the two islands. Many of the areas we collected from have no previous botanical records.

We have more than doubled the number of specimens held in the National Herbarium. We have donated specimens to the British Museum and other international herbaria. We have identified 18 Black Star species and 200 Gold Star species

4.6 Capacity building

Our project has resulted in a significant increase in capacity at the National Herbarium and in the Forestry Division. The most important way in which the capacity of our host country partners has been supported is through training. A detailed account of the training, human resources and institutional development is given in Section 4.2

4.7 Sustainability and Legacy

Our project will leave three lasting legacies:

1. A world class herbarium. It is clear that this new facility has kick-started significant teaching and research activity. UWI intend that the refurbished National Herbarium will become the

focus of a new Centre for Caribbean Biodiversity Research. They have made a major investment in new facilities, two new members of Herbarium staff, a new Chair in Biodiversity and a new course director for the MSc in Biodiversity.

2. A Conservation Check-List of the Plants of Trinidad and Tobago. We believe that this will become the authoritative reference for plant biodiversity research and conservation planning.
3. A well-funded MSc course in Biodiversity Conservation and a programme to develop the capacity of other regional institutions in teaching in this area. This project is funded until 2012.

The project research assistant, Ms Shobha Maharaj is now registered as a D.Phil. student at Oxford University and will carry out research on the data collected during this project until at least October 2011. All of the project partners are involved in her work and this will help maintain contact. Oxford University has made Dr John Agard, (Department of Life Sciences at UWI and former chairman of the Environmental Management Authority), Mrs Yasmin Baksh-Comeau (Curator of National Herbarium) and Mr Seepersad Ramnerine (Acting Director of Forestry Division) members of Shobha's supervisory committee. In this role they will be asked to comment on her research objectives and outputs and provide her with some support and guidance in developing her work.

We believe that we built a strong and successful team for this project and all of the partners are committed to looking for further opportunities to work together.

5 Lessons learned, dissemination and communication

We under-estimated the impact that a large and active project might have on a small and under-resourced institution such as the National Herbarium. Our counterparts were enormously enthusiastic and dedicated but they were simply overwhelmed by too many simultaneous demands on their time and energy. As the project gathered pace, many research scientists, students and policy makers became interested in accessing the results. We failed to anticipate that the success of the project would, itself, generate more work for our counterparts in meeting these new demands. Perversely, we would probably have been able to complete many of our proposed activities on time if the project had been less successful.

Dissemination: One problem that we have faced throughout this project is that, as the reputation and capacity of the National Herbarium have expanded the demand for access to and assistance have also dramatically increased. The challenge has therefore been to manage expectations and demands rather than to promote our achievements.

We plan to distribute complimentary copies of the Conservation Checklist of Plants to all relevant Government, NGO and educational institutions in Trinidad and Tobago. We will also use this text in teaching our newly established MSc in Biodiversity Conservation and Sustainable Development for the Caribbean.

UWI plan to hold an official opening of the new Herbarium to coincide with the launch of the MSc course. It is likely that this will attract media attention within T&T.

5.1 Darwin identity

Our project became widely known in T&T as "the Darwin Project". We have used the Darwin logo on field vehicles, stationary and herbarium labels. It will feature prominently on the cover of our Conservation Checklist and our BRAHMS website.

There is a reasonably high level of awareness of the Darwin Initiative within academic and conservation professionals in T&T as this is the second DI funded project to take place in the islands.

6 Monitoring and evaluation

Logframe indicators developed at the project design stage were very useful in drawing up the project MoU. Throughout the project they provided a useful bench-mark against which we were

able to monitor progress and focus on those areas where it had not been as good as we had planned. We held two project evaluation meetings at UWI and these indicators provided a valuable focus.

Whilst we made no major changes to the project design the project schedule evolved significantly. Many activities progressed faster than expected but others were delayed. It would, perhaps have been useful to update the project implementation timetable on an annual basis to show changes in the timing of key milestones in project activities. This would have maintained its relevance as a M&E tool.

In practice many of the quantitative outcome indicators that we proposed in our Stage 2 application proved to be less valuable as a means of monitoring progress than the project implementation timetable. We significantly under-estimated what we would achieve in most areas.

6.1 Actions taken in response to annual report reviews

So far as we are aware we have responded to all the reviewers' comments.

Reviewers' comments on our reports were circulated to project partners and our project advisory committee.

7 Finance and administration

7.1 Project expenditure

Category	*Budget*	*Spent*
Rents, overheads, etc.		
Office costs		
Travel and subsistence		
Printing		
Capital items		
300 GB Hard disk		
Desktop PC		
Nikon Coolpix 8800 camera		
Innovate 512 MB Compact Flash		
Aqua Zoom camera bag		
Snake Antivenin		
BCAP Tree climbing course		
Computer and printer		
Plant presses x2		
Secateurs x2		
Extendable pole pruners x2		
Garmin GPS72		
50m survey tape x3		
4WD vehicle (used)		
Computer software		
Salaries		
UK Salaries		
Student bursaries		
Trinidad salaries		
BRAHMS software support agreement		
TOTAL		

Travel and Subsistence: We made significant savings on subsistence in Trinidad when UWI agreed to house us for free in a University-owned house.

Printing: We decided to include photographs and full-plate line drawings in our Conservation Checklist and this has substantially increased production costs. The estimated cost of printing is over £15,000 but UWI have agreed to meet any shortfall from their own budget.

Salaries: At the time of making the application in 2004 we were instructed not to inflate salary costs year by year. Shortly after being awarded the grant there was a substantial increase in salary costs. We were forced to reduce the amount of time we employed the UK post-doc in order to cover some of these increased costs.

7.2 Additional funds or in-kind contributions secured

Additional funds

£340,000	EDULINK MSc in Biodiversity Conservation and Sustainable Development for the Caribbean.
£11,000	Building work to National Herbarium required to re-inforce floors so they could bare the weight of 200 steel herbarium cabinets.
£6,000	80 steel herbarium cabinets (in addition to the 120 identified in the original project document).
£20,000	Oxford University Canopy Biodiversity Expedition to Trinidad 2006.

In-kind contributions

Voluntary data-basing by Dr Paul Comeau (6 weeks work)

Loan of two 4-WD vehicles, fuel and drivers by Forestry Division for a total of 8 months.

Secondment of eight and fourteen Forestry Division staff to the project as field teams for the entire duration of the RB survey work.

7.3 Value of DI funding

None of this project's achievements would have occurred without DI funding. This project has triggered a great deal of further investment in biodiversity monitoring and conservation activities by both our partner institutions.

Annex 1 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements April 2005 - March 2009	Actions required/planned for next period
Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources		Entire flora of T&T now mapped and each species given an IUCN red-list ranking, plus conservation star rating.	
Purpose To build and maintain capacity in Trinidad and Tobago to monitor habitats, detect changes in plant populations and measure the effects of management.	1. Baseline information on the flora, its distribution and recent patterns of change made publicly available. 2. Expanded National Herbarium and enhanced taxonomic skills base. 3. New information used by policy makers, educators, managers and ENGOs	1. Survey of flora complete and Conservation Checklist in production. On-line database to be launched in August 2009 2. National Herbarium refurbished, re-ordered, catalogued and doubled in size. Two new staff members. All staff trained in information management and RBS techniques. 22 Forestry Division staff trained. 3. New MSc in Biodiversity Conservation. Major increase in Herbarium services.	
Output 1. Network of permanent sample plots enumerated	Ten 0.25 ha sample plots enumerated per habitat type.	Completed.	
Activity 1.1 Field surveys	Sampling methodology agreed. RBS training provided. 239 samples enumerated. All voucher specimens pressed, dried and catalogued. 82% identified to species.		

Output 2. Updated vegetation map of T&T. Assessment of changes in habitat structure, composition and distribution since 1984	Updated vegetation map of T&T. Assessment of changes in habitat structure, composition and distribution since 1984	Distribution of all high conservation value species mapped. T&T research assistant enrolled for PhD at Oxford University to study changes in habitats and consequences of climate change for future distribution.
Activity 2.1.Vegetation mapping	Ordination of field survey data completed. Supervised classification and updated vegetation map produced. On-going collaboration with International Institute for Tropical Forestry to produce detailed forest maps.	
Output 3. Taxonomy training courses provided for tertiary level students.	At least 30 students from UWI and ECIAF take new course in taxonomy and participate in field surveys by Yr3	MSc in Biodiversity Conservation and Sustainable Development for the Caribbean launched with EU funding.
Activity 3.1.Taxonomy training	1st meeting of Academic Management Board will take place in Trinidad from 24-27th September 2009. Course now expanded to include the University of Belize, the University of Guyana, the Anton De Kom University of Suriname and the Institute for Advanced Teacher Training of Suriname.	
Output 4. Taxonomy training courses provided for junior Forestry Division staff and Asa Wright guides.	At least 6 Forestry Division staff members and 4 Asa Wright guides take new course and participate in field surveys by Yr3	Completed
Activity 4.1 Taxonomy training	Training workshops held in 2008 for Trinidad and Tobago Field Naturalists' Club, Friends of the Botanic Gardens, technical staff from the Dept. of Life Sciences and 22 Forest Officers from the Forestry Division	
Output 5. Expansion of National Herbarium and collections catalogued on herbarium database (BRAHMS).	10,000 new accessions to National Herbarium and 90% of old and new accessions recorded on herbarium database by Yr3	Completed http://dps.plants.ox.ac.uk/bol/TRIN
Activity 5.1. Herbarium upgrade	BRAHMS database installed and working. Existing accessions added to database. Pre-1900 Oxford accession added to database. National Vegetation Survey voucher specimens added to database.	
Output 6. Field guide to the trees of T&T and Asa Wright Nature Centre published.	Field guides peer reviewed and publication dates established.	Revised output: Conservation Checklist in progress.
Activity 5.1. Analysis and publications	Final draft of Conservation Checklist to be completed in August 2009. Two journal papers in preparation.	

Annex 2 Project's final logframe, including criteria and indicators

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve: • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of benefits arising out of the utilisation of genetic resources			
Purpose			
To build and maintain capacity in Trinidad and Tobago to monitor habitats, detect changes in plant populations and measure the effects of management.	Baseline information on the flora, its distribution and recent patterns of change made publicly available. Expanded National Herbarium and enhanced taxonomic skills base. New information used by policy makers, educators, managers and ENGOs	Project data and reports available via National Herbarium website. Increase in the number of personnel within the Forestry Division, and ENGOs with taxonomic skills EMA, Forestry Division and ENGO reports and publications	Partner organisations remain committed to project.
Outputs			
Network of permanent sample plots enumerated	Ten 0.25 ha sample plots enumerated per habitat type.	Project data and reports available via National Herbarium website.	No unforeseen disruption to field surveys. Trained staff able to participate in survey work.
Updated vegetation map of T&T. Assessment of changes in habitat structure, composition and distribution since 1984.	Updated vegetation map of T&T. Assessment of changes in habitat structure, composition and distribution since 1984	Map and descriptions available via National Herbarium website. Copies of published papers sent to Darwin Secretariat.	Effective research collaboration with Forestry Division and Centre for Caribbean Land and Environmental Appraisal Research.
Taxonomy training courses provided for tertiary level students.	At least 30 students from UWI and ECIAF take new course in taxonomy and participate in field surveys by Yr3	Course materials published on-line. Student attendance and assessment records and certification.	>30 students opt to take new course.
Taxonomy training courses provided for	At least 6 Forestry Division staff	Course materials published on-	Staff available to take new course.

junior Forestry Division staff and Asa Wright guides.	members and 4 Asa Wright guides take new course and participate in field surveys by Yr3	line. Student attendance and assessment records.	
Expansion of National Herbarium and collections catalogued on herbarium database (BRAHMS).	10,000 new accessions to National Herbarium and 90% of old and new accessions recorded on herbarium database by Yr3	Database accessible via National Herbarium website	New herbarium storage facilities in place.
Field guide to the trees of T&T and Asa Wright Nature Centre published.	Field guides peer reviewed and publication dates established.	Copies of reviewer comments sent to Darwin Secretariat. Two copies of both guides sent when published.	N/A
Activities	**Activity Milestones (Summary of Project Implementation Timetable)**		
Field surveys	Sampling methodology agreed and tested (Aug 05). At least thirty 0.25ha sample plots enumerated per year. All voucher specimens pressed, dried, mounted and catalogued (March 08).		
Vegetation mapping	Recent remotely sensed images of T&T obtained (Sept 05). Cloud-free mosaic produced (Nov 05). Unsupervised classification and stratified random sampling design produced (Dec 05). Ordination of field survey data completed (Dec 07). Supervised classification and updated vegetation map produced (March 08).		
Taxonomy training	New course materials and timetable prepared (Jan 06). First cohort of ECIAF and UWI students enrolled (March 06). Course taught and students participate in National Vegetation Survey (May 06,07 and 08).		
Herbarium upgrade	BRAHMS database installed and working (Sept 05). Existing accessions added to database (June 07). Pre-1900 Oxford accession added to database (June 07). National Vegetation Survey voucher specimens added to database (March 08).		
Analysis and publications	Project website on-line (March 07). Draft user-friendly guide to Asa Wright Nature Centre produced (June 07). Draft field guide to trees of T&T produced (March 08). Analysis of habitat change completed and manuscript prepared for publication (June 08).		

Annex 3 Project contribution to Articles under the CBD

Project Contribution to Articles under the Convention on Biological Diversity

Article No./Title	Project %	Article Description
7. Identification and Monitoring	50	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
12. Research and Training	40	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
17. Exchange of Information	10	Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
Total %	100%	Check % = total 100

Annex 4 Standard Measures

Code	Description	Totals (plus additional detail as required)
Training Measures		
1a	Number of people to submit PhD thesis	1 (begun in 2008 and to be submitted in 2011)
4c	Number of postgraduate students receiving training (not 1-3 above)	60 per year (from January 2010) in five HEIs.
4d	Number of training weeks for postgraduate students	40 weeks per year (full-time MSc course)
Research Measures		
8	Number of weeks spent by UK project staff on project work in host country(s)	48
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1 (final draft Aug 2009)
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	1. BRAHMS database of National Herbarium of Trinidad and Tobago 2. BRAHMS database of Pre-1900 Trinidad Collections held by Oxford University etc.
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	1 database of Forestry Division permanent sample plot data (1981-present) collated, corrected and analyzed.
13b	Number of species reference collections enhanced and handed over to host country(s)	1: National Herbarium refurbished, re-ordered, doubled in size, catalogued and internationally networked.
Dissemination Measures		
15a	Number of national press releases or publicity articles in host country(s)	2 Press releases
15c	Number of national press releases or publicity articles in UK	1
19b	Number of national radio interviews/features in the UK	1: Project described on BBC Radio 4's Home Planet programme.
Physical Measures		
20	Estimated value (£s) of physical assets handed over to host country(s)	£13, 636. (4WD vehicle (used), plant collecting equipment, survey equipment, Garmin GPS72, SLR digital camera, desktop computer and printer, Software).
22	Number of permanent field plots established	239
23	Value of additional resources raised for project	TOTAL: £480,184 £69,403 Oxford University: Salaries, £340,000 EDULINK MSc in Biodiversity Conservation

Code	Description	Totals (plus additional detail as required)	
		£50,741	UWI: Building work to National Herb-arium, 200 steel herbarium cabinets, salaries, workshop costs.
		£20,000	Oxford University Canopy Biodiversity Expedition to Trinidad 2006.

Annex 5 Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide details for the main project contacts below. Please add new sections to the table if you are able to provide contact information for more people than there are sections below.

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Project Title	A Biodiversity Monitoring System for Trinidad and Tobago
UK Leader Details	
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Role within Darwin Project	Project Leader
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Partner 1	
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Role within Darwin Project	Lead partner
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Partner 2 (if relevant)	
Name	Mr Seepersad Ramnerine
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Role within Darwin Project	Partner
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