



Darwin Initiative for the Survival of Species

Final Report

Tree Diversity and Agroforestry Development in the Peruvian Amazon

Contents

1. Darwin Project Information	1
2. Project Background/Rationale	1
3. Project Summary	2
4. Scientific, Training and Technical Assessment	3
5. Project Impacts	11
6. Project Outputs	14
7. Project Expenditure	15
8. Project Operation and Partnerships	15
9. Monitoring and Evaluation, Lesson Learning	16
10. Darwin Identity	18
11. Leverage	18
12. Sustainability and Legacy	19
13. Post-Project Follow up Activities	20
14. Value for Money	20
15. Appendix I: Project Contribution to Articles Under the CBD	22
16. Appendix II: Outputs	24
17. Appendix III: Publications	26
18. Appendix IV: Darwin Contacts	28

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1. Darwin Project Information

Project title	Tree diversity and agroforestry development in the Peruvian Amazon
Country	Peru
Contractor	Royal Botanic Garden Edinburgh
Project Reference No.	09/017
Grant Value	166,685
Starting/Finishing dates	October 2000 – October 2003

2. Project Background/Rationale

Peru is a resource poor country containing c. 10% of the world's plant species. The most important habitat, both socio-economically, and in terms of numbers of species is the rain forest of the Amazon Basin. The International Centre for Research in Agroforestry (ICRAF; now rebranded as the World Agroforestry Centre), a key collaborator in this project, is developing small scale agroforestry systems for resource-poor farms using native tree species as a means of slowing the destruction of virgin forest by slash and burn, conserving genetic resources of trees and improving the livelihoods of poor farmers. ICRAF surveyed farmers to determine their preferred tree species for agroforestry, and compiled a list of 150 species that are widely used and have potential for various agroforestry systems. However, many of these priority tree species were not scientifically identified, and were known only by their Spanish vernacular names. This project discovered their scientific names and uncovered existing data relating to their uses and about related species of economic use. This is summarized in the project's principal output, a user-friendly guide for the identification and silviculture of these species. This guide will help ICRAF to collect seed from across their range for proper evaluation in growth trials. In the process, we have built the capacity of the Peruvian National Forest Herbarium (MOL), the principal collaborator in the project, by providing training of local personnel, new equipment and repatriated information from the Royal Botanic Gardens Edinburgh (RBGE) and Kew (RBG Kew).

Tree diversity and agroforestry development in the Peruvian Amazon aimed to reconcile the elimination of poverty by improving livelihoods on resource-poor small farms with the implementation of Peru's commitments to the CBD. If Peru is to meet its obligations to the CBD, the ability to balance economic development with biodiversity conservation is paramount. The capacity to identify its tree species biodiversity is fundamental to this aim. Unlike most other Latin American countries, Peru is not covered by a major international flora-writing project, and its own resources to identify its biodiversity are poor. This project aimed to address these problems in two ways: by the training of Peruvians in tree

identification, biodiversity assessment and biodiversity collections management, and through the repatriation of data and information on economic uses. Given the immense scale of Peru's plant diversity, we proposed a restricted and achievable target, focusing upon economically important Amazonian tree species that have the potential to alleviate rural poverty through improved agroforestry systems on resource poor farms.

Identification of the project

The work was identified through discussion with ICRAF, MOL, and the Darwin project 'Capacity Building and Repatriation of Data Scheme' awarded to the Royal Botanic Gardens, Kew.

ICRAF identified the taxonomic study of the 150 species of economic potential as an urgent priority to enable them to deliver their small-scale agroforestry programmes in Amazonian Peru. ICRAF requested the user-friendly identification guide to these economically important Amazonian tree species.

MOL considered that an inability within Peru to properly identify tree species of economic potential was preventing their effective evaluation in utilisation and conservation programmes. At the root of this problem lies a lack of high quality biodiversity data and trained personnel in Peruvian institutions. The Darwin-funded project 'Capacity Building and Repatriation of Data Scheme' identified MOL as a strong potential focus for a collaborative project of data repatriation and training for Peru.

3. Project Summary

Project purpose

To carry out a taxonomic study of 150 tree species with economic potential which will assist in implementing effective conservation and sustainable use programmes

Project objectives

- To train Peruvian scientists, technicians and students in taxonomy, field collection and identification skills, and in curation and databasing techniques
- To train Peruvian scientists in UK
- To collect and accurately identify 150 priority tree species selected by local farmers in the Peruvian Amazon as economically beneficial
- To prepare a database on these species using collections in herbaria
- To produce an identification manual in Spanish for these and related species
- To repatriate specimen data and important literature relating to priority species from UK to MOL
- To improve the capacity of MOL by supplying the basic equipment for running and curating its herbarium
- To promote awareness of Peruvian forest biodiversity issues locally, nationally and internationally

The original objectives and operational plan were not modified during the project period. Major changes involved additional outputs and activities, some of which were made possible by receipt of extra funding from one of the project partners, ICRAF. These outputs and activities were:

1. Germination trials of tree species for which no information existed (permission: February 2001).
2. Production of extra project outputs after receipt of ICRAF funding: image CD of MOL specimens; book summarizing MOL forest inventory studies carried out by undergraduate students trained via the project (permission: July 2003) .

Relevance to the Convention on Biological Diversity (CBD; see also Appendix 1)

- **Identification and monitoring** of valuable native forest tree species (**Article 7**; see also **annex 1** emphasising cultivated/domesticated species and relatives)
- **Improvement** to the capacity of MOL to carry out future biodiversity surveys (**Article 7/8/9**)
- **In situ conservation** of tree species in small-scale agroforestry systems that provide economic benefits (**Articles 8/10**)
- **Training** of local personnel through technical and scientific collaboration (**Article 12/18**)
- **Repatriation** of data from the UK (**Article 17**)

Accomplishment of objectives

The project met all its objectives as listed above. Significant additional accomplishments include (see “publication outputs under (4) below for details):

1. Mounting and incorporation of 8600 herbarium specimens and databasing of 9000 specimens in the herbarium of Universidad Nacional Agraria, La Molina (MOL).
2. Digital imaging of 2000 specimens (production of *Catalogo digital de fotos de especimenes de árboles del Perú*).
3. Publication of book *Relictos de Bosques de Excepcional Diversidad en los Andes Centrales del Perú* (330 pp.).
4. Publication of book *Illustrated Guide to the Trees of Peru* (850 pp.).
5. Reynaldo Linares (Darwin MSc student) gaining a distinction for his MSc thesis research on Peruvian seasonally dry tropical forest. This research has lead to four papers submitted to peer-reviewed journals, and has been presented at a major international conference.

4. Scientific, Training, and Technical Assessment

Research

Field research in Amazonia

Field research in the Peruvian Amazon was led by Dr Terry Pennington, and totalled 23 weeks. It was carried out with logistical support by ICRAF in the vicinities of Iquitos, Yurimaguas and Pucallpa, where ICRAF’s agroforestry projects are based. The principal objectives were to collect specimens from our list of 150 priority tree species using standard botanical collection techniques, and to train Peruvian participants in these techniques and in plant identification skills. We were able to collect high quality specimens of 135 (90%) of these species, of which 90% were collected fertile.

Additionally, we have collected seedlings of 50%, allowing seedling characteristics to be described in the identification manual. Seedlings are rarely collected, but the ability to identify them is important to foresters.

Our methodology centred upon permanently marking trees with aluminium tags and geo-referencing their location using the GPS purchased by the project. This enabled each tree to be visited repeatedly through the project to ensure collections of flowers and fruit. This allowed accurate scientific identification, and made available high quality specimens suitable for illustration for the field guide. These repeat visits also enabled us to gather phenological data on flowering and fruiting times. These data were not known for many of the species on our priority list, and are essential for planning seed and seedling collection programmes. Fruiting of tropical tree species is followed by a short period of seed release and germination. Local people need accurate information on the timing of fruiting, and the ability to identify seeds and seedlings, if they are to be able to collect them before they are destroyed by predators.

Additional fieldwork was carried out by Toby Pennington (6 weeks). This work was related to, and largely financed by other projects, but enabled us to visit Darwin project sites accompanied by the MOL technician. We were therefore able to continue his training, and also to collect further material of the priority species at little cost to the project. Toby Pennington was accompanied by Alexandre Monro (Natural History Museum), project leader of the recently completed Darwin project “Empowering local people to manage the biodiversity of El Salvador”, who was able to provide valuable additional training to the MOL technician. Alexandre’s visit represented a useful cross-fertilisation between two Darwin projects based in different host countries and UK institutions.

Publication outputs

a) Árboles útiles de la Amazonía peruana y sus usos (authors: Carlos Reynel, Terry Pennington, Toby Pennington, César Flores, Aniceto Daza)

The principal technical output of the project is the user friendly identification and silviculture manual (509 pp.) to tree species from the Peruvian Amazon with economic potential. Dr Carlos Reynel (project leader in Peru) and Dr Terry Pennington (UK project staff) led this work. It contains descriptions, illustrations and silvicultural information for 140 species. This is less than the 150 species on ICRAF’s original list, reflecting that some species were considered too well known for inclusion (e.g., mango, avocado), that some could not be located, and that others did not have sufficient economic potential. All 140 species are illustrated, with the majority (118) of the line drawings prepared by Carlos Reynel and Maureen Warwick (RBG Edinburgh) at no extra cost to the project, representing considerable value for money (these would have cost c.£12,000 to be produced by freelance artists in the UK). On one field visit (2002), Terry Pennington was accompanied by the RBG Kew photographer (again, at no cost to the project), who was able to take photos of the highest quality of the priority species for inclusion in the manual. Some of these images can be seen on the project website: www.darwintreediversity.org.

Much of the silvicultural information included in the guide was gleaned from bibliographic research in the libraries of RBG Kew and RBG Edinburgh by Tania Durt

(Darwin Fellow). In many instances, this information had been produced in other Neotropical countries, and the sources were not available in Peru. All this literature (c. 2000 copied pages) relevant to Peruvian forestry is now repatriated to MOL.

The draft format for the guide was developed in discussion with ICRAF, and was tested in the field by project staff, and staff of IIAP (Instituto de Investigaciones de la Amazonia Peruana). Draft page design for the manual was completed by Diccon Alexander, who designed the highly successful Darwin funded guide to trees in coffee plantations in El Salvador (*Árboles de los cafetales de El Salvador*). The principal author and project leader for this guide Alexandre Monro (Natural History Museum), accompanied Toby Pennington to Peru in October/November 2002, and provided valuable input into the content and design of the work.

b) *Relictos de Bosques de Excepcional Diversidad en los Andes Centrales del Perú*
[Relicts of forests of exceptional diversity in the Central Peruvian Andes] (editors: Dante Anton and Carlos Reynel)

This book (323 pp.) describes the results of six one hectare permanent plot floristic inventories in forest remnants in the Chanchamayo region of Central Peru. The inventory studies were carried out by four undergraduate students from MOL (Angélica Almeyda, Dante Anton, Sergio Caro and Euridice Honorio) and the MOL technician, Aniceto Daza. All of the students participated in formal training delivered by the project (see “training and capacity building activities” below), and all also benefited from one-on-one training in field methodology, specimen identification and data interpretation in relation to these research projects from Carlos Reynel, Terry Pennington and Toby Pennington.

The plots were situated on an altitudinal gradient from 1000-2300m. The results indicate the highest number of species recorded from these altitudes in the tropical Andes. This, in addition to the discovery of new species, endemic species, and many new records for Peru, highlights the conservation value of these forest remnants, few of which receive formal protection. The remarkable results from these studies are one reason why the follow-up research proposed to Darwin focuses upon Andean forests (see (13) below).

The additional funding received for publications by the project has allowed us to distribute this book free of charge in Peru to Universities, Government departments and NGOs. It is also available as a pdf file on the project website:
www.darwintreediversity.org.

c) *Illustrated Guide to the Trees of Peru* (authors: Terry Pennington, Carlos Reynel, Aniceto Daza)

This is the first comprehensive, up to date generic account of the Peruvian tree flora. Contents include an account of the forests of Peru, identification keys to families and genera, an illustrated glossary of technical terms, descriptions of 980 genera, references to important literature, information on distribution, ecology and uses of c. 1500 of the more common species. The descriptions are accompanied by c. 900 accurate black and white line drawings and a large section of colour images. The book will provide an essential tool for foresters, agriculturalists and others working with Peruvian forests.

The Darwin project has contributed to this book by facilitating fieldwork in the Peruvian Amazon. Many of the priority species studied by the project are included in the book. The

additional funding for publications received by the project will allow the purchase of 100 copies of this book, to be distributed free in Peru.

d) CD of 2000 specimen images (Catalogo digital de fotos de especimenes de árboles del Perú)

Using the digital camera purchased by the project, digital images were taken of 2000 specimens from the MOL collection. Most of these are unique to MOL, because duplicate specimens have never been distributed. These images have been burnt on to 50 CDs, which have been distributed free of charge to other herbaria within Peru. This has disseminated valuable information, as well as ensuring the long-term safety of specimen information, should any disaster (e.g., a fire) strike the MOL collection.

e) On-line herbarium specimen database

The specimen database generated by the project using the BG-BASE system is now searchable on-line: <http://rbg-web2.rbge.org.uk/peru/englishquery.html>). The on-line database is of the 9,000 MOL specimens databased. Most of these are not present in herbaria outside of Peru. Most of the records have full geographic, habitat and phenological information.

f) Research in Peruvian seasonally dry tropical forests

The Darwin MSc scholar, Reynaldo Linares (see “training” below) carried out his MSc thesis research on the seasonally dry forests of Peru. These ecosystems cover 55,000 km² of Peru, and are found on the Pacific coast, in InterAndean valleys, and in Amazonia. They are almost entirely deforested, but because they receive little scientific attention and publicity, their conservation is neglected. In Peru, they are only protected in one area on the Pacific coast. Reynaldo Linares’ thesis research (for which he received a distinction) examined patterns of tree species diversity and endemism in Peruvian seasonal forests in a continental context by comparison with published seasonal forest surveys from other countries. This study revealed high levels of endemism in Peruvian forests, and perhaps its most significant finding is that the Amazonian seasonal forests in the Tarapoto region of Peru are not clearly related to any other areas included in the analysis. These unique forests clearly merit formal conservation.

Reynaldo won a competitive bursary from RBG Edinburgh to write up his research for publication, which has resulted in a paper published in the international, peer reviewed journal *Candollea*, plus three other papers submitted. Reynaldo was also invited to present his research at an international conference (September 2003) “Tropical savannas and seasonally dry forests: ecology, environment, development”.

Training and capacity building activities

1. Training in plant collection and identification in the field

a) Peruvian scientists and technicians

This training totalled 29 weeks and was lead by Terry Pennington, with subsidiary trips lead by Toby Pennington. The MOL technician was present throughout, whilst

ICRAF technicians and scientists received 23 weeks training. Additionally in the areas of Iquitos and Pucallpa, retired staff from two Government organisations: INIA (Instituto Nacional de Investigaciones Agrarias) and IIAP (Instituto de Investigaciones de la Amazonia Peruana) participated in fieldwork. These older foresters have excellent skills in the identification of tree seedlings, which have now been passed on a younger generation of workers from ICRAF. The trainees were selected because they have permanent contracts with their organisations, and will therefore be able to pass on plant collection and identification skills beyond the end of the Darwin project.

Training formed part of the field research in Amazonia (see above). This ensured that all training delivered useful data for the project, thereby maximising outputs relative to input of staff time. It also ensured that the trainees saw the benefits of their new skills directly. Training was by “job shadowing”, followed by independent work assessed by the trainer. For example, in the field, the trainees were shown how to collect and press high quality specimens from trees, and which data relating to the trees must be recorded. The trainees were then expected to carry out these tasks unassisted, but observed by the trainer.

The trainees were taught:

1. How to climb trees safely and use long-arm pruners to collect specimens.
2. How to press specimens in the field for subsequent drying.
3. The data that must be recorded for an individual collection, which are necessary for an adequate herbarium specimen label.
4. How to preserve plant specimens in the field by overnight drying using a gas stove.
5. Techniques of field identification, especially key field characters for the priority species.
6. How to use the identification manual.

Assessment was by Terry Pennington, who ensured that each trainee had reached competence in each of the tasks.

b) Peruvian undergraduate students

Teaching Peruvian undergraduates methods, techniques and theory of taxonomy and biodiversity studies was a project commitment. Dr Toby Pennington (UK project leader) taught on a week-long field course (May 2001) and a four day field course (October 2002) alongside academic staff from the Universidad Agraria, La Molina (40 trainees in total, all MOL undergraduate forestry students). The courses covered basic skills in plant identification, standard botanical collection techniques, and lectures on major tree families. Assessment was via formal University examinations.

One particularly valuable aspect of this training was being able to interact with the students for a long period, and to identify those with particular interest in botany. It was these students that were selected for more advanced training and teaching elsewhere during the project. This coaching of selected, motivated students was a training element of the project that developed through the project (with the Darwin Secretariat notified of all changes, and these changes detailed in Annual Reports). It is these motivated students

with a particular interest in botany and biodiversity conservation who are likely to make a future impact in these fields in Peru. Hence, concentration on these students was a logical means of building project legacy. The training received was in both plant identification and collection in the field, and in herbarium curation.

Toby Pennington provided two days of plant identification training to an undergraduate student (Angélica Almeyda) carrying out a one hectare forest inventory project in the Chanchamayo valley. The training was carried out in her inventory plot, and consisted of collecting and identifying specimens. This plot study has subsequently been included in one of the published project outputs describing diversity patterns of Andean forest plots in this area (see above). Terry Pennington and Dr Carlos Reynel took the MOL technician and three undergraduate students on a three day field trip (August 2001) to the Chanchamayo valley, close to Lima. The students were all carrying out final year research theses supervised by Carlos Reynel on various aspects of the flora of this valley. The aim of this field visit was to provide advanced training in plant identification skills. Two of these undergraduate students subsequently used their experience to teach a plant identification workshop to some of the younger students (see below). This workshop (18 hours total), was entitled “*introducción a la identificación de familias botánicas*” (*introduction to the identification of plant families*). It was aimed at some of the younger and less experienced students at MOL, was fully subscribed with 15 participants, and was well received.

Toby Pennington taught two day-long courses (November 2002; 2003) at MOL to advanced undergraduates (20 in total) on the identification of Leguminosae [see supplementary materials 2], which is the dominant tree family in Latin American forests.

2. Training in herbarium curation

a) General herbarium curation

Training in this area took place throughout the project. It comprised formal courses, but principally involved individual training of technicians and students who were employed to carry out curation work through the project. Formal courses were provided for undergraduate students by Toby Pennington and Tania Durt, and one-on-one training by Carlos Reynel, Toby Pennington and Terry Pennington. Peruvian technician trainees were selected because they have permanent contracts at MOL. Undergraduate student trainees were those who showed the greatest interest in plant biodiversity studies, for example those carrying out their thesis research under the supervision of Carlos Reynel.

Formal courses (November 2002, November 2003) for undergraduate students, and also attended by MOL technician Aniceto Daza, covered how to use taxonomic monographs to name and curate plant specimens (the project purchased several recent monographs of key tree groups for MOL), botanical nomenclature, and taxonomic tools available on the world-wide-web. These courses were attended by 20 students in total. Tania Durt used her experience from the Herbarium Techniques course at RBG Kew to teach a half day workshop to eight Peruvian undergraduate students.

b) Database training

A one-week, full-time course in *BG-BASE*, the database purchased for MOL, was led by Dr Kerry Walter and Toby Pennington (RBGE). Dr Walter was in Peru for two weeks,

and outside of course time worked with undergraduate and MSc students at MOL discussing specific databasing issues relating to their research projects. The training course was attended by two MOL technicians and eight undergraduate students. The selection criteria were that the two MOL technicians have permanent positions and will thus be able to pass on skills beyond the end of the Darwin project. All the students were involved in research projects based in botanical inventory, and were collecting botanical specimens, which required databasing, identification and curation within the MOL herbarium. Teaching these students curation and databasing skills enabled them to understand and use the herbarium correctly.

Two days further training in the use of *BG-BASE* in Peru were provided by Tania Durt in May 2002. Trainees were Rocio Ravello (MOL technician) who entered most data at MOL, plus one undergraduate, Euridice Honorio, who had particular interest in the database and attended the databasing course in November 2000. Euridice developed some new materials for the manual of use of *BG-BASE* for MOL.

c) Achievements in herbarium curation in Peru

8600 specimens have been mounted and incorporated into the MOL collection, almost doubling its size. MOL staff and students databased c. 9000 MOL specimens. Tania Durt databased c. 3000 RBG Kew and RBGE specimens, and *BG-BASE* staff at RBGE were also able to convert an additional 15,000 thousand specimen records generously donated from a Missouri Botanical Garden (MO) database. Dr Kerry Walter translated 17,000 plant names from a text file of the Checklist of the Flora of Peru. MOL is therefore left with a substantial database comprising c. 27,000 specimen records, most of which have full geographic, habitat and phenological information. The c. 9000 MOL specimens are searchable on-line at <http://rbg-web2.rbge.org.uk/peru/englishquery.html>. The importance of this database for collection management at MOL is considerable; for example, it enabled the printing of standardised labels for MOL specimens, the majority of which had only hand-written labels.

In addition to databased information, plant specimen data was also repatriated from the UK to Peru in the form of cibachrome photographs (high quality, life size colour images). 301 specimens of tree species from RBG Kew that are not represented at all in the MOL collection, were made into cibachromes. These have been added directly to the MOL specimen collection, where they can substitute for specimens.

3. Physical capacity building: improvement of facilities at MOL

19.5K was invested in improving the herbarium facilities at MOL. This leaves an important legacy beyond the end of the project, because the MOL herbarium is used as a source of identification of Peruvian forest trees by University researchers, NGOs, the Peruvian Government Environment Department (Instituto Nacional de Recursos Naturales ;INRENA), petrochemical companies and the general public. Furthermore, it is used as an educational tool for forestry undergraduate students, of which the annual intake is 150.

The improvements delivered by the project have included:

Computer, printer and new database
Digital camera (for recording images of specimens in database)
74 new specimen cabinets
High security metal door to prevent theft of computer, printer and other valuables
Freezer for killing insect pests on specimens
2 new microscopes, 6 renovated microscopes, 30 handlenses
New plant drying facility
New field collecting equipment (climbing spikes, long-arm pruners, aluminium corrugates, GPS, binoculars)
Basic literature including taxonomic monographs
New lighting
4000 sheets of mounting paper

The success of the project in mounting specimens and incorporating them into the collection caused a problem of space. This has been solved by the British Embassy agreeing to fund (5000 US \$) an extension to the herbarium in March 2004.

4. Training and other activities in UK

Training in the UK principally involved the Peruvian Darwin Fellow (Tania Durt) and Peruvian Darwin MSc student (Reynaldo Linares). Both were resident in the UK for one year. Susana Ponce, a MOL student, also made a self-funded three month visit to RBGE, where she received training in herbarium curation and specimen databasing

a) Tania Durt

Tania Durt was employed by the project as Peruvian Darwin Fellow from April 2001 to April 2002. She split this time between RBG Kew and RBGE. She received training at both Institutes. At RBG Kew she attended a two month course, gaining an International Diploma in Herbarium Techniques. At RBGE she spent two weeks (spread across the year) training with Dr Kerry Walter and Rob Cubey who develop *BG-BASE* at RBGE. Tania now has a detailed knowledge of the *BG-BASE* system and has written a user-guide in Spanish, specifically for Peruvian project staff (see supplementary materials).

Tania databased 2936 specimens of Peruvian tree species from the rich collections at RBG Kew, using the *BG-BASE* system. None of these specimens are present in the MOL collection, so the repatriation of these data is especially valuable for Peru. The databasing focused upon the genera from our list of priority species, but other genera that have numerous species in Peruvian forests were also included. Tania co-ordinated the complex merge of these data entered at RBG Kew with the MOL database at RBGE in April 2002 and at MOL in May 2002.

At RBG Kew, Tania selected 301 specimens of tree species that are not represented at all in the MOL collection, which were made into cibachrome photographs (high quality life size colour images). These have been added directly to the MOL specimen collection, where they can substitute for specimens.

Tania also used the library at RBGE to carry out a bibliographic study of the taxonomy, ecology and growth characteristics of the 150 priority species. She made copies of 2000 pages of literature from diverse sources, most of which are not available in Peru. This

information has been included in the user-friendly guide that is one of the principal outputs of the project. The copies have all been sent to Peru, where they have been incorporated into the MOL herbarium library.

b) Reynaldo Linares

Reynaldo Linares, the Peruvian Darwin MSc student completed the University of Edinburgh/RBGE MSc in Taxonomy and Biodiversity of Plants in 2002. His performance was outstanding. He gained a distinction for his five-month research dissertation on Peruvian seasonally dry forests. Furthermore, he was awarded a highly competitive bursary, enabling him to stay in Edinburgh until December 2002 to write up this work for publication. This paper has already been published by the internationally refereed journal *Candollea*. He has three other papers arising from this research that are submitted, one to *Edinburgh Journal of Botany*, and two in Spanish for *Arnaldoa*, a Peruvian journal. He was an invited speaker (September 2003) at an international conference (Tropical Savannas and Seasonally Dry Forests: Ecology, Environment and Development), where he presented his thesis research. Reynaldo has designed two websites (<http://www.geocities.com/cerrosdeamotape/index.htm>; <http://neotropicaldryforest.tripod.com>; http://bosque_seco.tripod.com/index.htm) to publicise scientific research in Peruvian and other Neotropical seasonally dry forests. These forests, which grow in rain-shadow areas of the Peruvian Amazon, grow on fertile soils and have been decimated, but none are protected. One of Reynaldo's ultimate objectives is to ensure that some of these threatened forests achieve formal conservation status within Peru. This is one goal of a Darwin Scholarship application ("Tree diversity and conservation priorities in Peruvian seasonally dry tropical forests") submitted in March 2004 by Reynaldo and Toby Pennington.

Reynaldo is currently an associate researcher at MOL. Ideally, he would like to carry out a PhD project on the biogeography and evolution of Peruvian seasonally dry forests, based partly in Peru and partly in the UK. With Toby Pennington, he has written two proposals to funders who support overseas students for UK PhDs, but unfortunately, neither were funded.

c) Susana Ponce

Susana Ponce made a self-funded three month visit to RBGE from September to December 2002. She worked as a volunteer in the RBGE herbarium, receiving training from Toby Pennington in herbarium curation using taxonomic monographs, and in specimen databasing. She made a valuable contribution to herbarium curation at RBGE. Subsequently, she has gained a grant to study for an MSc in forestry in the University of Goettingen, Germany.

5. Project Impacts

The project purpose was to carry out a taxonomic study of 150 tree species with economic potential which will assist in implementing effective conservation and sustainable use programmes. The publication of the identification manual to these species is evidence that the taxonomic study of these species has been completed in the project period. This book has been distributed free to many NGOs (including PRONATURALEZA, WWF-Peru,

Asociación Peruana para la Promoción del Desarrollo Sostenible [APRODES]), Universities, and the Peruvian Government environment departments INRENA and INIA.

The identification manual has been widely distributed amongst ICRAF and its partners in the Peruvian Amazon. It will be used as a key tool in ICRAF's training and outreach programmes for the promotion and diversification of agroforestry systems. For example, Jonathan Cornelius (Programme Director, ICRAF, Peru), envisages a course based around the manual designed for farmers and implemented in modular fashion, involving them in seed collection, nursery germination, and establishment in agroforestry systems. It is too early after the publication of the manual to assess current social impact, but the beneficiaries will be smallholder farmers, through their adoption of diversified agroforestry systems.

Unexpected impacts were made with undergraduate students at MOL, whose interest and motivation exceeded expectations. Some more advanced undergraduates who were trained via the project delivered teaching in plant systematics and identification to less experienced students. This was their own, independent initiative. Two of these students (Euridice Honorio and Delicia Pino) have applied for grants to study for biodiversity related MSc degrees in Europe (Edinburgh and Goettingen, Germany). Delicia's application has been successful (April 2004), and she will start in Germany in August 2004.

Impacts relating to the CBD

The project has helped Peru meet its obligations under the CBD in several ways (see also Appendix 1):

- (i) By delivering information about valuable native forest tree species, and encouraging their conservation in small scale agroforestry systems that provide economic benefits for poor rural people.
- (ii) By improving capacity within Peru to carry out forest biodiversity surveys. This is the result of the improvements in the herbarium collection at MOL, including repatriated information from the UK, the provision of an online database, and the training of Peruvian scientists, technicians and students. Evidence that forest biodiversity studies can be delivered because of this improved capacity within Peru is provided by the publication of the book describing Andean forest plots (see above) and containing chapters written by four undergraduate students trained via the project.

Impacts on people: trainee outcomes

Trainee outcomes are detailed in the table below. Student trainees are only listed where they were employed by the project at MOL and participated in the curation element of the project, or where they received one-on-one training in relation to their research projects. Please note that some of students trained later in the project are still pursuing their studies, and that the employment rate of MOL forestry undergraduates in general is 100% environmentally related fields (employed by government and NGOs)

Trainee name	Trainee status	Current employment
Reynaldo Linares	Darwin MSc Scholar (UK)	Associate researcher, MOL
Tania Durt	Darwin Fellow (UK)	Royal Botanic Gardens Kew, Richard Spruce Research Officer (includes a major focus on repatriation of data to Peru)
Susana Ponce	Self-funded volunteer (UK)	MSc in Forestry, University of Goettingen
Aniceto Daza	MOL technician	MOL technician, full time
Rocio Ravello	MOL technician (databasing)	MOL technician, part time
Angelica Ulloque Vidal	MOL technician	MOL technician
Patricia de la Cruz Quispa	MOL technician	MOL technician
Delicia Pino	Student	Employed by NGOs, Lima; starting MSc in Forestry, University of Goettingen, August 2004
Euridice Honorio	Student	INIA, Iquitos, curator of Amazonian herbarium
Sandra Velarde	Student	Junior Professional Officer, Program on Alternatives to Slash and Burn, ICRAF, Nairobi, Kenya
Francisco Román	Student	Assistant Professor, Universidad Nacional Agraria, Forestry Faculty
Sergio Caro	Student	Employed by NGOs, Lima
Milton Tullume Chavesta	Student	INRENA
Dante Antón	Student	Intends to start PhD, Peru
Svetka Kulkich	Student	Still to graduate
Pamela Cáceres	Student	Still to graduate
S. Saldana	INIA, Pucallpa	Freelance forestry consultant
Waldir Upiachíua	INIA, Pucallpa	Forestry technician in private company: "Consorcio Forestal Amazónico"
Jorge Bazalar	IIAP, Iquitos	Tree identification technician, IIAP

Arquimedes Zamora	ICRAF	Farmer associated with ICRAF
Eduardo Lopez	ICRAF	Field technician, ICRAF, Pucallpa
Emanuel Ceijas	ICRAF	Freelance forestry consultant
Jorge Revilla	ICRAF	Field technician, ICRAF, Pucallpa
Holder Ocmín	ICRAF	Field technician, ICRAF, Yurimaguas

Collaborative impacts

Collaboration has been excellent between the UK and the principal Peruvian partner, MOL. There is commitment from both sides to develop this partnership in future. For example, a recent visit to the UK by Carlos Reynel (funded by the Royal Society) enabled a Darwin post-project funding proposal to be written. Collaboration with ICRAF, the minor partner in Peru has also been good, despite several changes in the leadership of ICRAF's Peru programme during the project period. ICRAF have recently expressed a desire to seek future collaborative project possibilities with both MOL and RBGE/RBG Kew.

Within Peru, local collaboration has also been fostered, especially via the distribution (free of charge) of the identification manual. For example, INRENA requested an additional 20 copies of the manual for their officials in the field, in addition to the 30 copies they were given. Links between MOL and the NGO APRODES have also been strengthened by project fieldwork in forest protected by APRODES in the Chanchamayo valley (described in the Andean forest plot book). APRODES are a major project partner in the proposed follow-up project (see (13) below). Relationships between MOL and the British Embassy have also been improved. The Embassy have recently (March 2004) agreed to fund an extension to the MOL herbarium (5000 US\$), which is essential to enable the specimens mounted during this project to be properly housed.

6. Project Outputs

All major project outputs were achieved (see Appendix II/III).

Additional outputs were (please see (3) and (4) above for details):

1. The book *Relictos de Bosques de Excepcional Diversidad en los Andes Centrales del Perú* [Relicts of forests of exceptional diversity in the Central Peruvian Andes] (eds D. Anton and C. Reynel).
2. The book *Árboles útiles de la Amazonía peruana y sus usos* (authors: Carlos Reynel, Terry Pennington, Toby Pennington, César Flores, Aniceto Daza).
3. Manual for the use of *BG-BASE* in Spanish.
4. CD of 2000 specimen images (*Catalogo digital de fotos de especimenes de árboles del Perú*).

The single output not achieved was a project Newsletter. It was decided that a website would be more effective (see www.darwintreediversity.org)

Dissemination

A principal means of dissemination is the new project website (www.darwintreediversity.org). This has details of the project's published outputs, plus its other activities (e.g. training). The published outputs can be requested from the site (whilst stocks last!). Cost of dissemination in Peru will be borne by MOL, in UK by RBGE and RBG Kew.

7. Project Expenditure

Item	Budget	Expenditure
Salaries (specify)		
Office administration costs		
Travel/Subsistence		
Capital items/equipment		
Conferences		
Printing		
Total		

No significant changes were made to the budget during the project. There are underspends of 13% on office and administration costs, and 17% on conference costs, though these only total £547. This helps balance the 7% overspend on travel and subsistence. The underspend on printing reflects a delay in the publication of the *Illustrated Guide to the Trees of Peru*, and the need to withhold funds to pay for its distribution in Peru.

8. Project Operation and Partnerships

Two partners worked on project activities: MOL and ICRAF. MOL, the main partner, is the Peruvian National Forest Herbarium, and is used as a source of identification of Peruvian forest trees by University researchers, NGOs, INRENA, petrochemical companies and the general public. Furthermore, it is used as an educational tool for forestry undergraduate students, of which the annual intake is 150.

ICRAF (now rebranded as the World Agroforestry Centre) is an autonomous, non-profit research body supported by the Consultative Group on International Agricultural Research. ICRAF aims to improve human welfare by alleviating poverty, improving food and nutritional security, and enhancing environmental resilience in the tropics. In Peru, it has a participatory tree domestication project in the Peruvian Amazon, which aims to improve the livelihoods of resource poor farmers through the use of native tree species.

Both MOL (Carlos Reynel) and ICRAF (John Weber [then ICRAF Programme Leader in Peru]) were involved in writing the original project proposal. In the first two years of the project, Carlos Reynel, John Weber and Toby Pennington met twice in Lima to ensure that project implementation was following the project schedule. These meetings helped to ensure that the partnerships followed out original plans. In the original proposal it was clear that MOL would be the main partner, and that ICRAF's role, whilst vital, was lesser in terms of staff time and overall involvement in project activities. MOL (largely

Carlos Reynel) managed project finances and staff in Peru, and was intimately involved in the planning and execution of herbarium curation training and fieldwork. ICRAF helped plan the logistics of the project fieldwork, and were instrumental in determining the content and format of the identification manual.

Additional collaboration

During fieldwork, collaboration was established with INIA, IIAP and APRODES, all of which operate agroforestry projects similar to those of ICRAF. Whilst there was no direct consultation with Peru's Biodiversity Strategy (BS) office through the project, ICRAF was formally involved in the preparation of the Peruvian Biodiversity Strategy, a process led by IIAP. MOL has frequent dialogue with the Peruvian government environment department INRENA, who are a major recipient of the identification manual (50 copies).

Longevity and effectiveness of local partnerships

The local partnerships have been active since the end of the project. Carlos Reynel has met with Jonathan Cornelius, the new head of ICRAF programmes in Peru to discuss possibilities for future research. Locally, ICRAF is involved with the Comité Ambiental Regional (Regional Environment Committee) for the Ucayali region. The Ucayali government has only been active for the last year, but ICRAF are actively collaborating in its forestry and environmental activities.

9. Monitoring and Evaluation, Lesson learning

Monitoring trainee outcomes

1. Peruvian undergraduate students

Students were monitored by their ability to collect and properly process plant specimens, through formal examinations on taxonomy and biodiversity, and by thesis research. Dr Carlos Reynel supervised this monitoring.

Undergraduate students attending field courses passed their formal examinations. Five undergraduate students who had received supervision from project staff passed their thesis research. Of these, four have had their research published in one of the project outputs, the book *Relictos de bosques de excepcional diversidad en los Andes Centrales del Perú*. The thesis students in particular are likely to continue in biodiversity related fields in Peru. This is demonstrated by some gaining jobs for NGOs or Peruvian governmental organisations, and by others studying for higher degrees (see (5) above). This demonstrates that the project has been successful in building future capacity in Peru for biodiversity studies. In particular, these students will understand the importance of field collection, accurate identification and well-curated biological collections in Peru.

2. MOL and ICRAF staff in the field

A series of milestones were set for monitoring: (i) by the end of the first trip (year 1), all participants should be able to collect and correctly process plant specimens independently; (ii) by the end of the second trip (year 2) they should be able to identify the majority of the target species; (iii) by the end of the third trip (year 3) they should

be able to train others in the use of the non-technical identification aids. Dr Terry Pennington supervised this monitoring.

All trainees demonstrated that they had learned the skills outlined above. Monitoring was by observation during the field trips. The MOL technician has subsequently carried out independent inventory work in the Central Andes, clearly demonstrating correct implementation of skills learned via the project. The training given to ICRAF staff has been actively used in seed collection activities. The wider knowledge gained by the ICRAF trainees constitutes a very important part of their professional skills and experience, and will be directly used in future activities such as evaluation and promotion of on-farm tree biodiversity.

The success of this element of the project was vital for achieving the purpose of the project: to carry out a taxonomic study of 150 tree species with economic potential which will assist in implementing effective conservation and sustainable use programmes. If the fieldwork element had not been successful, the principal output of the project, the user-friendly identification guide, would not have been produced.

3. MOL technicians and students employed in the herbarium

A series of milestones were set for monitoring: (i) by the end of the first year they should be able to use *BG-BASE* and to mount and curate specimens independently; (ii) by the end of the second year, they should be able to train others in these techniques; (iii) by the end of the project, it was hoped that 2000 specimens would be properly mounted and curated in the herbarium. Dr Carlos Reynel and Dr Toby Pennington supervised this monitoring.

The success of this element of the project is demonstrated by 8600 specimens mounted and incorporated into the collection, and 9000 specimens databased and now available on-line. This leaves a legacy for Peru of a greatly improved herbarium collection of forest trees, which will enable Peruvian biodiversity scientists to survey their forest resources more accurately in future.

Internal and external evaluation

The project has been monitored by the RBGE internal assessment system, with financial assessment monitored by the RBGE Finance Division. External evaluation has been carried out by the Scottish Executive Environment and Rural Affairs Department (SEERAD). SEERAD are the main sponsor organisation for RBGE, and have monitored the project alongside other RBGE research projects.

Lesson learning

We feel that the partnerships in this project have worked very well, especially with the principal partner, MOL. This reflects four factors:

1. That the project proposal was developed as a true collaboration. Perhaps Darwin should explore ways to seek evidence that all partners have provided real input and co-written a proposal – simply providing a letter of support does not necessarily do this.
2. That UK staff spent a good deal of time in Peru (one year in total), and in general did

not co-incide their visits, to maximise the time spent there by at least one UK staff member. This helps demonstrate genuine commitment to the local partners

3. That much training was done one-on-one. Whilst large training courses may sound impressive on paper, providing high numbers for output measures, it was clear that in our case, maximum legacy could be achieved by identifying key trainees, and investing time in them individually.

4. Communication from the UK to Peru was very frequent, by e-mail, and most critically, by telephone. Calls were made on average weekly. This can be done extremely economically using budget phone cards

10. Darwin Identity

We ensured that all press releases highlighted the Darwin Initiative. The Darwin logo was used on letterheads, labels that were placed on databased herbarium specimens, new herbarium cabinets purchased via the project, and all major published project outputs.

The understanding of the Darwin identity, and the work of Darwin, is improving in Peru. This has been helped recently by the wide distribution of the major outputs of this project, especially the identification manual, to Universities, NGOS and Government Departments.

The project was recognised as distinct, and with a clear identity, especially within the Universidad Nacional Agraria, La Molina, where the MOL herbarium is based. Within ICRAF, it did form part of a much wider programme involving the development of small-scale agroforestry systems, but despite this was seen as distinct because the work was entirely different from other aspects of ICRAF projects.

11. Leverage

ICRAF provided additional investment of 5000US\$. This enabled the identification manual to be produced to a high production standard, including the addition of colour photographs. This contribution also enabled the original publication budget of the project to be stretched to cover additional outputs (see 6 above).

In March 2004, the British Embassy (Lima) provided 5000US\$ to construct an extension to the MOL herbarium. This extension is essential because so many specimens were mounted that the existing facility had no space to accommodate them.

Increasing capacity to secure further funding within Peru

Toby Pennington applied for a Royal Society Developing World Study Visit grant (£2800) for Dr Carlos Reynel. This enabled Dr Reynel to visit the RBGE and RBG Kew in February and March 2004, when he worked on an application for Darwin post-project funding with Toby Pennington and Terry Pennington. This gave him first hand experience of developing a grant application. We have not yet attempted to capture funds from other International Donors, but this is part of our plans once we have learned of the outcome of the Darwin post-project application.

Toby Pennington worked with the Peruvian Darwin MSc student, and one other Peruvian student on several funding applications, thereby increasing their experience in writing

developing such proposals. These applications were: (i) a successful application for a thesis publication bursary at RBGE, plus two PhD applications with Reynaldo Linares (Darwin MSc student); (ii) an application for a Darwin Scholarship with Reynaldo Linares (submitted March 2004) (iii) an application to Alban, an EU programme that provides grants for Latin American students to study in Europe with Euridice Honorio, one of the undergraduate trainees. Euridice is hoping to study for an MSc in biodiversity and taxonomy of plants at RBGE and the University of Edinburgh.

This work with grant proposals responded directly to suggestions from reviews of previous Annual Reports that we should be developing the capacity of Peruvian project staff to write grant proposals. It should be noted that ICRAF's programmes in Peru are entirely externally funded, with the generation of these funds a major role for the programme leader, who requires no training in this area.

12. Sustainability and Legacy

This project has considerable legacy. The published outputs (books, CDs) have been widely distributed in Peru, and the specimen database is available on-line. The improved herbarium facilities at MOL will also endure for many years. The training given to Peruvian scientists, technicians and students will also have a lasting legacy. Scientists and technicians have permanent contracts, and will continue to use their new skills. The Darwin Scholar aims to pursue a career in biodiversity science and conservation in Peru, whilst the Darwin Fellow is employed at RBG Kew in a data repatriation project with a major focus on Peru. Undergraduate forestry students at MOL have a 100% employment record in forestry and related environment and biodiversity fields in Peru. Students trained by the project will bring a much greater appreciation of the role of herbaria and the properly identified plant specimens in vegetation inventory and conservation to a diverse array of biodiversity-related jobs in Peru. Direct evidence is provided by the current employment of students trained by the project. For example, Euridice Honorio coordinates an Amazonian herbarium for INIA, and Francisco Román has recently been appointed (March 2004) as assistant professor in the Forestry Department at the Universidad Nacional Agraria, La Molina.

The partners will keep in touch. RBGE/RBG Kew and MOL have already submitted a proposal to fund a further project. ICRAF and MOL are in dialogue concerning the possibility of future collaboration in Peru. This Darwin project is one of a pair of successful collaborative projects in Peru between RBGE and ICRAF, the second being a study of the genetic variation of the useful species *Inga edulis* in Amazonian Peru. Both parties have expressed a wish to continue collaborating in future, though specific project ideas have not yet been formulated.

The improved herbarium is used daily by undergraduate students and visiting academics and other biodiversity specialists. It is somewhat early, however, to measure how widely used and influential the major product, the identification manual, and other project outputs such as the specimen database and images will be. However, the initial signs are promising. For example, INRENA requested an additional 20 copies of the identification manual for their field staff. It is clear that the identification manual is already in use by field staff of NGOs and government organisations to whom it has been distributed.

Additional funding for future work

Funds (5000 US\$) were sought and received from the British Embassy (Lima) to build an extension to the MOL herbarium.

We were invited to apply for Darwin post-project funding, with an application submitted in March 2004 (see (13) below). This project aims to complete the curation of the MOL herbarium by mounting and databasing all specimens. It will also provide a complementary user-friendly identification and silviculture guide to economically useful species in Andean forests. If our application to Darwin is unsuccessful, we will attempt to fund this work from other sources.

13. Post-Project Follow up Activities *(max. 300 words)*

A post-project application, "Tree diversity, agroforestry development, and reforestation in Andean Peru", is submitted (March 2004). This suggested two follow-up activities that would help to consolidate the results of this Darwin project. Both are suggestions of Peruvian project staff at MOL, who are deeply committed to continuing their work.

The first is to mount, incorporate and database the backlog of fully identified specimens at MOL that have not been curated because of prior lack of funding and staff expertise. If these specimens remain uncurated, they are unavailable as a reference collection and therefore useless. The current Darwin project intended only to mount, incorporate and database collections relating to the 150 priority tree species and relatives, but with the hard work and commitment of project-trained MOL staff, we have made much greater progress. 8600 specimens have been mounted, of which 9000 are databased. The remaining backlog is 15000 specimens, which could be dealt with at low cost (c. 15K, including all salaries and materials). Considering the heavy use of this collection for identification of trees collected throughout Peru, and especially its educational value to undergraduate students at MOL, this would be a valuable long-term investment and legacy.

There is also great potential for further work on a related user-friendly identification manual containing silvicultural information relevant to re-forestation projects in Peru. NGOs such as APRODES (see "new links" above), plus petrochemical companies have communicated a clear need for this product to aid re-forestation programmes in Peru. Developing this manual would use staff trained during the current project and draw upon the improved collections in the MOL herbarium in combination with field and bibliographic research. There is much unpublished silvicultural information within Peru in institutional reports and student theses, which has never been disseminated. Conversely, for species growing outside Peru, silvicultural information is available from published work in neighbouring countries, which is missing from Peruvian libraries.

14. Value for money

We consider the project to have been value for money. Peru has been provided with a greatly improved herbarium facility that will enable future biodiversity scientists to better identify tree species in Peru. We have trained sixty Peruvian students, technicians and scientists in plant identification, herbarium curation and botanical databasing. The publication outputs of the project comprise c. 1700 printed pages, plus an on-line

database of 9,000 specimen records.

Toby Pennington
Terry Pennington
Carlos Reyne!

2 May 2004

15. Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use		Develop national strategies which integrate conservation and sustainable use.
7. Identification and Monitoring	20	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities which have adverse effects; maintain and organise relevant data.
8. In-situ Conservation	10	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	20	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	10	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		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		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.
16. Access to and Transfer of Technology		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 access and joint development of technologies.
17. Exchange of Information	15	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.
Total %	100%	Check % = total 100

16. Appendix II Outputs

Code	Total to date	Detail
Training Outputs		
2	1	Darwin Scholar: MSc in Biodiversity and Taxonomy of Plants (University of Edinburgh)
3	1	Darwin Fellow: Diploma in Herbarium Techniques (Royal Botanic Gardens, Kew)
4a	50	2 field courses 1 databasing course 2x herbarium curation/taxonomic tools on internet courses
4b	4	4 weeks training under output 4a
5	1	Darwin Fellow in UK for 1 year supervised by UK project staff
6a	20	Peruvian scientists and technicians: field plant collection and identification, herbarium curation Peruvian undergraduate students (employed by project/research projects supervised): botanical databasing, herbarium curation, plant identification
6b	36	36 weeks training under output 6a
7	2	Manual in Spanish for use of BG-BASE Teaching materials for undergraduate students
Research Outputs		
8	51	Weeks spent by UK project staff on project work in Peru
10	3	3 books: <i>Árboles útiles de la Amazonía peruana y sus usos</i> <i>Relictos de Bosques de Excepcional Diversidad en los Andes Centrales del Perú</i> <i>Illustrated Guide to the Trees of Peru</i>
11a	5	2 published (<i>Candollea</i>) 3 submitted (<i>Edinburgh Journal of Botany; Arnaldoa</i>)
12a	1	New database established at MOL with c. 27,000 specimen records
12b	1	Information in identification manual to be added to ICRAF useful trees database
13b	1	8600 specimens mounted and added to MOL collection. 301 cibachrome photos of RBG Kew specimens repatriated to MOL.

Dissemination Outputs		
14b	3	Third Biennial International Conference of the Systematics Association (UK) Tropical Savannas and Seasonally Dry Forests: Ecology, Environment, Development (UK) Peruvian National Botanical Congress
15a	4	National press releases or publicity articles in Peru
15b	1	Local press releases or publicity articles in Peru
15c	2	National press releases or publicity articles in UK
15d	3	Local press releases or publicity articles in UK
16a	4	4 websites: www.darwintreediversity.org http://www.geocities.com/cerrosdeamotape/index.htm http://bosque_seco.tripod.com/index.htm http://neotropicaldryforest.tripod.com http://www.rbge.org.uk/rbge/web/science/research/biodiversity/perueng.jsp
Physical Outputs		
20		£19500 (plus £3,000 additional funding in 2004 from British Embassy, Lima, to extend the herbarium)
22	4	Permanent field plots established by undergraduate students supervised by project staff
23	£8800	Additional resources raised for project: c. £3000 for publication costs (ICRAF) c. £3000 for MOL herbarium extension (British Embassy, Lima) c. £2800 for visit to UK by Carlos Reynel (Royal Society, London)

17. Appendix III: Publications

Type (e.g. journal paper, book, manual, CD)	Detail (e.g. title, authors, journal, year, pages)	Publishers (name, city)	Available from (e.g. contact address, email address, website)	Cost £
Book*	<i>Árboles útiles de la Amazonia peruana y sus usos.</i> 2003. Carlos Reynel, Terry Pennington, Toby Pennington, César Flores, Aniceto Daza. 508 pp.		www.darwintreediversity.org	Free
Book*	<i>Relictos de Bosques de Excepcional Diversidad en los Andes Centrales del Perú</i> [Relicts of forests of exceptional diversity in the Central Peruvian Andes]. 2004. (editors: Dante Anton and Carlos Reynel)		www.darwintreediversity.org (available as pdf file at this site)	Free
Book*	<i>Illustrated Guide to the Trees of Peru.</i> 2004. Terry Pennington, Carlos Reynel, Aniceto Daza. 850 pp.	David Hunt Botanical Publications	Terry Pennington	£30/ free in Peru
CD	<i>Catalogo digital de fotos de especimenes de arboles del Perú</i>		www.darwintreediversity.org	Free
Paper	Bridgewater, S., Pennington, R.T., Reynel, C., Daza, A. & Pennington, T.D. (2003). A preliminary floristic and phytogeographic analysis of the woody flora of seasonally dry forests in northern Peru. <i>Candollea</i> 58: 129-148.		Sam Bridgewater:	Free

<i>Paper</i>	Linares-Palomino, R., Pennington, R.T. & Bridgewater, S. (2003). The phytogeography of seasonally dry tropical forests in Equatorial Pacific South America. <i>Candollea</i> 58: 473-499.	Reynaldo Linares	Free
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18. Appendix IV: Darwin Contacts

Project Title	Tree Diversity and Agroforestry Development in the Peruvian Amazon
Ref. No.	09/017
UK Leader Details	
Name	Toby Pennington
Role within Darwin Project	UK Project leader
Address	Royal Botanic Garden Edinburgh, 20a Inverletith Row, Edinburgh, EH3 5LR
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	Terry Pennington
Role within Darwin Project	Leader field research and training in Peru
Address	Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB
Phone	
Fax	
Email	
Partner 1	
Name	Dr Carlos Reynel
Organisation	Universidad Nacional Agraria, La Molina (Departamento de forestales, herbario MOL)
Website address	www.darwintreediversity.org
Role within Darwin Project	Peru project leader
Address	Facultad de Ciencia Forestales, UNALM, Apto. 456, Lima 1, Perú
Fax	
Email	
Partner 2 (if relevant)	
Name	Dr Jonathan Cornelius
Organisation	World Agroforestry Centre (ex ICRAF)
Role within Darwin Project	None during project; recently appointed programme leader for ICRAF – Peru
Address	CIP, Apto.1558, Lima12, Perú
Fax	
Email	