

Darwin Fellowship - Final Report

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

Darwin Project Ref No.	162/12/030
Darwin Project Title	Building Capacity for Plant Biodiversity, Inventory and Conservation in Nepal
Name of Darwin Fellow	Ram Chandra Poudel: EIDPS15
UK Organisation	Royal Botanic Garden Edinburgh 20a Inverleith House, Edinburgh, EH3 5LR, UK
Your Organisation	Ethnobotanical Society of Nepal (ESON) c/o Tribhuvan University, Central Department of Botany, Kirtipur, Kathmandu, Nepal
Your role in your Organisation	Researcher and Project(s) Coordinator
Start/end date of Fellowship	01/09/2007-01/09/2008
Location	Edinburgh University, The School of Biological Sciences
Darwin Fellowship funding (£)	28,361
Type of work (e.g. research, training, other, please specify)	M.Sc in Biodiversity and Plant Taxonomy
Main contact in UK Organisation	Dr. Mark F. Watson
Author(s), date	Ram Chandra Poudel, Mark F. Watson; 18/12/08

1. Background

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

Between 2003 and 2006 I was one of the Darwin Scholars trained on the Darwin Initiative project (No. 162/12/030) " Building Capacity for Plant Biodiversity, Inventory and Conservation in Nepal". I was selected on merit for one of six places available through the open competition process on this project. The major collaborators of this three years long project were Royal Botanic Garden Edinburgh (UK) and Nepal Academy of Sciences (NAST) along with local partners Nepal Government, Ministry of Forest and Soil conservation, Department of Plant Resources and Tribhuvan University, Central Department of Botany. As a Darwin Scholar I successively completed all the practical and theoretical training modules and I also achieved a merit award for my results. I have utilized the skills and knowledge gained during training in writing flora of Nepal accounts of some plant groups as well as in the implementation of community based conservation projects in various districts of Nepal.

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

The aim of the Darwin Fellowship is to train Mr. Poudel with the highest quality education and knowledge on biodiversity research and conservation through the MSc in The Biodiversity and Taxonomy of Plants based at RBGE and awarded by the University of Edinburgh. This course has been rated world class and the very best of its kind by a recent education review of the RBGE.

- 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.

Ethnobotanical Society of Nepal (ESON) is an organization of professional botanists of Nepal and foreign biodiversity conservationists, researchers and scholars working in Nepal. Working closely with Tribhuvan University, Central Department of Botany, ESON regularly conducts national, regional and international workshops, researches, trainings and mostly local level community based projects on conservation and sustainable use of countries' plant resources. ESON is one of the leading organizations in *in situ* and *ex situ* plant conservation and is actively working with stakeholders which include national and international institutions, central and local governments, local communities and researchers to achieve various targets of CBD. Mr. Poudel is an executive member of ESON and has been working in the coordination of both local and central level programs of the organization. The current projects of ESON are; "Community-based conservation and sustainable utilization of medicinal plants in Rasuwa, Himalaya-Phase II" supported by Plantlife International, UK and "Development of Medicinal and Aromatic Plants Network (MAPs-Net) Nepal" supported by The International Centre for Integrated Mountain Development (ICIMOD).

ESON recently completed its first phase of Rasuwa project and "Plant Biodiversity Inventory, Identification of Hotspots, and Conservation strategies for Threatened Species and Habitats in Kanchenjunga-Singalila Ridge, Eastern Nepal", supported by Critical Ecosystem Partnership Fund, USA. ESON also provides support for the MSc course taught by the Central Department of Botany at Tribhuvan University. ESON's major achievements are the publication of three books; regular publication of newsletters, preparation of plant databases, a national report on important medicinal plants and plant areas, case studies of community based projects, the development of a robust network of national and international research institutions, individual experts and donor agencies and advocacy on conservation of endemic, threatened and rare plants through community forest user groups. For more information see www.eson.org.np

- If you have undertaken a formal course of training, please provide a brief explanation of the course and a link to the course website if available.

Royal Botanic Garden Edinburgh (RBGE) has one of the worlds' top collections of living plants and herbarium specimens, and thus is an excellent place to experience and learn plant biodiversity taxonomic and conservation research alongside world class experts in the field. The millions of plants in the collections have been gathered more than 120 countries and represent the entire range of vegetation types and ecology found on planet earth. Research methods conducted by the scientists at RBGE are equally diverse and span all areas from morphology and anatomy to cytology, molecular analysis and population ecology. Conservation and sustainable development is a major focus, and projects at RBGE are not only excellent examples of both *in situ* and *ex situ* conservation but also exceptional models of collaboration between developed country and biodiversity rich developing countries. With the increasing number of collections and collaborations RBGE realizes the need of transfer of skills and knowledge through the effective communication and training. RBGE now runs a suite of professional courses including the MSc in Biodiversity and Plant taxonomy taught jointly at the Garden and the University of Edinburgh.

The MSc course in the Biodiversity and Taxonomy of Plants was started in 1992, and has successfully provided top rated training on biodiversity and plant taxonomy to students from the United Kingdom as well as more than 22 overseas countries. This full-time twelve-month course is dedicated to the taxonomic study and conservation issues of lower and higher plants. Training and tutorials on both theoretical and applied subjects are designed with field trips and practical projects to reinforce skills learnt. Forming a bridge between traditional and modern approaches, this course equips students with a wide knowledge of plant diversity and its investigation, combined with instruction in the methods of pure and applied taxonomy. For more

information see <http://www.rbge.org.uk/education/professional-courses/msc-in-biodiversity-and-taxonomy-of-plants>.

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.

The MSc course at RBGE started on 1st September 2007, but due to delays in getting all the necessary documentation (UK Visa, IELTS results and appropriate flight tickets) I arrived Edinburgh on 13th September. Although I missed the welcome week and some induction sessions, I did not miss any coursework or lessons. The course schedule is given in Annex 1.

The training on the course is divided into two terms of taught classes followed by examinations, and one term for a personal research project. The two terms of taught classes are very intensive with lectures, practical work, field work and subsequent assignments on each module. Study schedule was mainly divided into four broad categories, autumn session, field trip to Belize, spring session and the project work. The autumn session covered subjects such as Angiosperm biodiversity, Herbarium Taxonomy, Plants and Fungi, and Cryptogamic biodiversity. A major component of the autumn term is the mini-revision project where students use the herbarium and library facilities to undertake a taxonomic revision of their own. I studied *Cyperaceae* for the Flora of Soqotra- see Annex 2 (this year all mini-revisions were run by the Flora of Arabia team). The theory taught in the lectures was reinforced with practical classes and assignments at the end of each module. The autumn session was completed with a written exam on Angiosperm biodiversity course in mid December 2007.

The field trip to Belize in Central America is one of the most exciting parts of this course. Although this field trip is mandatory part of the MSc course, it can also be joined by others needing training in tropical field botany who are enrolled on the RBGE Certificate in Practical Field Botany. In this context the two weeks long field excursion was not only among the friends in the course but also colleagues from different institutions and backgrounds who later participated in the training. The team was accompanied by well trained tropical botanists, including the curator of RBGE herbarium, as trainers and tutors. The trainees were from Oxford University, University of Belize, University of Sheffield and the postgraduate team from RBGE. Training was focussed mainly on the identification of tropical plant families, the preparation of herbarium specimens, database recording, ethnobotany of Maya communities and learning tropical ecology. Plants and ecology of Tropical forest around Lascuevas research station, Belize botanical garden and pine ridge forest was explored. The field trip was concluded with a practical exam at the end of the trip.

After returning from Belize the course work continued with the Spring session back at RBGE. The Spring course work started in the middle of January 2008 with the lectures, one day field trips and practical sessions on phylogenetics and population genetics, plant geography, cytology, evolution of plants and fungi along with their subsequent assignments. At the end of the term there were written exams on plant geography, evolution of plants and fungi and cryptogams in April 08. This concluded the taught part of the course and the total marks obtained from the exams taken in autumn and spring session and the Belize field course were then evaluated.

The last part of the MSc course is the Summer research project. The topic for my summer project was "Sub Section *Rhododendron campanulatum/wallichii* complex of the Himalayas one, two, three or four species?" (see Annex 3). Broad range of research activities were utilised during the project, and for me this was an excellent opportunity to gain experience in the excellent laboratory facilities and staff expertise at RBGE. This included the latest molecular techniques (PCR and DNA sequencing) as well as specialist techniques such as Scanning Electron Microscopy. Living plant collections from three of RBGE's specialist gardens (Inverleith, Dawyck and Benmore) were visited to collect *Rhododendron* samples for morphometric analysis and molecular sequencing. Moreover a total 300 specimens from Tokyo University and RBGE herbarium were consulted to resolve the taxonomic identities of the

species in *Rhododendron* subsection *Campanulata*. I submitted my project thesis on time at the end of August and gave my project presentation at the beginning of September 2008. The thesis was assessed and the marks included in the final assessment of the course in September. Final result of entire course was formally announced in the middle of November and I attended the graduation ceremony conducted by the Edinburgh University on 5th December 2008.

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

The award of the Darwin fellowship itself is a matter of great proudness and achievement for me. Continuous support from the RBGE staff especially my tutor/supervisor Dr. Mark F. Watson encouraged me to work hard during my course. The staff are very friendly and approachable and their help at RBGE and from Edinburgh University provided lots of opportunities to learn the latest advancements in taxonomy and conservation of plant biodiversity. Moreover the training I received in tropical field botany, Scanning Electron Microscopy, DNA extraction, PCR and sequencing I rank as the most important for my further research in biodiversity conservation.

Major documents prepared during the fellowship are as follows.

Poudel, R.C. (2007). Taxonomic review of *Isolepis* and *Cyperus* (Cyperaceae) for Flora of Soqotra Archipelago. Report submitted to Royal Botanic Garden Edinburgh. (size 1.60 MB, pages 15 with illustrations) ----summary in Annex II

Poudel, R.C. (2008). *Rhododendron campanulatum/wallichii* complex of the Himalaya: one, two, three or four species ?. Thesis submitted for partial fulfilment of requirements of MSc in Biodiversity and Taxonomy of Plants University of Edinburgh. Supervisors: Dr Mark F. Watson, Dr Colin Pendry, Mr. Tobias Marczewski (size 109 MB, pages 156 with lots of digital images) -- ---- summary in Annex III

Two other important documents should be mentioned here. The first is the article in RBGE's Annual Report 2007/8 which not only highlights the importance of this Darwin Fellowship, but also the value of the RBGE living collections in enabling such a study (file attached). My project will used as a case study in a new book by RBGE as it demonstrates the use of long term living collections developed over many years from expeditions to many countries in the Himalayan Region. The second document is the article on me in Darwin News issue 12, Sept 2008 (file attached).

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?

This postgraduate training provided me with a great deal of information on plant taxonomy and the conservation techniques. Due to lack of infrastructure and facilities in Nepal some of the techniques I learned might not be utilized, but I will be able to help develop these as the opportunities arise. The knowledge and skill I gained during the MSc course is very useful to understand taxonomic identities of plant groups and development of same sorts of research in future as well.

Royal Botanic Garden Edinburgh is leading the Flora of Nepal project in association with Nepalese institutions. Both UK and Nepalese counterparts of Flora project are dedicated in the publication of flora of Nepal volumes in the near future. With my training as a Darwin Scholar on the previous project (Darwin Initiative Project No. 162/12/030) and now as a Darwin Fellow I now have the skill sets and experience to work effectively in writing flora of Nepal accounts, developing the Flora of Nepal Database and undertaking taxonomic and conservation research by myself. I am also interested in extending my experience into community based conservation projects in Nepal, and looking to undertake further postgraduate research towards a Ph.D.

The contacts that I have made during this fellowship with the experts in UK including RBGE and the University of Edinburgh will be very helpful to pursue further research in Nepalese plants. Further this training also showed few opportunities in the development of collaborative projects between UK and Nepalese institutions both in applied and scientific researches. A good example of this is a PhD project proposal currently being formulated in collaboration with University of Edinburgh Department of Geosciences and RBGE to utilise GIS technologies in conservation of medicinal plants in Nepal.

- 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?

A project proposal was submitted to Darwin Initiative in September 2008 to continue community based medicinal plants conservation and sustainable utilization program started by ESON and Plantlife International UK with local communities in Rasuwa, Central Nepal. This project is aimed to expand the best lessons learned from our previous programs and also employ myself as field coordinator. This project was lead by Plantlife and involved ESON, RBGE and Aberdeen University, Sociology department. This project passed the first round of selection but unfortunately was later withdrawn by Plantlife due to internal problems within their organisation. Although it was not possible for the other partners to take on this project as it stood, there are many elements of the project that ESON and the other partners wish to develop. We intend to implement this project in future with slightly changed organizational framework between collaborative agencies.

In the short term I have decided to stay in the UK to write up my MSc project and further develop my skills in floristic research at RBGE. I am also preparing PhD project proposals and applying for funding for this.

- 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?

This postgraduate course is focused on the training of students on taxonomy, botany, plant distribution and phylogeny, population genetics of plant species and understanding the vegetation of the particular area. Without doubt I have increased by confidence and ability to undertake taxonomic researches which are directly applicable to solving conservation problems in Nepal, especially in the provision of reliable taxonomic data on which effective planning regimes can be formulated. From my previous research in Rasuwa I also see the need for genuine collaboration with local communities and implementation of socially and ecologically viable resource management programs. To be fully effective in these areas, especially in sustainable use, I would also benefit from social anthropological skills and I am intending to include these in a future PhD study.

- 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?

This course is very intensive and so I there is little free time develop new projects in Nepal and also initiate new collaboration to achieve the conservation targets of ESON. However, my ongoing collaboration with Plantlife was developed further and meetings in the UK resulted in the Plantlife application to the Darwin Initiative. Furthermore, several projects both *in situ* and *ex situ* conservation are running at RBGE and have provided many opportunities for me to learn of the different types of funding agencies in the UK, modes of collaboration and the possibility of many conservation project that could be equally applied in Nepal. Contacts I made with several experts of UK biodiversity institutions will be utilized to develop new research proposals in the study of Nepalese plants. We have recently developed collaboration research project between Royal Botanic Garden Edinburgh (Dr. Michael Moller), Ethnobotanical Society of Nepal (Ram C. Poudel) and Chinese Academy of Sciences, Kunming Institute of Botany (Dr. Lianming Gao) to study the population genetics of Nepalese *Taxus*. Although this is not finalised, if successful this research will start in mid 2009.

- 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 Darwin Fellowship scheme is a highly respected program that has helped many people from biodiversity rich developing countries to get training on biodiversity conservation in the worlds' top-rated British institutions. Personally I am indebted to Darwin Initiative and RBGE for the fellowship. My sincere thanks are to Dr. Mark Watson my supervisor/tutor who administered my fellowship at RBGE and also imparted me valuable information during his supervision.

This one year postgraduate training has definitely equipped me with skills that I could not have gained in Nepal and enabled be to work on fresh ideas to conduct biodiversity conservation in my country. However, working with scientists at RBGE I now see the need for higher postgraduate training at PhD level, and I am looking into opportunities for this. In Nepal the standard of PhD level training is poor, and so I am searching for opportunities to do this either in the UK, USA or China.

Annex I
TIMETABLE FOR SEMESTER ONE - AUTUMN 2007

Week Starting	1 17 Sept	2 24 Sept	3 1 Oct	4 8 Oct	5 15 Oct	6 22 Oct	7 29 Oct	8 5 Nov	9 12 Nov	10 19 Nov	11 26 Nov	12 3 Dec
MON am	–	Plants and people TL Gibby	Plants and people TL Legg	Plants and people TL Miller	Plants and people ICT Owen/Stuart	Plants and people TL Pendry/Dick	Plants and people TL Mann	Plants and people TL Tul.-Dougl.	Plants and people TL Rae/Martin	Plants and people TL McHaffie/Mcintosh	Plants and people TL Alexander	
MON pm	–	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	<i>Plants and fungi</i> 3 TL Helfer	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>		Cryptogam biodiversity 4 TL	<i>Minirevision</i>	Cryptogam biodiversity 5 TL	Herbarium taxonomy seminar LT	
TUE am	<i>Induction for all students</i> CR	<i>Herbarium taxonomy</i> <u>Lunch-walk</u>	Fungi excursion Dawyck Helfer	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i> <u>Lunch-walk</u>	<i>Herbarium taxonomy</i>	<u>Lunch-walk</u>	<i>Minirevision</i>	<i>Minirevision</i> <u>Lunch-walk</u>	<i>Minirevision</i>	Plants and fungi 6bis TL <u>Lunch-walk</u>	
TUE pm		<i>Herbarium taxonomy</i>		<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>		<i>Minirevision</i>	<i>Minirevision</i>	<i>Minirevision</i>		Visit CEH 12-17
WED am	Angiosperm biodiversity 1 Introduction TL	<i>Bonally (Pentland Hills) excursion</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	Bryophyte-lichen excursion	<i>Minirevision</i>	National Vegetation classification Lusby LT	<i>Minirevision</i>		
WED pm	AB practical 1 TL Springate/	NVC <i>Lusby et al.</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>		<i>Minirevision</i>	<i>Minirevision</i>	<i>Minirevision</i>		Biodiversity essay Seminar LT
THU am	<i>Plants and fungi</i> 1 TL Mann	<i>Angiosperm biodiversity 2 floral morphol</i> TL	Angiosperm biodiversity 3 seed morphol TL	<i>Herbarium taxonomy</i>	<i>Herbarium taxonomy</i>	Angiosperm biodiversity 5 Basal eudicots TL	Angiosperm biodiversity 6 Caryophyllids TL	<i>Plants and fungi</i> 7 Ellis TL	Angiosperm biodiversity 8 Pollination LT/TL	Angiosperm biodiversity 9 Rosids TL	Angiosperm biodiversity 10 Asterids TL	
THU pm	AB practical 2 TL Hughes	AB practical 3 TL Alexander	AB practical 4 TL Middleton	AB practical 5 TL Pendry	Cryptogam biodiversity 2 Helfer TL	AB practical 6 TL Moeller	Cryptogam biodiversity 3 Mann TL	<i>Herbarium taxonomy</i> <i>Key-writing</i> TL	Workshop all day	AB practical 7 TL Walter	Cryptogam biodiversity 6 TL	
FRI am		<i>Plants and fungi</i> 2 TL Helfer	<i>Angiosperm biodiversity 4 basal angiosperms</i>	<i>Herbarium taxonomy</i>	<i>Plants and fungi</i> 4 TL Mann	<i>Plants and fungi</i> 5 TL Mann	<i>Plants and fungi</i> 6 TL Sluiman	Angiosperm biodiversity 7 monocots	<i>Plants and fungi</i> 8 TL Long	<i>Plants and fungi</i> 9 LT Duckett	<i>Plants and fungi</i> 10 TL Long	
FRI pm	<i>Graduation day</i> LT +CR	Tutorial Belize TL	Cryptogam biodiversity 1 Helfer TL	<i>Herbarium taxonomy</i>		Tutorial Belize BR	<i>Tutorial Belize</i> TL 14.30	Seminar Richard Bateman LR2	<i>Tutorial Belize</i> TL 2-3 <i>Minirevision</i>	Tutorial Belize (Peter Furley) BR annex		Tutorial Belize TL
Course-work	Assignment biodiversity essay; 20 Sept hand in Tutorial Essay	24 Sept title biodiversity essay agreed				Biodiversity essay 29 OCT 5 PM				Hand-in <i>Minirevision</i> 21 Nov 5 PM		Plants and people essay 14 Dec 5 PM

BR, Board room; CR, Conference room; ICT, ICT suite; LR1: lecture room 1, LR2: lecture room 2; LT: lecture theatre; SAC, Scottish Agricultural College; TL: teaching lab

TIMETABLE FOR SEMESTER TWO: SPRING 2008

Wk Starting	FIELD-TRIP	1 21 Jan	2 28 Jan	3 4 Feb	4 11 Feb	5 18 Feb	6 25 Feb	7 3 Mar	8 10 Mar	9 17 Mar	10 24 Mar	11 31 Mar	12 7 Apr
MON am		Plant geography TL	Plant geography TL	Plant geography TL	Plant geography TL	Plant geography TL	Plant geography TL	Plant geography TL	Plant geography TL	Plant geography TL	Easter gardenClosed	revision	revision
MON pm		Tutorial Belize TL	Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1		Cytology practical SAC	AB practical 11 TL- Ronse DC	AB practical 13 TL- Harris	AB practical 15 TL- Newman	AB practical 17 TL- Tobi			
TUE am		Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Cytology practical lecture	Cytology practical	Phylogenetics & population genetics Kidner LT		<i>Evolution of plants & fungi Ronse DC LT</i>				
TUE pm		Lunch-walk Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Lunch-walk Phylogenetics & population genetics LR1		Cytology practical	Lunch-walk Phylogenetics & population genetics		Lunch-walk				Lunch-walk
WED am		Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Pteridophyte excursion Gibby/McHaffie	Cytology practical			Algae excursion Mann et al.	Angiosperm biodiversity palynology Blackmore BR annex	Gymnosperm walk Mill		
WED pm		Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1		Cytology practical				TL	AB practical 18 TL Markus Ruhsam		
THU am		Evolution of plants & fungi 11 Jeffree	15 th Annual Staff Conference LT	Evolution of plants & fungi 13 McHaffie	Evolution of plants & fungi 14 McHaffie	Evolution of plants & fungi 12 Jeffree	Evolution of plants & fungi 16 Jeffree	Evolution of plants & fungi 17 Bateman	Cryptogam biodiversity 9 TL	Evolution of plants & fungi 19 Mill	Evolution of plants & fungi 20 Mill		Cryptogam practical exam TL
THU pm		AB practical 8 TL Wilkie		Cryptogam biodiversity 7 TL	Cryptogam biodiversity 8 TL	AB practical 10 TL Ronse DC	AB practical 12 TL Ratter	AB practical 14 TL Kidner	AB practical 16 TL Richardson	Cryptogam biodiversity 10 TL	AB practical 19 TL Richardson/Lawrie		
FRI am		Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Project Sales Day LT	Cytology practical	Evolution of plants & fungi 15 Mann TL	Conference	AB practical 9 TL Ratter	Good Friday, garden closed			
FRI pm		Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1	Phylogenetics & population genetics LR1		Cytology practical		Conference	Tutorial on projects BRannex		AB practical 20 TL Kenicer		
Course work			Phylogenetic exercise I 4 Feb 5 PM		Phylogenetic exercise II 15 Feb 5 PM			Hand in cytology practical 7 March 5 PM			Project costing and timetable 31 March 5 PM		

Annex II

Taxonomic review of *Isolepis* and *Cyperus* (Cyperaceae) for Flora of Soqotra Archipelago

Summary

Cyperaceae (Sedges) are the third largest family in the Monocotyledons and seventh largest family in the angiosperm. This cosmopolitan family is rich in north-eastern South America, eastern and southern Africa, South and southeast Asia and Australasia. Sedges prefer little or less drained habitats such as swamps, bogs, river-beds, pools, coastal area to well drained places.

Sedges are usually annual or perennial herbs. Annuals are with fibrous roots and perennial with short or long creeping rhizomes, often emitting stolons with tubers. Stem or culm are usually tufted but occasionally solitary when the rhizomes or stolons are long-creeping which usually produce a solitary culm from each node. Leaves are usually three ranked when the culm are trigonous or triquetrous, often distichous or polystichous, usually in a basal cluster. In some genus leaves are reduced to bladeless sheaths. The flowers of sedges are very minute arranged in the inflorescence of spikelets. Spikelets in sedges vary in their shape, sizes and color and are found either solitary or in inflorescence. Flowers are inconspicuous and the floral characters too plays key role in the taxonomy of Cyperaceae. Dispersal of sedges very much depends on the habitat of the species. Species growing in and around water is mostly dispersal through water only.

Due to the small size and not being showy flowers many botanist don't want to even collect sedge. There is the tendency of avoiding this family due to the difficulties in the classification however work in Cyperaceae dates back to pre-Linnean period by Tournefort in 1719 and Micheli in 1729. Linnaeus (1753-1754) described 5 genera and 81 species under this family in his historical *Species Plantarum* and *Genera Plantarum*. Due to large number of species and complex nature of floral as well as vegetative parts taxonomy and classification of Cyperaceae is unstable.

Cyperaceae resembles with Poaceae, Restionaceae and Juncaceae in appearance, but in Poaceae the prophyll, the palea, enwrapping each flower and in Juncaceae and Restionaceae several ovules in the ovary and the capsule is indehiscent. Cyperaceae is recognized as taxonomically difficult group due to the reduced flower but nevertheless complex, floral and vegetative.

Altogether four species under two genera (*Isolepis* and *Cyperus*) were assigned during the examination of total 37 supplied specimens from Soqotra Archipelagos. Out of three species of *Cyperus* two species (*Cyperus laevigatus* L. and *Cyperus distachyos* ALL.) are treated under

subgenus *Juncellus* and one (*Cyperus pygmaeus* Rottb.) under subgenus *Micheliani*. Similarly rest a species, *Isolepis setacea* (L.) R. Br. represents different genus *Isolepis* of Cyperaceae.

For species like *Cyperus pygmaeus* Rottb. and *Cyperus distachyos* ALL. examinations of more specimens is needed as they represent very few vouchers in this present description.

Lastly this is really a great opportunity for me, who always wants to avoid even collecting grasses and sedges. This assignment though is very short in terms of time spent on the examination and consultation of specimens and literatures, became very fruitful to me to be acquainted with basic terms and structure of floral and vegetative characters of Cyperaceae. This work raises curiosity and built confidence on me, studying the sedges with minute but very interesting flowers and floral characteristics.

Annex III

***Rhododendron campanulatum/wallichii* complex of the Himalaya: one, two, three or four species ?.**

Abstract

Rhododendron Subsection *Campanulata* consists of an assemblage of taxa from the Himalayas with poorly defined taxonomic identities. They are extremely variable plants whose identification and classification has caused considerable confusion. This difficulty is attributed to the lack of reliable morphological characters and poorly known geographical distributions.

282 specimens representing collection from Kashmir through Nepal to Arunachal Pradesh including South East Tibet were examined thoroughly and a morphometric study of their leaves carried out. 60 living accessions flowering in the gardens of Inverleith, Benmore and Dawyck were used for morphometric study of the flower characters. Hairs on the abaxial surface of the leaf representing 31 specimens were studied in SEM. Both flower and leaf data gathered from SEM and morphometrics were subjected to separate and combined Principle Component Analysis (PCA). The result obtained was plotted in the GIS map. A molecular study compared sequences of matK and EST from 30 specimens representing full range of morphological variation.

SEM revealed 10 different hair types in subsection *Campanulata*. PCA of flowers and leaf characters gave distinct cluster of four different groups viz. *Campanulatum*, *Aeruginosum*, *Heftii* and *Wallichii* suggesting the importance of leaf (hair types, leaf length) and flower (length of corolla tubes, stamens and styles) characters in distinguishing individuals. However DNA sequencing of both the nuclear and chloroplast region did not show differences between the individuals. Out of the four groups given by PCA, the *Campanulatum* group is distributed widely from Kashmir to Sikkim while the other three groups occur in Eastern Himalaya (East Nepal to Arunachal Pradesh) with significant overlap between them. The presence of intermediate hair types and the relatively small morphological differences among the groups as well as their sympatric distribution clearly explain the whole complex as variations of a single widely distributed species *R. campanulatum*. Thus the revised taxonomic ranks of all the taxa in subsection *Campanulata* are assigned as, *R. campanulatum* var. *campanulatum*, *R. campanulatum* var. *aeruginosum*, *R. campanulatum* var. *heftii* and *R. campanulatum* var. *wallichii*. Moreover high diversities of these varieties in the Eastern Himalaya and intermixed distribution also show much possibilities of introgression between the varieties which could probably be known through molecular studies using highly specific genomic microsatellite regions.