

## Darwin Fellowship - Final Report

(Please check guidance for submission deadlines, max 6 pages.)

Darwin Project Ref No.	162/12/030 - Fellowship reference EIDPS021
Darwin Project Title	Building Capacity for Plant Biodiversity, Inventory and Conservation in Nepal
Name of Darwin Fellow	Dr Lokesh Ratna Shakya
UK Organisation	Royal Botanic Garden Edinburgh, 20a Inverleith Row, Edinburgh, EH3 5LR
Your Organisation	Amrit Campus, Tribhuvan University, Kathmandu, Nepal
Your role in your Organisation	Lecturer
Start/end date of Fellowship	6 <sup>th</sup> September 2009 - 5 <sup>th</sup> August 2010
Location	Royal Botanic Garden Edinburgh
Darwin Fellowship funding (£)	16,540
Type of work (e.g. research, training, other, please specify)	Taxonomic research on Orchidaceae, training in use of biodiversity informatics, nomenclature and herbarium curation
Main contact in UK Organisation	Dr Mark Watson, RBGE
Author(s), date	Lokesh Shakya, Mark Watson, 28 <sup>th</sup> January 2011

### 1. Background

- Briefly describe your involvement in the Darwin project before the start of your fellowship.

Dr Shakya was one of sixteen Darwin Scholars during Project 162/12/030. He participated fully in all the activities of the Project and was one of the top performers. After the Darwin project, Dr Shakya has regularly been involved in the study and collection of orchids for the Flora of Nepal Project, and has described several new records and new species.

- Describe aim and objectives of the Fellowship, and programme of work.

This fellowship was aimed at providing the base-line information desperately needed by conservation bodies in Nepal to engage in effective conservation action and instigating the sustainable use programmes for plant resources. The illegal wild collection of orchid for trade is a major problem. Information on identification and rarity will enable more effective controls in this area and benefit those engaged in horticultural cultivation to alleviate pressures on wild populations. The account of the orchids will contribute directly to completion of the Flora of Nepal which has been identified as a priority in the Government of Nepal's 10th Five-Year Plan (2002) and the National Biodiversity Strategy (2002).

This fellowship was undertaken by Dr Lokesh Shakya who has studied the orchids of Nepal for many years, both in the field and in the herbaria available to him in Nepal. He built on this by extending his study to the extensive Himalayan herbarium and literature collections held in the UK and finalised the draft account of the Orchidaceae for Flora of Nepal including the identification of six new records and four new species from Nepal. The draft account will be distributed in electronic format via the Flora of Nepal website ([www.floraofnepal.org](http://www.floraofnepal.org)) and the final version also in printed format. The website enables access to the specimen level information and geo-located specimen records, hence filling a requirement for electronic occurrence data to feed into GIS and other modelling programmes addressing ecological and environmental changes over time.

The UK is an important centre for Nepalese collections and originals, and specimens from these collections are housed at Royal Botanic Garden Edinburgh (E), the Natural History Museum London (BM) and Royal Botanic Gardens Kew (K). The UK is also a centre of excellence in the study of Himalayan orchids, with specialists at Kew (N.R.Pearce, P.J.Cribb and J.J.Wood) taking the lead in the production of the Orchidaceae volume of RBG Edinburgh's Flora of Bhutan. This fellowship enabled Dr Shakya to complete his research on the Orchids of Nepal by consulting the collections at E, BM and K, and working alongside Orchid specialists and other Himalayan floristic experts.

All herbarium specimens present at E, BM, K and the Linnean Society of London were meticulously examined and revised using macro morphological methods. Detail study of flowers were made to understand systematics of the group and to aid taxon delimitation. Line drawings of the main groups of orchid species were also prepared. The libraries of all four institutes were used in retrieving published information on the orchids of Nepal and Himalaya. Collaborations with orchid experts was particularly valuable in these three institutions aided the updating of the orchid flora of Nepal and establishing a collaboration network for future research.

RBGE provided the necessary office and laboratory facilities to work on herbarium specimens and living specimens available at E (and loan material from BM and K) and expert guidance to accomplish the research goals. Some of the specimens from BM and K were sent on loan to E for study there, but study visits to both BM and K were also necessary.

- Briefly describe the roles of the UK and Fellow's institutions.

RBGE's mission statement is 'to explore and explain the world of plants'. It has an international reputation as a centre for excellence in plant taxonomy, molecular systematics and biodiversity science based on its rich herbarium, living collections, library and archives. RBGE has wide-ranging education activities which include PhD, MSc, BSc, HND courses as well diverse public education programmes. RBGE contributes to many Flora projects worldwide, and coordinated the recently completed European Garden Flora (2000), Flora of Bhutan (2002) and Ethnoflora of the Socotra Archipelago (2004). The Floras Group manages the Flora of Nepal in collaboration with the University of Tokyo and Tribhuvan University and the Department of Plant Resources in Kathmandu. The Group is developing innovative biodiversity informatics tools to aid compilation of Floras and has an active fieldwork schedule. In addition to the Nepal project RBGE has successfully undertaken Darwin projects in Bhutan, Vietnam, Turkey, Laos, Peru and Chile.

The Amrit Campus of Tribhuvan University, Kathmandu, Nepal, specialises in undergraduate teaching. The Botany course run by the Botany Department includes plant taxonomy, ecology and other related fields. The Botany Department also runs an active Research Laboratory which is working on orchid systematics and conservation in Nepal. The ongoing programme of exploration is focussed towards different parts of the country and involves both in-situ and ex-situ conservation techniques. From the result of these explorations department has been successful in projects aimed at conserving orchids of Raja Rani in the east, Kathmandu Valley in the centre and Annapurna Conservation Area in the west. An Orchidarium has been established in the campus for cultivation of wild origin orchids from Nepal and used for ex-situ conservation as well as further scientific study.

## **2. Achievements**

- Summarise the work undertaken during your Fellowship. What were the main activities undertaken. Highlight any work undertaken but not originally planned and explain why this happened. Highlight any problems encountered and how they were overcome.

Work during the project was in three phases, the first a 4-month period spent at RBGE, the second a 4-month study visit in London working on the collections and with orchid experts at

the Natural History Museum, RBG Kew and Linnean Society of London; and the final phase back at RBGE consolidating the research.

### **Phase 1:** Edinburgh (6<sup>th</sup> September to end of December 2009)

Initially there was a period of induction and training with the Flora of Nepal team at RBGE. This included the use of facilities (Herbarium, Library etc) and particularly in use of the Flora of Nepal Padme database. All Latin names and literature of the Nepalese orchid species were entered into the database - 370 currently accepted names and many more synonyms (ca. 1000 names in total). Research was undertaken on the 468 specimens of Nepalese orchids held in the RBGE Herbarium, including identification, morphological analysis and data entry of all the collection details. Full descriptions of 25 species not available from herbarium collections held in Nepal were produced. One new subspecies of *Peristylus superanthus* was characterised.

### **Phase 2:** London (January to April)

Natural History Museum. Research and data capture was undertaken on the 989 Nepalese orchid specimens held in the herbarium (as above). Specimens of *Vanda*, *Zeuscine*, *Goodyera* and *Habenaria* were out on loan and so could not be consulted. Full descriptions were prepared for a further 22 species. Specimen annotations by past orchid specialists (P. Pradhan and Tuyama) were particularly useful in interpreting their species concepts. Types of a further 10 species not yet seen were studied. Two new species (*Bulbophyllum* and *Peristylus*) were characterised. Training was provided by NHM curation staff on use of their Herbarium, Library and other collections.

RBG Kew. Research and data capture was undertaken on the 371 Nepalese orchid specimens held in the General Herbarium (as above), and the many more voucher specimens from surrounding countries were consulted, including 98 Types of species now found in Nepal. Similarly 55 Nepalese orchid specimens in the Wallich Herbarium and 73 from the Lindley Herbarium were examined. Lindley is known as the 'Father of Orchidology' and his personal collections include Types of 45 Nepalese species. Full descriptions for a further 17 species were prepared. Training on the use of the Kew collections (herbaria and library) was provided by Kew staff. Very useful discussions were conducted with international orchid specialists at Kew, notably Dr Philip Cribb (co-author on Flora of Bhutan Orchidaceae volume), Dr Jeffrey Wood (co-author for many genera in Flora of China Orchidaceae) and Capt. Dudley Clayton, monographer of *Coelogyne*. In particular these resulted in clarification for groups where the taxonomic classification was unclear and the decision to recognise a further three new species from Nepal.

Linnean Society of London. Research and data capture was undertaken on the 66 Nepalese orchid specimens and 34 paintings held in the archives of the Linnean Society (as above). These include the earliest scientific natural history collections from Nepal, those by Francis Buchanan in 1802-3, and later by Edward Gardner in 1817-1820. These historic and fascinating materials have not yet been comprehensively studied and will be treated in more depth following on from the Fellowship. Type specimens of 12 Nepalese orchids were consulted. Training was provided on handling and use of the archive materials at the Linnean Society was provided by the Library staff, as well as help in accessing the materials. This work was in addition to that in the original plan as these collections only came to light during the study period. Including these in the study added a major new temporal dimension to the project extending the time period back some 200 years. It was also fortuitous that Dr Shakya was in London just at the time these collections came to light and he was easily able to undertake this extra work.

### **Phase 3:** Edinburgh (April to 5<sup>th</sup> August 2010)

The final phase of the Fellowship was back in Edinburgh consolidating and completing the research. The programme of work included adding all the specimens from KATH (1470) and TUCH (300) into the Padme dataset from notes made prior to the Fellowship visit, and checking the georeferencing of entered specimens. The nomenclature and classification was checked

using a checklist generated from the dataset. 160 line drawings prepared by Dr Shakya were scanned for use in reviewing the accounts (these will be inked in later and used to illustrate the Flora account. Refining draft accounts so that they are ready for publication is a time consuming process, particularly when striving for parallel descriptions. Dr Shakya worked C.Pendry, the Flora of Nepal Production Manager, to bring the *Habenaria* draft up to the required standard, and descriptions and other data were uploaded into the Padme Nepal dataset. This is used to generate the forthcoming online Flora, and is anticipated to go live by the end of March 2011. Data on 3800 orchid specimens are already accessible via the current version of the Plant of Nepal website in the Botanical Locator section ( <http://rbg-web2.rbge.org.uk/nepal/locator/index.html>) and include all the specimens studied during this fellowship

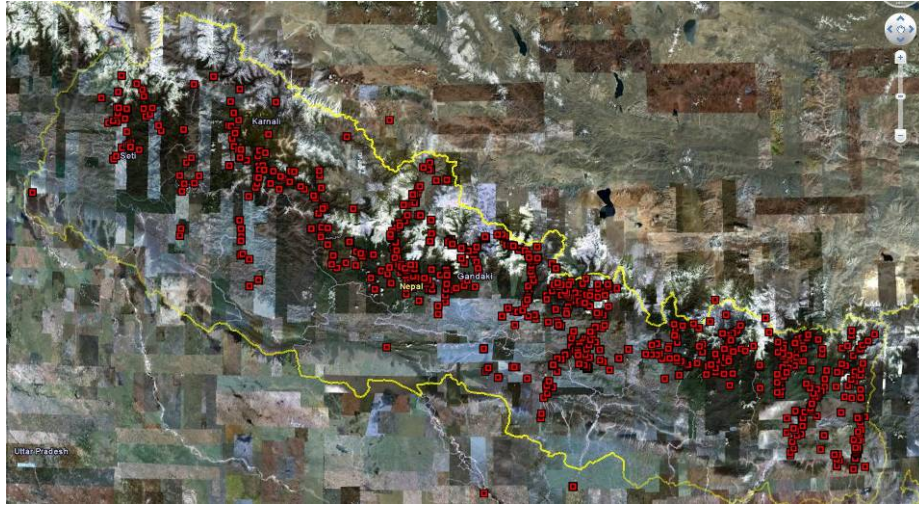
Due to family reasons Dr Shakya had to leave a few weeks early, and so was not able to complete the processing of finalising the species descriptions. However, he has all the information he needs now and is continuing with this process whilst back in Nepal. The next stage in the process of finalising the Flora of Nepal account is to send around the draft accounts for review by orchid experts. The collaborative links Dr Shakya has made during his UK visit will be very important for this, and he will be continuing to work with RBGE to complete this process.

- What have been the main achievements of your fellowship? Key documents should be annexed to this report.

The main achievements of the fellowship have been in capacity building for the Darwin Fellow and generation of valuable information on the orchids of Nepal. As mentioned above, the Darwin Fellow has extended his skills and experiences in preparing modern Flora accounts of the quality needed for an international publication, and learnt new skills in literature searching, data management using a database, retrospective geo-referencing of herbarium specimens, and the handling of archival materials over 200 years old. Working closely with herbarium staff in the three main UK taxonomic institutes has also been highly beneficial in learning and experiencing protocols and working methods which can be applied to institutes in Nepal.

The Orchidaceae is largest flowering plant family of Nepal, and so this major step forwards to wards the production of the comprehensive account for the Flora of Nepal has helped to achieve a great positive impact on orchid biodiversity and conservation. This has laid the basic foundation in the study of orchid biodiversity of Nepal, and mobilised a huge amount of primary occurrence data for others to use. The study focussed on distribution of all species represented in herbaria housed at UK and Nepal. This was particularly helpful for the study of rare and endangered species of orchids of Nepal which are very poorly represented in herbaria in Nepal, if at all as they have only been collected on a handful of occasions and often only by foreign botanists.

The project was highly productive in terms of information captured in digital format. In total 2122 specimens have been studied and included in the database, representing all available collections from Nepal at E, BM, K and LINN. During project 1472 specimens from KATH were also included in database. The following map it generated from the Padme database and includes all the Orchid specimen data digitised during the Fellowship. Not only does this graphically display the large quantity of records, but is also shows that there is generally good coverage across the country. It also highlights areas that need further fieldwork, and these mirror the patterns seen in other groups, so it is not just specific to orchids. The poorly known areas identified as part of this work will be used to target future fieldwork expeditions.



Six species have been identified as new country records for Nepal and further four (possibly five) as yet undescribed species have been characterised.

### 3. Outcomes, lessons and Impact

Do you feel that the work undertaken during your Fellowship has improved skills that are relevant and important for your work in your organisation? How are you planning to apply those skills in future work?

I have improved my skills in many areas, as mentioned in the section above. Key lessons learned in the many aspects of preparing high quality flora accounts were very important, as were data management skills and institutional organisational skills. I will be able to pass on many of these skills to the people I work with and the students that I supervise and teach at my University. In particular they will be disseminated to M. Sc. Botany (Taxonomy) students Tribhuvan University of Nepal and others who will contribute to write flora of Nepal.

It was particularly fortunate that a meeting of the Society of Himalayan Botany was held at RBGE during my visit. This is an international society, mostly based in Japan, and many Japanese and other international scientists attended. The Japanese have a strong research connection with Nepal and are main partners in the Flora of Nepal project. I was able to attend the meetings and give an oral presentation. Contacts established with Japanese botanists during the meeting will be very important for my future work and career development.

- What arrangements have been made for your future involvement, what more could be done, what discussions have taken place with your original employer to ensure that your new skills are utilised?

The future involvement will be to complete the Orchid flora writing by further consulting herbarium specimens deposited in Japan and working in collaboration with international orchid specialists who will be involved in reviewing the manuscripts. For this I will continue to work closely with colleagues at RBGE. New species and new records of orchids will be published in an international journal. I have been discussion with the management at my university to increase the space allocated to me to continue this work, especially access to IT and internet facilities. I am also seeking further teaching opportunities with students at TU through lectures and project supervision.

- Has the Fellowship helped to improve your capacity to solve practical problems related to the sustainable use and/or conservation of biodiversity in your country?

The fellowship has greatly helped my ability to critically assess and analyse herbarium specimens of Nepalese orchids deposited at different herbaria in the UK. It has been especially helpful in developing my knowledge and understanding of rare orchids only known from one or



two collections and not present in herbaria in Nepal. This is very important when linking with old names cited in the literature. Although I had researched the materials deposited in Nepal, it soon became clear that these were too incomplete to provide reliable evidence on which to base conservation decisions upon. So it was essential for me to study specimens in the UK and mobilise these data so they are available for conservation planning. This has led me through a gap filling process and to concentrate on gathering information on the rare and endangered orchid species of Nepal. The increased level of knowledge and understanding on species identity, ecology and distribution will certainly make a major contribution to the conservation of Nepal's orchid biodiversity of Nepal as the simple lack of reliable primary data has been a major hurdle.

- Have you had the opportunity to make contacts with other UK biodiversity institutions, intergovernmental organisations, NGOs or the private sector during your fellowship? Will these contacts be useful for your future work, and how are you planning to maintain them?

Yes, having travelled to and worked in four major UK botanical institutes (Linnean Society, K, BM and E), and collaborated with many staff. This has dramatically extended my network of collaborators and will be very useful in my future work. Further contacts made during the Society of Himalayan Botany meeting (discussed above) were also very important for me. These contacts will be useful to me in many ways in advancing further fieldwork and study in orchid conservation, understanding distribution of orchids in Nepal. I can continue correspondence using email and continue to build networks with other people and organisations. I am hoping that these contacts will also result in collaborative projects that will attract funding for research and conservation in Nepal, and also enable me to participate on other study visits, e.g. to Japan.

- Any other issue emerging from your experience as Darwin Fellow that you would like to raise, or suggestions for improvements to the Darwin Initiative Fellowship scheme.

The original Darwin Initiative project and this Fellowship have been highly beneficial to raising capacity for biodiversity research and conservation in Nepal, and they have lasting legacies. In addition to the Fellowship scheme it would be good if there was an opportunity for follow on funding to build on the Fellowship in my home country.

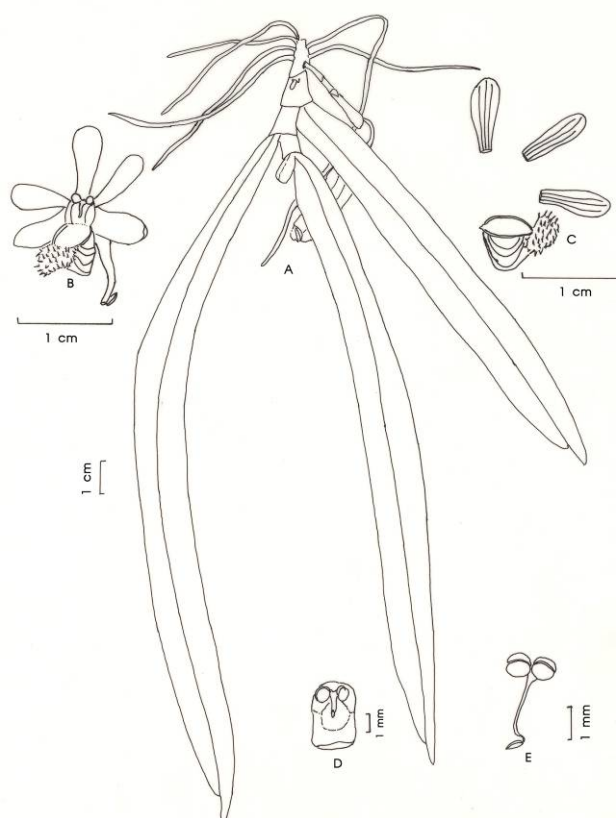


Figure 1. *Gastrochilus calceolaris* (Buchanan-Hamilton ex J.E. Smith) D. Don Var. *biflora* L.R. Shakya et M.R. Sherstha - A. Habit; B. Flower; C. Sepals, petal and lip spread out; D. Column; E. Pollinia.