

Darwin Initiative – Final Report

(To be completed with reference to the Reporting Guidance Notes for Project Leaders
(<http://darwin.defra.gov.uk/resources/reporting/>) -

it is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

Darwin project information

Project Reference	14-001
Project Title	Conservation and Monitoring of Meso-American Orchids
Host country(ies)	Costa Rica
UK Contract Holder Institution	Royal Botanic Gardens, Kew (RBG Kew)
UK Partner Institution(s)	Imperial College London (during the course of the project, Dr Savolainen has become a dual appointee between RBG Kew and Imperial College)
Host Country Partner Institution(s)	Lankester Botanical Garden (LBG), Universidad de Costa Rica (UCR) Centro de Investigacion en Biologia Celular y Molecular (CIBCM, UCR) Sistema Nacional de Areas de Conservacion de Costa Rica (SINAC) Ministerio de Ambiente y Energia de Costa Rica (MINAE)
Darwin Grant Value	£151,900 (Total)
Start/End dates of Project	1 June 2005 to 31 May 2008
Project Leader Name	Dr Vincent Savolainen
Project Website	http://www.jardinbotanicolankester.org/ing/project_a.html
Report Author(s) and date	Dr Martyn Powell and Dr Vincent Savolainen (RBG Kew & Imperial College London, UK), Prof. Jorge Warner and Mr Diego Bogarin (LBG, Costa Rica); 15 September 2008

1 Project Background

Among the richest tropical countries in terms of biodiversity, Costa Rica hosts an extraordinarily diverse orchid flora, with over 1,300 species on a relatively small territory of 51,000 km². In spite of the fact that this country has a well-developed network of protected areas, with over 25% of its territory composed of protected forests and reserves, the orchid flora remains under constant threat from factors such as deforestation and illegal trade. The CBD's 2010 targets and the Global Strategy for Plant Conservation (GSPC) have brought up new challenges for the Costa Rican scientific authorities. This project aimed to develop new expertise in Costa Rica for biodiversity research and conservation of Meso-American orchids. The project purpose, redefined from that originally proposed following the recommendation of a reviewer, is: to develop LBG as a modern platform for research, training and conservation of Meso-American orchids by: (a) hosting and training students and researchers in orchid taxonomy and conservation, (b) monitoring the threat status of orchids with IUCN red list assessments, (c) developing conservation strategies with government officials.

Outstanding project achievements include:

- LBG becoming the first institution in Costa Rica to be CITES-registered for exemption from Article VII;
- The ground-breaking identification of a universal DNA barcode for flowering plants (published in the *Proc. Natl. Acad. Sci. USA*; with the subsequent consideration of

- patenting this discovery in the US, entitled 'DNA Barcoding of Plants' P41629US), and
- The submission of two full IUCN-Red List conservation assessments.

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

The project has contributed to several Articles under the CBD, and the breakdown of these is provided in Annex 3.

The project has made positive strides towards supporting the CBD objectives and 2010 biodiversity targets, as well as aiding the host country in their efforts to build their capacity to meet CBD commitments. The stand-out achievement in building the capacity of the host country is the appointment of Prof Jorge Warner (project coordinator in the host country and Director of LBG) as the coordinator of the Commission of Biodiversity of the University of Costa Rica. This is an entity created for the evaluation and approval of all projects related to biodiversity, and the commission regulates all UCR project applications related to the Convention of Biological Diversity (CBD). He was elected to the role as a result of his experience in the Darwin Project, biodiversity management and as Director of Lankester Botanical Garden. The first project approved by the Commission of Biodiversity was this Darwin Project, and as such it serves as a model for all future research applications, and all documentation pertaining to the regulation and running of the project (e.g. MoC/MoU, MTAs) are used as template guidelines.

Other areas where this project has helped the host country meet its CBD commitments include: i) Evaluation of measures of biodiversity through surveys and inventories of the Costa Rican orchid flora, and DNA barcoding studies; ii) The provision of an improved research facility at LBG; iii) Establishment of long-term monitoring sites (Coco Island, Tapanti National Park, and Alberto Brenes Reserve) for assessing changes in biodiversity; iv) Digitisation of Meso-American orchid herbarium type specimens from the collection at RBG Kew, thereby facilitating access to systematic, ecological and biogeographical data that was previously not freely available; v) Training of staff, students and researchers in biodiversity issues.

These efforts to build the capacity of the host country fit directly with the strategies of governmental institutions (i.e. the Ministry of the Environment and Energy (MINAE), which is the legal authority for biodiversity, and the National System of Conservation Areas (SINAC), which is responsible for the conservation and sustainable use of the country's biodiversity) in the host country, as in its second National CBD report MINAE-SINAC highlight the need for training, surveys at the genetic level and an increased focus on large taxonomic groups.

A preliminary response to GSPC on behalf of Costa Rica has been written by LBG project partners (Annex 7).

The project has also supported a further biodiversity convention, namely the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In March 2006, as a result of this project, LBG became the first CITES registered scientific institution in Costa Rica (CITES number: CR-001), entitling exemption provided by Article VII, paragraph 6 of the Convention. This has facilitated the transfer of material between LBG and RBG Kew for scientific research.

3 Project Partnerships

The relationship between the two principal project partners, RBG Kew and LBG, had been in existence before the start of this Darwin project, but has undoubtedly been strengthened and enhanced during the course of the project. A Memorandum of Collaboration (MoC; see Annex 8a) between the two institutions was agreed upon and signed by both project partners, within which strict rules and guidelines pertaining to the transfer of material and running of the project were outlined. Resulting from this, there are also Material Transfer Agreements (MTAs) and a Notification of Transfer form in place which are used whenever there is a transfer of plant material (see Annex 8b).

Regular communication between project partners, both via email, telephone and direct meetings/workshops, ensured that all partners were heavily involved in project planning and decision making.

The project has led to new collaborations within the host country, and strengthened links between LBG and governmental organisations, i.e. MINAE, SINAC. These have been highlighted by the appointment of Jorge Warner as the coordinator of the Commission of Biodiversity of UCR, and the attendance of 15 MINAE officials at a training course on 'orchid conservation and identification' held at LBG in March 2008.

Several other contacts within UCR have also been instigated/enhanced as a result of this project, for example: i) Prof. F. Albertazzi's (Centro de Investigación en Biología Celular y Molecular; CIBCM) laboratory hosted our week-long training course on 'Phylogenetics and DNA barcoding for conservation' in April 2006, and remains available for LBG staff to undertake molecular phylogenetic research; ii) A GIS and red listing training course was held in collaboration with Prof. F. Aguilar (Laboratorio de Geomatica) in April 2007, which was publicised on the home page of UCR (see: http://www.ucr.ac.cr/mostrar_noticia.php?ID=833); iii) Prof. G. Avalos (School of Biology) invited D. Bogarin to give a talk about the research activities of LBG, including this Darwin Initiative project, to 40 students from the Costa Rican Natural History course. Resulting from the GIS training course conducted in April 2007, a new collaboration was born between LBG and Dr G. Biamonte from the Association for the Preservation of the Wild Flora and Fauna (APREFLOFAS) in Costa Rica. This organisation, founded in 1985, is private, non-profit making and non-governmental, and was established to fight for the conservation of nature through direct actions supported by research and environmental education programs (www.preserveplanet.org). It also chairs the Costa Rican Members Committee of the World Conservation Union (IUCN).

Project 'Digital Flora of La Selva Biological Station', which forms part of the OTS (Tropical Studies Organisation), invited Diego Bogarin to collaborate with them and assist them in orchid identification and sharing knowledge of the orchid flora (see: http://sura.ots.ac.cr/local/florula3/fr_colab.php).

During the funding period collaborations have also been formed with several other Darwin Initiative projects, with the partnership between this project and a further Dr Savolainen led project (EIDPO13: Integrating Evolutionary History and Phylogenetic Measures of Biodiversity into Conservation Planning) resulting in a groundbreaking, and highly publicised, publication on DNA barcoding (Lahaye *et al.*, *PNAS*, 2008). Contact was also established with another Darwin Initiative project based in Costa Rica and Panama (15027: Baseline Tools for Management of PN La Amistad) and a joint one-day meeting was held between the respective project partners in October 2006.

At the third International Orchid Conservation Congress (IOCC), organised and hosted by LBG and UCR in March 2007, a poster was presented which outlined the research aims of four projects (including this project) working in the use of molecular tools for species identification, forensics, and conservation, under the auspices of the Darwin Initiative (10-025: Molecular tools for promoting biodiversity in rainforest fragments of Borneo; 14-059: Certification to support conservation of endangered Mexican desert cacti; 13-018: Building genetic forensic capacity to reduce South Africa's illegal trade).

Furthermore, LBG and RBG Kew are involved with an additional Darwin Initiative project (16012: Orchid Seed Stores for Sustainable Use [OSSSU]), and through relationships fostered as a result of this project LBG are involved with two further research projects with other institutions; one is "Phylogenetics of the genus *Polystachya*" with Drs Rose Samuel and Anton Russell (University of Vienna), and the other is the PhD project of Yael Kisel (Imperial College London) on speciation and endemism in Costa Rican orchids.

Collaboration with international programmes on DNA barcoding has also been strengthened, e.g. the Consortium for Barcoding of Life, as Prof. J. Warner presented a poster on the DNA barcoding aspect of this Darwin Project at the Second International Barcoding Conference in Taipei in September 2007.

4 Project Achievements

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

The approval of the CITES registration request, with LBG becoming the first institution in Costa Rica to be CITES registered, facilitates research and transfer of material between LBG and any collaborating overseas institution; this provides a solid foundation for attracting future research projects and activities related to the conservation of biodiversity.

During the workshop at UCR on GIS and IUCN-Red List assessment, the *Sample Red List* Index project was also discussed in depth (www.kew.org/gis/projects/srli/index.html). The Sample Red List is an IUCN initiative in response to CBD's 2010 target and global challenge of "significantly reducing the current rate of loss of biodiversity by 2010". This work aims to evaluate changes in status of a random selection of species (1000 of each major group of organisms). RBG Kew is involved in the coordination and development of methodologies for this project. In a total of 1000 species of angiosperms chosen for the Sample Red List, 28 species are Costa Rican orchids. These species have been prioritised for our work on Red List assessment in order to contribute to this important global target of the CBD.

The knowledge and expertise in orchid ecology and conservation that is being enhanced at LBG has now made this institution a key player in decision-making processes with regard to protected areas in Costa Rica. As just one example, the recent work on Barra Honda National Park by D. Bogarin, CBD implementation officer in this project, has reinforced the need to protect this unique ecosystem.

4.2 Outcomes: achievement of the project purpose and outcomes

The project purpose was redefined to: "to develop LBG as a modern platform for research, training and conservation of Meso-American orchids" and the project has been extremely successful in achieving this goal, with significant increase in collections, databases, researchers, technical skills, research publications, international awareness, association with governmental organizations (see Section 4.3 for full details).

(a) hosting and training students and researchers in orchid taxonomy and conservation
See training below.

(b) monitoring the threat status of orchids with IUCN red list assessments

Two full Red List assessments have been submitted to the IUCN for inclusion on the Red List (*Epidendrum cocense* and *E. insulanum*) and a publication series of 'Threatened Costa Rican Orchids' is planned, which will include their IUCN threat status (see Annex 9 for examples for 5 species).

(c) developing conservation strategies with government officials (e.g. MINAE, SINAC)

LBG has a strong link to orchid specialist groups, forming an integral part of the Mesoamerican orchid specialist group. Efforts have been made to gain the support of the IUCN orchid specialist group, i.e. through submission of Red List assessments, which will undoubtedly strengthen the standing of LBG with conservation authorities and enhance subsequent recommendations regarding policy and management.

The new databases and geo-referenced specimen data available at LBG will enable a variety of uses of this data to be employed in addition to IUCN conservation assessments (the full database is not published yet but contains >15,000 data entries, although some of the data are published online at Epidendra [www.epidendra.org]). These include:

- Basic distribution maps to accompany scientific papers
- Identify collection effort – where to prioritise future collections
- Species richness analysis

- Range prediction models
- Biogeography analysis
- Identify representation of orchids in protected areas
- Analysis of Life zones and association with species

The application of these approaches can in turn provide useful and informative recommendations regarding policy and management, and LBG is already in regular consultation with MINAE over matters of orchid conservation. In addition, the attendance of 15 MINAE officials at a training course on orchid identification and conservation, held at LBG, will make them better informed to provide conservation decisions about orchids.

4.3 Outputs (and activities)

There are seven types of project output listed in the logframe: 1) Staff and students trained; 2) Habitat/spp assessments and monitoring plots; 3) Publications; 4) Species/DNA reference collections & DNA barcodes established/enhanced; 5) Dissemination; 6) Meso-American orchid network enhanced; 7) New research & education facility at UCR.

4.3.1 Staff and students trained

Training has been a key component of the project, and there have been various training activities organised over the past three years. In total 31 students and 22 staff have been trained in areas related to the project's research. A one-week practical training course on 'Phylogenetics and DNA barcoding for conservation' was organised and run by F. Albertazzi (CIBCM), G. Gigot and M. Powell (RBG Kew) from 04-07 April 2006, and was attended by six students from CIBCM at UCR. The training was organised as one-week intensive courses and involved hands-on experience of molecular biology techniques such as DNA extraction, PCR and cycle sequencing, with a seminar on DNA barcoding and its link to conservation. As part of the training week, two hour-long seminars were presented by project leader V. Savolainen, which were attended by 30 students. These seminars covered topics such as 'Assembling the Tree of Life' and in-depth uses of phylogenetic trees for studying evolution and speciation.

Several other seminars have been given over the course of the project, including: i) 'LBG's research and conservation activities' given by J. Warner to approximately 30 staff, researchers and students at RBG Kew in July 2005; ii) 'Phylogenetics and DNA barcoding for conservation' given by G. Gigot to eight LBG staff and students.

With regard to training in GIS and Red List assessments, two separate training activities took place. In April 2006 four staff project members (V. Savolainen, G. Gigot, M. Powell and D. Bogarin) attended a Red List assessment course at RBG Kew run by Dr C. Hilton-Taylor (Manager of the Red List Unit at IUCN). In April 2007 a week-long training course was run by S. Bachman and G. Gigot (RBG Kew) in association with F. Aguilar (Laboratorio de Geomatica, UCR) on 'GIS and Red List Conservation Assessment', which was attended by 15 students from UCR and three staff members (see Annex 10 for participant list and Annex 11 for course evaluation). Both of these activities introduced attendees to the concept of Red List assessments, showed case studies of Costa Rican orchids, and taught how to use such assessments in practice.

A four-day course was run by LBG in March 2008 for 15 staff members of MINAE (see Annex 12); the course was centred on 'orchid identification and conservation' and was well received by all attendees.

In addition to the structured training courses, project partner D. Bogarin visited RBG Kew on three separate occasions (12 weeks August-October 2006, 8 weeks August-September 2007, 4 weeks January-February 2008) for intensive training in molecular biology techniques and herbarium digitisation.

Furthermore, there have been several undergraduate and Masters' students undertaking part-time internships at LBG over the course of the project, and they have received training from D. Bogarin, Prof. F. Pupulin and Prof. R. Dressler, in orchid conservation and identification, and

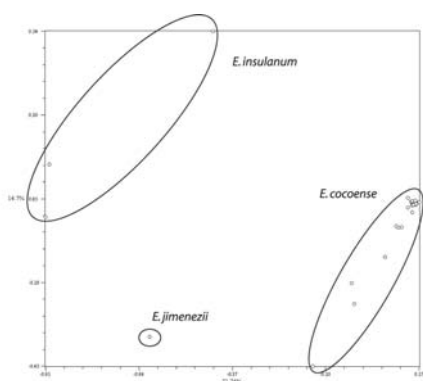
database management and maintenance. The following table identifies the role each student had and what they have progressed to do:

Name	Level	Project & Role	Current activities	No. training weeks
Jose Daniel Zúñiga	MSc	Project coordination of different LBG collection databases (living collection, spirit vouchers, pollinia collection); week-long training in orchid collection in Coco Island	PhD at Rancho Santa Ana University, California, USA	18
Adam Karremans	Undergraduate	Project coordination of different LBG collection databases (living collection, spirit vouchers, pollinia collection)	In the Netherlands studying for a Masters degree	19
Gustavo Rojas	MSc	Coordination of different LBG collection databases (living collection, spirit vouchers, pollinia collection)	Attending courses in Germany as part of his MSc project with UCR/LBG	19
Emily Serrano	Undergraduate	Databasing biodiversity data	Working at Museo Nacional de Costa Rica	5
Steve Barquero	Undergraduate	Databasing biodiversity data	Working at LBG and studying at UCR	5
Christopher Ramírez	Undergraduate	Databasing biodiversity data	Working at LBG and studying at UCR	5
Daniel Ramírez	Undergraduate	Development of Epidendra website	Working at LBG and studying at UCR	9
Enzo Salas	Undergraduate	Databasing biodiversity data	Working at LBG and studying at UCR	5
Christina Smith	Undergraduate	Databasing biodiversity data	Working at LBG and studying at UCR	5
Anabel Quiros	Undergraduate	Databasing living collections data	Left	7

4.3.2 Habitat/spp assessments and monitoring plots

The Coco Island Red List for *Epidendrum cocense* and *E. insulanum* have been approved and they will be soon added to the IUCN Red List. The other species are rare species that we evaluated but we need to submit it to the IUCN and wait for the evaluation. We agree that the submission of red list assessment for only two species may not sound very impressive. However, it is noteworthy that this was the first time that LBG undertook such an activity and it has been a long process, especially given that their first impression was that the IUCN Red Listing was a very complicated process. We envisage that LBG will now process many more Red List applications following this initial positive experience.

Mr Steve Bachman, Species Conservation Assessment officer from the GIS section at RBG Kew, visited LBG and UCR from 29 March to 14 April 2007. He took part in the GIS-Red List workshop, organised the GIS-Red List training course in April 2007 and provided expertise on LBG's databases for GIS work and Red List Assessments. As a result of the workshop, it became clear that LBG's databases need further improvement before GIS work can start. The different databases –vouchers, pollinia, silica and living collections- need to be linked and georeferencing has to be done as necessary. For example, LBG's living collection includes over 17,000 individuals, over 15,000 specimens are registered in the main database, of which approximately 4,000 specimens have been geo-referenced but ca. 3,000 specimens have only textual locality information. At the taxon level (species and sub-species) there are an estimated 1,700 orchid taxa: 190 have fully geo-referenced specimens, 412 have partially geo-referenced specimens and 1,161 have no geo-referenced data. Based on these geo-referenced specimens, 190 preliminary IUCN-Red List assessments were carried out using the software Arcview 3.2 from ESRI and a method developed at Kew (Willis, F., J. Moat, Paton, A. 2003. "Defining a role for herbarium data in Red List assessments: a case study of *Plectranthus* from eastern and southern tropical Africa." *Biodiversity and Conservation* 12(7): 1537-1552.). As a result, 12 species were evaluated to be in a Threatened category (CR, EN or VU, IUCN 2001). The remaining 178 taxa were known from too few localities, and therefore were evaluated as Data Deficient, thus highlighting the fact that more collecting is required.



Coco Island National Park was visited in April 2006 and >100 orchid samples were collected. DNA extraction of those samples has been completed and a population study has started with AFLP primer trials, already confirming the species status of the three species of *Epidendrum* – although this was disputed in the past. (see Figure on the left: AFLP-based genetic clustering, i.e. PCA, of three species of *Epidendrum* (orchids) endemic to Coco Island).

A second visit was made to the Coco Island monitoring site (nine-day trip, April 2007) by the RBG Kew and LBG project officers, in addition to one MSc student from UCR (J.-D. Zuniga), and the sampling of the island's flora was improved with the collection of 577 samples.

4.3.3 Publications

The online e-field guide, *Epidendra* (www.epidendra.org), designed by project partners F. Pupulin and D. Bogarin, has information on over 1000 orchid species, including taxonomic history, scans of Kew's herbarium sheets, conservation status (where known), links to relevant literature, and colour photographs. Each accession is in the process of being linked to the various LBG databases (i.e. silica and spirit) and, in the case of species which have been studied for DNA barcoding, DNA sequence databases.

There have been nine papers published by project partners, with a further paper accepted for publication, as a result of the project (see Annex 5). The majority of these papers have been on orchid taxonomy (seven), and were made possible by the collecting trips and concurrent taxonomic discoveries undertaken as part of this project. The publication that has created the greatest level of publicity however, has been the ground-breaking research on DNA barcoding carried out by the project. This paper has been published in *Proceedings of the National Academy of Sciences USA* (February 2008) has undoubtedly been the major success of the past year, producing widespread publicity for the project's results in this field (See section 4.5 for the paper's abstract and Annex 13 for a full pdf of the manuscript). Over 50 websites (a select few examples are included in Annexes 14-16) reported on the publication, as did various radio and TV stations.

A patent may also be deposited by Imperial Innovation to the US Patenting Agency ('DNA Barcoding of Plants' P41629US) with Diego Bogarin from LBG/UCR as one of the inventors (see Annex 30).

4.3.4 Species/DNA reference collections & DNA barcodes established/enhanced

There has been a considerable increase in all of the LBG collections as a result of fieldwork activities conducted under the auspice of this project. An impressive total of 54 field expeditions have been carried out by project partners, both from the host country and the UK. These trips have resulted in a total of 2,265 specimens collected.

Silica collection

The target for 600 samples available for DNA barcoding work in LBG's silica-dried collection has been surpassed with 700 additional silica samples having been introduced into the collections of LBG, which now has 1046 records. With this project, the silica collection has been improved by 65%. Nearly 700 samples have been sent to RBG Kew for DNA extraction.

Spirit collection

3082 vouchers were kept since the project started; the collection has been improved by 70%.

Herbarium specimens

2265 specimens collected, vouchered or studied (plus 1,024 digital scans, see below). Including orchids for barcoding purposes, samples for taxonomic studies and Coco Island non-Orchidaceae samples.

Following a preliminary study of a DNA matrix of 432 orchid sequences (representing 74 taxa and 50 species), which analysed six potential DNA barcodes proposed by the Plant Working Group of the Consortium of the Barcoding of Life (see www.kew.org/barcoding), the plastid DNA region '*matK*' was identified as a putative barcode for Meso-American orchids. The increase in species collections at LBG enabled the matrix to be increased to comprise over 1000 *matK* barcode sequences for Meso-American orchids, which has formed the basis of a ground-breaking paper on DNA barcoding (see Section 4.5).

Regarding the digitisation of Meso-American herbarium specimens held at Kew, a considerable effort was made during D. Bogarin's visit to the UK in the summer 2006, when 1,024 scans were produced from Kew's orchid herbarium, representing more than 800 species. It represents an enormous compilation of taxonomic data from Charles Lankester's collections, and Mesoamerican historic specimens (hence the name Lankester Botanic Garden in Costa Rica). It includes 236 types and all these specimens provide new access to some rare data for orchid taxonomists. These scans have been duplicated on a hard drive and sent to LBG. This collection of images will be instrumental in Costa Rica for all LBG's staff, students or other specialists on request, and many of these scans are to be made available online in Epidendra. A set of 11 DVDs was compiled for these digital images of types and specimens of the RBG Kew and Lindley Orchid Herbarium. A one-day event was held at LBG to celebrate this achievement in March 2008, with several officials from governmental institutions and other national research institutions present. A total of 10 sets of these DVD's were distributed to local

botanical institutions and research centers such as Costa Rican National Museum, National Institute of Biodiversity, National University, Costa Rican Technological Institute, Herbarium of the University of Costa Rica.

4.3.5 Dissemination (other than publications)

The third International Orchid Conservation Congress (IOCC) was organised by LBG and UCR, with assistance from RBG Kew, in March 2007. Nearly 150 delegates from 23 countries attended the conference, which featured several meetings of the IUCN/SSC specialist groups. The congress programme is available online (<http://www.jardinbotanicolankester.org/ing/congress.html>). This Darwin project was represented at the conference by three talks and one poster, as well as at five additional international conferences (see Section 5 for full details).

There have been several press releases to publicise the project and its activities; a general overview of the project was published in issue 28 of *Kew Scientist* (October 2005), this is an international newsletter reporting on news from RBG Kew (see Annex 17, page 5); the organisation of the third IOCC featured three press releases in the national newspaper *La Nación*; the DNA barcoding research publication in *PNAS* resulted in over 50 international press releases, including TV and radio coverage; an interview with the Darwin Initiative project officers by P. Seaton of the IUCN-Orchid Specialist Group was published in the popular journal *Orchid Review* (November 2008 issue).

There were two principle workshops dedicated to the project activities; in August 2006 in Kew a workshop on phylogenetics and DNA barcoding (V. Savolainen, M. Powell, G. Gigot and D. Bogarin) was held, and in March-April 2007 in LBG a workshop was organised between project partners on GIS and Red List assessment (V. Savolainen, J. Warner, F. Pupulin, D. Bogarin, G. Gigot and M. Powell).

4.3.6 Meso-American orchid network enhanced

LBG forms an integral part of the Meso-American Orchid Specialist Group, whose primary objectives include: i) to Collect, document, and disseminate information about orchid diversity and conservation; ii) to facilitate appropriate contacts to increase efforts by individuals and organizations that work on orchid conservation; iii) to determine and regularly check the status and needs of orchids and the habitats that are rich in orchids; and iv) to make specific recommendations for the species to be properly managed and for their survival.

The organisation and hosting of third IOCC, which incorporated the Second International Conference on Neotropical Orchidology, and had nearly 150 delegates from 23 nations, played a crucial role in enhancing the Meso-American orchid network. Several workshops were organised at the Congress for IUCN-Orchid Specialist Groups, the full list can be seen at (<http://www.jardinbotanicolankester.org/ing/congress.html>).

The attendance of a representative from APREFLOFLAS at the GIS and Red Listing course held at UCR in April 2007 has also great potential to enhance the network, as this organisation chairs the Costa Rican Members Committee of the World Conservation Union (IUCN).

All of the project's activities are intrinsically linked to the objectives of the Meso-American Orchid Specialist Group, and the publicity generated by these has led to a greater awareness of orchid research in Meso-America and increased the number of collaborative research projects.

4.3.7 New research & education facility at LBG

The research facilities available at LBG have undergone significant improvement over the duration of the project. The collections and databases have been increased, leading to a greater resource for research. The databases of LBG have also been valorised for GIS and Red Listing, and the potential to produce Red List assessments for Costa Rican orchids has been made possible. This is highlighted by the publication of a series on 'Threatened Costa Rican Orchids', based on Red List assessments, sponsored by UCR.

A wide range of new skills and techniques have been learnt by LBG staff and students over the course of the project, such as molecular biology techniques, herbarium digitisation, orchid identification and conservation, GIS and Red List assessments. These will broaden the research possibilities at LBG as they can be incorporated into future research projects.

There has been a substantial increase in the awareness of LBG as an international research facility as a result of the project's activities, most notably through the DNA barcoding publication (Lahaye et al, PNAS), as well as through all of the publications and press coverage stemming from the project, and the hosting of the IOCC. Through project activities there has been an increase in links and standing within UCR and other national institutions, which have led to more undergraduate students receiving training and undertaking research projects at LBG.

Closer links with governmental institutions, such as MINAE, SINAC have facilitated research as, for example, collecting permits are granted more rapidly than previously. These links have been formed throughout the duration of the project, as J. Warner has been in regular contact to obtain collecting permits and offer advice on orchid conservation. His appointment as coordinator of the Commission of Biodiversity of UCR further strengthens the link between LBG and those institutions responsible for the conservation of biodiversity within Costa Rica.

The establishment of wireless internet connection at LBG in February 2008 represents the first time that the internet has been freely available to all staff, researchers, and students. Although a seemingly minor issue, it has had a considerable impact on the working capabilities of all connected to LBG and has made communication with both national and international colleagues much easier.

4.4 Project standard measures and publications

All of the project standard measures are quantified in Annex 4, and full details of all publications pertaining to the project are provided in Annex 5.

The project has had one paper published in a high-profile journal (Lahaye *et al*, 2008, *PNAS*) and this publication has had a sizeable impact in the field of DNA barcoding. There has been considerable previous research undertaken in the search for a universal barcode for the angiosperms, and our results represent the largest survey undertaken and have identified the gene *matK* as a viable barcode.

An example of the trend of opinion voiced about this publication is detailed below with a quote from the Defra website by Joan Ruddock, Minister for Climate Change and Biodiversity: "*This is a great breakthrough that could save many endangered plants. The Defra-funded Darwin Initiative has a reputation for producing real and lasting results and I congratulate everyone involved in this project which could have huge benefits for plant identification and conservation in the future.*"

4.5 Technical and Scientific achievements and co-operation

The three principal areas of scientific research conducted by this project have been DNA barcoding, orchid taxonomy, and a phylogenetic study of the orchid genus *Scaphyglottis*. All of the publications resulting from this project are detailed in Annex 5 and pdf's of each are provided (Annexes 18-25). The DNA barcoding paper included barcodes from over 1000 Meso-American orchids and revealed cryptic species, with the need for further taxonomic work. For example, four accessions of *Lycaste tricolour* (Klotzsch.) Rchb. were sequenced, and one of these accessions, *Lycaste cf. tricolour*, did not cluster with the other three; taxonomists had indeed suspected it could be another, separate, species. *Lycaste cf. tricolor* grows on the Pacific slopes of Costa Rica, whereas the other three representatives (i.e., the "typical" *L. tricolor*) grow on the Atlantic side. There are also discrete morphological differences. The pollinarium of *Lycaste cf. tricolor*, like all other representatives of that species in the Pacific slope, have long stipes, a twisted column and a hairy anther cap, whereas the typical *tricolor* have short stipes, a straight column and a smooth anther cap. These differences in column are probably also involved in reproductive isolation whereby *L. cf. tricolor* would deposit pollinia on

the shoulder of the pollinating bees and the “true” *tricolor*, with their straight column, would deposit pollinia on the back of the bees. This case of a cryptic species has subsequently been published as a separate publication (Bogarin, D. ‘A new *Lycaste* (Orchidaceae: Maxillariinae) from Costa Rica’).

Abstracts are provided below for our DNA barcoding paper and three of the orchid taxonomy papers:

DNA barcoding the floras of biodiversity hotspots

Renaud Lahaye*, Michelle van der Bank*, Diego Bogarin†, Jorge Warnert†, Franco Pupulin†, Guillaume Gigot‡, Olivier Maurin*, Sylvie Duthoit*, Timothy G. Barraclough§, and Vincent Savolainen‡§

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DNA barcoding is a technique in which species identification is performed by using DNA sequences from a small fragment of the genome, with the aim of contributing to a wide range of ecological and conservation studies in which traditional taxonomic identification is not practical. DNA barcoding is well established in animals, but there is not yet any universally accepted barcode for plants. Here, we undertook intensive field collections in two biodiversity hotspots (Mesoamerica and southern Africa). Using >1,600 samples, we compared eight potential barcodes. Going beyond previous plant studies, we assessed to what extent a “DNA barcoding gap” is present between intra- and interspecific variations, using multiple accessions per species. Given its adequate rate of variation, easy amplification, and alignment, we identified a portion of the plastid *matK* gene as a universal DNA barcode for flowering plants. Critically, we further demonstrate the applicability of DNA barcoding for biodiversity inventories. In addition, analyzing >1,000 species of Mesoamerican orchids, DNA barcoding with *matK* alone reveals cryptic species and proves useful in identifying species listed in Convention on International Trade of Endangered Species (CITES) appendixes.

A new *Lycaste* (Orchidaceae: Maxillariinae) from Costa Rica

Bogarin, D. Lankesteriana 7(3): 543-549 (2007)

Jardín Botánico Lankester, Universidad de Costa Rica. P.O. Box 1031-7050 Cartago, Costa Rica, A.C.

Lycaste bruncana from Costa Rica is described and illustrated. This species is sister to *L. tricolor*, its closest relative, from which is easily distinguished by the lip shape, with a narrow isthmus and spathulate midlobe, the lanate to lanulose infrastigmatic surface, the pollinarium with a longer stipe, the subrectangular pollinia and the tomentose anther cap. However, among Costa Rican species of *Lycaste*, the most remarkable character of *L. bruncana* is the twisted column, which may be indicative of a reproductive barrier. Information related to biogeography, distribution, morphology, molecular data and pollination is provided and discussed.

A second species of *Restrepiella* (Orchidaceae: Pleurothallidinae)

Pupulin, F. & Bogarín, D. Willdenowia 37: 323-329 (2007)

Jardín Botánico Lankester, Universidad de Costa Rica. P.O. Box 1031-7050 Cartago, Costa Rica, A.C.

Restrepiella lueri is described as a species new to science and illustrated from Costa Rica. The new species differs from *R. ophiocephala* by (1) the free lateral sepals with irregularly dentate margins, (2) the glabrous petals provided with three low, longitudinal keels, (3) the elliptic, simple lip, longer than the column and as long as the petals, ciliate along the margins and hirsute at apex, with three longitudinal keels from the base extending to the middle of the blade, and (4) the column without a foot. A key to the species of *Restrepiella* is provided.

Elleanthus ligularis*, a name for a relatively common ‘new’ species of *Elleanthus* sect. *Chloidelyna

Dressler, R.L. & Bogarin, D. *Lankesteriana* 7(3): 539-542 (2007)

Jardín Botánico Lankester, Universidad de Costa Rica. P.O. Box 1031-7050 Cartago, Costa Rica, A.C

Elleanthus ligularis is described and illustrated. The flowers of this species are apparently self-pollinating. Fruiting material has been collected in Colombia, Costa Rica, Cuba and Panamá, but the species remained nameless in the absence of flowers, and is here described as *Elleanthus ligularis*. Costa Rican plants in cultivation have flowered in late December, January, February and April. The species is similar to *E. graminifolius*, but the plants are more robust, with wider leaves and the blade of the lip is subquadrate, rather than obtriangular, with a very short base.

With regard to the phylogenetic study on *Scaphyglottis*, which formed the basis of the part-time MSc project of D. Bogarin, a four-gene DNA matrix has been produced for a total of 158 taxa (ITS: 111 accessions, *matK*: 74 accessions, *ycf1*: 57 accessions, *trnH-psbA*: 57 accessions). The MSc project has been submitted for evaluation in August 2008, and the results will be published in a peer-reviewed scientific journal.

4.6 Capacity building

The training of host country researchers by UK project partners has represented the greatest component of capacity building in the project. Several training activities have been organised during the project in an attempt to build the capacity for research of staff and students in the host country.

The Costa Rican DI project officer, D. Bogarin, has received extensive training in molecular biology techniques over the course of three visits to the UK, including DNA extraction, PCR, DNA sequencing and phylogenetic analyses. In addition, a week-long training course at CIBCM taught similar techniques to six UCR students, and has therefore increased the capacity of both LBG and UCR to apply molecular biology techniques to research activities.

Similarly, whilst in the UK D. Bogarin attended a training course on GIS and Red List assessments. The use of Red List assessments was agreed to be the principle monitoring method used in this project, and subsequently two full Red List assessments have been submitted to the IUCN, as well as 190 preliminary assessments from data held within the LBG databases. A training course was held at UCR on GIS and Red Listing, and D. Bogarin participated in the running of this course, which was attended by staff and students from UCR and LBG. Resulting from the decision to use Red List assessments to monitor the status of Costa Rican orchids, UCR has decided to publish a new series on ‘Threatened Orchids of Costa Rica’.

The digitisation of 1,024 specimens from RBG Kew’s orchid herbarium represents an important compilation of taxonomic data from Charles Lankester’s collections, and Mesoamerican historic specimens. It includes 236 types and all these specimens provide new access to some rare data for orchid taxonomists.

In accordance with Darwin Initiative reporting guidelines, the capacity of the UK lead institution to be an effective project partner is reported on: RBG Kew has increased its capacity to be effective project partner through the experiences gained over the lifetime of this project. For

example, the evaluation forms introduced to assess the training courses provide an invaluable source of feedback, and ensure that future courses will better meet the demands of the attendees.

4.7 Sustainability and Legacy

The development of LBG as a research facility for the conservation and monitoring of Meso-American orchids will endure. The increase in international awareness of LBG as not just a botanic garden, but also as a world-class research institution has led to a greater number of institutions looking to collaborate with and utilise the facilities of LBG, e.g. the University of Vienna, Imperial College London, and a further Darwin project with RBG Kew.

The privileged relationship established between LBG and Costa Rican government authorities, especially concerning research and collecting permits, are regularly reinforced by our project activities and fieldwork in the whole country. LBG is regarded as an expert facility for conservation of the epiphyte flora and regularly provides advice to government officials.

The establishment of monitoring sites for biodiversity, coupled with the initial Red List pre-assessments of species from data from LBG databases, ensures that there are aspects of the project which will be sustained. The forthcoming publication of 'Threatened Costa Rican Orchids' by UCR is a direct result of this project, and project partners will continue to collaborate on this and other associated research publications

The identification of *matK* as a universal DNA barcode for flowering plants is a considerable achievement by the project, and this will leave a lasting legacy of the project, particularly if proposed plans to patent *matK* as a barcode go ahead.

The Costa Rican project officer, D. Bogarin, initially employed by the project, has been appointed to a full-time position as a researcher within LBG.

Project resources will be allocated as per the MoC agreement. All of the silica/herbarium collections acquired through the project are duplicated in the host country and the UK.

5 Lessons learned, dissemination and communication

There are several valuable lessons that have been learned from the experiences of this project, and we believe that project partners in both the host country and the UK are now more capable of dealing with the demands of such a project. The importance of good practice when dealing with governmental institutions cannot be overstated, and has been a key factor behind the success of the project. Allowing sufficient time to gain all of the necessary permits and agreements is also a critical factor that needs to be incorporated into project planning, and therefore there needs to be a period of time devoted to permit applications, and the subsequent issue of permits, before collecting can begin.

Several problems have been encountered with the project website. The difficulty and cost of getting information onto the website has been underestimated, and this is an area which needs to be considered in greater detail in future project applications. Ensuring that there are funds dedicated to IT support is a key lesson learnt.

There was also an underestimation of the monitoring and Red List assessments, which took considerably longer than anticipated to complete. In the future more time and resources will be dedicated to compiling Red List assessments.

The dissemination of information relating to project achievements has been to both a scientific and wider public audience, both in the host country and internationally.

Several presentations have been given at high-profile international conferences by partners involved in the project, ensuring that the scientific community has been made aware of this Darwin Initiative project:

Southern African Society for Systematic Biology (SASSB). South Africa: August 2006

Talk: Gigot, G., J. Warner & V. Savolainen. 2006. DNA barcoding and orchid conservation in a Meso-American biodiversity hotspot.

III International Orchid Conservation Congress (IOCC), Jardín Botánico Lankester, Universidad de Costa Rica, Costa Rica: 9-23 March 2007

Talks: Gigot, G., J. Van Alphen-Stahl, D. Bogarín, J. Warner, M.W. Chase & V. Savolainen. 2007. Finding a suitable barcode for Mesoamerican orchids.

Bogarín, D. & F. Pupulin. 2007. Las orquídeas del Parque Nacional Barra Honda, Guanacaste, Costa Rica.

Pupulin, F. 2007. Epidendra, the botanical databases by Jardín Botánico Lankester. *Lankesteriana*

Poster: Gigot, G. 2007. Molecular tools and DNA Barcoding for conservation

Second International Barcode Conference, Taipei, Taiwan: 18-21 September 2007

Poster: Gigot, G., D. Bogarín, F. Pupulin, R. Lahaye, V. Savolainen, J. Warner. 2007. DNA Barcoding for Conservation of Meso-American Orchids. (see Annex 27).

Second Scientific Conference on Andean Orchids. Loja, Ecuador: November 14-17, 2007

Talk: Bogarín, D & F. Pupulin. 2007. The genus *Campylocentrum* in Costa Rica: some critical questions and a few answers.

Poster: Bogarín, D, Warner, J., G. Guillaume & V. Savolainen. 2007. Conservation of Meso-American Orchids. (see Annex 28).

Orchid evolutionary biology and conservation: from Linnaeus to the 21st century, Linnean Society, UK: 31 October to 2 November 2007

Talk: Gigot, G. 2007. DNA Barcoding of Costa Rican Orchids for Biodiversity and Conservation.

19th World Orchid Conference, Miami, USA: 23-27 January 2008

Poster: Warner, J., D. Bogarín, G. Gigot, M. Powell & V. Savolainen. 2008. DNA Barcoding of Meso-American orchids for biodiversity research and conservation. (see Annex 29).

Ten scientific papers have been published by project partners, and a full list of these is available in Annex 5, along with pdf's (Annexes 13; 18-25). Three of these papers were in the special issue of *Lankesteriana* produced for the IOCC proceedings, which was distributed to over 350 worldwide institutions, disseminating the results and the Darwin Initiative programme to a wide audience. A review of the project was also published in the popular journal, *Orchid Review*, following an interview of DI officers G. Gigot and D. Bogarin by Dr P. Seaton from the IUCN-Orchid Specialist Group (Seaton, P. 2007. Conservation in Costa Rica. *Orchid Rev.* 115: 214-217). This interview was also reviewed on *Cutting Edge*, the Missouri Botanical Garden Website (<http://www.mobot.org/MOBOT/research/Edge/oct07/oct07lit.shtml>).

Dissemination will be ongoing after the project has ended, as future research publications of data gathered during the project will be published, and presentations of the research outcomes will continue.

5.1 Darwin identity

All of the publications resulting from the project (see Annex 5) have acknowledged the role of the Darwin Initiative, and all publicity generated by the project has made reference to the role of the Darwin Initiative in the success of the project.

Several presentations have been given at high-profile international conferences by people involved in the project (see above), and each of these included the Darwin Initiative logo and acknowledged the support it provided. The poster presented at the third IOCC in March 2007 outlined the purpose of the Darwin Initiative and represented four different DI projects which used molecular biology tools, highlighting some of the range of funding opportunities which it offers (Annex 26). As this conference was attended by 144 people from 23 different countries, it

promoted the Darwin Initiative to a wide audience. In addition, the two eye-catching conference banners which were in place to welcome participants included the Darwin Initiative logo, providing further publicity.

The third IOCC also published the proceedings of the Congress in a special issue of the journal *Lankesteriana*. This issue was supported in part by our Darwin project and the Darwin Initiative has been acknowledged throughout (the DI logo appears on the opening page and the back cover). The e-field guide (Epidendra) was also launched at the congress, and the home page of this guide prominently features and acknowledges the Darwin Initiative.

The profile of the Darwin Initiative, and the opportunities it affords, within Costa Rica has undoubtedly been raised as a result of this project, as emphasised by the fact that the current project has set a precedent within the Commission on Biodiversity of UCR and is used as a model for all future research applications which are involved with biodiversity. All of the institutions named in Section 3 are now aware of the Darwin Initiative, and of its importance in this project. Given the success of this project in the host country, it is likely that future Darwin Initiative projects will be viewed favourably by administrative institutions.

5.2 Monitoring and evaluation

The overall purpose of the project was amended from that originally proposed in response to a request following an annual report review (see Section 6.1 for details), but the fundamental principle to develop a research facility in Costa Rica for the conservation of Meso-American orchids remained the same. Aligned with this we identified seven areas in which the impacts of this endeavour could be maximised, and thus progress of the project over three years was monitored according to these seven main outputs as outlined in the logical framework. They were: 1) Staff and students trained; 2) Habitat/spp assessments and monitoring plots; 3) Publications; 4) Species/DNA reference collections & DNA barcodes established/enhanced; 5) Dissemination; 6) Meso-American orchid network enhanced; 7) New research & education facility at UCR.

The Logical Framework Approach to project management was utilised for the duration of the project, with monitoring carried out in accordance with the seven areas described above via a 'project-monitoring table'. Originally the project website was intended to be the primary source of monitoring the project's progress, but given that problems were encountered with the updating of the website, regular phone and email contact between project partners allowed for frequent monitoring, evaluation and updating. In addition to this, the workshops that were organised, and spread over the three years, allowed the project partners to meet and provided an excellent forum for monitoring the progress of the project against the Logframe.

Monitoring of the financial situation was principally carried out between the Finance Department of Kew (Mr G. Sarkis) and Ms Karen Bacquero of LBG.

5.3 Actions taken in response to annual report reviews

The reviews provided in response to annual reports were always discussed between project partners, and other collaborators where relevant, and the response to issues raised were agreed jointly between project partners. All of the issues raised in response to the annual reports have been addressed over the course of the project, and these can be summarised as follows:

- *Simplification of the project purpose:*

Following concerns about the potentially over-ambitious and complex nature of the project, it was agreed to simplify the project purpose. The original project purpose was: "To create in Costa Rica a multi-site expert centre for biodiversity research and conservation of Meso-American orchids by: (a) establishing long term monitoring sites for CBD 2010 targets and GSPC, (b) capacity building in six overseas biodiversity institutes, (c) developing material transfer agreements and new conservation strategies for epiphytic orchid flora."

The simplified purpose is: “To develop the Lankester Botanical Garden at the University of Costa Rica as a modern platform for research, training and conservation of Meso-American orchids by: (a) hosting and training students and researchers in orchid taxonomy and conservation, (b) monitoring the threat status of orchids with IUCN red list assessments, (c) developing conservation strategies with government officials (MINAE, SINAC, etc).”

- *Clarification of monitoring methodology and progress indicators:*

Issues were raised about the exact details of the monitoring methods that were to be used in the project, and whether they would be restricted to IUCN Red List assessments. Monitoring methodology was a much-discussed topic with project partners, and ultimately our monitoring approach was restricted to red list assessments. We acknowledge the fact that more comprehensive assessments are ultimately desirable, but Darwin grants are small and only allow us to make a start towards a more ambitious goal.

Progress indicators for the project, primarily preliminary IUCN conservation assessment and data analysis for detailed IUCN conservation assessments, have been selected to comply with those agreed by the Convention of Biological Diversity as ‘Provisional Indicators for Assessing Progress towards the 2010 Biodiversity Target’. More specifically, they are linked to the focal area ‘Status and trends of the components of biological diversity’, which can be assessed by ‘trends in abundance and distribution of selected species’ and ‘change in status of threatened species’.

- *Update of project website and dissemination to a wider public:*

Dissemination of the project’s results and research has greatly improved in the past year, and as such has reached a wide and varied audience. Full details of this dissemination can be seen in Section 5. There have been problems during the course of the project with getting relevant information on to the project website, but these were largely overcome and all of the missing reports, conference presentations, and publications were made available to the webmaster at UCR for uploading to the website.

- *Training course evaluation forms:*

It was felt after the first annual report that all training courses run by the project would benefit from being evaluated by attendees; as a result each subsequent training course that was run was assessed by means of an evaluation form.

- *Consideration of how to provide policy and management recommendations:*

The present project represents only a small grant that has only been running for two years, and as such it is too early to expect to be able to dictate to conservation authorities. However a full report (detailing methodologies, preliminary results, future plans etc) is being prepared for sending to appropriate authorities (e.g. MINAE and SINAC) will increase the awareness of our project with them.

6 Finance and administration

6.1 Project expenditure

	Budget	2005/6	2006/7	2007/8	Total	Variance
<i>Rents, rates, heating, lighting, cleaning, overheads</i>						
<i>Office costs e.g. postage, telephone, stationery</i>						
<i>Staff (G. Gigot and D. Bogarin)</i>						

<i>Travel & Subsistence</i>						
<i>Printing</i>						
<i>Conference & Seminars</i>						
<i>Others (consumables for DNA extraction, barcoding etc)</i>						
<i>Capital items (1 laptop)</i>						
TOTAL	151,900	33,948	62,841	52,389	149,178	2,722 (under-spent)

6.2 Additional funds or in-kind contributions secured

The hosting of the third IOCC by LBG/UCR was made possible by significant funding by sponsors of the event, as was the publication of the conference proceedings in the special issue of *Lankesteriana*.

Matched funding arrangements included full salary costs for ten members of staff at RBG Kew, and nine in Costa Rica. There was also contribution to fieldwork costs by UCR, whereas the herbarium digitalisation, DNA banking and laboratory facilities were core-funded by RBG Kew.

6.3 Value of DI funding

The project represents excellent value for money for a number of reasons, and through the support of the Darwin Initiative the image and international awareness of LBG as a centre for scientific research has been enhanced considerably.

The scientific publicity created by the project has been considerable, most notably as a result of the publication in the prestigious scientific journal *Proceedings of the National Academy of Sciences, USA* (Lahaye *et al*). This publication highlighted the role of LBG in the research and referenced the Darwin Initiative itself; equivalent publicity would be extremely costly. The patent that may be applied for may bring significant income to LBG and RBG Kew in the future.

The standing of LBG within UCR has risen considerably as a result of the project activities and the positive publicity that LBG has generated, and LBG and its research facilities have attracted a lot of subsequent interest and offers of collaboration; e.g. LBG is involved with another Darwin Project (16012: Orchid Seed Stores for Sustainable Use [OSSSU]).

In April 2008 the Costa Rica project officer, D. Bogarin, was offered a permanent position as a researcher at LBG. Had it not been for his role in this project, and the publication record he developed over the course of it, then it is possible that he would not have been given the same opportunity to continue a highly promising scientific career at LBG.

The appointment of Prof. J. Warner as head of the Biodiversity Commission of UCR also provides evidence of the value of the Darwin funding, as this project is used as a template for all applications for biodiversity research within UCR. The demonstration of his capabilities in dealing with a large, multi-national and multi-institutional project has played a role in his appointment to such a prestigious position.

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 2007 - May 2008	Actions required/planned for next period
<p>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</p> <ul style="list-style-type: none"> • 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 			
<p>Purpose To develop the Lankester Botanical Garden at the University of Costa Rica as a modern platform for research, training and conservation of Meso-American orchids by: (a) hosting and training students and researchers in orchid taxonomy and conservation, (b) monitoring the threat status of orchids with IUCN red list assessments, (c) developing conservation strategies with government officials (MINAE, SINAC, etc).</p>	<p>1) Number of Red List assessments by LBG; 2) Number of research publications submitted by LBG; 3) Number of days spent by LBG staff with governmental officials for developing research and conservation strategies. <i>(these are the new indicators in response to the referees comments to the annual report)</i></p>	<p>Improved databases and collections allow for routine Red List assessments and monitoring activities; two full Red List assessments have been submitted to the IUCN for approval.</p> <p>Ten research publications have been submitted by LBG project partners. One of these papers identified a DNA region (<i>matK</i>) as a suitable DNA barcode, and there is a patent pending on the use of <i>matK</i> as a DNA barcode.</p> <p>Formally there four days spent with government officials at the training course held at LBG in March 2008. D. Bogarin full contract from April 2008 (50 days) and J. Warner 10% of his time for three years (90 days).</p>	
<p>Output 1. Staff and students trained</p>	<p>1. 2 (1) training weeks to 15 students and 8 staff p.a.</p>	<p>72 training weeks for undergraduate students, 47 weeks for postgraduate students, 32 weeks for staff.</p>	

Activity 1.1. Staff training	4 staff members attended a training course on 'GIS and Red Listing' at RBG Kew in August 2006; 3 staff members attended a week-long training course on 'GIS and Red Listing' at UCR in April 2007; 15 members of MINAE staff attended a 4-day training course on 'orchid identification and conservation' at LBG in March 2008.	
Activity 1.2. Student training in Costa Rica	6 students attended a 1-week training course at UCR on 'DNA barcoding and phylogenetics for conservation' in April 2006; 15 students attended a 1-week training course on 'GIS and Red List assessments' at UCR in April 2007; 10 students monitor LBG's databases, e-field guide and are trained in orchid taxonomy and conservation; 1 student visited the Coco Island site and received training in plant identification and collection.	
Output 2. Habitat/spp assessments and monitoring plots	2. Coco & Tapanti plots & orchids assessed	Two of the endemic orchids from Coco Island have been fully assessed according to the Red Listing criteria and these assessments have been submitted to the IUCN.
Activity 2.1. Visit and sample collection	A total of 54 collecting trips were carried out in the host country, including 2 visits to Coco Island. A total of 2,265 samples have been collected.	
Activity 2.2. LBG's database and Red List assessment	The databases of LBG were assessed for their viability to provide sufficient data for red list assessments of orchid species; 194 species were identified as being	

		<p>suitable for red listing and of these 190 have had preliminary assessments carried out (including for 84 species from the three project monitoring sites). Two full assessments have been submitted to the IUCN for inclusion on the Red List. A guide to the 'Threatened orchids of Costa Rica' is soon to be published by UCR.</p>	
Output 3. Publications	3. e-field guide & 4 papers accepted	An e-field guide has been designed and 10 papers have been published (2 on DNA barcoding, 7 on orchid taxonomy, 1 on the e-field guide).	
Activity 3.1. e-field guide		<p>LBG's e-field guide, Epidendra, is available online (www.epidendra.org) and utilises LBG's databases along with RBG Kew's digitised herbarium specimens. It currently contains information on over 1000 species.</p>	
Activity 3.2. Papers		<p>A ground-breaking paper on DNA barcoding was published in PNAS based largely on data collected from the project (Lahaye <i>et al.</i>, 2008). 3 further papers pertaining to the project (DNA barcoding, e-field guide and orchid taxonomy) were published in the special issue of <i>Lankesteriana</i> dedicated to the IOCC proceedings, and 6 further papers on orchid taxonomy were published in 2007 (see Annex 5 for full details)</p>	
Output 4. Species/DNA reference collections & DNA barcodes established/enhanced	4. Orchid DNAs (600), ex situ collection (ca ½ orchid flora) & herbarium available for use	668 accessions of orchid DNA, digitised herbarium specimens have been distributed to several other institutions in the host country and are available for specimens on the Epidendra website.	

Activity 4.1. LBG's living and silica collections	54 fieldtrips have been conducted in Costa Rica, with 2,265 samples collected. LBG's silica collection has been improved by 65% since the inception of the project, now comprising 1046 records.	
Activity 4.2. Orchid DNA collections	Almost 700 orchid samples have been sent to RBG Kew for DNA extraction.	
Activity 4.3. Orchid DNA barcoding	A matrix has been compiled with 1566 barcodes included for orchids, including 1084 species from Meso-America. Results of this data have been published in a highly publicised manuscript (Lahaye <i>et al.</i> PNAS)	
Activity 4.4. Kew's herbarium specimens digitisation	1024 scans produced from Kew 's Herbarium, including 236 types (representing more than 800 species). A set of 11 DVDs is done for these digital images of types and specimens of Kew and Lindley Orchid Herbarium. A total of 10 sets of these DVD's will be distributed to local botanical institutions and research centres.	
Output 5. Dissemination	5. Conference organised & 3 workshops & 4 press releases	The third IOCC was successfully organised and well received, xx workshops have been organised and taken place and there have been several press releases relating to various aspects of the project.
Activity 5.1. Conferences		The third IOCC, organised by LBG, took place in San Jose, Costa Rica in March 2007 and the project was represented by 4 talks, 2 banners and 1 poster. In addition, partners promoted the project and its work at a further 5 international conferences (SASSB 2006; Taipei

		2007; Ecuador 2007; Linnean Society 2007; WOC, Miami 2008).	
Activity 5.2. Workshops		In August 2006, D. Bogarin visited RBG Kew and 4 staff participated in a workshop on phylogenetics and DNA barcoding. In March/April 2007, 6 RBG Kew/LBG staff took part in a workshop on GIS and Red List assessment.	
Activity 5.3. Press releases		>50 on-line press releases following the publication of the research on DNA barcoding (Lahaye <i>et al.</i>); IOCC received press coverage in <i>La Nacion</i> , a national Costa Rican newspaper; <i>Kew Scientist</i> ; <i>Orchid Review</i> interview article.	
Output 6. Meso-American orchid network enhanced	6. Network activities increase	The success of the IOCC and press coverage of the PNAS paper have significantly enhanced LBG's status as a research institution at international level, along with the dissemination of project results at various international conferences. A workshop in March-April 2007 created new collaborations and project potential utilising LBG's taxonomic data.	
Activity 6.1. Project partners dynamic		J. Warner visited RBG Kew to set up the project and its MoC in July 2005; D. Bogarin made three visits, totalling 24 weeks, to RBG Kew/Imperial College London for training; UK project partners (G. Gigot, M. Powell, V. Savolainen, S. Bachman) spent a combined total of 28 weeks in Costa Rica	
Activity 6.2. IOCC impact		The third IOCC had a sizeable impact on the orchid research and conservation community, with 23 countries represented by 144	

		delegates. The conference proceedings were published in a special issue of the journal <i>Lankesteriana</i> .	
Activity 6.3. GIS network within UCR		6 members of staff from RBG Kew, LBG and UCR attended a GIS-Red List workshop and planned research activities on this, such as the training course at UCR which was attended by 15 people from 3 institutions, and there is considerable interest in applying this technique to the study of biodiversity in Costa Rica.	
Output 7. New research & education facility at UCR	7. Facility running	Ten students have used the research facility at LBG over the duration of the project; wireless internet connection was installed at LBG in February 2008, allowing internet access to all researchers for the first time. The databases and collections of LBG have been significantly enhanced as a result of this project, providing greater resources for researchers.	

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

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Goal:</p> <p>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</p> <ul style="list-style-type: none"> • 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 			
<p>Purpose</p> <p>To develop the Lankester Botanical Garden at the University of Costa Rica as a modern platform for research, training and conservation of Meso-American orchids by: (a) hosting and training students and researchers in orchid taxonomy and conservation, (b) monitoring the threat status of orchids with IUCN red list assessments, (c) developing conservation strategies with government officials (MINAE, SINAC, etc).</p>	<p>1) Number of Red List assessments by LBG;</p> <p>2) Number of research publications submitted by LBG;</p> <p>3) Number of days spent by LBG staff with governmental officials for developing research and conservation strategies.</p> <p><i>(these are the new indicators in response to the referees comments to the annual report)</i></p>	<p>1. Documents and correspondence between Lankester, UCR, MINAE, NGOs & RBG Kew</p> <p>2.MTA, conservation & CBD documents updated @ MINAE</p> <p>3.Red List assessments</p> <p>4.Publication and correspondence with editors</p>	<p>Strategies developed throughout the project are of high quality and are in demand by wider scientific and nature conservation authorities</p> <p>Joint programme of activities has proven useful and partnership continues</p> <p>Public interest in conservation, especially of orchids, continues to be high enough to support in-country biodiversity initiatives & reserves</p>
<p>Outputs</p> <p>1.Staff & students trained</p> <p>2.Habitat/spp assessments and monitoring plots</p> <p>3.Publications</p> <p>4.Species/DNA reference collections & DNA barcodes established/enhanced</p>	<p>1. 2(1) training weeks to 15 students & 8 staff p.a.</p> <p>2.Coco & Tapanti plots & orchids assessed</p>	<p>1.Attendees lists</p> <p>2.Conservation assessments documents</p> <p>3.Correspondence</p> <p>4.DNAs duplicated according to MTA & online databases @</p>	<p>There is a broad interest from staff, researchers and students for training and networking in orchid biology, biodiversity and conservation, and to attend conference and workshops</p> <p>Material produced is of good quality & accepted for publication</p> <p>Collecting permits are issued by MINAE</p>

<p>5. Dissemination 6. Meso-American orchid network enhanced 7. New research & education facility @ UCR</p>	<p>3. e-field guide + 4 papers accepted 4. DNAs orchid (600), ex situ collection (ca 1/2 of orchid flora) & herbarium available for use 5. Conference organised + 3 workshops + 4 press releases 6. Network activities increase 7. Facility running</p>	<p>Lankester 5. Registration and attendees lists, press 6. Correspondence & joint documents from partners 7. Annual reports from Lankester & other partners</p>	<p>Lankester Garden's statutory mission continues to be supported by UCR</p>
<p>Activities</p> <p>1. Specific training 2. Assessing conservation status 3. Collecting 4. Setting up policies and strategies for in and ex situ orchid conservation and sustainable use (incl MTA & CBD 2010) 5. Research & education networking</p>		<p>Yr1: MoU (07/05); Conserv assessment Tapanti (02/06); Univ training (11/05); 200 orchid spp collected (04/06); web site launched (03/06); staff hired (08/05). Yr2: Workshop (02/06); Conserv assessment Coco/Monteverde (03-04/06); Training (11/06); orchid pollination work and re-assess Tapanti (03/07); 200 spp collected (04/07); DNA barcoding (07/06). Yr3: International Orchid Conservation Congress (03/07); Conservation re-assessments (04/07); training (11/07); Collect 200 spp (03/08); global conservation strategy (02/08); e-field guide (02/08); exhibition (03/08)</p>	

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
6. General Measures for Conservation & Sustainable Use	5	Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	15	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.
8. In-situ Conservation	5	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation	10	Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity	5	Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	20	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).
13. Public Education and Awareness	5	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts	10	Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources	10	Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.

Article No./Title	Project %	Article Description
16. Access to and Transfer of Technology	5	Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
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
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Other Contribution		Smaller contributions (eg of 5%) or less should be summed and included here.
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	N/A
1b	Number of PhD qualifications obtained	N/A
2	Number of Masters qualifications obtained	1 submitted (Diego Bogarin, UCR 'Phylogeny of the genus <i>Scaphyglottis</i> (Orchidaceae:Laeliinae)'); Target 1: TARGET MET (pending award of MSc)
3	Number of other qualifications obtained	N/A
4a	Number of undergraduate students receiving training	31 (6 on 'DNA barcoding & phylogenetics for conservation', 15 on 'GIS & Red Listing', 10 on Taxonomy & conservation at LBG'); Target 30 undergraduate students: TARGET EXCEEDED
4b	Number of training weeks provided to undergraduate students	72 weeks; Target 60 weeks: TARGET EXCEEDED
4c	Number of postgraduate students receiving training (not 1-3 above)	3 (D. Bogarin*, J.-D. Zuniga, A. Kellermans); Target 5 postgraduate students: TARGET NOT MET (Length of training was increased as opposed to number of students)
4d	Number of training weeks for postgraduate students	47 (D. Bogarin* 10 weeks, J.-D. Zuniga 18, weeks, A. Kellermans 19 weeks); Target 10 weeks: TARGET EXCEEDED
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(ie not categories 1-4 above)	1 (D. Bogarin as CBD project officer); Target 1: TARGET MET
6a	Number of people receiving other forms of short-term education/training (ie not categories 1-5 above)	22 (15 MINAE, 4 RBG Kew, 2 LBG, 1 APREFLOFLAS); Target 8 staff receive 3x1 wk training: TARGET EXCEEDED
6b	Number of training weeks not leading to formal qualification	32 (15 x 1 week MINAE course, 3 x 1 week GIS & Red List course; D. Bogarin 14); Target 24 weeks: TARGET EXCEEDED
7	Number of types of training materials produced for use by host country(s)	DNA barcoding; GIS, and Red Listing; Target 2 (barcodes. GSPC monitoring): TARGET EXCEEDED
Research Measures		
8	Number of weeks spent by UK project staff on	28: G. Gigot (14 weeks), M. Powell (9 weeks), V. Savolainen (3

Code	Description	Totals (plus additional detail as required)
	project work in host country(s)	weeks), S. Bachman (2 weeks) ; Target 27 person weeks: TARGET EXCEEDED
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	2 full Red List assessments submitted to IUCN (<i>Epidendrum cocoense</i> and <i>E. insulanum</i>), 5 threatened Costa Rican orchids published by UCR with preliminary Red List assessments (<i>Dracula inexperata</i> , <i>Encyclia ossenbachiana</i> , <i>Kefersteinia retanae</i> , <i>Masdevallia chasei</i> , <i>Stenotyla lankesteriana</i>); Target 6 species plans produced: TARGET EXCEEDED
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1 (Epidendra: www.epidendra.org); Target 1 orchid e-field guide: TARGET MET
11a	Number of papers published or accepted for publication in peer reviewed journals	10 (2008: Lahaye <i>et al</i> PNAS, Blanco <i>et al</i> Harv.Pap.Bot.; 2007: Bogarin <i>Lankesteriana</i> , Dressler & Bogarin <i>Lankesteriana</i> , Pupulin & Bogarin <i>Willdenowia</i> , Dressler & Bogarin <i>Orchids</i> , Dressler & Bogarin <i>Harv.Pap.Bot.</i> , Gigot <i>et al</i> <i>Lankesteriana</i> , Bogarin & Pupulin <i>Lankesteriana</i> , Pupulin <i>Lankesteriana</i>); Target 2 published/2 submitted: TARGET EXCEEDED
11b	Number of papers published or accepted for publication elsewhere	None
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	2 (Distribution data for GIS; DNA barcoding matrix); Target 2 (monitoring, barcodes): TARGET MET
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	3 (RBG Kew's www.rbgekew.org.uk/data/dnaBank ; LBG's pollinia, silica databases); Target 1: TARGET EXCEEDED
13a	Number of species reference collections established and handed over to host country(s)	3 (LBG's silica, DNA and spirit voucher collections); Target 3: TARGET MET
13b	Number of species reference collections enhanced and handed over to host country(s)	3 (LBG's living collection and herbarium, RBG Kew's DNA bank); Target 3: TARGET MET
Dissemination Measures		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	1 (Third IOCC 2007); Target 1 conference organised: TARGET MET

Code	Description	Totals (plus additional detail as required)
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	6 (SASSB 2006; Third IOCC 2007; Taipei 2007; Ecuador 2007; Linnean Society 2007; WOC, Miami 2008); Target 2 conferences attended: TARGET EXCEEDED
15a	Number of national press releases or publicity articles in host country(s)	3 (IOCC press coverage); Target 3 press releases: TARGET MET
15b	Number of local press releases or publicity articles in host country(s)	Covered under 15a
15c	Number of national press releases or publicity articles in UK	>50 press releases/publicity articles; Target 1 press release: TARGET EXCEEDED
15d	Number of local press releases or publicity articles in UK	N/A
16a	Number of issues of newsletters produced in the host country(s)	N/A
16b	Estimated circulation of each newsletter in the host country(s)	N/A
16c	Estimated circulation of each newsletter in the UK	N/A
17a	Number of dissemination networks established	1 (CBOL); Target 1: TARGET MET
17b	Number of dissemination networks enhanced or extended	2 (RBG Kew; Meso-American Orchid Specialist Group); Target 1 network enhanced: TARGET EXCEEDED
18a	Number of national TV programmes/features in host country(s)	Coverage following the IOCC was made in written press as opposed to other forms of media.
18b	Number of national TV programme/features in the UK	
18c	Number of local TV programme/features in host country	
18d	Number of local TV programme features in the UK	
19a	Number of national radio interviews/features in host country(s)	
19b	Number of national radio interviews/features in the UK	
19c	Number of local radio interviews/features in host country (s)	
19d	Number of local radio interviews/features in the UK	
Physical Measures		
20	Estimated value (£s) of physical assets handed over to host country(s)	2 laptops (£2,200)

Code	Description	Totals (plus additional detail as required)
21	Number of permanent educational/training/research facilities or organisation established	Research facility established at LBG; Target 1 research facility established: TARGET MET
22	Number of permanent field plots established	Coco Island, Tapanti, Alberto Brenes Reserve; Target 3: TARGET MET
23	Value of additional resources raised for project	Sponsorship of IOCC and special issue of <i>Lankesteriana</i>

*: D. Bogarin qualifies under both the staff and post-graduate student categories, as he was the Costa Rican DI project officer, but was also undertaking a MSc.

Annex 5 Publications

Type (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
Journal	Lahaye, R., M. van der Bank, D. Bogarín, J. Warner, F. Pupulin, G. Gigot, O. Maurin, S. Duthoit, T. Barraclough, V. Savolainen. 2008. DNA Barcoding the Floras of Biodiversity Hotspots . Proc Natl Acad Sci USA, 105:2923-2928	Proceedings of the National Academy of Sciences Washington D.C. United States of America	PNAS, 500 Fifth Street, NW, NAS 340, Washington, DC 20001 USA http://www.pnas.org/	
Journal	Bogarín, D. 2007. A new <i>Lycaste</i> (Orchidaceae: Maxillariinae) from Costa Rica . Lankesteriana 7(3): 543-549.	Jardín Botánico Lankester-UCR	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica http://www.jardinbotanicolankester.org/esp/lankesteriana.html	
Journal	Dressler, R.L. & D. Bogarín. 2007. <i>Elleanthus ligularis</i>, a name for a relatively common "new" species of <i>Elleanthus</i> Sect. <i>Chloidelyna</i> . Lankesteriana 7(3): 539-542.	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica http://www.jardinbotanicolankester.org/esp/lankesteriana.html	
Journal	Pupulin, F. & D. Bogarín. 2007. A second species of <i>Restrepiella</i> (Orchidaceae: Pleurothallidinae) . Willdenowia 37: 323-329.	BGBM Berlin-Dahlem	Freie Universtat Berlin, Koningin-Luise-Str. 6-8 D-14191 Berlin http://www.bgbm.fu-berlin.de/bgbm/library/publikat/willdenowia.htm	
Journal	Dressler, R.L. & D. Bogarín. 2007. Two attractive new species of <i>Sobralia</i> from Panama . Orchids 76 (9): 696-701.	American Orchid Society	American Orchid Society, 16700 AOS Lane, Delray Beach, FL 33446-4351 http://orchidweb.org/aos/	
Journal	Dressler, R.L. & D. Bogarín. 2007. A new and bizarre species in the genus <i>Condylago</i> (Orchidaceae: Pleurothallidinae) from Panama . Harv. Pap. Bot. 12 (1): 1-5.	Harvard University Herbaria	22 Divinity Avenue, Cambridge, Massachusetts 02138, USA http://www.huh.harvard.edu/publications/	
Journal	Gigot, G., J. Van Alphen-Stahl, D.	Jardín Botánico Lankester-UCR	Jardín Botánico Lankester-UCR	

	Bogarín, J. Warner, M.W. Chase & V. Savolainen. 2007. Finding a suitable barcode for Mesoamerican orchids. Lankesteriana 7 (1-2): 200-2003.	PO Box 1031-7050 Cartago, Costa Rica	PO Box 1031-7050 Cartago, Costa Rica http://www.jardinbotanicolankester.org/esp/lankesteriana.html	
Journal	Bogarín, D. & F. Pupulin. 2007. Las orquídeas del Parque Nacional Barra Honda, Guanacaste, Costa Rica. Lankesteriana 7 (1-2): 446-449.	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica http://www.jardinbotanicolankester.org/esp/lankesteriana.html	
Journal	Pupulin. 2007. Epidendra: the botanical database of Jardín Botánico Lankester at the University of Costa Rica. Lankesteriana 7 (1-2): 178-180.	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica http://www.jardinbotanicolankester.org/esp/lankesteriana.html	
Journal, special issue	Proceedings of the III International Orchid Conservation Congress (IOCC)	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica	Jardín Botánico Lankester-UCR PO Box 1031-7050 Cartago, Costa Rica http://www.jardinbotanicolankester.org/esp/lankesteriana.html	
Journal	Blanco, M.A., G. Carnevali, D. Bogarín, & R. B. Singer. 2008. Further dissentangling of a taxonomic puzzle: <i>Maxillaria ramosa</i> , <i>Ornithidium pendulum</i> , and a new species, <i>O. elianae</i> (Orchidaceae). Harv. Pap. Bot. Accepted for publication.	Harvard University Herbaria	22 Divinity Avenue, Cambridge, Massachusetts 02138, USA http://www.huh.harvard.edu/publications/	

Annex 6 Darwin Contacts

Ref No	14-001
Project Title	Conservation and Monitoring of Meso-American Orchids
UK Leader Details	
Name	Dr Vincent Savolainen
Role within Darwin Project	UK Project leader
Address	Imperial College London and Royal Botanic Gardens, Kew
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Fax	
Email	
Other UK Contact (if relevant)	
Name	Imperial College London
Role within Darwin Project	VS is dual appointee between RBG Kew and IC
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Partner 1	
Name	Prof Jorge Warner
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Role within Darwin Project	Host country project leader
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Fax	
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Partner 2 (if relevant)	
Name	
Organisation	
Role within Darwin Project	
Address	
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Email	

Annex 7: Draft Costa Rican response to GSPC
Annex 8a: Project MoC
Annex 8b: Project Notification of Transfer
Annex 9: Threatened Costa Rican Orchids
Annex 10: GIS and Red List course participant list
Annex 11: GIS and Red List course evaluation
Annex 12: Orchid identification and conservation course participant list
Annex 13: Lahaye et al, 2008
Annex 14: DNA barcoding press coverage (BCGI)
Annex 15: DNA barcoding press coverage (Defra)
Annex 16: DNA barcoding press coverage (BBC)
Annex 17: Kew Scientist press release
Annex 18: Pupulin, 2007
Annex 19: Bogarin, 2007
Annex 20: Bogarin and Pupulin, 2007
Annex 21: Dressler and Bogarin, 2007a
Annex 22: Dressler and Bogarin, 2007b
Annex 23: Dressler and Bogarin, 2007c
Annex 24: Gigot et al, 2007
Annex 25: Pupulin and Bogarin, 2007
Annex 26: Darwin Initiative project poster (IOCC)
Annex 27: Second International Barcoding conference poster
Annex 28: Second Scientific Conference on Andean Orchids poster
Annex 29: 19th World Orchid Conference poster
Annex 30: matK patent application (IN STRICT CONFIDENCE)