Building Nicaraguan and Costa Rican capacity in biodiversity conservation

Dipteryx panamensis

Darwin Initiative Final Report 2006

Project number: 162/12/020

Darwin Initiative

Final Report

1. Darwin Project Information

Project Reference No.	162/12/020
Project title	Building Nicaraguan and Costa Rican capacity in biodiversity conservation
Country	Nicaragua and Costa Rica, Central America
UK Contractor	School of Agricultural and Forest Sciences, University of Wales, Bangor
Partner Organisation (s)	INBio and CATIE, Costa Rica
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Project website	http://darwin.bangor.ac.uk
Author(s), date	Lorraine Gormley, June 2006

2. Project Background/Rationale

The project is located in the Rio San Juan border region of Costa Rica and Nicaragua, Central America. Central America is renowned as a biodiversity hotspot and harbours high species richness. In recognition of this, regional governments have designated the "Mesoamerican biological corridor", considered to be the world's most ambitious conservation initiative, as the major focus in their implementation of the Convention on Biological Diversity. The Rio San Juan border region between Costa Rica and Nicaragua is a key section of this corridor (comprising the largest rain forest area in the Americas north of the Amazon) but has received little conservation attention. Thus the project's focus on this critical "frontier forest" section of the corridor, addresses a major international conservation priority.

Although Costa Rica has a well-developed system of biodiversity inventory and conservation (e.g. through INBio), at the time of developing the project proposal there had been little coverage of the remoter northern Maquenque region, which lies within the Rio San Juan basin and where the forest was unprotected and subject to rapid conversion and fragmentation. Similarly, although a large area of intact neighbouring forest in Nicaragua had been given protected status in a new biosphere reserve it had received very little formal biodiversity assessment, or conservation management. There was an urgent need to strengthen the capacity of Nicaraguan and Costa Rican NGOs who have a major responsibility for conservation planning and management in the area.

This project therefore focused on building regional conservation capacity through training and staff exchange in biodiversity assessment in fragmented forest landscapes (an increasingly common component of the Mesoamerican biological corridor). It documented the distribution of plant and insect biodiversity within the

landscape of the Maquenque area (Costa Rica) using expertise in species identification (INBio), habitat characterisation and rapid biodiversity assessment (UWB, CATIE). The information collected through the project activities contributed to the creation of the new Maquenque National Wildlife Refuge designated in 2005 by the Costa Rican government's Department of the Environment (MINAE).

3. Project Summary

Purpose:

To build capacity in biodiversity conservation and management in Nicaragua and Costa Rica, through the facilitation of regional and international exchange of knowledge and skills.

Outputs:

1. Enhanced expertise of Nicaraguan/Costa Rican NGO staff in biodiversity assessment and protected area management.
2. Biodiversity of the La Cureña area formally described.
3. Priority habitat management plans and local tree and insect species identification guides.
4. Guidelines for national park biodiversity management plan.
5. La Cureña area given protected status by designation of a new national park.

The project has been very successful in accomplishing its objectives. We have trained 36 course participants over two courses in biodiversity identification, monitoring and evaluation and one course, additional to the original project plan, was held in permanent plot establishment and measurement (Output 1). We have established and measured 12 permanent sample plots in order to monitor plant diversity in the project area, 6502 individuals, from 343 plant species have been identified (Output 2)(Appendix VI). In addition six of these plots were utilised to carry out an inventory of dung beetles and 11900 specimens were collected and identified (Output 2) (Appendix VII). Local tree and insect species guides have been developed and are available on the project website (http://darwin.bangor.ac.uk) (Output 3). We have also developed biodiversity guidelines for the Maquenque National Wildlife Refuge (Output 4)(Appendix VIII). The area of La Cureña/Maquenque has been protected by the designation of a new wildlife reserve, the Maquenque National Wildlife Refuge, in June 2005 (Output 5). This designation was a result of wide consultation with stakeholders by the Centro Cientifico Tropical (CCT), who found that many were opposed to a national park and thus proposed the establishment of a national refuge which contains both strict conservation areas and multi-use areas. The Darwin project partners continue to be involved in the planning of conservation action in the Maquenque (La Cureña) area and has attended meetings to discuss the conservation strategy for the area. These include the management plan, further research and continued monitoring in collaboration with other organisations including the Ministry of the Environment (MINAE), the San Juan-La Selva Biological Corridor committee and the Lapa Verde Project of the CCT.

The project has contributed to a number of the Articles under the CBD. It has particularly addressed the issues covered by Articles 6, 7, 8, 12, 13 and 17.

4. Scientific, Training, and Technical Assessment

Research - this should include details of staff, methodology, findings and the extent to which research findings have been subject to peer review.

Summary

We have established 12 permanent sample plots (PSPs) in the Maquenque Mixed National Wildlife Refuge and completed plant and insect inventories in Maquenque , Costa Rica and also in the Bartola Refuge, Nicaragua, a private reserve which adjoins the Reserva Indio Maiz, the largest forest area in the Americas outwith the Amazon basin. Both are a part of the Mesoamerican Biological Corridor. A total of 6503 trees from 333 species were measured and identified within the 12 PSPs and over the area the plant species inventory carried out by the project has increased the species list to 863 plant species.

Five plant species new to science have been found and described by the project (Gesneriaceae: *Drymonia glandulosa* Kriebel, *Drymonia rubripilosa* Kriebel; Symplocaceae: *Symplocos striata* Kriebel and N. Zamora; Chrysobalanaceae: *Licania arachicarpa* N. Zamora; Fabaceae: *Swartzia maquenqueana* N. Zamora and D. Solano) (Appendix III) and during fieldwork in Nicaragua 12 plant species were found which were new records for Nicaragua (Rubiaceae: *Alseis costaricensis* C.M. Taylor; Bombacaeae: *Ceiba rosea* (Seem.) K. Schum; Dichapetalaceae: *Dichapetalum moralesii* Prance; Myrtaceae: *Eugenia basilaris* McVaugh; Lauraceae: *Licaria debilis* (Mez) Kosterm; Celastraceae: *Maytenus guyanensis* Klotzsch; Sapotaceae: *Pouteria silvestris* T.D. Penn, *Pradosia atroviolacea* Ducke; Lepidobotryaceae: *Ruptiliocarpon caracolito* Hammel and N. Zamora; Vochysiaceae: *Vochysia allenii* Standl. and L.O. Williams.

Based on six of the PSPs, sample grids for dung beetles were established and 1430 pitfall traps set. From these traps 11900 specimens from 38 species have been collected and identified. In addition, course participants have completed biodiversity projects utilising the knowledge gained during the Darwin project courses and the MSc student funded by the project has completed the taught portion of her course and is now working on the research for her thesis. Plant and insect web guides have been published online (http://darwin.bangor.ac.uk) and a series of laminated ID cards of the 50 most important species for conservation in the area are currently being published (see Appendix III for an example).

Establishment of a system of permanent sample plots and plant diversity assessment

In order to carry out long term monitoring of plant diversity in Maquenque, we established 12 permanent sample plots (PSPs)(6 more than originally planned for the project). On the basis of existing knowledge of variation in forest composition over the landscape we sought to sample a major floristic division observed in the forests – between those to the west dominated by *Pentaclethra macroloba* and those to the east in which the importance of this species is considerably reduced. Six sites were therefore selected in each of two areas of Maquenque, three each in logged and unlogged forest within each area. Site selection was subjective based on the following criteria. The study area is divided among a large number of relatively small private properties, often with complex histories of ownership and logging. The willingness of owners to permit research on their land, potentially for a period of many years, was a precondition to site selection. Similarly, in the case of logged forests, we sought sites with an officially-approved forest management plan that would provide as much information as possible on logging history, even though many sites may have been selectively logged before legally-sanctioned management was

implemented. For both these reasons, we selected sites whose owners had current agreements for forest management (either for production or for environmental service payments) with the Commission for Forestry Development in San Carlos (CODEFORSA), a natural resource management NGO.

A single 100 m x 100 m permanent sample plot (PSP) was installed at each of the twelve sites. In order to avoid edge effects on stand characteristics, plots were located at least 150 m from forest edges and log landings. Exact plot location was determined using randomly-selected distances from a point 150 m into the forest, this point being located either from a random point along the forest edge or the most convenient entrance to the forest; swamps and riparian areas were avoided and the random location procedure repeated if they were encountered. The geographical location of all plots was determined by GPS, either directly within the plot or by measurement with compass and tape from the nearest possible GPS point. PSP techniques were essentially those described by Finegan and Camacho (1999), which were in turn derived from Alder and Synnott (1992). Each plot was divided into 20 m x 20 m subplots to facilitate the location of trees. Between November 2004 and May 2005, the stem diameter at breast height (dbh = 1.3 m) was measured for all trees, palms and lianas with dbh $\geq$10 cm. For buttressed trees or those with a deformation at 1.3 m, the point of measurement was moved 20 cm above the end of the buttress or deformation. The height of points of measurement moved in this way was measured to the nearest cm. Botanical identification was carried out by the following procedure. An experienced field worker, Marvin Zamora, identified species on a previously-defined list using scientific names supplied by coauthor Nelson Zamora from the ongoing Manual of Costa Rican Plants. All other species were identified by Nelson Zamora and an assistant, Daniel Solano, directly during fieldwork or through herbarium study of specimens, mostly sterile, taken in the plots.

These samples have enabled us to characterise the structure, composition and diversity of the community of trees, arborescent palms and lianas in old-growth forest on well-drained soils in the Maquenque Refuge, and identify landscape-scale spatial pattern in these community characteristics and the factors related to it. Our sampling design sought specifically to detect the effects of intrinsic factors – geographical location (and correlated environmental variation, not measured directly) – and human impacts – selective logging – on forest stand characteristics. They will also enable long term monitoring of forest diversity and dynamics in this newly designated protected area which will be crucial in its conservation management. Appendix VI details the analyses of these data.

Dung beetle diversity in the Maquenque Refuge

Coprophagous beetles (Coleoptera: Scaraebidae; subfamily Scarabaeinae) are important forest ecosystem components: as decomposers, they participate in the reincorporation of soil nutrients by feeding on and burying excrement; they contribute to the soil's water penetration and aeration through tunnel construction; they also disperse seeds and can be important agents in destroying larvae and eggs of flies and other vertebrate parasite organisms. Beetles possess high species diversity showing varied requirements from specialists to generalists with great sensitivity to environmental variability. Furthermore, they are a relatively easy group to collect and they are well known in Costa Rica, with a clear species level taxonomy, thanks to taxonomy studies conducted in recent years. Because of these and other characteristics, coprophagous beetles have been frequently designated as appropriate to be used as biodiversity and ecological indicators. Many studies have been published showing the effect of anthropogenic intervention on ecosystems, which is reflected by the coprophagous beetle communities in these ecosystems. The effect of diversity reduction and structural changes (mainly species richness and

abundance) due to deforestation, fragmentation, selective cutting and other diverse natural environment modifications upon the beetle communities has been documented in these works.

The dung beetle biodiversity inventory carried out within the project studied communities through diversity analysis at local community level (*alpha diversity*), and also between communities within the Maquenque Refuge (*beta diversity*). Coprophagous beetles were assessed as indicators in six different forest plots (based around the plant inventory PSPs) and one pasture plot. All sites were distributed within the Maquenque Mixed National Wildlife Refuge (MMNWR). Biodiversity was also characterized through the analysis of the geographic distribution of beetle species found. The objective of this research was to provide information of the current state of the MMNWR's biodiversity, using as reference some specific sites within its boundaries to determine if anthropogenic disturbance affects community diversity, and at the same time to set the basis for future monitoring, and to conduct further comparative and complementary studies in other sites within the Refuge.

During the months of January - October, 2005, the six chosen forest plots were visited three times during the year, with a period of three months between one visit and the next. During each visit, 80 pit traps were installed, each one consisting of a 300 ml plastic cup, buried with its top at surface level, containing 100 ml water and barley plus 10 ml of pig excrement which was placed in a plastic spoon. This was fixed to the ground by its handle, leaving the bait no less than 3 cm over the centre of the buried cup's mouth. To avoid flooding, each trap was covered with three wide understory plant leaves (palms of *Calyptrogyne*, *Geonoma*, or *Bactris* genus, or dicots of *Heliconia* or *Calathea* genus) in a bended position with their petioles buried near each trap. Traps were placed in four subsets. The four traps of each subset were arranged in the corners of a 2 m x 2 m square. Trap subsets were arranged every 40 m in a 120 m x 160 m grid, giving a total of 20 subsets per grid. Traps were set during the morning and left there for a period of 48 hours, after which they were removed and beetles collected. Captured specimens in each subset of four traps were placed together in plastic bags with alcohol and tagged. In November 2005, 80 additional traps were installed, also in subsets of four traps in two pasture areas combined with *Gmelina arborea* and *Eucalyptus* sp trees. A total of 1520 traps were installed during the year, plus 380 trapping replicates, 60 for each forest and 20 for the pasture (subsets of four traps).

Sampled beetles were separated, identified and quantified to species level. They were also categorized by size (<13 mm small; > 13 mm large) and by their behaviour when building their nests (dung beetles, tunnel diggers and endocoprids), following the same functional groups classification used by several authors, where diggers are beetles that build their nests digging tunnels under the food source; endocoprids build their nests inside their food sources and dung beetles take pieces of food and roll them, going away to then build their nests and bury them. Furthermore, according to information available on species beetles were characterised according to their geographical distribution. One to five specimens, representing each species found in each forest and at each date, were mounted on pins, duly tagged. These are kept in the collections of the Instituto Nacional de Biodiversidad de Costa Rica. Results and analyses of this work are presented in Appendix VII.

Rapid biodiversity assessment of plant and insect species, Maquenque

Project staff carried out 12 field trips to Maquenque in order to undertake inventories of plant and insects. A total of 3769 dung beetles (Subfamily Scarabaeinae) were collected and most identified to species level. These data have been added to the

INBio database. The plant inventory has resulted in a plant species list for the area of 863 species, a voucher specimen has been collected for each species and stored in the INBio Herbarium. At least seven rare species have been collected that were previously unknown in the area and three species new to science have been discovered and described (Appendix IX).

Plant diversity in the Refugio Bartola, Rio San Juan, Nicaragua

We utilised the Alwyn H. Gentry Forest Transect methodology to collect data on plant diversity in the Refugio Bartola. Course participants and instructors as part of the second project training course carried out a field assessment of the forest before selecting two distinct sample areas (based on botanical and topographical criteria). We then laid three principal transects of 100 m, in each of the two areas, and then 10 sub-transects of 50 m separated by 10 m were laid perpendicularly to the principal transects. In each of these sub-transects all individuals with a diameter at breast height (DBH) greater than 2.5 cm found within 1 m either side of the transect were measured. For each new morphospecies a sample was collected and labelled numerically.

In total we measured and identified 1549 plants of 278 species. Within this inventory we found 12 species of plants which were new records for Nicaragua and had not been included in the recently published Flora of Nicaragua (Stevens et al. 2001). These findings are very important within the context of the Mesoamerican Biological Corridor and the Rio San Juan Basin. Our plant inventory has produced some of the first data on plant diversity within the buffer zone of the Reserva Indio Maiz.

Insect diversity in the Refugio Bartola, Rio San Juan, Nicaragua

Within the context of the project we sampled dung beetles in the Refugio Bartola as part of the second training course in order to assess the insect diversity of the area and also to teach the course participants the methodologies for doing this.

In order to sample the dung beetles, we utilised the transects laid for the botanical assessment. In each of the two forest areas sampled we utilised the three principal transects as guides and laid 20 sample points separated by at least 40 m. At each point we set four pitfall traps in a 2 m x 2 m square and baited with pig excrement. The traps were left for 48 hours. The beetles collected were identified to species. In total we collected 1666 individuals of 26 species.

'Exchange of research experiences in the Huetar Norte Conservation Area (including Maquenque)' Workshop, December 2004

This workshop was organised in order to share experiences in the ongoing research that is occurring in the Maquenque area. INBio, our project partner, has a joint program with the Costa Rican National System of Conservation Areas (SINAC), which is part of the Ministry of the Environment (MINAE), to assist in the monitoring of biodiversity in Maquenque. The Darwin project is an integral part of this and the current work of the Darwin project was presented at this workshop by Nelson Zamora. Bryan Finegan, CATIE, another project partner, also presented the results of ongoing research into the use of geospatial data in mapping and monitoring floristic diversity in the San Juan-La Selva Biological Corridor (of which Maquenque is a part). The report of the workshop is in Appendix 3.

Training and capacity building activities

'Identification, evaluation and monitoring of biodiversity' courses, February 2004 and February 2005

The first 'Identification, evaluation and monitoring of biodiversity' course was held in February 2004. The course was held in INBio, Santo Domingo, Costa Rica with the field component being carried out in Boca Tapada, La Cureña within the, at the time proposed, Maquenque Wildlife Refuge. The second course was held in the Refugio Bartola, Nicaragua. Both courses covered both the theory and practise of biodiversity assessment. Appendix X details the course programmes, methodologies, biodiversity data collected and the reports from the course participants.

The general objective of the courses was to strengthen knowledge and capacity of personnel from non-governmental organisations (NGOs), government organisations (GOs) and academic institutes in Nicaragua and Costa Rica in the evaluation, conservation and management of natural forest biodiversity. The trainees were selected according to the strength of their CVs and the relevance of their work to the conservation of the project area. Eleven trainees attended the first course and fifteen trainees attended the second course from a variety of Nicaraguan and Costa Rican NGOs, academic institutions and government organisations (Appendix X).
The specific objectives were:

1. To generate information about insect and plant communities in the forests of the Rio San Juan basin, part of the Mesoamerican Biological Corridor, Nicaragua and Costa Rica,
2. To build the capacity of conservation staff in collecting, analysing and interpreting this information,
3. To build the capacity of conservation staff in biodiversity evaluation

'Utilisation of Permanent Sample Plots in Natural Forest for Studies of Plant Biodiversity' Course, December 2004

The general objective of this course was: to strengthen the knowledge of conservation professionals in the monitoring of plant biodiversity using permanent sample plots (PSPs).

The specific objectives were:

1. To emphasise the importance of information generated by PSP studies in strengthening conservation efforts,
2. To strengthen criteria for decision making in the design of plant biodiversity studies using PSPs,
3. To build capacity in techniques for the establishment and maintenance of PSPs in the field,
4. To build capacity in information collection and analysis from PSPs,
5. To emphasis the importance of reliable taxonomic information in biodiversity monitoring using PSPs.

The course was held in December 2004, with a theoretical section carried out in INBio and a practical section carried out in the Maquenque area. The course covered the theory and practice of setting up a system of permanent sample plots in order to measure plant diversity and to monitor forest dynamics over the longer term. Course

participants were also taught how to analyse the data generated from PSPs. Other related subjects were covered including forest dynamics, the impact of humans on tropical forest, plant identification and biodiversity database management. Course participants were also given a tour of the Herbarium in INBio. A total of ten trainees attended the course, some from our partner institutes of INBio and CATIE and others from the Nicaraguan NGOS of FUNDAR and VIDA. Appendix XI details the course programme and the participants.

CATIE MSc student

Dalia Sanchez, a member of staff with Cocibolca, a Nicaragua conservation NGO, started her MSc programme in CATIE in January 2005. She is currently finishing the research component of her work and her research proposal is attached in Appendix XII. In addition, she recently held a workshop to disseminate her research (Appendix XII).

5. Project Impacts

The project has trained local staff in skills needed to contribute to the conservation of an internationally important area of the Mesoamerican Biological Corridor. It has also supported and facilitated a bi-national process through the bringing together of conservation organisations from both Costa Rica and Nicaragua during project workshops and meetings. These relationships have been strengthened by the project and will continue now that the project has finished. A comprehensive inventory of plants and beetles has been carried out providing some of the first biodiversity data for the area. The project has also greatly strengthened the working relationship between CATIE, INBio and University of Wales Bangor, and other organisations such as CCT (Lapa Verde project) and the San Juan - La Selva Biological Corridor Committee which will enhance ongoing conservation work in the Maquenque area. In addition, we have forged stronger links with Nicaraguan institutions including the University of Leon and URRACAN as well as local Nicaraguan NGOs, Fundar and Fundacion del Rio.

The project has supported both Costa Rica and Nicaragua in its obligations to the Biodiversity Convention, particularly in Articles 6,7,8,12,13 and 17:

Article 6 - **General measures for conservation and sustainable use**: The project has developed management guidelines for the Maquenque Mixed National Wildlife Refuge which are based on plant and insect biodiversity data collected by the project.

Article 7 - **Identification and monitoring**: The project has established 12 permanent sample plots which will be used to monitor biodiversity in the newly designated Maquenque Mixed National Wildlife Refuge. Baseline plant data has been collected for 6502 individuals from 343 species and beetle data totalling 11900 individuals from 38 species. In addition, plant and insect inventories have been carried out during 12 field trips. Overall, this has provided a list of plants for the Maquenque area totalling 965 species and a gallery of approximately 1000 images (see project webpage). Voucher specimens of all the plants and beetles collected have been prepared and are stored in INBio, Costa Rica. A database of these data is also held at INBio.

Article 8 - **In-situ conservation**: The project has contributed to the creation and management of a new wildlife refuge in an area of Costa Rica which had no protected area status. It has produced management guidelines for priority

biodiversity areas and has been actively involved in the El Castillo-San Juan-La Selva Biological Corridor Initiative which is facilitating the conservation of an area of the San Juan river basin in the north of Costa Rica (which includes the Maquenque area) and in the south of Nicaragua of the internationally important Mesoamerica Biological Corridor.

Article 12 - **Research and training**: the project has held three training courses in biodiversity conservation. Two courses focussed on the identification, evaluation and monitoring of biodiversity and one focussed on the establishment and utilisation of permanent sample plots (PSPs) in natural forest to study plant biodiversity. We also established and measure 12 PSPs and the wealth of plant and insect data collected from these has been analysed in two technical reports which form the basis for two scientific papers. The plant data, in addition to its use in conservation monitoring, has been used to investigate the effects of geographical location and selective logging on forest stand characteristics. Much of this information has been included on the management guidelines for the new Maquenque refuge.

Article 13 - **Public education and awareness**: The project has involved a range of organisations in its training courses. These include Nicaraguan and Costa Rican conservation NGOs (Fundacion del Rio, Fundacion Amigos del Rio San Juan, CODEFORSA, IREMADES, Asociacion GAIA), Nicaraguan and Costa Rican universities (University of Leon, Nicaragua; National Autonomous University of Nicaragua; URRACAN, Nicaragua; National University, Costa Rica) and the environment ministries of both countries (MINAE, Costa Rica and MARENA, Nicaragua). The resulting capacity building has improved their ability to promote biodiversity conservation to a wider audience. In addition, the projects activities have been made public through both the UK and Central American press.

Article 17 - **Exchange of information**: The project has facilitated information exchange within the San Juan River basin between Costa Rican and Nicaraguan organisations. in addition, much of the biodiversity information collected is available to anyone interested on the project web page.

The personnel trained on the project's training courses were all selected from organisations, both non-governmental and governmental, that are key in the conservation of the San Juan River basin area of Costa Rica and Nicaragua. The majority of the personnel are still working with the same organisations and making a great contribution to the management of these areas.

In terms of collaboration between local partners and the UK partner, our relationship has been greatly strengthened by the project and indeed the project has been catalyst for the development of other projects. As the project has contributed to the establishment of a new wildlife refuge in Costa Rica, this will also contribute to local peoples' livelihoods in the form of increased income from ecotourism in the area.

6. Project Outputs

Please refer to Appendices II and III for details of project outputs, publications and material that can be publicly accessed. Project outputs have been disseminated through our project web page and local press. We have participated in meetings to share our project experiences with others working in the area and the final project workshop included participants from a wide range of national conservation NGOs and GOs (Appendix XIII). In addition, we have published three peer reviewed articles and at least three more are in preparation. These will disseminate the project results

to an international audience. Work will continue to disseminate project results now the project has finished with staff in UWB, INBio and CATIE currently carrying out further analyses on the data collected during the project. These institutes will bear the cost of this further information dissemination.

4. Project Expenditure

Item	*Budget (please indicate which document you refer to if other than your project schedule)*	*Expenditure*	*Balance*

8. Project Operation and Partnerships

UWB, INBio and CATIE were the main project partners as initially planned in the project proposal. The number of other local organisations involved in project activities was greater then initially planned and widened the impact of the project. A total of 7 NGOs (FUNDAR, Fundacion del Rio, CODEFORSA, Cocibolca, CECOS, IREMADES, Asociacion GAIA), 2 GOs (MINAE and MARENA) and 8 academic institutes (UWB, Wales; INBio, Costa Rica; CATIE, Costa Rica; University of Leon, Nicaragua; National Autonomous University of Nicaragua; URRACAN; Museo Entomologico Leon, Nicaragua; National University, Costa Rica) were involved in the project. The three main partners were involved in project planning and implementation during regular project meetings.

Local and international partnerships continue to be active now that the project has finished. Their contribution to conservation in the project area will continue and it is hoped that further funding will be secured to build on project outcomes.

9. Monitoring and Evaluation, Lesson learning

In order to effectively monitor and evaluate project activities, project partners were in regular email and telephone contact. In addition regular meetings were held including all partners to discuss and refine project activities. In addition, participants in both

the training courses held in Year 2 of the project were given evaluation forms. The feedback from these can be seen in Appendix X. The publication of peer reviewed papers of new species found during project fieldwork also serve as an independent evaluation of project work (Appendix IX). A large part of project activities involved the collection of comprehensive baseline data for biodiversity in the project area. This information had never previously been colleted and its existence, analysis and dissemination demonstrate the value of this aspect of the project.

During the three years of the project very few problems were encountered. In Year 1 of the project it became evident that the original number of weeks of training stated in the proposal would be difficult to achieve due to the difficulty that NGO staff had in securing this much time away from their everyday duties. This did not reflect reduced commitment to the project by trainees and their organisations but simply the workload that course participants have to carry out within their everyday jobs. As a result of these lessons learned we revised the programme of capacity building courses in Year 2. Instead of one capacity building course, we held two courses which focussed on different aspects of biodiversity conservation. The first addressed the setting up of a system of permanent sample plots and the collecting and analyses of the data from these, while the second was a continuation of the Year 1 'Biodiversity evaluation, monitoring and identification' course.

We minimised the effect of this change by ensuring that all course participants had time in the field carrying out plant and insect inventory during the courses and by planning individual projects with the trainees which they carried out as hands on experience in their own time after the taught course was completed. This involved independent fieldwork and was followed by a week in INBio and CATIE to analyse and consolidate their work with project staff support and produce a final report.

10. Actions taken in response to annual report reviews (if applicable)

We have discussed and adopted many of the recommendations made in the reviews of our year 1 and 2 Annual report. The principal action that we took as a result of the Year 1 review, coupled with the lessons learned in the first year of the project, was to hold two capacity building courses instead of one. We focused on different aspects of biodiversity monitoring in each course, thus attracting different course participants for each course and reducing the issue of course participants' difficulty in securing time away from their everyday posts.

Our second annual report review made a number of recommendations regarding the sustainability of the project. After discussion with the main project partners we have ensured that the recommendations have been followed in the project plan by: (1) ensuring that the material produced for the training courses is stored and available to all project partners and collaborators to hold further courses (subject to funding); (2) planning the long term monitoring of the PSPs. Long term monitoring in various forest sites in Costa Rica is carried out by CATIE and it is planned to include the Maquenque sites in their monitoring; (3) voucher specimens of the plants and insects collected during the projects' rapid biodiversity assessments and PSP monitoring are held in INBio and available on request. Information from the INBio database where the inventory results are stored is also publicly accessible. These will be managed for the long term by INBio; (4) strengthening links between the main partner institutes and also extending these links to a number of other NGOs and government agencies. This collaboration will continue particularly with respect to the project area and the final project workshop (Appendix XIII) brought together these stakeholders in order to consolidate the incorporation of project outputs into the conservation

management of the new refuge in Maquenque.

11. Darwin Identity

The Darwin Initiative was publicised throughout the duration of the project through use of the Darwin Logo on all project publications, including the training course material, the management guidelines, and identification guides which have and will be widely disseminated. Particularly within the project area the project and its participating institutes was known to be providing essential local training and baseline biodiversity information for the new refuge. The project had a distinct identity and role in providing training, information and establishing crucial systems for long term monitoring within the larger Maquenque conservation initiative.

12. Leverage

A recently approved UWB/CATIE EU FP6 INCO/DEV project entitled 'Working group on evaluation and synthesis of information on tree cover and biodiversity along the Mesoamercian Biological Corridor' is ongoing and will build on work carried out by the Darwin project. UK project staff worked with project partner institutes to develop this proposal.

13. Sustainability and Legacy

The project outputs, almost without exception, will endure now that the project has finished. The professionals trained in biodiversity conservation will continue to contribute to conservation in the project area, the tree and insect guides will be accessible on the webpage and the plant ID cards available in INBio and distributed to academic bookshops and tourist outlets/venues. The plant and insect biodiversity information will continue to be used in the conservation planning of the Maquenque refuge by the park's committee. Partners are continuing to work together on another project and hope to lever further funding to continue working in the Nicaraguan side of the El Castillo – San Juan – La Selva Biological Corridor. The MSc student funded by the project is carrying out research to improve conservation planning in another crucial area of the Mesoamerican Biological Corridor in Nicaragua (Appendix XII).

14. Value for money

The project represented very good value for money. It trained conservation professionals from two countries in biodiversity evaluation, identification and monitoring. The trainees will continue to work in the conservation of an internationally important section of the Mesoamerican Biological Corridor therefore extending the influence of the original project. Plant and insect species guides will be used beyond the project finish date and are widely accessible. They are also relevant to other areas of Costa Rica and Nicaragua and will be a key reference for conservation in the San Juan River basin as a whole.

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

Please complete the table below to show the extent of project contribution to the different measures for biodiversity conservation defined in the CBD Articles. This will enable us to tie Darwin projects more directly into CBD areas and to see if the underlying objective of the Darwin Initiative has been met. We have focused on CBD Articles that are most relevant to biodiversity conservation initiatives by small projects in developing countries. However, certain Articles have been omitted where they apply across the board. Where there is overlap between measures described by two different Articles, allocate the % to the most appropriate one.

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	25 %	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	25 %	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		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		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	25 %	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	10 %	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 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.
Total %	**100%**	**Check % = total 100**

16. Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
1a	Number of people to submit PhD thesis	
1b	Number of PhD qualifications obtained	
2	Number of Masters qualifications obtained	1 (thesis still to be completed)
3	Number of other qualifications obtained	
4a	Number of undergraduate students receiving training	
4b	Number of training weeks provided to undergraduate students	
4c	Number of postgraduate students receiving training (not 1-3 above)	
4d	Number of training weeks for postgraduate students	
5	Number of people receiving other forms of **long-term** (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	
6a	Number of people receiving other forms of **short-term** education/training (i.e not categories 1-5 above)	40 (NGO, GO and academic institute staff)
6b	Number of training weeks not leading to formal qualification	6 weeks (2 x two week courses in evaluation, monitoring and identification of biodiversity, 1 x one week course in permanent sample plot establishment and measurement, 1x 1 week follow up course.)
7	Number of types of training materials produced for use by host country(s)	3 (course material, species lists and identification guides on web page, plant species ID cards)
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	20 weeks
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 (biodiversity guidelines and a technical publication based on the PSP data to guide refuge management)
10	Number of formal documents produced to assist work related to species identification, classification and recording.	4
11a	Number of papers published or accepted for publication in peer reviewed journals	3 (with a further 3 in prep.)
11b	Number of papers published or accepted for publication elsewhere	
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	2
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	2

13a	Number of species reference collections established and handed over to host country(s)	2
13b	Number of species reference collections enhanced and handed over to host country(s)	2

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	2 (Final project workshop in Costa Rica and on-going research workshop in Nicaragua)
14b	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	3 (British Ecological Society Annual Meeting, UK 2005, oral paper and poster presented; IX Congreso Latinoamericano de Botánica, República Dominicana 2006, poster presented)
15a	Number of national press releases or publicity articles in host country(s)	3
15b	Number of local press releases or publicity articles in host country(s)	
15c	Number of national press releases or publicity articles in UK	1
15d	Number of local press releases or publicity articles in UK	1
16a	Number of issues of newsletters produced in the host country(s)	4
16b	Estimated circulation of each newsletter in the host country(s)	50
16c	Estimated circulation of each newsletter in the UK	
17a	Number of dissemination networks established	
17b	Number of dissemination networks enhanced or extended	2
18a	Number of national TV programmes/features in host country(s)	
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 Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	£6650
21	Number of permanent educational/training/research facilities or organisation established	
22	Number of permanent field plots established	12
23	Value of additional resources raised for project	£48,200

17. Appendix III: Publications

Provide full details of all publications and material that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Details will be recorded on the Darwin Monitoring Website Publications Database that is currently being compiled.

Mark (*) all publications and other material that you have included with this report

Type * (e.g. journals, manual, CDs)	**Detail** (title, author, year)	**Publishers** (name, city)	**Available from** (e.g. contact address, website)	**Cost £**
Journal *	*Symplocos striata* (Symplocaceae), una especie nueva de la vertiente Caribe de Costa Rica, Kriebel, R. and Zamora, N., 2004	Lankesteriana 4(3): 171-174	Nelson Zamora, INBio	
Journal *	Una nueva especies y un nuevo registro de *Drymonia* (Gesneriaceae) en Costa Rica. Kriebel, R., 2005	Lankesteriana 5(1): 81-83	Nelson Zamora, INBio	
Journal *	A new species and notes on *Drymonia* (Gesneriaceae) from Costa Rica. Kriebel, R., 2006	Novon 16:65-68	Nelson Zamora, INBio	
Journal *	Una nueva especie de *Swartzia* Schreb. (Fabaceae), del Refugio Nacional de Vida Silvestre Mixto Maquenque, Costa Rica. Zamora, N. and Solano, D.	In preparation.	Nelson Zamora, INBio	
Web page	Guide to the Dung Beetles of the Maquenque Mixed National Wildlife Refuge, Costa Rica	http://darwin. bangor.ac.uk	Available online	
Web page	Photographic Species Guide to the Plants of the Maquenque Mixed National Wildlife Refuge, Costa Rica	http://darwin. bangor.ac.uk	Available online	
Technical report	Lineamientos para la conservación de la biodiversidad en el Refugio Nacional de Vida Silvestre Mixto Maquenque	Project partners	Bryan Finegan, CATIE	

	(RNVSMM), Costa Rica			
Technical report	Effects of geographical location and selective logging on stand characteristics of Costa Rican lowland rain forest in a regionally important conservation area.	Project partners	Bryan Finegan, CATIE	

18. Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	Building Nicaraguan and Costa Rican capacity in biodiversity conservation
Ref. No.	**162/12/020**
UK Leader Details	
Name	Dr Lorraine Gormley
Role within Darwin Project	Project Leader
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Fax	
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Other UK Contact (if relevant)	
Name	Dr John Healey and Dr Fergus Sinclair
Role within Darwin Project	Co-Principal Investigators
Address	School of Agricultural and Forest Sciences University of Wales Bangor Gwynedd, LL57 2UW
Phone	
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Partner 1	
Name	Nelson Zamora
Organisation	INBio
Role within Darwin Project	Project Leader in INBio
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Fax	
Email	
Partner 2 (if relevant)	
Name	Dr Bryan Finegan
Organisation	CATIE
Role within Darwin Project	Project Leader in CATIE
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Fax	
Email	

Appendix V Report of project achievements against Logical Framework

Project summary	Measurable Indicators	Progress and Achievements April 2004-Mar 2005
Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources		
Purpose (insert original project purpose statement) Capacity built in biodiversity conservation and management in Nicaragua and Costa Rica, through the facilitation of regional and international exchange of knowledge and skills.	(insert original purpose level indicators) • Increased NGO capacity in biodiversity conservation and management. • Improved biodiversity assessment and monitoring in both Nicaragua and Costa Rica (Rio San Juan basin). • Documentation and learning materials available to Central American NGOs/institutions	(report impacts and achievements resulting from the project against purpose indicators – if any) • NGO capacity increased as a result of biodiversity inventory, monitoring and evaluation course and permanent sample plot course. • The increased capacity provided by project training is contributing to improved biodiversity assessment in both Nicaragua and Costa Rica. In addition the monitoring of the 12 PSPs established by the project has and will provide essential plant and insect biodiversity information for managing this area. Biodiversity guidelines for the management of the refuge have also been produced. • Course documentation and learning materials have been produced and distributed as part of the capacity building courses. Plant and insect web guides have been published online (http://darwin.bangor.ac.uk) and a series of laminated ID cards of the 50 most important species for conservation in the area are currently being published.

Outputs		
(insert original outputs – one per line)	(insert original output level indicators)	(report completed activities and outcomes that contribute toward outputs and indicators)
1. Enhanced expertise of Nicaraguan/Costa Rican NGO staff in biodiversity assessment & protected area management.	1. Increased quality and quantity of NGO biodiversity assessment and conservation work.	Nicaraguan and Costa Rican NGO and government staff have increased expertise in biodiversity conservation as a result of project training in inventory, biodiversity evaluation and monitoring, and in the establishment and measurement of permanent sample plots (PSPs).
2. Biodiversity of the La Cureña/Maquenque area formally described	2. Report (identifying priority habitats/species) and species database produced and in use; two international peer-reviewed papers.	Inventory of plants and insects in the La Cureña/Maquenque area complete. Permanent sample plots (PSPs) established and measured, identification of species within plots completed. Species database produced and continually updated. Three international peer reviewed papers published, with three more in preparation. Plant and insect databases produced and voucher specimens of all beetle and plant species held in INBio. 'Guidelines for the Management of Biodiversity in the Maquenque Mixed National Wildlife Reserve' produced.
3. Priority habitat management plans and local tree and insect species identification guides.	3. Management plans and identification guides produced and in use by local NGOs and institutions.	Plant and insect web guides have been published online (http://darwin.bangor.ac.uk) and a series of laminated ID cards of the 50 most important species for conservation in the area are currently being published. Priority habitat management planning has been included in 'Guidelines for the Management of Biodiversity in the Maquenque Mixed National Wildlife Reserve' in order to support the existing management planning initiative which is led by the Committee of the San Juan-La Selva Biological Corridor and the Tropical Science Center (CCT)

4. Guidelines for national park biodiversity management plan.	4. Guidelines produced and in use by MINAE and CODEFORSA.	Guidelines for the Management of Biodiversity in the Maquenque Mixed National Wildlife Reserve' produced and disseminated to the Committee of the San Juan-La Selva Biological Corridor which consists of 16 NGOs (including CODEFORSA) and conservation initiatives.
5. La Cureña (Maquenque) area given protected status by designation of a new national park.	5. National park created	The project collaborated with key stakeholders (Committee of the San Juan-La Selva Biological Corridor; CCT; MINAE), and contributed important baseline biodiversity information, during the designation process of the Maquenque Mixed National Wildlife Refuge (June 2005). The designation of 'refuge' was a result of wide consultation with local stakeholders by the Centro Cientifico Tropical (CCT), who found that many were opposed to a national park and thus proposed the establishment of a national refuge which contains both strict conservation areas and multi-use areas.

Appendix IX

Publication of new species

and

An example of the ‘Indicator plant species for the conservation of the Maquenque Mixed National Wildlife Refuge’ species identification guides