

ORCHID SEED STORES FOR SUSTAINABLE USE (OSSSU):

Darwin Initiative Project Ref Number: 16-012
2007-2010

Final Report: 31 December 2010



**Orchid Seed Stores for Sustainable Use:
a Darwin Initiative project**

Darwin Initiative Final Report: Submission deadline 31 December 2010

Darwin Project Information

Project Ref Number	16-012
Project Title	Orchid Seed Stores for Sustainable Use (OSSSU)
Country(ies)	Ecuador, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Guatemala, Mexico, <i>India</i> , China, Indonesia, the Philippines, Singapore, Thailand, Vietnam.
UK Contract Holder Institution	Royal Botanic Gardens, Kew
Host country Partner Institution(s)	See below
Other Partner Institution(s)	<p>1) Jardín Botánico de Quito, Ecuador (Latin America Hub); 2) University of Cuenca, Ecuador; 3) Universidad Tecnica Particular de Loja, Ecuador; 4) BIOFAN, Universidad Autonoma Gabriel Rene Moreno (UAGRM), Bolivia; 5) Agronomia Faculdade de Ciências Agrárias Universidade do Oeste Paulista – UNOESTE, Brazil; 6) Banco Base de Semillas, Instituto de Investigaciones Agropecuarias (INIA), Chile; 7) Jardín Botánico Nacional, Viña del Mar, Chile; 8) Fundación Jardín Botánico de Cali, Colombia; 9) Jardin Botanico Lankester, Costa Rica; 10) Orquideario Soroa, University of Pinar del Río, Cuba; 11) Universidad del Valle de Guatemala, Guatemala; 12) Jardín Botánico, Universidad Autónoma de México, Mexico; 13) Sichuan Hengduan Mts Biotechnology, Chengdu, China (Asia Hub); 14) Kunming Institute of Botany, Yunnan, China; 15) Bogor Botanic Garden, Indonesia; 16) Institute of Plant Breeding, College of Agriculture, the Philippines; 17) Mahidol University, Thailand; 18) Singapore Botanic Gardens, Singapore; 19) Dalat Institute of Biology, Vietnam.</p> <p>Associate Members by Letter of Agreement: 20) Estonian Univ of Life Sciences, Estonia, www.emu.ee/; 21) Kadoorie Farm & BG, Hong Kong, China, www.kfbg.org.hk/; 22) Federal Univ of Parana (UFPR), Brazil; www.ufpr.br/; 23) Beijing Botanical Garden, China, www.beijingbg.com/; 24) Xishuangbanna Tropical Botanical Garden, China, www.english.xtbg.cas.cn/; 25) Sóller Botanic garden, Mallorca, Spain, www.jardibotanicdesoller.org/en/jbs.php;</p> <p>Discussions on network expansion: 26) ICAR National Research Centre for Orchids, Sikkim/Darjeeling, India, www.sikkim.nic.in/nrco (moving towards full MoU); 27) Universita della Tuscia, Viterbo, Italy, www.unitus.it/; 28) The Smithsonian Institute, USA, www.si.edu/; 29) Jardin Botanique de Montréal, Canada, www.ville.montreal.qc.ca/; 30) - Jardín Botánico Nacional, Dominican Republic; 31) Maduro's Tropical Flowers, Panama, madurostropical.com/Contenido/Eng/historia.html; 32) Club Peruano de Orquideas, Peru, www.peruorchids.com/en/index.html; 33) Institute for Biotechnology Research, Jomo Kenyatta University of Agriculture and Technology, Kenya, www.jkuat.ac.ke/; 34) IRD, Montpellier, France; 35) ARI-IRD & University of Yaoundé I, Cameroon; 36) Atlanta and Missouri Botanic Gardens, USA.</p> <p><i>NB: 27 countries and 36 institutes actively involved in OSSSU or wishing to join.</i></p>
Darwin Grant Value	£ 220,049
Start/End dates of Project	1 Oct 2007 to 30 Sept 2010
Project Leader Name	Prof. Hugh W. Pritchard
Project website	http://osssu.org
Author(s) and main contributors, date	Philip T. Seaton, Dr Tim Marks & Prof. Hugh W. Pritchard 31 December 2010

1 Project Background

The need for a global network of orchid seed storage facilities for sustainable use was raised at the 11th World Orchid Conference (1984, Miami) and in the Orchids Status Survey and Conservation Action Plan of the IUCN/SSC Orchid Specialist Group (1996). The Action Plan also recommends the sustainable use of germplasm through the "propagation of plants where possible from seed, usually in aseptic conditions" and that "orchid societies, establish and support ex situ propagation units in countries with high orchid biodiversity." The Proceedings of the Second International Orchid Conservation Congress (Sarasota, 2004) called for 90% of threatened orchids to be in ex situ collections by 2010 in support of Target 8 of the GSPC. This project has contributed substantially to efforts to reach that target by conserving > 380 species of orchids as seed and through the development of *in vitro* methodologies for the germination of nearly 250 species of orchids. We achieved this through the establishment of an orchid seed conservation network of >20 institutes from 15 main countries and two further 'associate' countries; most of these were supported through capacity building and modest infrastructure improvements. The countries were selected on the basis of known orchid biodiversity and the country members drew up lists of target species before the project started.

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

The project supported the Governments' implementation of CBD Articles 5, 9, 10, 12, 13, 15, 18, 19 and 22 by promoting the sustainable use (propagation) of species (including ornamentals), engendering co-operation between government bodies and the private sector (small scale rather than international commercial operations), developing a network capable of facilitating co-operation in conservation research and protocol development, and building infrastructural and human capacity for orchid conservation. OSSSU is of relevance to the following themes: Access and Benefit Sharing; Forest and Mountain Biodiversity; Global Strategy for Plant Conservation; Protected Areas; and Sustainable Use and Biodiversity.

OSSSU has contributed indirectly to the goal of reducing the loss of biodiversity through additional safeguarding of hundreds of orchid species in living collections through seed banking. In the case of Chile, genetically representative collections of the species have been made from the wild.

The host country institutions allowed their staff (usually two per institute) to attend the training workshops and to carry out the work (OSSSU did not cover staff costs in country other than some administration by the hub countries: China and Ecuador), indicating a strong current commitment to orchid conservation. Those staff also committed to extensive cascade training (staff and students) and external communications through contributions to conferences. Commitments in the future appear just as strong, based on the c. 20 letters of support we received from collaborators when the UK Management Team bid (unsuccessfully) for post-project funding from DI.

Whilst OSSSU supported modest improvements in facilities (freezers mainly), being part of OSSSU enabled two institutes to bid successfully for major laboratory improvement (UTP Loja Ecuador, and the National Botanic Garden, Chile).

The vast majority of OSSSU institutions are government-related and thus aware of the CBD, but we are not aware of regular contact in country. From discussions at the Costa Rica workshop in 2010, it seems that the CBD focal points engage very little with scientific / technical staff working on conservation programmes. However, the biodiversity focal points were invited and contributed to the 2007 workshops in Ecuador (Patricia Galiano, CITES Administrative Authority, Ministerio del Ambiente; who also gave a lecture) and Chengdu (Ms Wang Chunling, Deputy Director of the Department of Wild Fauna & Flora Conservation, State Forestry Administration, and Mr Long, SFA).

3 Project Partnerships

The key host country partners were **Ecuador** and **China**, who acted as regional, scientific hubs and training sites for the 2007 workshops; they with the other countries have undertaken conservation activities (seed harvesting, storage), laboratory studies (including germination protocol development), maintained conservation collections, developed education programmes and disseminated outputs. The countries are: (Americas) Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Guatemala, Mexico; (Asia) Indonesia, the Philippines, Singapore, Thailand, Vietnam. **Of the original 16 target countries, only India did not sign an MoU** and took no further part in the project after the training workshop in Chengdu at which the country was represented by two staff. Discussions have accelerated with India between November 2009 and November 2010 through discussions with the Indian Council for Agricultural Research (ICAR) and its specialist National Research Centre on Orchids (Sikkim) with the latest suggestion that an agreement between Kew and ICAR could be signed in April 2011. Two new countries joined OSSSU as associates and actioned conservation studies (Estonia and Spain). Estonia contributed to the overall targets of OSSSU (see Volumes 1 and 2) and could be considered to be the 16th country member. In addition, other associates also joined from countries that were already members of OSSSU (China, Brazil). There are ongoing discussions with Cameroon, Canada, Dominican Republic, France, Kenya, Italy, Panama, Peru and USA, bringing the total number of countries either involved in OSSSU or wishing to join to 27. This latter group included some countries that signed up as associates but are yet to initiate collaborative studies.

The UK partners developed the overall framework for the project and approached the country institutes with a request for a list of species of greatest conservation concern within the country. This provided the basis of the overall target of 250 species to be conserved. The UK partners provided technical backstopping, acted as the clearing house for orchid seed conservation biotechnology information and managed the project. There was no specific contact with other UK institutes although talks on OSSSU have been given in the UK, particularly to members of the British Orchid Council.

Developing the international partnerships was challenging and very time consuming, particularly the negotiations. Only in the case of INIA, Chile did the Royal Botanic Gardens Kew have existing relations for conservation work. This was partly the case for the Kunming Institute of Botany, CAS, with whom RBG Kew has a seed conservation agreement, although the orchid specialist in OSSSU is not formally a part of the seed bank. Of the other countries, the standard >10 page MoU we developed was acceptable. However, negotiation with three countries (Ecuador, Mexico and India) was protracted. Ecuador eventually signed in early 2009 after: 1) an appendix was added to the MoU; 2) Pritchard was called to a meeting at the Embassy in London; and 3) Seaton had made a special return to Quito meet with Dr Wilson Rojas (Director of Biodiversity and Protected Areas, Ministry of the Environment). Delays in Mexico and India related to difficulties in finding the right person to join OSSSU. In India our approaches to the Botanic Garden of the Indian Republic in Noida, Delhi proved unsuccessful, even though training was delivered in Chengdu to two staff. Nonetheless, recent discussions indicate that an agreement with another part of the Indian Government (Indian Council for Agricultural Research-NCRO) may be possible in 2011. The UK Management Team took the decision early on (subsequently supported by the evaluator) to add collaborators to OSSSU through associate membership to increase the likelihood of delivering against targets. A positive aspect of such negotiations has been the realization that there is a considerable orchid conservation constituency that wishes to collaborate across the world. It should be noted that to establish and maintain such contacts over three years has required the exceptional commitment, social networking skills and diplomacy of the UK Project Manager, Phil Seaton.

4 Project Achievements

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

OSSSU had a focus on one element of biodiversity conservation, that of the seeds of orchids whose species constitute about 8% of the world's flowering plants. OSSSU had a positive impact on the prospects for survival of > 380 orchid species (**Volume 1, Appendix 1, Table 10**) and the sustainable use of seeds through the development of *in vitro* methodologies for the germination of nearly 250 orchid species (**Volume 1, Appendix 1, Table 11**).

OSSSU also contributed substantially to institutional capacity building, through workshops in Ecuador, China and Costa Rica for 16, 21 and 23 participants respectively (excluding the Management Team from the UK - Pritchard and Seaton; **Volume 1, Appendix 1, Tables 1 - 3**). Capacity building was supported by the distribution of 92 copies of the manual 'Growing Orchids from Seeds' to institutes in 21 countries (**Volume 1, Appendix 1, Tables 4 - 5**). Trained staff have cascaded their knowledge to >100 staff / students (technicians, teachers, undergraduates and postgraduates) (**Volume 1, Appendix 1, Table 6**), to the public and to scientific colleagues at conferences (audiences of >1500) (**Volume 1, Appendix 1, Table 7**). Small capital investments were made to institutes in 11 countries to improve facilities (see **Volume 1, Appendix 1, Table 8**). Finally, the living collections of 11 countries are being enhanced through the pull-through of *in vitro* plantlets of c. 240 species from the successful germination tests **Volume 1, Appendix 1, Table 9**).

Overall, OSSSU increased the capacity for future orchid conservation in up to 21 countries.

4.2 Outcomes: achievement of the project purpose and outcomes

The Purpose of OSSSU was "To create an orchid seed bank network across 16 countries to: 1) conserve as seed 250 species from diverse habitats of varying levels of endangerment; and 2) develop protocols for the production of *in vitro* plants in support of the sustainable user of threatened species." As noted in '3 Project Partnerships' above, OSSSU has worked with 15 MoU countries and two associate countries. Further expansion to 27 countries is envisaged and remains the long-term objective. **The species conserved as seed totalled 386 (Appendix 1, Table 10), 54% above the target.** The species were drawn from 119 genera. It is difficult to be precise on the number of threatened species that have been conserved as a fully updated IUCN global redlist for orchids is not available. However, as an indication of the relevance of the species stored, eight of the 28 species shown in the CITES Orchid Gallery (www.cites.org/gallery/species/orchid/orchid_list.html) have been conserved:

Cattleya walkeriana (Brazil), *Cattleya warscewiczii* (Colombia), *Paphiopedilum bellatum*, *P. charlesworthii*, *P. concolor* and *P. henryanum* (all China), *Rhynchostylis gigantean* and *Vanda coerulea* (both Thailand). However, all collaborators are committed to working with threatened species based on national needs. A few records for seed storage (56 in total) and for germination were provided by three associate members of OSSSU (Estonia Univ of Life Sciences; Kadoorie Farm and Botanic Garden, China; UFPR, Brazil), which further demonstrated a functioning (and expanding) network.

4.3 Outputs (and activities)

Please see Annex 1 below. All eight outputs and sub-targets were achieved except for the publication of 'Growing Orchids from Seed' in Chinese; the Chinese version of this laboratory manual (to accompany the English and Spanish language editions) will be published in 2011.

4.4 Project standard measures and publications

Please see Annex 4 below for the project standard measures, and Annex 5 below for the publications list.

4.5 Technical and Scientific achievements and co-operation

Technical and scientific cooperation between countries in OSSSU has been exceptional. OSSSU is a functioning scientific, technical and educational network.

Participants in the workshops were enthusiastic to share their knowledge and this commitment has continued throughout the three years. Innovations shared have included: 1) a new method for orchid seed disinfection within a sterile syringe (China); and 2) the sucrose pre-treatment of seeds to enhance tetrazolium vital stain uptake (Brazil).

The achievement of producing seed from >380 species reflects the experience and technical competence of the OSSSU members. This is more remarkable when one considers that the average time for capsule maturation is 3 – 6 months for orchids (and up to one year for some species). Even with this lag time to seed harvest, the seed banking target was exceeded.

The project had no opportunity to promote traditional knowledge, but did seek to promote the knowledge of the specialists in each country, particularly for the germination work. The UK Management Team recognised that the specialists had excellent prior-knowledge of how to germinate some of the target species (or related species in key genera) and set up a procedure whereby a comparison could be made between a traditional orchid germination medium (Knudson C) and what was considered to be the 'best practice' medium. This has resulted in comparable data for > 150 species germinated on two (sometimes more) media; trends in the data will be assessed for any relationship between nutrient composition and species habit, habitat, etc. Some germination and viability data has already been peer-reviewed and four papers accepted / submitted for publication (**see Volume 2 – Publications**). Detailed methodologies can be found in those publications and are not detailed here.

Increasingly storage results will become available and enable OSSSU collaborators to comment on the long-term storage prospects for a wide range of orchid species under conventional seed bank conditions.

4.6 Capacity building

OSSSU trained an average of two staff per institute at the 2007 workshops in Ecuador and China to protect against staff turnover and a diminution of the impact of the training. The open-door policy at the 2010 Costa Rica workshops to associates of OSSSU (and those wishing to join) resulted in the involvement of staff from 21 institutes from 17 countries, including countries outwith the original 16 target countries: Estonia, USA, Dominican Republic and Panama. OSSSU members delivered cascade training to five technicians, 104 undergraduate, 10 masters (and equivalent experience) and 3 PhD students. We estimate this to come to about 200 person weeks of training through the workshops or cascade training. Finally, Pritchard and Seaton gave numerous lectures in many countries on OSSSU and orchid conservation, spending about 10 weeks overseas on OSSSU business. These efforts have increased in-country capability for conservation work over the longer term.

OSSSU indirectly contributed to institutional building as new working practices had to be adopted to meet the DI Project management needs. This was true for many of the institutes as they had not been involved in significant international projects before. The exception was Lankester Garden in Costa Rica, which had been involved in a previous DI Project.

The UK lead institution has considerable experience of partnering within DI Projects and the Project Leader (Pritchard) has led three (DIRECTS, CCESSA and OSSSU) successful DI Projects since 2003.

4.7 Sustainability and Legacy

The 3-year term of the DI project has enabled long-lasting relationships with around 20 countries to be established and / or enhanced. Attendees at the 2010 workshop in Costa Rica noted a determination for the network to continue and expand through additional funding of US\$ 2-3 million by 2015 to enable about 2000 orchid species to be conserved. The UK Management Team are now working with the Kew Foundation to review possible funding sources.

The initial selection of institutes (by the Management Team) to join OSSSU was based on prior-knowledge about their capability (or wish) to deliver orchid conservation. Those institutional commitments remain strong and are almost certainly enhanced as a result of the successes of OSSSU, including staff training and knowledge exchange. We are confident that institutes will continue to commit resources to this orchid conservation network. Evidence for this view includes the commitment by Lankester Gardens, Costa Rica to bank by 2020 all endemic orchids (c. 25% of about 1500 species); and Kadoorie Farm and Botanic Garden, China has committed to conserve about 60 species by 2012.

RBG Kew has input 0.5 x Band D post for Phil Seaton to continue as orchid conservation project management until September 2011 so that communication across the network continues and to work up a major funding bid (see comment above).

Enduring beyond the project, and any extension, will be seeds of >300 species in cold store, and thousands of seedlings being turned into plants from the *in vitro* germination studies. Some of these will grace institutional living collections for many years to come, serving as an educational and research resource.

5 Lessons learned, dissemination and communication

The main lesson from the project is the need to have a near full-time project manager to ensure communications across the network are regular and targets on track. Phil Seaton achieved this by contributing beyond his OSSSU funding (0.3 Band D post). The Project Leader wishes to formally recognise his appreciation for this effort.

External communications by OSSSU members has been excellent, resulting in 17 papers or books, 9 newsletter articles, >30 newspaper or web articles, >30 presentations (talks and posters) at conferences to audiences >1500 scientists / conservationists. Dissemination of the outputs of OSSSU will continue, spearheaded by Phil Seaton and Tim Marks of RBG Kew with inputs from Hugh Pritchard. We plan to write a major review on the successes of the project, possibly for the peer-review journal *The Botanical Review* (CIF 2.4) or *Biodiversity and Conservation* (CIF 2.0). Other publications are anticipated on seed storage and more on germination. Also the web site will be updated as the data continues to be produced.

One disappointment has been the difficulties publishing 'Growing orchids from seed' in Spanish and Chinese. The Spanish version appeared in 2009 and we remain optimistic that the Chinese version (now at the printers in SE Asia) will appear in 2011. The main problem has been insufficient funds for printing and translation. However, to ensure the Chinese version is published we have shared the costs with Kadoorie Farm and Botanic Gardens, China. The Project Leader also wishes to formally recognise his appreciation for this support.

5.1 Darwin identity

The DI logo was used on all presentations (at least 30 talks and posters in 12 countries) made by the members and the funding source acknowledged in publications. The DI logo also appeared on the cover of 'Growing Orchids from Seeds' (Spanish version) and will also be on the Chinese version when published in 2011.

OSSSU was a distinctive DI Project independent of any larger programme.

Undoubtedly, awareness and understanding of the DI objectives and achievements was significantly enhanced in the three countries that staged the workshops: Ecuador, China and Costa Rica. Presentations were made by the management team at both the 2007 workshops introducing the DI scheme to participants. In addition, DI was promoted through > 30 national and international news articles (newspapers and on the web) in 11 countries (Costa Rica, China, Ecuador, Brazil, Malaysia, UK, Chile, Mexico, Australia, Malta, USA) (**see Volume 2 - Publications**)

6 Monitoring and evaluation

There were no substantial changes to the project design or logframe over the three years of the project.

Baseline information on species of interest for conservation, and those of scientific, economic or endemic value, were provided by the prospective collaborators before the project started. This list was then used to inform the selection of species to be pollinated for seed production and subsequent storage and germination. There was some nervousness about the list becoming restrictive, as orchids do not necessarily flower every year. But the long list of species provided flexibility of choice.

We established a project advisory group in the first year, including an orchid biologist external to Kew, Prof Michael Hutchings of the University of Sussex. Internal staffs were also involved (Margaret Ramsey, Grace Prendergast, Tim Marks and Steve Alton). It soon became clear however that the UK Management Team (Pritchard and Seaton) were working effectively together, the project was on target and that there was no need for regular internal meetings on the basis that independent advice was being provided by the external reviewer (see comments below).

We found the comments of evaluator(s) perceptive and constructive and found the process to be a valuable element of the DI project management.

6.1 Actions taken in response to annual report reviews

Evaluation comments focussed mainly in the following areas:

1) striving for 16 MoUs - The management team signed up 13 countries relatively quickly and maintained an enthusiasm to sign up Ecuador, Mexico and India through the project. Ecuador and Mexico signed belatedly in 2009. However, the situation with India looked like it would take more time to come to fruition (discussions are still ongoing but now looking positive) and the management team decided early on to reduce the risk of the main target (seeds of 250 species banked) not being achieved by attracting associate members to the network. This proved to be relatively straightforward, particularly as we could provide clear evidence that OSSSU was working. In total we have good contacts now with 27 countries and expect working relations to grow. In effect, OSSSU achieved 15 country MoUs and two associate countries (Estonia and Spain) that have initiated complementary studies that contributed to targets. Other associates within countries with whom OSSSU already had an MoU also contributed to targets, particularly China.

2) database development and a password protected area for data sharing - The UK Management Team database attempts to record, in a Microsoft Excel spreadsheet (the preferred option based on collaborators comments), all the data provided by the collaborators. This 'database' has the following fields: country / institute; species name; species identification number / code; Redlisting; pollination date; pod parent; pollen parent; number of capsule; date of capsule harvest; number of seeds per capsule; number of seed lots stored; germination % before storage; date of germination sowing; medium for germination; viability % by tetrazolium staining; date seed entered and was removed from storage; images of plants and seeds. It has been a tremendous effort to secure the data from collaborators and not surprisingly the data is incomplete for some species. This is partly the result of the protocols discussed at the training workshops not being followed consistently. The most likely cause would be that OSSSU did not contribute to staff costs in country and thus there may have been pressure on staff time to do other work. As a consequence, the information uploaded onto the OSSSU website under 'Resources' → 'Database' reflects closely Tables 10 (storage) and 11 (germination) in **Appendix 2 of Volume 1 of the Final Report**. The team continue to request and rationalise data and the work of uploading more information will continue next year as RBG Kew have agreed to fund Phil Seaton as 0.5 x Band D post until September 2011.

3) post-training assessment - The main part of the 2010 workshop in Costa Rica was taken up with presentations by OSSSU members following a prescribed format (provided by the management team) to maximise comparison of achievements and approaches. Through subsequent Q&A session this enabled a quick assessment to be made as to the impact of the training. In general the management team are content with the level of application of knowledge to the orchid conservation objectives of OSSSU. However, it was also clear that some parts of the agreed protocols had not been followed precisely. For example, not all capsule ripening times had been recorded and only a few laboratories had determined the number of seed per capsule. These elements of the protocols serve wider scientific goals and do not detract from the main deliverables: seed conserved and germinated, both of which were a great success.

7 Finance and administration

7.1 Project expenditure (information provided by George Sarkis – Assistant Projects Accountant, RBG Kew)

Total Years Costs	Grant (£)	Total actual Darwin Costs (£)	Variance %	Comments (please explain any variance)
Staff costs				Minor variance
Overhead Costs				Small variance
Travel and subsistence				Large variance due to extra travel associated with negotiations with Ecuador, Mexico and India
Operating Costs				Large variance (although relatively small amount) due to inadequate provision for translation and production of the laboratory manual
Capital items (see Volume 1, Annex 1, Table section 8)				£2 k underspend, mainly on freezers as some collaborators accessed facility elsewhere in institute
Others (workshops and consumable spend overseas)				About half this amount was a saving on the workshops in 2007 (see comment below*). There were also occasional difficulties in transferring funds to some countries.

TOTAL	Grant	Actual claim	Not claimed		

* Not claimed in 2007-2008, as follows: underspend on conference and seminars, i.e. the two workshops in Ecuador and Chengdu in the autumn of 2007; on capital items; on postage, telephone and stationery.

7.2 Additional funds or in-kind contributions secured

The presence of 43 different participants at the 3 workshops (Ecuador and China in 2007 and Costa Rica in 2010) represents 43 working weeks of support (at least, as many members attended workshops in both 2007 and 2010) provided by collaborators from the countries involved. At UK costs (Kew ready reckoner of staff costs for Band D, for example) this equates to about 1 year at **£78 k** full staff costs.

We estimate that the main collaborators (15 countries) each provided two staff members (a supervisor and a technician) for about 5% of their time (for the laboratory work, supervision, PR work, report writing, etc). On the basis of an average of Band D support this gift-in-kind comes to: £78 k x 30 staff x 0.05 x 3 years = **£351 k**.

Thus the total gift-in-kind is £78 k + £351 k = £429 k (at UK costs).

In addition, small sums of money totalling \$31 k (£20 k) have been generated in some countries to cover local costs, sometimes including fieldwork. Examples are: \$12 k by the National Botanic Garden in Chile, and \$8 k by Quito Botanic Gardens.

7.3 Value of DI funding

After 25 years gestation, the concept of a global network of orchid seed stores (for sustainable use) became a reality only because of DI funding, and reduced the risk of loss for about 380 orchid species now banked as seed.

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

Project summary	Measurable Indicators	Progress and Achievements April 2007 - March 2008	Actions required/planned for next period
<p>Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve</p> <ul style="list-style-type: none"> • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources 		(report on any contribution towards positive impact on biodiversity or positive changes in the conditions of human communities associated with biodiversity eg steps towards sustainable use or equitable sharing of costs or benefits)	(do not fill not applicable)
<p>Purpose (insert original project purpose statement)</p>	To create an orchid seed bank network across 16 countries to: (1) conserve, as seed, 250 species from diverse habitats of varying levels of endangerment; and (2) develop protocols for the production of <i>in vitro</i> plants in support of the sustainable use of threatened species.	15 countries with MoUs in place until 2012. Associates joined from 2 new countries (Estonia and Spain). With associates from Brazil and China, they made a significant contribution to targets. >380 species' seed banked and <i>in vitro</i> germination methods produced for 239 species.	Our ambition for the next phase of this project is to conserve about 2000 orchid species by 2015 and to make the web site a 'global orchid facility' for educational and scientific use, subject to securing new funds.
Output 1.	Improved 'in-country' facilities for seed storage and <i>in vitro</i> germination;	OSSSU distributed storage vials and silica gel packets to all collaborators, including associates. About £10,000 was spent on equipment, mainly freezers for seed storage and some desiccators.	
Output 2.	Trained staff in orchid conservation biotechnology	OSSSU workshops were attended by 43 scientists from 20 countries including the 16 countries originally targeted to be members of OSSSU. Knowledge gained at the workshop and during the project work has been cascaded widely with the objective of maximising the take up of findings. Such legacy building involved five technicians, 104 undergraduate, 10 masters (and equivalent experience) and 3 PhD students. The cascade training was funded through gift-in-kind.	
Output 3.	Data and germination protocols, and storage information;	> 500 species were worked on to ensure that pollinations resulted in seeds being available from the 250 target species. Ultimately, > 380 species' seeds were processed and banked (54% above target). <i>In vitro</i> germination protocols were developed for 239 different species; for 75% of these comparable data has been produced on two media. Some of the information has appeared in published articles.	

Output 4.	Training materials in Spanish, Chinese and English	'Growing Orchids From Seeds' has been used as the laboratory manual for the OSSSU project and 92 copies (either in English or Spanish) have been distributed to institutes in 21 countries. The Chinese version has been translated and (frustratingly) is still with the publisher in SE Asia, but will be published in 2011. Protocols for all aspects of the work programme were introduced and discussed at the training workshops in Ecuador and China in 2007 and English and Spanish language versions are available on the web-site, with some publications (www.ossu.org).
Output 5.	Distributed, searchable electronic database	The spreadsheet uploaded onto the web for access by collaborators under password protection (login = orchidseed; password = semillas) has: genus, species, accession number, country, institute, storage temperature, storage date, no. tubes stored, seed weight (i.e. weight of seed stored), germination test carried out (Y or N), germination on Knudson C, germination on another medium (the latter two defined as >10% success). Information to be added includes seed capsule harvest times (i.e. time to maturity).
Output 6.	Advisory replies to enquiries	Throughout Phil Seaton has been fielding a considerable number of email requests for general information on the project and specific guidance on the targets, protocols, etc.
Output 7.	Conservation collections of seeds / in vitro plants created / strengthened	All countries (15 MoU countries and Estonia) have enhanced orchid seed stores, with a cumulative OSSSU collection of 386 species. More than one collection has been stored for 105 species, and 15 of these are in more than one country. 11 countries have generated <i>in vitro</i> seedlings for c. 240 species (some overlap between countries) from the germination tests that are being used to enhance existing living collections.
Output 8.	Public talks (in-country) on integrated conservation strategies and procedures	Promotion of integrated conservation has been achieved through posters at conferences and talks to scientists and the public. For conferences, at least 11 posters were presented in six countries and a minimum of 20 talks given in 12 countries. Cumulative audience numbers were at least 1500 for the talks and 5000 attended the 3rd Mahidol Orchid Show in Thailand at which there was an OSSSU poster. Many institutional talks were also given.

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

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve: (1) the conservation of biological diversity (2) the sustainable use of its components, and (3) the fair and equitable sharing of benefits arising out of the utilisation of genetic resources</p>			
<p>Purpose</p> <p>To create an orchid seed bank network across 16 countries to: (1) conserve, as seed, 250 species from diverse habitats of varying levels of endangerment; and (2) develop protocols for the production of in vitro plants in support of the sustainable use of threatened species.</p>	<p>Number of countries actively contributing to the science and sharing information</p> <p>Number of countries wishing to join network (Eol)</p>	<p>DI annual reports, Bulletin Board traffic, etc.</p> <p>Correspondence</p>	<p>No breakdown in communication and trust between UK lead and the collaborating institutes leading to cancellation of MoUs.</p> <p>No institutional realignment</p>
<p>Outputs</p> <p>Improved 'in-country' facilities for seed storage and in vitro germination;</p> <p>Trained staff in orchid conservation biotechnology</p> <p>Data and germination protocols, and storage information;</p> <p>Training materials in Spanish, Chinese and English</p> <p>Distributed, searchable electronic database</p> <p>Advisory replies to enquiries</p> <p>Conservation collections of seeds / in vitro plants created / strengthened</p> <p>Public talks (in-country) on integrated conservation strategies and procedures</p>	<p>16 countries</p> <p>> 32 trainees (plus cascade to many more)</p> <p>250 species</p> <p>1 set of guidelines on orchid seed conservation</p> <p>1 created</p> <p>Response to enquiries within 30 days of receipt</p> <p>1 multispecies collection per institute</p> <p>At least 1 per year per institute</p>	<p>Institutional annual reports</p> <p>Attendance lists and workshops reports</p> <p>Publications and web uploads</p> <p>Refer to OSG site</p> <p>Accessible in all 16 countries</p> <p>Correspondence</p> <p>Collections databases held locally</p> <p>Posters / web site</p>	<p>Impact of altered institutional budgets tolerable</p> <p>Loss of trained staff from institutes minimal</p> <p>Species germination is not intractable</p> <p>Cost of any translation needs not increase prohibitively</p> <p>Interoperability between countries / software</p> <p>Filing is efficiently performed</p> <p>Created collections maintained adequately / continuity of care</p> <p>Publicity reaches the target audience</p>

		notices and head count record	
<p>Activities</p> <p>Equipment purchase</p> <p>Information consolidation and distribution</p> <p>Species seed collected and conserved, database created</p> <p>Produce in vitro plants via germination.</p> <p>Organise and run two training courses, write and distribute training materials;</p> <p>Education programme established</p>	<p>Activity Milestones</p> <p>Y1: Sign MoUs (12/07); two training workshops (10-11/07); purchase equipment (10/07 – 3/08); initiate lab work (11/07); collect, clean, store and sow c. 40 orchid species (all year); establish and operate clearing house(CH) , and web site (3/08); design data base (3/08); public lectures (all year). Y2 (all year): Collect, clean, store and sow c. 90 orchid species; update database & operate CH; publications and lectures. Y3: Collect, clean, store and sow c. 90 orchid species; update database & operate CH; publications and lectures (all year); Y4: (all year): Collect, clean, store and sow c. 20 orchid species; update database & operate CH; publications and lectures; hold final workshop; issue final guidelines</p>	<p>Assumptions</p> <p>Export of major items from UK avoided;</p> <p>Kew access to databasing and other e-literature maintained and systems compatibility globally;</p> <p>Easy access to (targeted) species / plants / seeds continues;</p> <p>Power supply remains regular and infrastructure intact;</p> <p>Sufficient staff of appropriate calibre identified and available for the courses.</p> <p>Fits institutional priorities / timelines</p>	

Annex 3 Project contribution to Articles under the CBD

Project Contribution to Articles under the Convention on Biological Diversity

Article No./Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use	5 (from pollen to seed and plant production)	Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	5 (Chile fieldwork)	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	0	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation	20 (seed processing and storage)	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	20 (devise and apply in vitro germination approaches)	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	0	Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	30 (reproductive biology studies, cascade training, etc)	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness	5 (general PR work)	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	0	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	0 (no	Whilst governments control access to their genetic resources

Article No./Title	Project %	Article Description
Genetic Resources	exchange of material between countries)	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	5 (through workshops and technical backstopping)	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 (contribution of country nationals in workshops, share experiences, report / paper writing, etc)	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	0	Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Other Contribution		Smaller contributions (eg of 5%) or less should be summed and included here.
Total %	100%	Check % = total 100

Annex 4 Standard Measures

Code	Description	Totals (plus additional detail as required)
Training Measures (NB. Items 1 – 6 a were supported through gift-in-kind by OSSSU participants)		
1a	Number of people to submit PhD thesis	3 currently being supported
1b	Number of PhD qualifications obtained	0
2	Number of Masters qualifications obtained	7 through gift-in-kind (+3 teachers of this grade trained)
3	Number of other qualifications obtained	0
4a	Number of undergraduate students receiving training	104 of which 9 were involved in projects.
4b	Number of training weeks provided to undergraduate students	On the basis of 3 months per undergraduate project on average for 9 students = 108 weeks; plus 0.5 x 1 week for 95 students = 47.5 weeks. Total estimated to be 155 weeks
4c	Number of postgraduate students receiving training (not 1-3 above)	<i>(+3 teachers of this grade trained)</i>
4d	Number of training weeks for postgraduate students	Generally, orchid biology and seed storage would be a component only of their studies. We estimate that training cascaded from OSSSU to PG students was about 1 week a year. For 7 masters = 7 weeks. For PhD students, this would be 1 week per year for 3 years for 3 students = 9 weeks. Total estimated to be 16 weeks (plus 3 weeks for teachers)
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(ie not categories 1-4 above)	0
6a	Number of people receiving other forms of short-term education/training (ie not categories 1-5 above)	Training of about 1 week each was provided to five technicians.
6b	Number of training weeks not leading to formal qualification	16, 21 and 23 participants at the training workshops in Ecuador, China (2007) and Costa Rica (2010) = 58 weeks
7	Number of types of training materials produced for use by host country(s)	Protocols for OSSSU work were produced in English and Spanish and are on the web site. 'Growing Orchids from Seeds' laboratory manual was translated into Spanish and Chinese. 92 copies of the manual (in English and Spanish) have been distributed to institutes in 21 countries. Disappointingly, the Chinese version is still with the printers in Southeast Asia, but will be distributed in 2011.
Research Measures		

Code	Description	Totals (plus additional detail as required)
8	Number of weeks spent by UK project staff on project work in host country(s)	3 workshops x 1 week x 2 staff = 6 weeks. With additional trips for negotiations with Ecuador, Mexico and India, attracting associates to the network and other site visits the total easily exceeds 10 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)	0
10	Number of formal documents produced to assist work related to species identification, classification and recording.	5 books have been written / edited by OSSSU participants (See Volume 2)
11a	Number of papers published or accepted for publication in peer reviewed journals	3 (with 1 under review). The Botanical Review has an impact factor of 2.5; Seed Science & Technology CIF = 0.7; J. Trop. For. Sci CIF = 0.3; In vitro Cellular and Developmental Biology – Plant CIF = 0.9. (See Volume 2)
11b	Number of papers published or accepted for publication elsewhere	2 conference proceedings chapters; plus 6 popular articles in journals targeted at orchid specialists / conservationists (See Volume 2)
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	1 (compilation of data on seed storage and germination from the collaborators) on the web site under password protection.
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	<i>At least 5 collaborators have added data to existing in-country conservation databases.</i>
13a	Number of species reference collections established and handed over to host country(s)	0
13b	Number of species reference collections enhanced and handed over to host country(s)	c. 240 species were germinated successfully across 11 countries , with seedling being grown on to support living collections enhancement
Dissemination Measures		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	3, as planned
14b	Number of conferences/seminars/workshops attended at which findings from Darwin project work will be presented/disseminated.	Presentations (talks, posters) at at least 21 conferences in 13 countries (Ecuador, Bolivia, Philippines, China, UK, Thailand, Cuba, South Africa, Germany, Brazil, Colombia, Chile, Mexico,

Code	Description	Totals (plus additional detail as required)
		Guatemala). Visiting lectures also given at institutes in many countries, including USA. (see Volume 1, Annex, Table 7).
15a	Number of national press releases or publicity articles in host country(s)	At least 32 newspaper or web articles on the OSSSU project and its workshops (See Volume 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	9 newsletters articles (see Volume 2)
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	0
16b	Estimated circulation of each newsletter in the host country(s)	The newsletters (RHS Orchid News, Kew Scientist, SAMARA, Orchid Review, Darwin News) referred to under 15c above tend to have international reach . Print runs are in the many hundreds.
16c	Estimated circulation of each newsletter in the UK	About 50 institutes , government agencies in the UK for Kew Scientist and SAMARA.
17a	Number of dissemination networks established	1 (through the new OSSSU website)
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	3 TV reports in Ecuador on workshop November 2007; 1 TV report in Vietnam on orchid conservation
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	2 interviews in Ecuador 4 interviews in Thailand
19b	Number of national radio interviews/features in the UK	0
19c	Number of local radio interviews/features in host country (s)	1 for student radio in Ecuador during the 2 nd Scientific Conference on Andean Orchids
19d	Number of local radio interviews/features in the UK	

Code	Description	Totals (plus additional detail as required)
Physical Measures		
20	Estimated value (£s) of physical assets handed over to host country(s)	Capital budget spent was £10 k
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	<p>\$12,000 National Botanic Garden, Chile; \$1,000 UNOESTE, Brazil; \$8,000 Quito Botanic Garden, Ecuador; \$10,000 Lankester BG, Costa Rica.</p> <p>\$ 31,000 in total (£20 k)</p> <p><i>Additionally, major orchid laboratory / garden improvements of > \$300,000 at Singapore Botanic Gardens and Univ of Loja, Ecuador.</i></p>
Other Measures used by the project and not currently including in DI standard measures		

Annex 5 Publications

Type *	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
	JOURNAL / CONFERENCE ARTICLES			
Journal (popular)	Seaton PT, Pritchard HW (2008) Life in the Freezer: Orchid seed banking for the future. <i>Orchids</i> October 2008 , 762-773.	American Orchid Soc.	www.aos.org	Journal sub.
Journal (popular)	Seaton PT, Perner H (2008) Field trip to Huanglong, China. <i>Orchids</i> October 2008 , 3 pp.	American Orchid Soc.	www.aos.org	Journal sub.
Journal (popular)	Seaton PT (2008) Visiting Papallacta Ecuador. Making a field trip to high elevations in South America. <i>Orchids</i> November 2008 , 862-864.	American Orchid Soc.	www.aos.org	Journal sub.
Journal (popular)	Seaton PT, Orejuela Gartner. JE (2008) Saving <i>Cattleya quadricolor</i> . Developing an action plan for a Colombian orchid. <i>Orchids</i> September 2009 , 548-551.	American Orchid Soc.	www.aos.org	Journal sub.
Conference proceedings	Seaton PT, Marks T, Perner H, Jijon C, Pritchard HW (2009) Orchid seed banking takes off. <i>Proceedings of the Second Scientific Conference on Andean Orchids</i> (eds.) AM Pridgeon and JB Suarez. pp. 173-183. http://repositorio.utpl.edu.ec/dspace/bitstream/123456789/2462/41/15%20Orchid%20seed%20banking%20takes%20off.pdf	Univ of Loja, Ecuador	http://repositorio.utpl.edu.ec ;	Free online
Journal (popular)	Horak D (2010) Orchid Conservation: orchid conservation heroes. <i>Orchids</i> , January 2010 , pp 38-43.	American Orchid Soc.	www.aos.org	Journal sub.
PR journal (high impact)	Seaton PT, Hu H, Perner H, Pritchard HW (2010). <i>Ex situ</i> Conservation of orchids in a warming world. <i>Botanical Review</i> 76 , 193-203. DOI: 10.1007/s12229-010-9048-6	New York Botanical Garden	http://www.springer.com/life+sciences/plant+sciences/journal/12229 ; www.nybgpress.org	Journal sub.
Journal (popular)	Seaton PT (2010) Conserving <i>Cypripedium macranthos</i> . <i>Orchid Review</i> March 2010 , 42-45	Royal Horticultural Society	www.rhs.org.uk/Plants/RHS/Journals/The-Orchid-Review	Journal sub.
Conference proceedings	Seaton PT, Pritchard HW (2010). Orchid Seed Stores for Sustainable Use: a model for future seed-banking activities. <i>Proceedings of the Third Scientific Conference on Andean Orchids</i> . (in press), pp. 278-287.			

PR journal	Nadarajan J, Wood S, Marks TR, Seaton PT, Pritchard HW (2011) Nutritional requirements for in vitro seed germination of twelve terrestrial, lithophyte and epiphytic tropical orchids. <i>Journal of Tropical Forestry Science</i> (in press)	Forest Research Institute of Malaysia (FRIM)	http://info.frim.gov.my/cfdocs/infocenter/Korporat/2003Publications/Links/JTFS22(4)/CONTENTS22(4).htm	Free online
PR journal	Hosomi ST, Santos RB, Custodio CC, Seaton PT, Marks Tr, Machado-Neto NB (2011) Preconditioning <i>Cattleya</i> seeds to improve the efficacy of the tetrazolium test for viability. <i>Seed Science and Technology</i> (in press)	International Seed Testing Association, Switzerland	http://www.seedtest.org/en/science_and_technology/content---1--1084.html	Journal sub.
PR journal	Hosomi ST, Custodio CC, Seaton PT, Marks TR, Machado-Neto NB (2011) Improved assessment of viability and germination of <i>Cattleya</i> (Orchidaceae) seeds following storage. In Vitro <i>Cellular and Developmental Biology – Plant</i> (submitted)		www.springer.com	Journal sub.
	Seaton P and Ramsay M (2005). <i>Growing Orchids from Seed</i> . Royal Botanic Gardens Kew, 83 pp. (Used as the training guide at workshops in Quito, Ecuador and Chengdu, China)			
Book	Seaton P, Ramsay M and Warner J (translator) (2009). <i>Cultivo de orquídeas por semillas</i> . Royal Botanic Gardens Kew, 82 pp. (NB Chinese version still at printers in SE Asia)	Royal Botanic Gardens Kew, UK	http://www.kewbooks.com/	c. £10
Book	Hartini S and Puspitaningtyas DM (2010) <i>Orchids of Sumatra</i> . Keanekaragaman Tumbuhan – Pulau Sumatera. (NB. No cost to OSSSU)	Indonesian Institute of Science Press.	Lembaga Ilmu Pengetahuan Indonesia – LIPI. www.lipi.go.id/	?
Book	Thammasiri K (2007) <i>Orchid Production Technology</i> (in Thai). Chapter 9 – Orchid Breeding; Chapter 10 – Orchid Conservation. (NB. No cost to OSSSU)	Amarin Printing Co. Ltd, Thailand	www.alacrastore.com/company.../Amarin_Printing_Publishing_Public_Co_Ltd-2015210	?
Book	Thammasiri K (2007) <i>Thai Orchids: Conservation and Sustainable Use</i> . (in Thai). Chapter 3 – Thai Orchid Conservation. Chapter 4 – Sustainable Use of Thai Orchids. (NB. No cost to OSSSU)	Amarin Printing Co., Ltd, Thailand.	www.alacrastore.com/company.../Amarin_Printing_Publishing_Public_Co_Ltd-2015210	?
Book	Francioli SE, Novoa Quezada P (2009), with foreword by Phillip Seaton. <i>Orchideas de la Region de Valparaiso.</i> , 83 pp. ISBN: 9568201076 ISBN 13: 9789568201074	Taller La Era	http://www.buscalibros.cl/orquideas-region-valparaiso-sergio-	\$18

			elortegui-cp_3632098.htm	
Newsletter article	Seaton P (2007) Global seed storage project. <i>RHS Orchid News July-Aug 2007</i>	RHS Magazine, London	www.rhs.org.uk/Plants/RHS/Journals/	Journal sub.
Newsletter article	Pritchard HW (2007) New grants: Orchid Seed Stores. <i>Kew Scientist Newsletter Issue 32, 8 (Oct 2007)</i>	Royal Botanic Gardens, Kew, UK	www.kew.org	Free online
Newsletter article	Seaton P (2008). Orchid seed storage network launch. <i>The Orchid Review 2008</i>	RHS, UK	www.rhs.org.uk/Plants/RHS../Journals/The-Orchid-Review	Journal sub.
Newsletter article	Seaton PT, Pritchard HW (2008) .Orchid seed: from Lindley to modern biotechnology. <i>Samara Issue 14 (Jan-June 2008)</i> .	Royal Botanic Gardens, Kew, UK	www.kew.org	Free online
Newsletter article	Seaton P (2009) Appeal for Cuban botanic gardens damaged by hurricane. <i>RHS Orchid News March 2009</i>	RHS Magazine, London	www.rhs.org.uk/Plants/RHS/Journals/	Journal sub.
Newsletter article	Seaton PT, Pritchard HW (2009) Conserving orchid biodiversity in the 21 st Century. <i>Darwin News Issue 15, 2</i>	Darwin Initiative, UK	http://darwin.defra.gov.uk/	Free online
Leaflet	Banco de Germoplamsa	UTPL Equador		
Newsletter article	Neto N (2009) Brazilian orchid seed stores for sustainable use (OSSSU) takes off. <i>Samara Issue 17, 10 (July-Dec 2009)</i>	Royal Botanic Gardens, Kew, UK	www.kew.org	Free online
Newsletter article	Seaton P (2010) Orchid Seed Stores for Sustainable Use (OSSSU). <i>The Orchid Review December 2010</i>	RHS, UK	www.rhs.org.uk/Plants/RHS../Journals/The-Orchid-Review	Journal sub.

Annex 6 Darwin Contacts

Ref No	16-012
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