PLANT ENDEMISM OF THE CENTRAL ANDEAN VALLEYS, BOLIVIA

DARWIN INITIATIVE FINAL REPORT
FOR 1 OCTOBER 2002- 28 FEBRUARY 2006

DEPARTMENT OF PLANT SCIENCES
UNIVERSITY OF OXFORD

Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project Ref. Number	162/11/010
Project Title	Plant Endemism of the Central Andean Valleys of Bolivia
Country(ies)	Bolivia
UK Contractor	Department of Plant Sciences, University of Oxford
Partner Organisation(s)	Herbario Nacional de Bolivia, La Paz (principal partner) Herbario Nacional Forestal "Martin Cardenas", Cochabamba Herbario del Oriente, Museo "Noel Kempff Mercado", Santa Cruz Herbario de Chuquisaca, Sucre
Darwin Grant Value	£187,866
Start/End dates	1 October 2002 – 28 February 2006
Project website	*N/A*
Author(s), date	*John R. I. Wood with contributions from Robert Scotland and Colin Hughes*

2. Project Background

Bolivia is a country of great plant diversity having a total flora of some 15,000 species but is perhaps botanically the least explored country in the neotropics. There are only embryonic herbarium and botanical resources; the national herbarium itself is only about 25 years old and others are newer still. Expertise is still very limited and few Bolivian botanists have studied at postgraduate level or have published original papers. Bolivia is also the poorest country in South America with a long history of political instability and has few resources to devote to biodiversity studies or conservation.

Most conservation efforts in Bolivia have till now been centred on the moist tropical forests in the Andean foothills and Amazonian lowlands, and it is in these areas that most protected areas are located. The essential premise of the project is that

the drier, central Andean valleys are relatively neglected both in terms of research and of conservation, and that they contain rich biodiversity and important centres of plant endemism. The area of the project's work is essentially the Andean basin of the Rio Grande and its tributaries but we have also looked superficially at the series of inter-Andean valleys lying between this area and the Peruvian border.

This area contains several of the country's major centres of population including Cochabamba and the legal capital, Sucre, while the two largest cities, La Paz and Santa Cruz lie at the edge of the project area. While this clearly increases the potential threat to the biodiversity of the project area and the urgency of identifying key areas for protection, it also means that all four established herbaria, our partner institutions in Bolivia, have a close interest in our area of study. These institutions are all relatively new and have few resources. They have almost no tradition of taxonomic research, which remains largely the preserve of non-Bolivians to this day.

In view of the near absence of protected areas within the inter-Andean valley system the project aimed to identify hotspots with concentrations of endemic species. The idea was to provide scientific justification for selecting specific areas for conservation, and to present recommendations to the national authorities, specifically the Dirección General de Biodiversidad. In order to achieve this the project needed to address a number of additional problems including lack of botanical exploration in the project area, the scarcity of taxonomic skills among Bolivian botanists and the lack of public awareness of the rich endemic flora of the Inter-Andean valleys.

The need for the project arose out of discussions between Stephan Beck and John Wood, both of whom had lived and worked in Bolivia for many years. When they discussed the situation and the need with the then Director General of Biodiversity, Dr Mario Boudouin, and with the representatives of the regional herbaria in Bolivia, the idea was endorsed enthusiastically by all parties. Subsequently all four institutions entered into agreements with Oxford University and all are anxious that the project is extended into a follow-up stage. Additional indications of the commitment of our local partners can be seen in their provision of office space and facilities as well as staff time. There has never been any doubt about the commitment of any of our four local partners and this commitment is even stronger as the project draws to its close.

3. Project Summary

3.1 The project purpose and outputs are set out in the attached logical framework. This has not been formally modified but one reviewer has suggested that "enhanced herbarium capacity" should be treated as an output rather than an activity and it is so treated in the discussion below.

3.2 There has been no change in the original objectives and only minor changes in the timing of the operational plan. The two principal changes were both approved about a year in advance by the Darwin secretariat. The first of these related to the timing of UK training. It was agreed that Bolivian botanists would come for UK training in the summers of 2004 and 2005, rather than in 2003 and 2004. The reason was to allow sufficient time for the identification of projects and supervisors. It became obvious early in the project that the five months between the selection of project workers and the initial proposed start date for training, was too short. The second change related to the presentation of our final report to the Dirección General de Biodiversidad. This was postponed from November 2005 till February 2006 because of the Bolivian political situation, elections in December 2005 and change of government in January 2006. It was agreed that it would be better to report to the new government in February 2006 and this was agreed by the Darwin secretariat in the summer of 2005.

3.3 The project activities and outputs contribute to the following articles under The Convention on Biological Diversity:

Article 6: The aim of the project is to provide information about the location of hotspots of plant diversity in The Andean Valleys with a view to their long-term protection. We have proposed specific sites for conservation taking into account their sustainable use by the local communities.

Article 7: The project aim relates directly to the identification of key components of plant diversity in an area rich in endemic species with a very local distribution. A lot of our effort in the field has been directed to this task.

Article 12: The project has a strong research and training element. It has successfully provided training in plant taxonomy or botanical illustration to six Bolivians in the U.K. and less intensively to others in Bolivia. All six Bolivians, as well as UK staff, have research results published, accepted or, at least, submitted for publication. This research and our field work in general has led to the discovery and identification of around 50 new species and provided new data about plant endemism in the project zone on which conservation efforts can be soundly based. Our data was of considerable use in the recent training workshop for the IUCN red data books for Bolivia.

Article 13: Our production of six high quality posters for use in schools and a popular field guide with over 500 photographs are significant steps to raising public awareness of plant diversity and are already creating a lead which others are trying to follow.

Articles 16-17: The project has contributed substantially to the transfer of low level technology and information. In particular we have been innovators in the introduction of the BRAHMS (Botanical Research and Herbarium Management System) data base system and of digital photography. The latter, in particular has

opened doors for the repatriation of data allowing Bolivian botanists studying in the UK to photograph type specimens and other material unavailable in Bolivia.

3.4 The project has achieved all its objectives, specifically the following:

- The purpose (main objective) of the project was to identify hotspots of plant endemism in and around the central Andean valleys of Bolivia. A report was formally delivered to the Bolivian government (copy submitted with this report) in the presence of the new deputy minister for Natural Resources and the Environment, the Director General of Biodiversity and the British Ambassador on 16 February 2006. This identified six areas within the project area for conservation or changed status on the basis of both pragmatic and scientific grounds. Although outside the scope of the project, one of these proposals, the development of *in situ* and *ex situ* conservation of cactus in the Pulquina Cactus Garden has been taken up by Kew Gardens with finance from Rio Tinto in collaboration with an NGO (Green Cross Bolivia), one of our collaborating institutions (Herbario del Oriente, Museo Noel Kempff Mercado, Santa Cruz) and the local community. This collaboration has been achieved through the project´s intervention and negotiation. Some progress has been made with most of the other proposals in terms of securing community support, the interest of NGOs or other agencies (DANIDA is likely to part finance one of our proposals) and government approval but these activities lie outside the scope of the current project and plans to move this forward have been proposed as part of the project follow-up.
- The report submitted to the Dirección General de Biodiversidad contains a list of the endemic species from the project region. This is based on field, herbarium and library work. Although far more accurate than previous attempts to list endemic species from these areas, the list still has limitations. It is extremely accurate in families for which the project team has good knowledge but in some families and genera (notably Cactaceae) there is uncertainty about species delimitation while in others (notably Euphorbiaceae and Compositae) we have only had sporadic expert input. In a few families (Gramineae is an example) recording is very sporadic and it is very uncertain whether apparently endemic species are really so.
- The project has established the BRAHMS data base in all four herbaria and the project team use this facility to record data, generate specimen labels and lists, link data with photographs and generate maps. The amount of data within the system varies from herbarium to herbarium but all have around 15,000 common entries. All also have a varying but increasing amount of data specific to their own herbarium. The BRAHMS data base is most actively used in the three smaller herbaria as La Paz has its own, albeit less flexible system. Herbarium and some literature records of endemic species have been included in the data base to generate maps such as those shown in the report to the DGB and in our publications but we have not been able to map all endemic species.

- The Bolivian team members have developed significant taxonomic skills both at a general level and in specific plant families. This is discussed in more detail in 4 below.
- A field guide was published in December 2005. This contains more than 500 photographs and treats a similar number of species from the project area. This book has received unanimous praise from both within and without Bolivia. Many have commented on its attractiveness and its accessible price, both of which serve to promote knowledge of the flora of the Andean valleys and the need for their conservation. A field guide using digital imagery and with numerous photographs is an innovation in Bolivia and is likely to be followed by others in the near future.
- 500 sets of six colour posters were printed in March 2005 for use in schools. These are backed up by a teachers guide and by training visits to schools. All have commented on the quality and attractiveness of the posters. At the time of writing distribution and training activities are still in progress and we underestimated the time required to get all the posters into the schools and in use. One NGO (SIRENARE) has taken up distribution in La Paz Department which will help in this task.
- To the general public and the government authorities the main achievement of the project has been the production of the field guide and the posters
- To the herbarium authorities our main achievement has been the support offered to the herbaria in terms of furniture, equipment, paper and other material for mounting specimens, payment for technicians and other practical measures designed to enhance the capacity of their institutions.
- To the project team the most important achievement has been the training opportunities they have received and all have produced papers being published in peer-reviewed journals.
- Additional outputs have included extensive training in botanical illustration, for which one of our awards was given, movement from the proposal to the implementation stage of conservation in relation to one of our proposals, more publications, collections etc than originally envisaged and perhaps most important of all enhanced confidence in the majority of our team members.
- There are no major weaknesses but we are well aware that our coverage of the project area has inevitably been patchy. We are also aware that some of the skills taught need more reinforcement and practice if they are to be well used. We have identified fewer specimens than we had hoped and probably underestimated the difficulties of accurately identifying plants over a wide range of families in a tropical area. Although not strictly part of the project, we doubt how far the project recommendations will be taken up without the co-ordination provided by project follow-up, the most important of which involves three political divisions in which three separate project partners are involved. Our legacy in terms of conservation will be much reduced without this follow-up.

4. Scientific, Training and Technical Assessment

4a Training.

4a.1 Selection criteria. The project was planned around a basic structure of one person from each of the four major herbaria working for six months per year with the representative of Oxford University (John Wood) over the three years of the project. In the event two of the herbaria (Sucre and Cochabamba) opted for having two people working 50% of their time over the six months the project was active in Bolivia thus creating a team of six project workers. Selection was by public advertisement followed by an interview conducted jointly by John Wood and the head of the respective Bolivian institution. The team consisted of Moises Mendoza (Santa Cruz), Teresa Ortuño (La Paz), Magaly Mercado and Margoth Atahuachi (Cochabamba) and Hibert Huaylla and Alain Carretero (Sucre). These remained constant for the life of the project with one exception, that of Alain Carretero of Sucre, who resigned half way through the project to take up a scholarship in Denmark and was replaced by Julia Gutierrez. Training focused on these six people although other workers and students from all four herbaria were invited to attend field trips, workshops and other training activities in Bolivia on an informal basis where spaces were available. Around 20 people have benefited from this, many on several different occasions.

A special case relates to botanical illustration. Each herbarium was invited to submit names of interested artists for one of the two botanical illustration workshops given in February 2004. A total of around 15 people attended the two workshops and of these, one, Eliana Calzadilla, was selected for further training both on Rosemary Wise's second visit to Bolivia and for about two months at Oxford in 2005.

4a.2 Content. The content of training ranged over a wide area including the following key areas:

- On the job field work. Our team of six all received on the job training in the field with emphasis on collecting, note-taking, drying and field identification of plant specimens. The emphasis was always on selection and quality preservation of good specimens, which would provide the raw material for scientific research, not simply vouchers for the presence of a species in a particular area.
- Training workshops. Workshops of 3-5 days were provided in Bolivia on the following themes: routine plant identification (3), digital photography (1), botanical illustration (2), systematics of Leguminosae (1), use of BRAHMS date base system (2) including data entry, creation of reports, mapping, linking of digital photographs to data, transfer to/from EXCEL etc. Workshops were informal and

participatory with the aim of passing on specific skills and included the use of reference books and on-line information, such as IPNI as well as specific manuals in the case of botanical illustration, legume systematics and BRAHMS.

- UK training. Five of the project team (Julia Gutierrez could not participate for family reasons) and the selected artist (Eliana Calzadilla) came to Britain from June to September in 2004 and 2005 for training in the UK. Training was centred round a guided research project under the supervision of a botanist at Oxford and someone at another institution including the Royal Botanic Garden, Edinburgh, the Royal Botanic Gardens, Kew and Bonn University. All projects were successfully completed and have resulted in or will shortly result in publications in peer-reviewed journals. Training varied according to the individual project but involved skills in all aspects of taxonomic research including bibliographic research, typification and nomenclature, revision and assessment of taxonomic characters for species delimitation, preparation for publication including the commission and supervision of art work, use of SEM etc.

4a.3 Assessment and accreditation. No formal assessment has been made but the success of the training can be assessed by the following:

- All members of our team including both Alain Carretero and Julia Gutierrez as well as Eliana Calzadilla remain as actively and enthusiastically involved in plant biodiversity work and the life of their institutions as during the project.
- The quality of the project specimens has been commented on favourably by numerous botanists both from within and outside Bolivia.
- All members of the team have learnt to use digital photography successfully and the quality of their work can be seen in “La Guia Darwin de Las Flores de los Valles Andinos de Bolivia”.
- All team members can operate BRAHMS adequately including the various skills outlined in 4a.2 above.
- All team members who received UK training have developed their taxonomy and research skills to a level where they can produce original taxonomic papers which have been accepted or submitted for publication in peer reviewed journals. Three include SEM photos taken by Bolivians in our team. Most significantly all have additional publications in various stages of preparation for publication after the project’s end. It appears the project has provided the impetus to encourage at least five Bolivians to do the on-going original research that is essential to document plant diversity in Bolivia. Illustrations by Eliana Calzadilla are being used in at least four publications at the time of writing with another commissioned for later this year.

- Although these publications give good evidence that at least five Bolivians can identify species within five, major plant families - Mendoza (Apiaceae), Ortuño (Amaranthaceae), Mercado (Labiatae), Atahuachi (Leguminosae), Huaylla (Iridaceae) – all have wide general identification skills, especially Mendoza and Mercado, while several have knowledge of other families, notably Gutierrez (Compositae), Huaylla (Ferns) and Mendoza (Portulaceae, Cactaceae). This can be evaluated by examining the quality of the identification of specimens in our lists and in Bolivian herbaria.

4b Scientific/Research assessment

There is a close link between our training and our research programme and the same Bolivian staff have been involved. Our research is mostly taxonomy-based as set out below

- Field work and botanical exploration. The project collected around 3900 specimens under the main sequence of numbers ("Wood" collections), to which should be added at least another 1600 numbers of which "Mendoza" collections amount to around 1000. The project has, therefore collected a total of >5500 specimens all of which were deposited in the National Herbarium in La Paz and most of which were duplicated in other Bolivian herbaria and also at Kew. In addition some 300-400 living collections, mostly of cactus, were made and these are kept in the Cochabamba Botanical Garden and at Sucre. A large proportion of the plants collected were also photographed. All are data-based. The result is a very large bank of high quality material available for research purposes now and in the future. While the project has undoubtedly improved our knowledge of the plant diversity of the project area, much still needs to be done. Large areas are difficult of access and even the more accessible areas were not all visited at different seasons. Selection of areas to explore has, therefore, been based partly on practical grounds, although we are now aware that extremes of climate and topography as well as certain geological formations, especially the presence of sandstone, are likely to be associated with a richer diversity of species.
- New species. A considerable number of new species have been discovered by the project and this total continues to grow. It is difficult to put an exact figure on this as there are no experts working in many families. A rough figure of 50 new species will probably be not wide of the mark. Many of these new discoveries are narrowly restricted endemics of high conservation value; some are also of great horticultural value. Possibly the most outstanding family has been Iridaceae, a smallish family in Bolivia

in which we have discovered at least six new species. Only in the week of writing this report news has been received from experts of a new species of Asclepiadaceae, first collected in our very last field trip in February 2006 and of a new Compositae collected in November 2004. All the taxonomic publications listed below contain new species found by the project.

- Taxonomic research. The key project workers were encouraged to develop a specialist knowledge of a particular family or group. They were encouraged to study the group in the field and in the herbarium in Bolivia and the project financed visits within and outside the project area to widen their field knowledge of these groups. We also financed the loan of specimens for study. These groups/families then became the focus of their UK training. About eight original taxonomy papers, which are listed in Appendix 3, were prepared in consequence.
  Supervision was by Colin Hughes (Oxford), Thomas Borsch (Bonn), Mark Watson (Edinburgh), Paul Wilkin and Alan Paton (Kew) with participation by Robert Scotland (Oxford) and overall supervision and help with preparation for publication by John Wood (Oxford).
  After returning to Bolivia our Bolivian colleagues continued working on plant taxonomy, mostly in the same plant families, and other publications are under active preparation including an annotated key to *Mimosa* in Bolivia, some 45 species (Atahuachi), a revision of *Talinum* in Bolivia (Mendoza), the *Gomphrena perennis* complex (Ortuño), a new species of *Hippeastrum* and a revision of *Cardenanthus* (Huaylla).

- Oxford staff involved in the project have also been active in research and their papers are listed in Appendix 3. Other publications are in preparation by Wood (papers on *Tecoma* and *Lepechinia*), while papers based on the project's collections and field work are being prepared by other botanists, not connected directly with the project including a series of papers by David Goyder (Kew) on Asclepiadaceae. All these papers are subject to peer review and all are based mainly on work carried out in the Darwin project.

5. Project impact

- The project purpose was to identify hotspots of endemic plants for conservation. The project identified six areas for future conservation on pragmatic as well as scientific grounds and our recommendations were presented in a final report (attached) to the Dirección General de Biodiversidad in February 2006. These recommendations have been

welcomed by the DGB and by all other stakeholders with whom we have had the opportunity to discuss them. One recommendation (The Pulquina Cactus Garden) is already up and running with involvement of our project partner in Santa Cruz and Kew Gardens under the coordination of Green Cross Bolivia on behalf of the mayor of Comarapa. There is active interest to move towards implementing our other recommendations but the process is complicated involving many stakeholders with different interests. In our opinion follow-up to this original Darwin project is necessary to secure effective conservation and management of the other five areas. An unexpected impact of the project has been to generate considerable interest both amongst botanists and managers of national parks in the production of attractive popular guides along the lines of our posters and field guide.

- The project's contribution to Bolivia's obligations under the CBD is set out in Appendix 1. Significant contributions include a considerable impact in the field of research and training (perhaps more than doubling Bolivia's capacity in plant taxonomic research), important contributions to public awareness and education through our posters and field guide and opening doors to technology particularly through the use of digital photography and the BRAHMS data base. At the level of general measures which contribute towards national strategies we have successfully drawn the attention of authorities, institutions and NGOs to the importance of the hitherto neglected Inter-Andean dry valleys in the planning of conservation policies.
- Bolivia was (and to some extent still is) very dependent on foreign expertise in plant taxonomy, which underpins plant biodiversity studies. At the start of the project only two Bolivians (Monica Moraes, Roberto Vazquez) were active in serious plant taxonomic work. We have added five, perhaps six people to this total. All five have publications in the pipeline, four (and hopefully soon the fifth) are actively working on the production of further research papers and all those who worked with the project continue to work with their herbarium institution. One (Magaly Mercado) has now got a permanent post, the status of the herbarium workers in Sucre has risen significantly and all are picking up some additional funding/projects. All plan to continue in this work. We have also trained a young artist to support future scientific publications. In short the project has made a very significant step towards establishing a cohort of young motivated plant taxonomists in one of the most biodiverse countries of the neotropics.
- Collaboration between the Department of Plant Sciences, Oxford, and our four Bolivian partners has been excellent throughout the project and all are eager to continue the collaboration. Both sides have benefited from this; Oxford has gained links and research opportunities in Bolivia while Bolivia has obtained technology, knowledge and confidence from its collaboration with the university. Most Bolivians see the collaboration as more positive than most other international initiatives because of our publications and successful training programme – very few other projects offer serious taxonomic training to Bolivian botanists. We have made some progress in fostering contacts between our partner institutions and local communities

and NGOs but much more can be achieved here in the follow-up to the project.

- The project has had no negative impact that we are aware of. The project has had a very positive effect on the individuals participating in the project, raising their confidence and knowledge as evidenced by their finished and projected publications. Both women and men have benefited equally with slightly more resources in terms of staff directed towards the two poorer centres of Sucre and Cochabamba. Local communities may well benefit from the proposed follow-up and Pulquina is already benefiting from the Cactus garden where several local people have employment.

6. Project outputs

- Project outputs are quantified in Appendix 2. Note that our two principal outputs (The Field Guide and set of 6 posters) do not fit into the categories provided. All planned outputs were achieved but more reference collections and more scientific publications were made than was anticipated.
- Publications are detailed in Appendix 3.
- Information relating to project outputs as well as our project recommendations were contained in a report presented to the Director General of Biodiversity in La Paz. This report was distributed at four conferences held in La Paz, Sucre, Cochabamba and Santa Cruz at which attended the Minister for the environment, The British Ambassador, Bolivian government officials related to biodiversity and conservation, senior, representatives of our partner institutions, representatives of NGOs involved in conservation work, Bolivian scientists, students and representatives of the press. Detailed plans and an agreed budget has been left behind for continued teacher training by principal project workers related to the use of the posters in the schools. The sale of the field guide will generate resources for all four partner institutions.

7. Project expenditure

Expenditure details	Original total budget	Actual expenditure	Difference

- Figures in the table above may differ slightly from claims made by the university as these are based expenditure records which are based on exchange rates at date of encashment rather than date of presentation of accounts. Bank charges are not included and amount to perhaps £400 over the life of the project.
- There are no major discrepancies but the following points should be noted:

    1. There was a favourable exchange rate (10-15% change in our favour) soon after the start of the project. This meant that fixed payments (especially local salaries) cost less in sterling terms and local costs (printing, conferences, local travel etc) were less than budgeted.
    2. In contrast UK salaries were more than expected because estimates were based on 2001 figures and, as instructed, did not take into account increments and inflation. Overheads rise as a percentage of UK salaries in accordance with Oxford rules.
    3. We were able to negotiate extremely good deals for printing without sacrificing quality in any way. Good deals were also negotiated for Huaylla's 8 weeks at Kew as part of his UK training.
    4. Travel costs were higher than expected but this is partly due to including travel related to printing, workshops etc within this category rather than under those heads.

8. Project Operation and Partnerships

- All four local partners worked with the project from start to finish. They are Herbario Nacional de Bolivia, La Paz, Herbario Nacional Forestal "Martin Cardenas", Cochabamba, Herbario del Oriente Boliviano, Santa Cruz and Herbario de Chuquisaca, Sucre. All four are university dependencies. All four are involved in biodiversity issues, linked through their parent departments to workers in zoology and other themes related to biodiversity. All are frequently used as partners or consultants in biodiversity studies in conjunction with government or NGO biodiversity agencies.
- Before the start of the project planning was principally between the Herbario Nacional in La Paz and Oxford through correspondence between Wood & Beck. After the start of the project all four institutions were equally active partners. No modification of plans was necessary.
- There were no other similar projects during the project's lifetime. Missouri Botanical Garden and in a minor Way New York Botanical Garden had botanical research projects in Bolivia. Their objectives were different from ours but we had cordial relations with them. From the beginning we collaborated with and had the approval of the Dirección General de Biodiversidad, who supported the project throughout. We reported to them informally and formally and they are anxious for project follow-up.

- In our training programme we collaborated with staff from the Royal Botanic Gardens, Kew, The Royal Botanic Garden, Edinburgh and Bonn University. In field work we collaborated with staff from Kew, Hull University, the Field Museum (Chicago), Missouri Botanical Garden and Bonn University. We consulted experts from many institutions, principally resident in the United States, Germany, Argentina and Brazil and loaned specimens from over 10 institutions. We have collaborated in publications with staff from Missouri as well as from Bonn, Edinburgh and\ Kew.
- The project only ended recently but we believe collaboration will continue between our partners. More community participation is desirable but this involves time, patience and personal contact and will only develop slowly. Private sector financial support is desirable and it is to be hoped that increased political and economic stability in Bolivia will facilitate this.

9. Monitoring and Evaluation, Lesson Learning

- There is no formal strategy for monitoring and evaluation, just as there were no formal base-line studies and there are no plans for this. Essentially we have monitored progress against our ability to meet the targets and milestones set out in the project documents. We have met all of these, some ahead of schedule and some with slight slippage. In terms of outputs and especially publications, evaluation is in terms of peer review (scientific publications) and in terms of feedback from users in terms of the field guide and the posters. This has been uniformly positive, usually very enthusiastic and occasionally overwhelming as when the Ministry of Education requested some 15,000 sets of our posters, whereas our print run was a mere 500. In terms of technology and training, we have judged success by the ability of our colleagues to apply what was taught (digital photography excellent, use of BRAHMS data base - basic skills fine, more advanced skills patchy, botanical illustration excellent, collecting skills variable but generally much improved, identification skills improving but variable and showing less progress than we would have liked). All our partner institutions wish to continue collaboration and government authorities have similarly expressed their satisfaction at our results, which they regard as exceptional.
- The project faced few problems during its life beyond pressures of time, which meant that we were unable to explore the project area as exhaustively as we would have liked. However we are aware of some longer term problems which affect sustainability and which are a good deal more intractable:
  Research funding: All Bolivian scientific institutions are under-funded where they are funded at all. Biodiversity has the advantage of attracting overseas funding but is otherwise equally deprived. The project can only have a modest impact on this. By raising the profile of biodiversity studies we have helped create a permanent herbariumcuratorship in Cochabamba and lever funds out of the university central office in Sucre where the herbarium and

its workers were previously ignored by the university authorities. The status and permanence of the herbarium is now assured and the university rector in Sucre issued a formal letter of recognition for our role in this.
Staff motivation and dependence culture: There are few plant taxonomists in Bolivia and few workers in plant diversity and they mostly lack confidence and the motivation to continue working when outside funding dries up. It is difficult to predict what will happen in the future but we have certainly more than doubled the number of plant taxonomists who actively publish their results. We have tried to set out a programme for continuing research and publication after the project's end. How far this "kick start" will work remains to be seen but indications at present are that most project workers will carry on along the lines of research and publication established during the project's life.
Sustainable conservation: Bolivia is going through profound political change and most existing protected areas were established by earlier "elitist" governments imposing conservation with little reference to existing communities. Conservation is, therefore, politically controversial. We have tried to prepare the ground for conservation of the areas we have recommended in our report by discussion with local communities, looking at how they can benefit and promoting a bottom-up approach. This does not necessarily accord with the thinking of various parties in conservation in Bolivia, including some NGOs.

- The following key lessons from our experience are extremely subjective but worth noting:

    1. The importance of understanding the whole context of the project in the planning stage and, therefore, of Darwin's pre-project programme. In our case we benefited from Beck and Wood's long-standing connections with Bolivia. This ensured useful inputs and realistic outputs.
    2. The importance of good local partnerships. It is important not only to work with local partners but to ensure benefits go not only to individuals but to partner institutions.
    3. The project should have simple high-profile outputs. We have secured the "congratulations" of the Bolivian authorities and senior people in our partner institutions because of our field guide and posters, not our scientific results. Attractive products in colour raise the Darwin profile enormously.
    4. Good taxonomy is an essential foundation for well-targeted conservation efforts. Too many recent conservation efforts in Bolivia have poor scientific support and several protected areas contain poorer diversity than unprotected areas outside.
    5. Follow-up measures are desirable, if not essential to ensure project achievements are truly sustainable. Has Darwin evaluated the legacy of projects five years after their end?

10. Actions taken in response to annual reviews

Only minor issues have been raised in reviews of our annual reports. These include requests for further details (names of project workers), queries about apparent slippages or budget changes, which were all authorised in advance. One suggested change in our logframe from an activity (enhanced capacity …) to an output was not formally made as it seemed essentially semantic and did not impact on project activities. The most substantive recommendation was to become involved with NGOs so as to secure implementation of project results. We have done this in the last year of the project through our strong links with Green Cross and discussions with Conservation International and other organisations. We have passed on review comments to our partners but there has never been a situation which required detailed discussion.

11. Darwin Identity

- The project was identified as the "Darwin Project" from the beginning and the word "Darwin" was incorporated into the title of the field guide. The words "Darwin Initiative" appeared in all press reports. The logo was used in all our own publications such as the field guide, the posters, the teachers' notes and the official report submitted to the DGB, NGOs and other organisations. All scientific publications in which project members participated, acknowledged Darwin funding.
- At the start of the project, the Darwin Initiative was almost entirely unknown in Bolivia, both among Bolivians working in biodiversity and (apparently) to the British Embassy. This has now changed completely. There can be few in either government, university or NGO biodiversity circles who have not heard of "Darwin". It is not well-known to the public as a whole but teachers are becoming familiar with it through the posters. The project has an excellent reputation within Bolivia.
- The project was recognised as a distinct entity with a clear identity.

12. Leverage

- We received three free flights (to Sao Paulo) from British Airways. We received large donations of time from a variety of international experts but in particular staff at Kew and Edinburgh Botanic Gardens. Cash from our partner institutions was always scarce but we negotiated various payments in kind such as free paper cutting by university printing presses or agreements to match 50% of funds for some purchases (e.g. a computer for Sucre). However these contributions were relatively minor. A constant problem of Bolivian scientific institutions is the lack of research and

equipment funding (a large proportion of their budgets goes on salaries and utilities). Most research and most projects depend on outside funding.

- We drew our partners' attention to the importance of collaboration with NGOs and with commercial companies but opportunities are limited with both of these. Our attempt to gain funds from BG (British Gas -Southern Cone), failed after reaching provisional agreement because of uncertainties in the gas industry in Bolivia. It should be noted that although various agencies are interested in conservation work, no one apart from The Darwin Initiative provide funds to link this with taxonomy.

13. Sustainability and Legacy

- Almost certainly the most enduring of our achievements will be the training key project workers received. The knowledge, skills, confidence and enthusiasm this brought is likely to be a long-lasting legacy. All our staff continue to work in their institutions and all equipment is in regular use. Another legacy is likely to be the example of our field guide. This is stimulating others to produce similar works for other areas to arouse public interest in plant diversity. Another important legacy is the much higher profile of the inter-Andean valleys and their rich endemic flora in conservation circles. Conservation International, for example, is looking at this area for the first time after concentrating its efforts on moist forest areas in the past. The project has increased contacts between the four Bolivian partner institutions and also between them and Oxford and a wide range of other international institutions, most notably Kew. These contacts are likely to be maintained.
- It is too early to comment on the application of our conclusions and outputs. One of our recommendations (The Pulquina cactus Garden) has already been implemented and there are positive indications of support from stakeholders for the others. Our field guide is selling well and teachers have received the posters enthusiastically.
- We have applied for Darwin follow-up funding. Funding from Rio Tinto (via Kew) and Green Cross International already goes to the Pulquina Cactus garden. We have made tentative negotiations with other organisations DANIDA, several NGOs) about our other recommendations but it is uncertain how far they will follow these up in the absence of our participation. .
- Retrospectively it might have been better to start negotiations with NGOs, community leaders and other stakeholders at an earlier date but this would have been at the cost of our research and, therefore, the soundness of our results. More time would have been nice!
- In summary our legacy in terms of research and training is secure, whereas our legacy in terms of conservation (our recommendations) is insecure without project follow-up.

14. Value for money

Our impression is that the project was outstanding value for money. In the first place all important project workers, both British and Bolivian, worked far longer than they were paid for. Salary costs were a relatively small element in the total budget. In the second place we were able to produce our key products (Field guide and posters) at outstandingly low cost – the price of £1.30 for a 200 page full colour field guide with over 500 photographs must be outstanding by any standards. Thirdly we were able to secure the participation of research supervisors free of cost at Kew and Edinburgh Botanic Gardens and at Bonn University, partly because of collaboration by the project with their staff in field work and partly because of long-standing links between Oxford staff and individuals in these institutions. Finally the BRAHMS data base was installed and regularly updated without charge or licence fees. The British ambassador was amazed at the number of scholarships, publications etc, which we had achieved with our budget.

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	10%	Raised awareness of importance of Inter-Andean dry valleys because of their rich endemic flora
7. Identification and Monitoring	20%	Study of project area with collection of > 6000 reference collections including significant number of undescribed species. Identification of key areas for conservation
8. In-situ Conservation	5%	Identification of key areas of conservation and negotiations to get these conserved
9. Ex-situ Conservation	3%	Living collections of cactus in Botanical Garden (Cochabamba) and promotion of Pulquina Cactus Garden
10. Sustainable use of Components of Biological Diversity	0%	
11. Incentive Measures	0%	
12. Research and Training	30%	Effective training programme in plant taxonomy , more than doubling the number of active Bolivian taxonomists; training of botanical artist; research into flora of key areas; about 10 research publications
13. Public Education and Awareness	20%	Production of posters and field guide, the former for use in schools, the latter for the general public
14. Impact Assessment and Minimizing Adverse Impacts	0%	
15. Access to Genetic Resources	0%	
16. Access to and Transfer of Technology	8%	Introduction of BRAHMS data base system and digital photography
17. Exchange of Information	4%	Loan of specimens for research, photographs of material elsewhere, photocopies, purchase of books, repatriation of some data
19. Bio-safety Protocol	0%	
Total %	**100%**	**Check % = total 100**

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	0
1b	Number of PhD qualifications obtained	0
2	Number of Masters qualifications obtained	0
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	0
4b	Number of training weeks provided to undergraduate students	0
4c	Number of postgraduate students receiving training (not 1-3 above)	0
4d	Number of training weeks for postgraduate students	0
5	Number of people receiving other forms of **long-term** (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	0
6a	Number of people receiving other forms of **short-term** education/training (i.e not categories 1-5 above)	6 project workers received training in UK from June to September
6b	Number of training weeks not leading to formal qualification	Approx 13 each in UK totalling 78 UK training weeks . Indeterminate number in Bolivia but at least 15 for 7 people (115 weeks) and at least one week for 20 others (20 weeks).
7	Number of types of training materials produced for use by host country(s)	2 (Artist handbook and legume handbook). NOTE SIX FULL POSTERS FOR USE IN SCHOOLS (500 SETS) NOT INCLUDED AS DO NOT FIT CATEGORIES
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	91
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	0

Code	Total to date (reduce box)	Detail (←expand box)
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1
11a	Number of papers published or accepted for publication in peer reviewed journals	12
11b	Number of papers published or accepted for publication elsewhere	3
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	4 (BRAHMS established with training, helpfile etc) in all tour partner institutions
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host countr	0
13a	Number of species reference collections established and handed over to host country(s)	>5500
13b	Number of species reference collections enhanced and handed over to host country(s)	"enhanced" = ?identified – unknown but >1000 "enhanced" = ?mounted – unknown but > 3000

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	4
14b	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	2
15a	Number of national press releases or publicity articles in host country(s)	2
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	0
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	3
16b	Estimated circulation of each newsletter in the host country(s)	100
16c	Estimated circulation of each newsletter in the UK	4
17a	Number of dissemination networks established	0
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	0
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	1
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	0
19b	Number of national radio interviews/features in the UK	0
19c	Number of local radio interviews/features in host country (s)	0
19d	Number of local radio interviews/features in the UK	0
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	£25800*
21	Number of permanent educational/training/research facilities or organisation established	0
22	Number of permanent field plots established	0
23	Value of additional resources raised for project	£1500

* This includes the project vehicle but in fact this has not been handed over yet as it was stolen in December 2006 and we are still awaiting payment from the insurance company. This money will either be divided between the partner institutions or used to purchase another vehicle if the project follow-up is agreed.

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 £**
Book	La Guia Darwin de las Flores de los valles Bolivianos – J.R.I.Wood (ed) 2005	N/A	Project partners, eg Herbario Nacional de Bolivia, Casilla 10077, La Paz, Bolivia	£1.30 (20 Bolivianos)
Posters	Plantas de Los Valles Andinos de Bolivia (set of 6) – 2005	N/A	Project partners, eg Herbario Nacional de Bolivia, Casilla 10077, La Paz, Bolivia	N/A
Journal	Two new species of Mimosa endemic to Bolivia – M.Atahuachi & Hughes, C.E. 2006	Brittonia, New York Botanical Garden,	New York Botanical Garden, Bronx, NY 10458-5126, USA	N/A
Journal	A new species of Acacia (Leguminosae: Mimosoideae) endemic to Bolivia – M. Atahuachi & Rico, L. 2006	Kew Bulletin, London	Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB	N/A
Journal	A new species of Leucochloron (Leguminosae: Mimosoideae) endemic to Bolivia –	Kew Bulletin, London	Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB	N/A

	C.E.Hughes & Atahuachi, M. 2006			
Journal	Dos nuevas especies de Gomphrena (Amaranthaceae-Gomphrenoideae) de los valles secos de Bolivia - Ortuño, T. & Borsch, T 2005	Novon 15(1):180-189, St Louis	Missouri Botanical Garden, P.O.Box 299 St Louis, MO 63166-0299, U.S.A.	N/A
Journal	A further new species of Gomphrena (Amaranthaceae; Gomphrenoideae) from the dry valleys of Bolivia Ortuño, T. & Borsch, T 2006	Kew Bulletin, London	Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB	N/A
Journal	Revisión taxonómica de Eryngium (Apiaceae-Umbelliferae) para Bolivia - Mendoza, J. M. & Watson M.F. 2006	Candollea, Geneva		N/A
Journal	Scutellaria L. in Bolivia with observations on Section Perilomia – M.Mercado & Paton, A.J. ?2006	Kew Bulletin, London	Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB	N/A
Journal	Notes on Sphenostigma (Iridaceae) – Hibert Huaylla & Wilkin, Paul ?2007	Kew Bulletin, London	Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB	N/A
Journal	A distinctive new species of Ovidia (Thymeliaceae) from Bolivia -	Novon 14(3):332-	Missouri Botanical Garden, P.O.Box 299 St Louis, MO 63166-0299, U.S.A.	

	Rogers, Z, Antezana, C., Wood, J.R.I., & Beck, S.G. 2005			
Journal	New Boraginaceae from Tropical America 5: A new species of Varronia from Bolivia – J.S. Miller & Wood, J.R.I. 2006	Novon	Missouri Botanical Garden, P.O.Box 299 St Louis, MO 63166-0299, U.S.A.	
Journal	The Salvias of Bolivia – J.R.I.Wood 2006	Kew Bulletin	Royal Botanic Gardens, Kew Richmond, Surrey, TW9 3AB	N/A
Book of conference papers	Inter-Andean Dry Valleys of Bolivia – Floristic Affinities and Patterns of Endemism: Insights from Acanthaceae, Asclepiadaceae and Labiatae – J.R.I.Wood in Pennington, R. T., Lewis, G. & Ratter J (eds)			
Journal	The Darwin Initiative Project in Bolivia – J.R.I.Wood 2003	Oxford Plant Systematics 10	Serena Marner, Department of Plant Sciences, University of Oxford, South Parks Road, Oxford, OX1 3RB	N/A
Journal		Oxford Plant Systematics 12	As above	N/A
Journal		Oxford Plant Systematics 13	As above	N/A

Appendix IV: Darwin Contacts

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

Project Title	Plant Endemism in the Central Andean Valleys of Bolivia
Ref. No.	***162/11/010***
UK Leader Details	
Name	Dr Robert Scotland
Role within Darwin Project	Team Leader
Address	Department of Plant Sciences, University of Oxford, South Parks Road, Oxford OX1 3RB
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	John Wood
Role within Darwin Project	Field Coordinator
Address	Department of Plant Sciences, University of Oxford, South Parks Road, Oxford OX1 3RB
Phone	
Fax	
Email	
15.	
Partner 1	
Name	Dr Stephan Beck
Organisation	Herbario Nacional de Bolivia (Director)
Role within Darwin Project	Director of principal partner institution in Bolivia
Address	Casilla 10077, Calle 27, Cota Cota, La Paz, Bolivia
Fax	
Email	
Partner 2	
Name	Susana Arrazeola
Organisation	Centro de Biodiversidad y Genetica (Director), Facultad Tecnica, Universidad San Simon, Cochabamba

Role within Darwin Project	Director of University umbrella authority for Herbario Nacional Forestal "Martin Cardenas" in Cochabamba, second partner institution in Bolivia
Address	Casilla 538, Cochabamba, Bolivia
Fax	
Email	
Partner 3	
Name	Ing. Carlos Perez
Organisation	Carrera de Agronomia (Director), Universidad San Francisco Xavier de Chuquisaca, , Sucre
Role within Darwin Project	Director of university department responsible for partner institution, Herbario de Chuquisaca
Address	Casilla 1046, Sucre, Bolivia
Fax	
Email	
Partner 4	
Name	Ing. Patricia Herrera
Organisation	Museo de Historia Natural "Noel Kempff Mercado", Santa Cruz
Role within Darwin Project	Director of Museum responsible for partner institution, Herbario del Oriente, Santa Cruz
Address	Casilla 2489, Av. Irala 565, Santa Cruz
Fax	
Email	