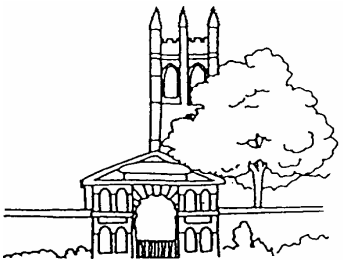
Oxford Plant Systematics



With news from Oxford University Herbaria (OXF and FHO), Department of Plant Sciences, Oxford

OPS 10 **February 2003**



Lupinus weberbaueri at 4,900m, Quebrada Ulta, Cordillera Blanca, Peru. This magnificent Andean lupin is one of a set of unusual high altitude acaulescent species, with densely pubescent long-petioled leaves and large fistulose infloresences. The inflorescences of *L. weberbaueri* can reach more than 1 metre in length with up to 20 densely packed pale lavender, pink or white flowers per whorl. Although this species is apparently now rare, the plant photographed here is in a small colony that is protected within the Huascarán National Park, see article by Colin Hughes on pages 6-7.

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Editorial

There is worldwide interest in biodiversity. E.O. Wilson's latest book *The Future of Life*, accurately places this interest in an ethical context and it makes for chilling reading. For example, his description of the encroaching alien and invasive flora of Hawaii is a harrowing example of tropical biodiversity as ecological disaster. The central dilemma outlined in the book is that conservation of biodiversity demands a timeframe too distant for humans who are hard-wired to think in short term solutions. Interest in biodiversity is also prevalent in political and scientific circles. At the Earth Summits in Rio and most recently in Johannesburg politicians have made progress in agreeing 42 articles in the convention on biological diversity. Recently in the U.K. we have had the second House of Lords report in ten years looking into taxonomy which they dubbed as the science underpinning conservation. Since the early 1980s the terms biological diversity and its abbreviated form Biodiversity have exploded onto the pages of scientific journals. Interest in the subject of biodiversity is high.

The three levels at which biodiversity is often measured and discussed: ecological, genetic and organismal, demonstrate the broad nature of biodiversity research encompassing ecology, population genetics, taxonomy and systematics etc. Diversity can be described in terms of an ecological hierarchy (biomes, ecosystems, niches, habitats) or individual organisms genetically measured in the context of their population structure. However, most discussion of diversity relies on counts in terms of species numbers and associated information. Clearly, species are important units of biodiversity and therefore knowledge of species through research in taxonomy has a vital and important role to play in the current situation. However, as demonstrated in the House of Lords report, interest and funding of taxonomy, in the UK university sector, is low.

In contrast to the extremely depleted state of taxonomic research within the UK university system, the Department of Plant Sciences at Oxford is this year celebrating the opening of the re-furbished Daubeny Herbarium. This considerable financial investment in people and space demonstrates a continuing commitment to taxonomic research. Since 1992 we have successfully trained 16 PhD students in taxonomy, the majority of whom are now in full-time taxonomic posts elsewhere. Since 1992 external grant income associated with taxonomic research has exceeded 4 million pounds. During that time we have had two Royal Society funded University Research Fellowships in taxonomic monography. Interest in taxonomy and biodiversity is also mirrored in our undergraduate degree that enjoys a level of whole organism input. We were therefore pleased to welcome Lord Sainsbury and other guests to join us in June for the opening of our re-furbished herbarium.



Lord Sainsbury and Professor Chris Leaver, Head of the Department of Plant Sciences, at the re-opening ceremony of the Daubeny Herbarium on 24 June 2002.

The above is a short synopsis of my lecture given on the day the herbarium was re-opened. Despite the nerves - it was the first time I ever lectured in a hall with reserve seating – the day went well. All agree that the refurbishment is a huge improvement and work is beginning now to re-furbish the Fielding-Druce Herbarium. This issue of OPS once again reflects the extent and scale of our research activities and includes a Darwin-funded project in Bolivia, DFID funded research in Ghana and Grenada, monographing Andean Lupins and plant collecting in Africa. Taxonomy is indeed alive and well at Oxford Plant Sciences.

Robert Scotland

News items

The refurbished **Daubeny Herbarium** was re-opened by Lord Sainsbury of Turville, Minister for Science and Innovation, on 24 June 2002, see editorial, photographs on this page and page 16.

In May 2002 the **Oxford University Herbaria** gained full registration as a museum from Resource: The Council for Museums, Archives and Libraries.



Daubeny Herbarium (February 2003)



Dr. Robert Scotland meeting Lord Sainsbury with Professor Leaver after his lecture on 24 June 2002.

Brian Thomas Styles Memorial Prize
This prize is awarded for an outstanding DPhil thesis in the subject area of tropical or subtropical plant taxonomy in memory of Brian. In 2002 the prize was awarded jointly to **Elizabeth Moylan**, for her thesis on the Systematics of *Hemigraphis* Nees (Acanthaceae), and **Tom Evans**, for his thesis on the taxonomy and sustainable management of rattans in Lao PDR.

Student Progress

Ruth Eastwood (D.Phil., first year). The systematics of Andean lupins and the origin of *Lupinus mutabilis* Sweet. Supervised by Dr Colin Hughes (Oxford) and Dr Julie Hawkins (Reading). BBSRC studentship.

The genus *Lupinus* is a large diverse genus (c. 200 species) distributed across the Old World (Mediterranean and North Africa) and New World. Due to horticultural and agricultural use, lupins are also found in South Africa, northern Europe, Australia and New Zealand, where in some cases large naturalized populations have formed. Despite the fact that the majority of *Lupinus* species are found in the New World one centre of lupin diversity, the Andes, has received little recent taxonomic attention. Domestication of lupins occurred in parallel in the Old World (i.e. *L. albus*) and the New World (*L. mutabilis*) yet no detailed studies have been carried for the latter. Once debittered the beans are used as a source of protein. The origin of *L. mutabilis* is unknown and the identification of its wild relatives may pinpoint important genetic resources which could be incorporated into modern lupin breeding programmes.

My aims for the first 9 months are: a) to construct a well-resolved species-level molecular phylogeny for Andean *Lupinus*, densely sampled for *L. mutabilis* and closely related species, b) to identify and delimit the close relatives of *L. mutabilis*, c) to write a taxonomic account for *L. mutabilis* and closely related species and d) to characterise the morphological diversity found in Andean *Lupinus* and identify whether and how this has been altered by domestication.

During my first term I learnt basic lab skills and generated ITS sequences for 20 Andean Lupins. I used my data in combination with existing ITS lupin sequence data to build a gene tree that includes 97 accessions. This preliminary tree is poorly resolved and places Andean lupins in a large unresolved group with North American species. I have also been familiarising myself with the morphology of the genus and surveying morphological variation. I attended The UK Legume Workshop and The Young Systematists Forum. I have really enjoyed my first term which has cemented my view that lupins are a fabulous group to work with.

Timothy Waters (D.Phil., second year). Systematics of *Agathis* Salisb. Supervised by Stephen Harris (Oxford) and Aljos Farjon (RBG Kew). NERC studentship.

Agathis is a genus of tropical conifers found in lowland and montane forest, and occasionally in scrublands, throughout much of Malesia and in the southwest Pacific islands. By virtue of its long history of taxonomic confusion, its paucity of discrete macromorphological characters, the availability of appropriate molecular markers, and its intrinsic importance as a major timber-producing tree, it is an ideal genus within which to explore a number of issues relating to the principles, methods, and utility of different types of data in species delimitation.

Despite over forty years of heated discussion within systematics over the methods employed in the reconstruction of phylogeny, and much recent interest in "species concepts", the methods for detection and delimitation of species - the other principal task of systematics - have received remarkably little attention. Recent work by Wiens & Servedio (2000) on a statistical approach to species delimitation and to quantifying levels of confidence in delimitation decisions has offered a start, but the underlying mathematics needs to be extensively developed in order to deal with the complexities of continuous rather than discrete data, and to understand the spatial components to taxonomically significant variation.

Previous accounts of the genus *Agathis* (de Laubenfels 1972, 1988; Whitmore 1980) have differed widely on species boundaries and on the extent and nature of inter- and intraspecific variation. About a thousand herbarium specimens have been examined from major US and European herbaria in an effort to understand and identify potentially useful characters. Morphometric analyses have enabled an understanding of the nature of variation in continuously varying vegetative characters in some parts of the genus, and offered an insight into current delimitations, but an insufficiency of specimens and inadequate geographic data makes it difficult to assess variation in cone size and shape in a statistically rigorous manner. Additionally, a number of characters that are useful in the field - such as tree architecture - are not easily understood from herbarium specimens.

Accordingly, a particular subgroup of the genus - the putatively monophyletic New Caledonian group of species - is being intensively studied to understand patterns of both molecular and morphological differentiation across landscapes and between and within populations of putatively separate species, with two months fieldwork in New Caledonia this spring. Chloroplast microsatellite markers originally developed for forestry work by the University of Queensland, and for analysis of the genus *Araucaria* by the team at RBG Edinburgh, as well as a number of others developed for conifers, are being assayed for their transferability to the *Agathis* genome and their variability, and a suite of morphometric characters that may discriminate between species and allow the estimation of tree-architectural parameters is being developed.

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Alex Wortley (D.Phil., third year). Systematics of *Thomandersia* Baill. Supervised by Robert Scotland (Oxford), Paula Rudall (Kew) and David Harris (Edinburgh). Burtt-Davy Studentship.

Thomandersia (T. Anders. ex Benth.) Baill. is a distinctive, monophyletic genus comprising six species of trees and shrubs that form a significant part of the vegetation of tropical West Africa. It was last monographed by Heine in 1966. Heine's species delimitation has been upheld, and additional anatomical observations made, in a comprehensive study of herbarium specimens from BR, FHO, K, MO, P and WAG, and a study of *T. congolana, T. hensii* and *T. laurifolia in situ* collected during fieldwork in Cameroon.

In addition to these intra-generic issues, the controversial systematic position of *Thomandersia* has been studied in terms of the phylogeny of Lamiales *sensu lato. Thomandersia's* morphology is aberrant for any family in which it could be classified. Traditionally placed in Acanthaceae, it has also been associated with Pedaliaceae or placed in a monogeneric Thomandersiaceae. Anatomical sectioning of the retinacula (hook-like outgrowths of the funicle) of *Thomandersia* and other taxa in Acanthaceae, has demonstrated that these structures are structurally similar, constituting primary homologues. However this is the only character supporting a relationship between *Thomandersia* and Acanthaceae, and the retinacula are not therefore supported as secondary homologues of the two taxa. Phylogenetic analyses of chloroplast *rbc*L and *ndh*F sequences spanning all major families of Lamiales, have placed *Thomandersia* outside a monophyletic Acanthaceae and instead suggested a relationship to Bignoniaceae, Martyniaceae, Schlegeliaceae or Verbenaceae.

These analyses raise a number of issues relating to systematics' targets of accurate, supported and resolved phylogenies. The tree model presently obtained for Lamiales is characterised by poorly-resolved and weakly supported short internal branches between monophyletic families or putative family-level taxa such as *Thomandersia*. Investigations are underway to determine the most productive methodology for resolving the position of *Thomandersia* within Lamiales. These include studies of simulated molecular sequence data and the production of a detailed matrix of morphological character-states.

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Expeditions and visits

Colin Hughes spent two months doing fieldwork in Peru and Bolivia in April and May to collect *Lupinus* and other legume material. An account his travels entitled *Breathless in the Andes* is included on pages 6 - 7.

Denis Filer attended the South East Asian Botanical Collections Information Network (SEABCIN) meeting in Thailand in March. He visited Brazil twice giving BRAHMS courses in Belém, Brasilia, Manaus and Rio de Janeiro. He also visited the herbaria in Wageningen and Leiden in the Netherlands reviewing BRAHMS networking in that country. In October, he ran a database course at the National Herbarium in Kuwait.

Donovan Bailey and **Colin Hughes** attended the *Plant Species-level Systematics: Patterns, Processes and New Applications* Symposium in Leiden, 13-15 November, where Donovan presented a joint paper entitled *Characterization of angiosperm nrDNA polymorphism, paralogy and pseudogenes*.

Robert Scotland spent one month at the University of California at Davis working with Mike Sanderson on the hollow curve of taxonomic distribution and learning to play poker. Robert gave seminars at Davis and at Berkley.

Departmental artist **Rosemary Wise** spent two weeks in the University of Uppsala in June drawing for Dr Mats Thulin's *Flora of Somalia*. Mats had found yet another new *Acacia* species which was drawn for the Oxford *Acacia* Project. During August Rosemary was invited to run a course in Botanical Illustration by the Nairobi based company RELMA for participants from five African countries. A further week was spent working on the Oxford *Acacia* project in the East African Herbarium.

The Darwin Initiative Project in Bolivia

In March 2002 the Department of the Environment, Food and Rural Affairs (DEFRA) confirmed that the Department of Plant Sciences at Oxford had won an award under the Darwin Initiative for a three-year project to investigate plant endemism in the central valleys of Bolivia. In this way an idea conceived some six months earlier, endorsed by the Bolivian authorities and enthusiastically promoted by Robert Scotland finally came to fruition.

Bolivia has arguably the least known flora in the neotropics with few significant collections in the 19th century and some major areas completely unexplored botanically until the 1980s. The flora is certainly diverse but less so than in countries closer to the equator. Accurate figures for the total number of flowering plants do not exist but estimates of up to 20,000 are common, although the author believes a figure of 10-15,000 is more realistic. A significant proportion of this total consists of plants endemic to Bolivia but the number varies greatly from family to family with particularly high figures in families such as *Cactaceae* and *Solanaceae*.

As in other Andean countries there is a diversity of habitat. Lowland areas range from very humid rain forest to extensive dry forest in the chaco fringes and significant areas of swamp, cerrado and campo rupestre vegetation. The Andean slopes boast the most southerly areas of true tropical cloud forest whereas the inner valleys and higher slopes range from cold, high altitude desert and alpine type vegetation through semi-desert scrub to dry forest. Habitat destruction is perhaps less than in other South American countries but has been most obvious in the lowland forests. It is in these areas that most conservation efforts have been concentrated and where most of the national parks are situated.

Oxford Plant Sciences' Darwin project is based on the premise that Bolivia's Andean valleys are at least as rich in endemic plants as the lowland forests, where most recent interest has been focussed. These valleys are mostly relatively dry. Natural vegetation is varyingly degraded and consists of open, dry, usually spiny bushland merging into dry forest with transitions to more humid forest. At higher altitudes there are extensive areas of poor, stony pasture with woody vegetation restricted to gullies and steep, almost inaccessible slopes. Human settlement and interference is extensive principally through forest clearance and grazing by goats. At first sight our premise that these valleys contain concentrations of endemic plants seems improbable but it is strongly supported by preliminary fieldwork and studies in individual families. A good example is the genus *Salvia* with around 30 species in Bolivia, over half of which are endemic to the country and most of these restricted to the central Andean valleys. A more general example is the family *Cactaceae* which reaches its greatest diversity in Bolivia in the Andean valleys and is rich in endemic species. Since this family is vulnerable to indiscriminate, sometimes commercial collecting, it is regrettable that its principal habitats mainly lie outside the network of protected areas.

The aim of the Darwin project is to identify hot spots of endemic plants in the central valleys of Bolivia. In order to do this effectively the project is co-operating with four Bolivian herbaria under the leadership of the Herbario Nacional de Bolivia in La Paz. The project began in October 2002 and much of our time in the first months has been occupied in establishing the means to achieve our task. The first step has been the selection of one or two persons in each Bolivian institution to work with the project during its three-year life. Selection is a joint process in which we have identified Bolivian botanists with some track record in plant taxonomy and a willingness to do work in the field and the herbarium. An important objective of the project is to train Bolivian botanists both in the field and at Oxford so they can continue and develop the work after the project's end. One important aspect of this is to make use of Rosemary Wise's expertise in plant illustration to develop skills in botanical illustration among selected Bolivian botanists.

Another important initial objective of the project is to provide equipment to achieve our aim. Each institution has been provided with a computer and the software for BRAHMS developed by Denis Filer at Oxford so that a comprehensive database of plants occurring in the central valleys can be created. This will be an essential tool in evaluating where the hotspots of plant endemism really are as well as facilitating more mundane tasks such as the production of herbarium labels. We have also purchased digital cameras for the team in Bolivia. Digital storage of plant images will be an important adjunct to the main database and will help in the production of a field guide in the final stages of the project. However one of the most important resources the project is providing consists of materials and equipment for storing and processing specimens. Like many herbaria those in Bolivia have a huge backlog of specimens stored in boxes. By providing paper, folders and storage capacity the Darwin project will make available a large number of specimens hitherto inaccessible to researchers.

To these specimens will be added those collected by the project. Our field work has only just begun and it is impossible so far to know how many specimens we are likely to collect nor what proportion are endemic.



Moises Mendoza, one of the project workers, holding a particularly attractive orchid specimen.

This will be a drawn-out process throughout the duration of the project and beyond. However the following comments on two recent pieces of field work, may give some idea of the possibilities.

Just before Christmas I spent four days in the field with Magaly Mercado and Moises Mendoza near the small village of Independencia. This lies some 200 kilometres north of Cochabamba. The first botanist to visit the zone was Otto Kuntze in the late nineteenth century and further visits were made by Martin Cardenas, the father of Bolivian botany, in the middle years of the twentieth century. Visits by different botanists in the last twenty years have been sporadic but more frequent and we are only just becoming aware of what is here. At the head of the valley above the town of Independencia are some interesting forest relics. The dominant tree is a species of *Podocarpus*, a mainly southern hemisphere coniferous genus. The particular species is *Podocarpus cardenasii*, endemic to Bolivia and mainly found in this zone. At higher altitudes the forest transitions into heathy grassland where the attractive blue-flowered perennial is *Salvia sophrona*, a species only found in scattered localities in central Bolivia. At lower altitudes the forest has been cleared for rough grassland and the introduced African grass, *Pennisetum clandestinum* is often dominant. Two spiny *Mimosa* shrubs are frequent in disturbed places along tracks in this zone. One is an Acacia-like shrub with pods bent into almost a complete circle and is the relatively widespread *Mimosa recurvata*. The other is of untidy, scrambling habit and has straight pods. First spotted by Colin Hughes in May this year, there is another collection of this species in the La Paz herbarium from the neighbouring valley of Quime and it almost

certainly represents a new, hitherto undescribed endemic species. In gullies there are still patches of forest and in one of these we found a spectacular climbing *Asclepidaceae*. Originally also collected in the neighbouring valley of Quime by an English woman from Alton in Hampshire, known by little more than the name of Miss Brooke, this was originally placed in is own, endemic genus, as *Fontellaea boliviana,* but according to recent studies by David Goyder at Kew it is more correctly placed in *Philibertia*.



Fontellaea boliviana

Returning to the village of Independencia, a weedy species of *Dicliptera* (*Acanthaceae*) named after the city of Cochabamba as *D. cochabambensis* is found. This is widespread over the central valleys of Bolivia but despite its weedy habit and presence near the centre of at least three major Bolivian cities (it is both very distinct and endemic), its presence more or less defines the zone in which our Darwin project works. Nor is it the only endemic *Acanthaceae* found here. In dry bushland below the town is a rather variable, little, pink-flowered *Justicia, J. pluriformis*, which is common in dry valleys in this area and first found by Otto Kuntze 120 years ago but not described until this year.

After Christmas I spent a day in the rugged sandstone ridges about 20 kilometres west of Sucre, Bolivia's legal capital. Although Bolivia's government moved to La Paz more than a century ago it is indicative of the relative botanical neglect of Bolivia that there seems to have been no botanical exploration of the Sucre area until the last twenty years or so. The sandstone ridge is interesting. On the most spectacular, although not the highest mountain, Cerro Obispo, there is a colony of a distinctive and undescribed holly (*Ilex* sp.). Much more common in the same zone is another shrub, a species of *Thymeliaceae*, which cannot reliably be placed in a genus. It is extremely common over this whole range of sandstone hills but was only collected for the first time in 1992 and is still undescribed. There are only half a dozen or so plants which could reasonably be called shrubs in this area and yet another, a species of *Maytenus*, appears to be new and endemic to this region. Unlike most *Maytenus* this is an attractive, unarmed plant with long drooping branches. Lower down on the steep shale slopes below the sandstone is yet another new endemic plant. This is a small tree in the genus *Aspidosperma* in *Apocynaceae*.

These plants are all conspicuous shrubs and it seems highly likely that there are many unknown and endemic species amongst the herbs. Certainly along the short journey from Sucre I passed five undescribed new endemic species in families I am reasonably familiar with. These were a *Dyschoriste* in *Acanthaceae*, a small species of *Salvia* with sticky blue flowers, a rather inconspicuous species of *Philibertia* in *Asclepiadaceae,* a small Mimosoid in the genus *Desmanthus* and a relatively handsome and distinctive *Festuca.* I have no idea about species in the large families of *Cactaceae*, *Compositae* and *Solanaceae*, all of which are well represented in this region, but it seems a reasonable guess that the total number of new and endemic species from this area will rise significantly when these families are properly studied later in the project.

And if this area were to be a hot spot for endemic species, would it be worth some form of protection? There is really no threat to the area but it has two other values, which add strongly to the case for protection. It is reasonably accessible to a major population centre and offers obvious amenities for hiking, rock climbing, camping and family outings. Additionally the area is rich in fossils and a strong case could be made for protection of its palaentological wealth. The botanical case cannot yet be made but it seems probable that by the end of the project we should be able to give Bolivia's Direccion General de Biodiversidad some well-supported arguments for the botanical worth of the zone.

J.R.I.Wood

Breathless in the Andes

My heart is pounding, my lungs are gasping for air which rasps through my throat, and there seems to be insufficient blood in my legs to power me up the slightly intimidating loose scree slope that I am heading up to inspect a possible patch of lupins that I had spied from below with my binoculars. It is cold, there is a keen wind blowing from the south, the air is crystal clear, and there is a sprinkling of fresh snow on the ground from the previous night that doesn't seem to be melting even in the afternoon sun. As I near my quarry, I cross into the shadow of a dark cliff at the top of the scree; it feels several degrees colder, the slope steepens, the scree is looser and the snow surface icy, making it hard to keep my footing. As I draw closer, I check with the binoculars again. I can now see for sure that there is a small colony of lupins tucked in at the base of the cliff, growing on loose gravelly scree, in full bloom despite the harsh weather. My pace quickens, probably more than it should given the slightly perilous slope I am on and my breathless state, and I stumble up to take a closer look.

It is not surprising that I am feeling breathless, I am, after all, 5,000 m or 16,500 ft. up in the Cordillera Real in the Bolivian Andes, and the altitude is taking its toll. Not only that, but the view across to the icy slopes of the 6,000m peak Huayana Potosi glistening in the sun, is enough to take your breath away. And, if that wasn't enough, we have found the elusive *Lupinus* aff. *tominensis* – a striking bright blue-flowered, large acaulescent rosette species that seems now to be rather rare and for which there are only a handful of previous collections. We had been searching for it all day in this area, scanning the slopes, scrambling up likely looking gullies, until finally we locate this one small colony on the screes. All in all it is an exciting moment.

I had started field collections of the Andean lupins the year before in Cajamarca in northern Peru. Everyone had warned me that Lupins are a notoriously difficult group for which species delimitation is extremely confusing, and which is burdened with a surfeit of names, the legacy of the misdirected *Species Lupinorum* of Charles Piper Smith, who alone described some 800 species. In fact, I had even been told some years ago by a senior curator at a large herbarium, that collecting lupins in the Andes was a waste of time because nobody could name any of them. Somehow, none of that had put me off. In fact quite the opposite – I was drawn to the Andes, I was ready to get my teeth into something substantial, and I was keen to expand my interests in legumes. Rupert Barneby, whose treatment of *Lupinus* for the North American Intermountain Flora provides an excellent example of how to avoid the quicksands that engulfed Charles Piper Smith and who had previously attempted to put some order to the NY collections of Andean *Lupinus,* commented to me that the lupins around Cajamarca seemed to be particularly chaotic. It seemed like a good place to start.

I flew to Lima, linked up with botanists from the Universidad Agraria La Molina (MOL) herbarium, and set off with herbarium technician Aniceto Daza north along the coast to Trujillo, then inland and up to Cajamarca. We spent four days there making day trips along four different roads out of Cajamarca, not straying more than 50km from the city. Within a few km of Cajamarca in any direction we were finding lupins and after four days, we had made 20 collections of what I felt probably represented at least 11 species, and there

was at least one other species that I had seen herbarium material of that we hadn't managed to locate. Wow! If there are 12 species within a 50km radius of Cajamarca, how many were there going to be in the



***Lupinus aff. altiplani**, 4,700m, Zongo Pass, Cordillera Real, Bolivia*

Andes as a whole? I was excited, but I was also starting to get worried, I had seen more than enough different lupins to absorb in the space of just four days. We pressed on east to Celendin, across the gargantuan cleft carved by the Rio Marañon into Amazonas and the mountains around Leimebamba, circled north by Huancabamba and then south for another sortie into the mountains of Ancash. We were still finding different lupins, but we were also seeing things that looked the same as some of the Cajamarca species. Finding the same thing in different places was reassuring. Perhaps there weren't that many species after all.

Last year I returned to the Andes for a longer visit, this time accompanied by Rob Forrest, a school biology teacher friend from Scotland who wanted to take a break from teaching and get a taste of plant collecting. We spent a month back in central and northern Peru, again working with Aniceto Daza, and a month in Bolivia, there working in collaboration with botanists at the Herbario Nacional (LPB) in La Paz and going to the field with Arely Palabral, a student in La Paz. This allowed us to sample much more widely, and it is now clear that the Cajamarca area is indeed unusually diverse. I have not found such high diversity of lupin species in any other area of the Andes so far.

Of course, for a complex group like the lupins, the importance of fieldwork goes well beyond collection of research material. Fieldwork provides the opportunity to survey whole plant diversity within and among populations and examine characters, such as flower colour and habit, which are lost when material is pressed and dried. This is crucially important for any group which spans diverse and often extreme environments and is especially so for the Andean lupins. The enigmas of colour change in petals, inflation of stems, and habit, which are extremely labile in lupins, can be directly observed *in vivo*. Questions like - Is that simply a younger version of that one? or - Is that a diminutive version of the same thing growing in more luxuriant conditions 500m lower down? - are much easier to answer in the field than puzzling over herbarium sheets. After two field trips, some of the more distinctive species are, like the easy pieces bits of a large jigsaw puzzle, beginning to slot into place.

Lupin hunting in the Andes is very much a high altitude affair. In contrast to the more temperate latitude North American lupins, which proliferate at low elevations on the coast and in the deserts as well as in the mountains, the Andean Lupins occur almost exclusively at mid to high elevations, and only rarely stray below 2,500m. Only *L. mollendoensis*, which grows on the dry desert lomas south of Arequipa in southern Peru, occurs at low elevations. The Andean species reach their greatest diversity in the grassy páramos, jalcas and punos around or above the treeline between 3,000 and 4,000m. A subset of dwarf prostrate and acaulescent rosette species grow even higher up, often well above 4,500m in the sparsely vegetated super-páramo and alpine zones, topping 5,000m close to the upper limit for vegetation where plants give way to scree, rock and ice at these tropical latitudes.



***L. aff. pulvinaris**, 4,700m, Cordillera Real, Bolivia*

The high altitude species, and particularly the group of species which form acaulescent rosettes are adapted to the extreme conditions of the Andean freeze-thaw zone, where diurnal temperatures vary more than seasonal temperatures, and where frost can occur on virtually any cloudless night of the year. These species are amongst the most spectacular of all the Andean lupins. Some such as the magnificent *L. alopecuroides* in Ecuador or *L. weberbaueri* in Peru have splendid 1m tall fistulose inflorescnces of numerous white, pale lavender or pink flowers held above the foliage. Others, such as *L.* aff. *pulvinaris* and *L.* aff. *nubigenus*, have smaller, more cryptic infloresences held below the foliage. All lack significant shoot development, have long-petioled leaves and are usually densely pubescent, a set of attributes to match the extremes of the freeze-thaw regime. Daily freeze–thaw means that there is often a thick layer of frost crystals in the soil surface layers. Despite the reduced air pressure and frozen soil surface layers, we found active root nodules held deep down on long stout taproots in cold loose sandy gravel. At 4,950m this must be close to the altitude record for nodulation.

However, although they are resistant to harsh conditions, these high altitude lupins apparently succumb to browsing by llama and alpaca which occur in vast herds in many parts of the central Andes. Unlike many lupins, which are renowned for their unpalatable leaves, these species appear to have been driven back onto cliffs, screes and steep gullies where animals cannot reach and where we are forced to scramble around to find them.

At the end of our stay in Bolivia, we struck northeast from Lake Titicaca, up through the dry hills that flank the eastern shore towards the isolated and wild Cordillera Apolobamba, a range of spectacular ice peaks that straddles the frontier between Bolivia and Peru. Our last night we slept in a polytunnel, usually reserved for oca, potatoes and other vegetables, at the Ulla Ulla Vicuña Reserve headquarters. Although we had collected no plants that day, we kept the plant drier running. It was –15°C that night. We awoke to the sound of humming alpaca, their thick wool coated in hoar frost. After two months I was by then fully acclimatized to the altitude, but it was all still as breathtaking as ever.

Research on the systematics of lupins is funded by a Royal Society University Research Fellowship. Fieldwork in the Andes was supported by the Stanley Smith (UK) Horticultural Trust.

Colin Hughes

Hunting *Thomandersia*: observations of an apprentice plant collector



Alex Wortley in Cameroon

Thomandersia (Acanthaceae) comprises six species of trees and shrubs endemic to western central Africa. However, after negotiating more than two years' research on the genus without even glimpsing a living plant, I began to think I might have avoided the hazards of tropical fieldwork. Not so. One fateful day last September I received a call from my supervisor, David Harris:

David (excited) "I've managed to get you a place on an expedition to Cameroon."
Me (uncertain) "Cameroon? Great. Fantastic."
David "Can you be ready to leave in 2 weeks time?"
Me (naïvely) "Of course, no problem."

And that was that. Now, I knew where Cameroon was (right in the "armpit" of Africa, between Nigeria and Gabon). I knew that three species of *Thomandersia* could be (or had once been) collected there. I even knew that it contains the tallest mountain in West Africa (Mount Cameroon), and that most of the people speak French. Beyond that, I was pretty much in the dark. I hadn't the faintest idea how to organise a tropical collecting expedition in the rainy season, what equipment I would need, where I would get it and how I would use it when I got there. Fortunately for the first part of the trip I was to join an Earthwatch team led by Kew's Martin Cheek, who had pretty much arranged everything already (for the second half I was on my own, but at least by then I would have a working knowledge of the terrain and procedures involved, even if I hadn't picked up any French). And thankfully there were any number of experienced fieldworkers in the department, all incredibly generous with encouragement, equipment and (usually conflicting) advice.

For the next fortnight I was more efficient than any self-respecting student lifestyle should accommodate: booking flights, filling in forms, receiving injections in every possible appendage. Grovelling to the safety officer whose forms "MUST be completed BEFORE making any travel arrangements, and then AT LEAST three weeks before departure". Locating a plant press, learning how to use a plant press, working out how a plant press would fit in my rucksack. Applying for a visa, smiling sweetly at the Cameroonian High Commission, arguing with the Cameroonian High Commission, and finally bursting into tears in the Cameroonian High Commission. Stealing my dad's secateurs, buying jewellery-tags ("Jewellery-tags? What on earth for?" But everyone said they were essential, so who was I to argue?), and begging everyone I met for unwanted cardboard and tabloid newspapers. I had no time for crash lessons in French or a full course of malaria pills. On October 9th I bought a tent (blithely ignoring the instructions: THIS TENT MUST BE FULLY WATERPROOFED BEFORE IT IS USED), and at 1am on October 10th I loaded myself and my luggage onto a bus and slept blissfully all the way to the airport.

Although it is a fairly hefty shrub with beautiful big flowers and bright shiny fruits, looking for *Thomandersia* in Cameroon is significantly more difficult than looking for a needle made of hay in a very large haystack, but nonetheless exciting for that. I could give a long and rambling account of all the amazing things I saw, found, met, did, smelt, ate, stepped in and collected in the forests, towns and beaches of Cameroon. But instead I'll briefly recount a few of the lessons I learned through this "baptism of fire" to tropical plant-collecting, starting with some basic practical considerations:

1. Take a GPS handset (or at least a compass) for recording collection localities, finding the rest of the group when lost in the forest, and finding the way back to the hotel when you've gone down the road to buy some oranges. Preferably also take the instructions for the handset with you.
2. Don't leave socks/towel/notebook "drying" on the roof of your tent all day in the rainy season.
3. If squeamish, don't tell the camp manager about the cockerel that keeps you awake at night: he will wring its neck in front of you and serve it up for dinner.
4. Check the altitude the target plant inhabits. After two weeks on the Earthwatch camp at M'fou (600m above sea level) I looked through my notes and found *Thomandersia* has never been collected above 480m. An interesting observation, but hardly conducive to amassing a large number of specimens.
5. Also check the months in which it flowers and fruits - and try to coincide your visit with these times. Especially if the plant has particularly nondescript leaves, and inhabits a forest surrounded by other plants with similarly nondescript leaves.
6. Believe what the expedition leader tells you. If he says there are no cash-machines and you can only change dollars and euros in Cameroon, all the sterling in the world is not going to pay the bus fare. And if he says tuck your trousers into your socks to keep out the biting ants, do it, unless you want to have to remove ALL your clothes in the middle of the forest and jump around until they fall off.
7. *Don't*, however, believe everything you're told. "There are huge clumps of *Thomandersia* at the top of Mont d'Elephant," may well actually mean there is one small, infertile bush at the bottom of the hill, which you will notice on the way up but he will be told is a completely different family (Myristicaceae I think, and I was too polite to argue), and you will only finally be able to collect it once you have trudged all the way to the top of the hill and down again and are in such a filthy temper that you don't bother to take proper collecting notes.
8. Make sure you know where you are going and why you are going there before you blithely follow the local guide. Almost breaking a leg crossing a 400 foot sheer waterfall is acceptable if there is a big thicket of *Thomandersia* on the other side, but not if it is just "to look at the view."
9. Don't set up the plant-dryer where the village goats can discover that it is a warm place full of tasty things to eat. Especially if your collections include mushrooms.
10. Don't rely on propping up the plant-press in front of an electric fan in your hotel room as a substitute plant-dryer when on the road in countries where the electricity supply is less than reliable.
11. When your collections are getting damper and mouldier by the day because of the aforementioned method of drying, don't attempt to compensate by putting them in an

oven that is more frequently used for cooking.

12. And don't go barefooted into the bathroom when there are snakes about…

Unlikely as it may sound, I had a brilliant experience in Cameroon, thanks largely to the people I met, travelled among, and worked with. I learnt a huge amount about plants and plant collecting, and I can't wait to go back. Despite all my mistakes and misjudgements, I did manage to find at least one individual of each of the three Cameroonian species of *Thomandersia,* and made some interesting and novel observations. My first encounter with "my genus" has made my D.Phil really come alive; I would not have missed it for the world. Although my collections have variously been eaten, turned mouldy and been incinerated (sometimes all three), not to mention lost somewhere between Brussels and Frankfurt on the way home, I have a fair amount of material and a huge number of memories to sustain me through the rest of my thesis.

Three final things I'll remember should I be lucky enough to return to Cameroon. Next time I'll go during the mango season; I'll bring back an even bigger tin of the local chocolate spread than last time; and yes, jewellery-tags *are* essential.

Alex Wortley

FRP Field Guides project – the final stages

The DFID/FRP field guides project is due to end in June 2003. Outputs from the project include the short or skeleton field guides - "guidelets"- designed in various formats so that we could test directly which methods and formats work best for different sorts of people. As a DFID-funded project, our main goal was to promote field guides as a means of poverty alleviation around tropical forests, either directly by helping local tour guides or vendors to make money from eco-tourists, or indirectly, by promoting greater awareness at the village level of local biodiversity. One of the more surprising findings has been that there is limited general awareness of local plant species - other than the very commonest or most used - amongst the villages of our study areas.

The 'trees of Ghana' and 'plants of Grenada' guidelets are to become full field guides, based on the materials and lessons from the project. We can see how functional these guides may be from another main project output: the results of tests which were conducted to see whether the target audiences could use various guidelets to identify tropical plants satisfactorily.

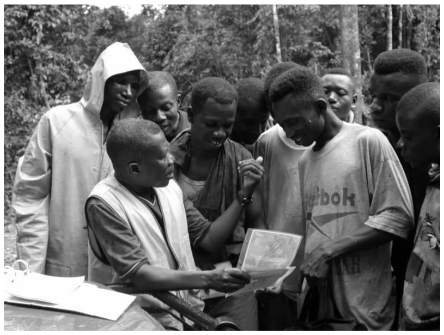
The Ghana big-tree guidelet

A previous field guide for all the 700 species of trees of Ghana by William Hawthorne (W.D. Hawthorne. 1990. *Field Guide to the forest trees of Ghana*. Chatham. Natural Resources Institute. Ghana Forestry Series 1) had been based on Rosemary Wise's line drawings of leaves, with text. These sorts of guide work reasonably well for technical and experienced field botanists, but only those with a good grasp of English have any hope of using the text, and the book was too large for convenient field use and too cheaply bound. The general public at least tends to prefer photographs to drawings.

It has been apparent for some time and confirmed by early project workshops that, if a wider spectrum of Ghanaians are to be helped by any field guide to use forests or species sustainably then: (1) photographs are needed; (2) the text should be simple or optional; and (3) the format should be sturdy, but as light as possible. Large trees are best identified using their slash (bark section), and a key component of the slash is the colour and pattern, so a colour guide to trees showing detailed slashes alongside other useful features was called for.

Furthermore, the Ghana tree guidelets have been designed to test whether picture gallery guides, designed to be browsed like paint colour charts, are workable when based primarily on the slash details. Another aim is to test whether a 'modular guide' can be made to work, where one species per sheet or card is produced, to be reshuffled or added to for different purposes (if it does, then international initiatives could be devised to produce guide pages once per species, with sets compiled for different countries). This implies a book without a rigid structure, and certainly one that works without a classical key or other such index. In the first half of the period we made laminated species cards for about 128 species (although more have been added since, and some cards cover pairs of related species). The front of the cards all have a square, detailed slash picture, adjacent to other photographs of useful characteristics, such as buttresses or details of fallen leaves. On the backs of the cards, rather than waste space, some textual information and line drawings were added in black and white, but during the tests these were virtually unused, except by those who could use the old guide anyway. Trials of these cards were conducted mostly in 2002 in a number of localities with pronounced differences in species diversity and human history.

At one extreme we ran tests in Jachie, the closest village to Kumasi. This has been an important place in Ashanti history, on the main route between Lake Bosumtwi, a large sacred lake in a meteorite crater, and Kumasi, the capital of the Ashantis. The legendary Okomfoo Anokye - a fetish priest of Arthurian importance and one of the founders of the Ashanti state in the late 17th century - left his marks in some of the rocks still seen in the village. The Jachie fetish grove, which includes old graves and has been protected for spiritual reasons, is one of the largest remaining patches of forest in the environs of Kumasi. Our collaborator, Ntim Gyakari, lives in the village and arranged with the chief and fetish priest for our project to number trees and try out field guides on Jachie and Kumasi residents.



Ntim Gyakari discusses the Tree Guidelets with professional tree-spotters, Boi Tano FR

At another extreme, we ran tests many hours drive away in the wet evergreen forest of the Western region, where two test sites (Boi Tano FR, and part of Fure Headwaters FR near the tiny villages of Simpa and 'Woman No Good') are around villages with only a few decades of local history. The inhabitants here have come mostly to farm Cocoa and other crops. The Wet Evergreen forests are generally much more primary than the semi deciduous forest like Jachie, with many species rarely found in the fallow outside reserves, and surrounded by generally fewer people. We hypothesised that few of the local plants of these new Western Region villages can have played as important a role in the culture of the extant population, nor would they be as familiar to the people as in Jachie, and we expected that this might influence the results of the test in these areas. Between these extremes, we also conducted trials in Bandai hills, a species-poor, very dry forest, with one or two very rare tree species (such as an almost extinct Ghanaian endemic Caesalpinioid legume, *Talbotiella gentii*), and in Tano Ofin, an unusual 'Upland Evergreen' sort of hill forest.

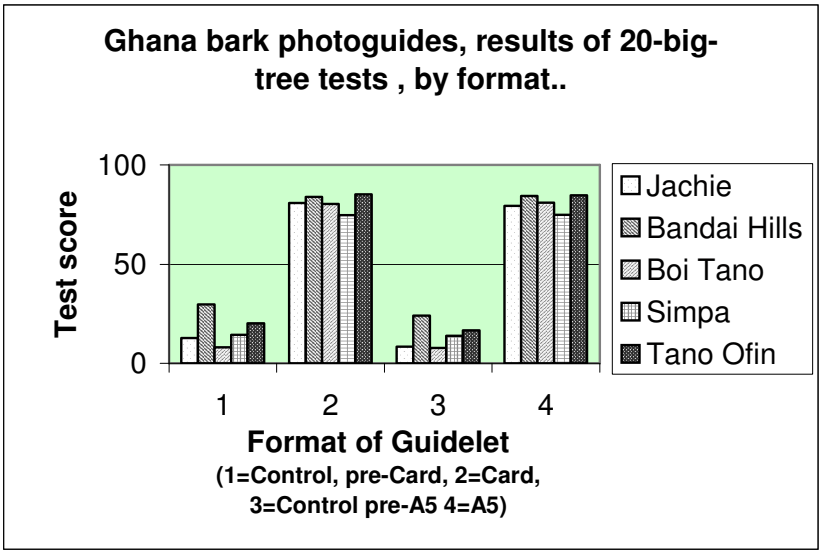
These test sites were chosen also to fit in with an initiative by a collaborator, Abu Juam Musah, manager of the Biodiversity Component of the Ministry of Lands and Forestry in Ghana, to increase awareness of the biodiversity of 'Globally Significant Biodiversity Areas' (GSBAs). All test sites were in GSBAs, except Jachie. Three interviewers, Agatha Rockson (University of Science and Technology, Kumasi), Nana

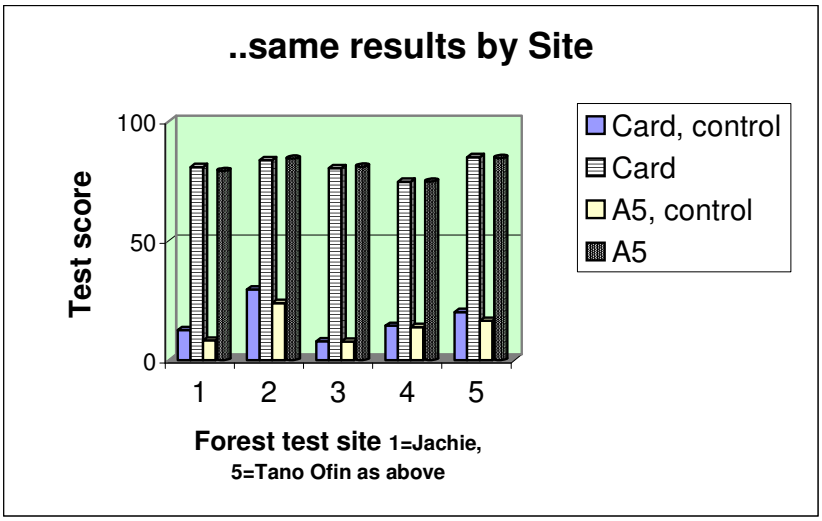
Adjoa (Legon University Botany Deptartment) and Letitia Asante)Forestry Service) persuaded 373 respondents to attempt to identify 20 trees each with our 128 page guidelets. They have incidentally increased local awareness of biodiversity, particularly considering that all of the respondents showed a massive improvement of identification skills in the process.

Leaving a detailed analysis for elsewhere, the summary of results show that whereas there is some variation in terms of general local knowledge of the trees - shown by the 'control' figures in the graphs - in general people can recognise less than a quarter of their local trees without using the guidelet. However their recognition increased to an average of around 80% of species by browsing the guidelets, after a brief training in the layout by our evaluators. In the site where people knew their trees best (Bandai hills – site 2 above), the average score was about 25% correct without the guide. Page size, whether small postcard size or A5, made little difference to overall accuracy, although some people complained they were too small to see properly.

In Cameroon, Stuart Cable, Rita Lysenge and Elias XXX conducted tests on 19 species of *Cola*, with 278 respondents from 16 Mt Cameroon villages, Limbe botanic Garden staff and with students from Buea. These tests covered mostly sterile plants of this 'difficult' genus. The aspects of field guides under test here included comparisons of various combinations of: photos of fresh or dried (herbarium) leaves, photocopies, Xrays of venation, line drawings and actual dried leaves (pressed, in a polythene bag), with or without added basic textual information. Virtually all respondents here could read and speak English, unlike many of the farmers in the Ghanaian tests. The material was arranged in 7 groups based on basic characters such as leaf shape and type (some species are digitately compound, others are simple or lobed). Initial analysis shows surprisingly little difference between the formats in terms of accuracy, but low overall accuracy, compared to different sets of plants in the other tests. The range of overall scores was c. 45-55% correct, with only a minor improvement where key features were indicated on the illustrations with words and arrows. Although this may not seem encouraging, this is 50% of species that, on the whole were unknown without the guidelets, (except the commercially important and well-recognised *C. nitida* and *C. acuminata* that have been extensively traded in West Africa and were in the original Coca Cola). There is much further analysis to do on this dataset, for instance to clarify what sorts of mismatches were commonly made, and how more subjective feedback, e.g. on perceived usability, related to test scores.

Incidentally, we have an ongoing test which a handful of respondents have completed in the Daubeny Herbarium, to identify 20 sterile herbarium *Cola* specimens using the guides. It seems, if only.we could persuade a few more people to turn up, that the average score here will be >75% correct with any format. It is certainly much harder to persuade people to take part in user evaluations in Oxford than it is in Africa.

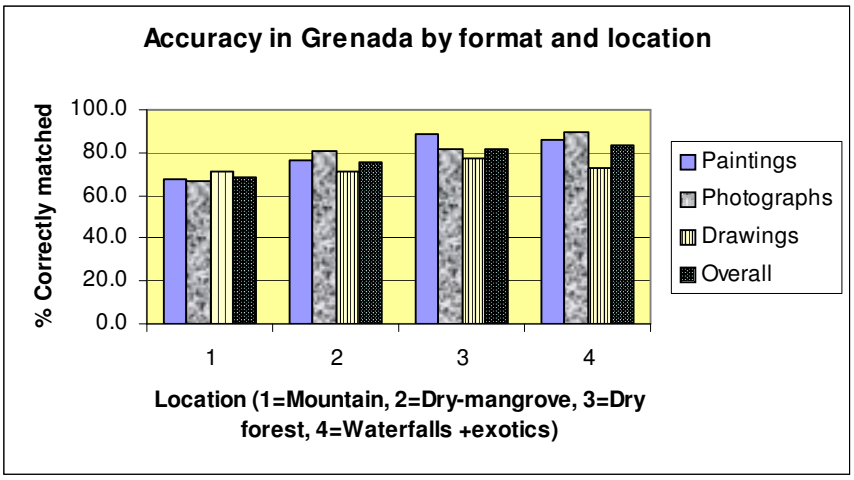




The plants of Grenada guidelet

In Grenada, Dean Jules from the Grenada Forestry Department, and up to seven other field assistants, have tested and interviewed 439 Grenadians and tourists from ages 11 upwards in four main sites. Each respondent had 20 test plants, all with foliage and sometimes flowers or fruits at least clearly visible from the ground, and was given a shuffled hand of 20-24 cards, with at least six of each of the three formats being tested. All species were included at most once in each shuffled hand. Each card for a few cards with species that were not present and one or two species amongst the test plants but not represented in the hand of cards. The formats were either photographic (a small mosaic of photographs, featuring the leaf and other key features) or botanical paintings or line drawings that had been prepared by Rosemary Wise on earlier visits, each of the type typically seen in various botanical guides. Respondents were asked to match each numbered plant to one of the shuffled picture cards they were given, or to say it was not there.

The overall results are summarised on page 11, again without getting involved here in the complexity that we will be exploring in detail. Even in the hardest conditions, the average 'match rate' was more than 65%. In sub-montane forest around the Grand Etang Lake, few people knew more than one or two species beforehand, and this proved the hardest set of species for the respondents to match to the cards.



Respondents were generally previously familiar with several (although still less than half on average) of the plants in the Annandale waterfalls area, where there are many exotic and well-used species such as Cinnamon, Nutmeg and Mango, alongside indigenous lowland moist forest species. Respondents were also more successful in matching the cards to the plants there. It was clear that people were recognising the tree, say a mango, then looking for a card that fitted their mental image of a mango, including its fruit, rather than the actual (fruitless) tree in question. In this area, the average correct match rate was about 80% (ie 16 out of 20 plants correctly matched). The Dry forest and mangrove vegetation around Bathway and Levera in the north of the island are intermediate in terms of familiarity of species, and also in terms of accuracy of the various formats.

Considering many of the respondents had little interest in or experience of tropical botany, and there was no training of what attributes to look for, nor any guiding text or keys to help diagnosis, we can see that there is good scope for picture-based field guides to provide 'mostly right' identifications.

An interesting aspect of these Grenada trials is that drawings, although the least liked overall and least accurate by a small margin, were similarly useful in all four sites, with c. 67-72% correctly matched. Contrast this with the photographs, which were marginally the most liked and generally the most accurately matched, or paintings which were both more successful than drawings in the 'easy and familiar' vegetation, but less successful than drawings when the going got tough. It seems that colour (whether of leaves or the coloured flowers and fruits which were often not present on the plant at the time) is a useful feature where users are trying to recognise a picture of a plant they know previously. The same features may well be misleading with unfamiliar plants, where people try to match a picture to a plant in front of them. In these cases, it seems that forcing amateurs to concentrate on shape and structure maybe a net advantage for accuracy, even though this is considered generally less satisfying.

Conclusions

As a first approximation, here are some conclusions:

- ☺ Guides based primarily around digital photography of fresh plants, with minimal jargon, are to be recommended for tropical forest guides that only need to work to a generic level, or where absolute accuracy is not important for all sets of 'difficult to separate' species. An average of about 80% species accuracy has been achieved with picture guides to broad sets of species.
- ☺ Production potential for guides rich in pictures have fallen with modern digital photography and computing power.
- ☹ But one of main bottlenecks for guides with a larger intended audience is finding an enthusiastic publisher given the high printing costs of good quality colour guides.
- ☹ Don't rely uncritically on recognition of individual plant species by people living next to forests, nor therefore on knowledge that hinges on this – such as local rarity. This may seem to run counter to a thread within the modern paradigm of conservation.
- ☺ However, do realise that with very little in the way of basic guide material and time, there is vast scope to help enthusiastic people improve their identification skills, and therefore to facilitate improvements in rural livelihoods hinging on plant identification, such as inventory participation and ecotourism. For these cases, self-published guides perhaps with the help of NGOs are to be recommended as part of any conservation and development programme.
- ☺ Where rare plants, or close relatives need to be distinguished accurately, guides in some cases yield more accurate answers if based on line drawings.
- ☹ But for these difficult species there probably can be no substitute for patience, dedication and an eye experienced as spotting small differences. That, by the way, applies equally to village experts, such as herbalists, as to professional taxonomists or herbarium workers. Do not expect 100% accurate identifications even with the most carefully thought out field guide.
- ☹ Unfortunately, there is a widespread perception of text and line-drawing based guides as boring.
- ☹ DFID or other development agencies stand to help facilitate publication of colour guides by acting as, or supporting a trustworthy, minimal profit agency, that arranges for, say, African developing countries to print their homespun guides in countries such as many in Asia, or in Trinidad, where the quality/cost ratio is perhaps ten times more favourable than say in Europe or West Africa.

In conjunction with Anna Lawrence, of the Environmental Change Institute also in Oxford, we are putting the lessons of this project into a make-your-own field guide 'cook book', hopefully to facilitate local guide production for and by people close to their forests, and by NGOs, technicians in government departments and enthusiastic individuals in the tropics in general.

We will also be putting these lessons and images and many other materials onto a budding herbarium website, in a bid to facilitate plant field guide production for tropical forests, whether for encouraging eco-tourism or more technical awareness of their biodiversity. For readers interested in our comprehensive bibliography, free useful images, references to the full guide books on Grenadian and Ghanaian trees, downloadable versions of our guidelets and a fuller description of our lessons learnt, watch out on http:\\Herbaria.plants.ox.uk.

William Hawthorne

BRAHMS and monography

Introduction

The task of assembling large amounts of data from specimens and bibliographic sources, editing these data, and preparing complex outputs including taxonomic treatments, specimen lists, maps and indexes, is a daunting and time consuming one for the monographer embarking on a new work. Using the appropriate database methods, monograph preparation can be speeded up. With ever fewer basic resources available to a dwindling army of taxonomists, there is a pressing need to do exactly that.

The BRAHMS database (Botanical Research And Herbarium Management System – see www.brahms.co.uk) provides support and guidance to monographers with the assembly of names, authors, protologue citations, synonyms, types, descriptive text and specimen data into an integrated system. The contribution extends beyond assembling, storing and processing these data. It provides a valuable perspective, hard to obtain with conventional filing systems, contributing to the resolution of nomenclature, in particular synonymy and typification and the gradual process of building the final product. It also provides a logical framework helping to clarify what needs to be done thereby providing valuable direction at the critical early stages of new projects.

Checklists, synopses, floras, revisions and monographic accounts can be seen as a continuum, going from simple to complex output - all produced from the same database. Such a database can also be further developed for new research; to create spin-off products, perhaps for a wider audience; to contribute to a more general herbarium database; and used to make the data available electronically on the web.

A draft list of names

A first step is to create a draft list of names. Initially, this may include a mixture of valid and invalid, accepted, synonymous and other temporary names. This name list is initially assembled in a BRAHMS Rapid Data Entry (RDE) file – a type of simple spreadsheet. A range of data processing tools is provided with RDE to help with initial tidying up of such lists and the gradual adding of the correct taxonomic status. See Fig. 1.

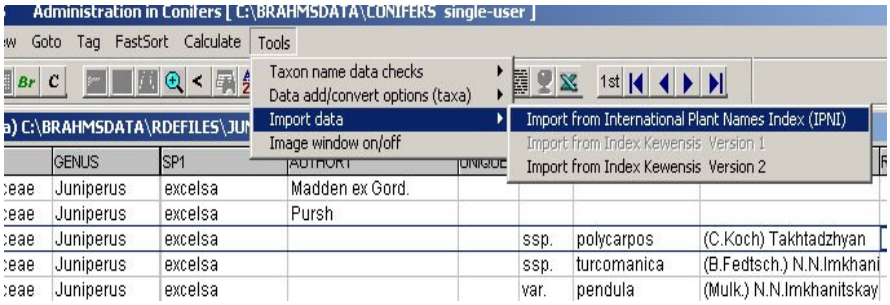


***Fig 1**. Names can be directly imported from various internet sources including IPNI found at http://www.ipni.org. The web site can be accessed using the BRAHMS w*eblink toolbar *option. After downloading, the records can be imported to RDE using an option on the Tools menu as shown here. At this stage, common editing activities are to remove unwanted names, tidy up spelling irregularities and to standardize author and protologue citation formats. At any stage, the names list can be transferred into the main BRAHMS database where a further battery of processing tools becomes available.*

Gathering specimen data

As with the draft name list, collection data are initially added into Rapid Data Entry files. RDE for collection entry has evolved over the last fifteen years into an efficient way to capture data from large numbers of specimens. Dictionaries of taxa, geographic places, collectors amongst others can be accessed to speed up and standardise data entry. Images of specimens or their labels can also be stored at this stage and this is an increasingly popular method to check data at a later stage.

Editing nomenclature

At the core of monography is decision making about the status of names, their nomenclatural relationships to each other and to type collections. To assist with this process, related names can be edited in a BRAHMS spreadsheet screen with specialised tools to enable the organisation of names including their links to collections. See Fig. 2.

Descriptions of taxa

Descriptive text and other facts can be added to families, genera and species. Data fields can be added as required for the work in hand. Such data can be used to create queries and can be included in reporting outputs. See Fig. 3.

Preparing to map

Unless all your collections come with GPS readings, accurate species distribution map production starts with the painstaking process of pinpointing collection locations on maps and/or looking them up in atlas indexes or gazetteers and subsequently editing the collection file. It is useful to build a consistent geographical database including subdivisions of countries (often additional to the label information of specimens) as these will be used to sort specimens accordingly in the final products, e.g. checklists or specimen lists. Ambiguous locality names and descriptive locality statements can be stored in a memo field under LOCNOTE. With the altitude data, BRAHMS can calculate altitude ranges for species. See Fig. 4.

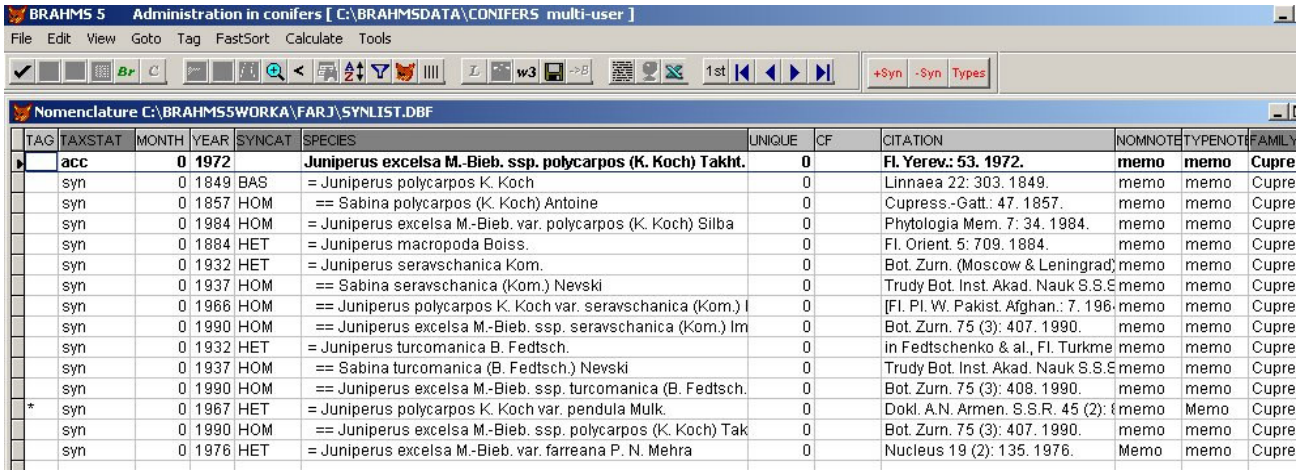
Reporting in action

BRAHMS can gather together data from all corners of your database to create different types of product and publication, from simple lists to more complex monographic publications formatted for specific journals. Outputs can be viewed on the screen, printed or sent to your word processor. Monographic outputs tend to be more complex than most as they bring together species and specimen level data and format these data in a rigorous way. Reports are produced using report templates. Sample templates are provided with BRAHMS – and new ones can be added as needed.

Once a report template has been designed, a report such as the one illustrated in Fig. 5. here is easily produced by a) selecting the accepted name(s) to report on and b) choosing the correct report template.

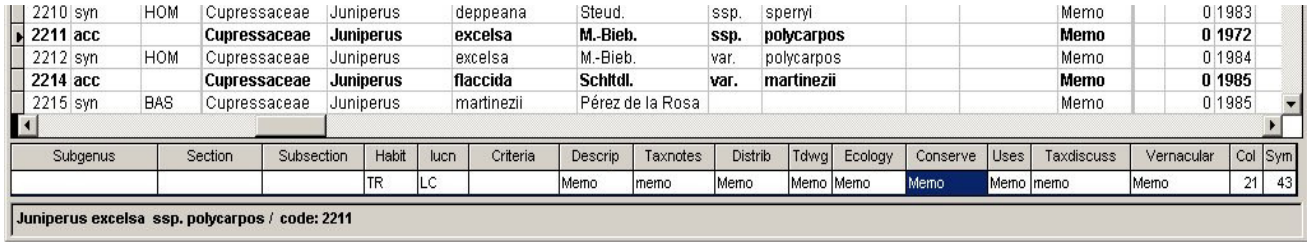
Formatting complex outputs

The format of the final outputs is controlled by setting up report templates. BRAHMS also includes special formatting tools to help pre-format especially complex items into memo fields that can be simply dropped into your reports. These include format controls for taxonomic treatments and specimen citation lists. See Fig.6.



TAG	TAXSTAT	MONTH	YEAR	SYNCAT	SPECIES	UNIQUE	CF	CITATION	NOMNOTE	TYPENOTE	FAMILY
	acc	**0**	**1972**		**Juniperus excelsa M.-Bieb. ssp. polycarpos (K. Koch) Takht.**	**0**		**Fl. Yerev.: 53. 1972.**	**memo**	**memo**	**Cupre**
	syn	0	1849	BAS	= Juniperus polycarpos K. Koch	0		Linnaea 22: 303. 1849.	memo	memo	Cupre
	syn	0	1857	HOM	== Sabina polycarpos (K. Koch) Antoine	0		Cupress.-Gatt.: 47. 1857.	memo	memo	Cupre
	syn	0	1984	HOM	= Juniperus excelsa M.-Bieb. var. polycarpos (K. Koch) Silba	0		Phytologia Mem. 7: 34. 1984.	memo	memo	Cupre
	syn	0	1884	HET	= Juniperus macropoda Boiss.	0		Fl. Orient. 5: 709. 1884.	memo	memo	Cupre
	syn	0	1932	HET	= Juniperus seravschanica Kom.	0		Bot. Zurn. (Moscow & Leningrad)	memo	memo	Cupre
	syn	0	1937	HOM	== Sabina seravschanica (Kom.) Nevski	0		Trudy Bot. Inst. Akad. Nauk S.S.S	memo	memo	Cupre
	syn	0	1966	HOM	== Juniperus polycarpos K. Koch var. seravschanica (Kom.) I	0		[Fl. Pl. W. Pakist. Afghan.: 7. 196	memo	memo	Cupre
	syn	0	1990	HOM	== Juniperus excelsa M.-Bieb. ssp. seravschanica (Kom.) Im	0		Bot. Zurn. 75 (3): 407. 1990.	memo	memo	Cupre
	syn	0	1932	HET	= Juniperus turcomanica B. Fedtsch.	0		in Fedtschenko & al., Fl. Turkme	memo	memo	Cupre
	syn	0	1937	HOM	== Sabina turcomanica (B. Fedtsch.) Nevski	0		Trudy Bot. Inst. Akad. Nauk S.S.S	memo	memo	Cupre
	syn	0	1990	HOM	== Juniperus excelsa M.-Bieb. ssp. turcomanica (B. Fedtsch.	0		Bot. Zurn. 75 (3): 408. 1990.	memo	memo	Cupre
*	syn	0	1967	HET	= Juniperus polycarpos K. Koch var. pendula Mulk.	0		Dokl. A.N. Armen. S.S.R. 45 (2): 8	memo	Memo	Cupre
	syn	0	1990	HOM	== Juniperus excelsa M.-Bieb. ssp. polycarpos (K. Koch) Tak	0		Bot. Zurn. 75 (3): 407. 1990.	memo	memo	Cupre
	syn	0	1976	HET	= Juniperus excelsa M.-Bieb. var. farreana P. N. Mehra	0		Nucleus 19 (2): 135. 1976.	Memo	memo	Cupre

Fig 2. *This screen displays part of the nomenclatural information of a particular accepted taxon. The list of names is headed by the accepted name. Information on taxonomic status, year of publication, category of synonym, protologue citation and notes is stored in separate fields. The screen provides an immediate overview of the synonymy of this taxon. For each name, more details (e.g. information on types) can be viewed by clicking on the*  *toolbar button. Manipulation of synonymy and type links is undertaken using the '+Syn', '-Syn' and 'Types' buttons. In building the synonymy, these may first be dealt with as plain synonyms by assigning the category 'Syn' in the SYNCAT column; later they are assigned more specific categories (BASyonym, HOMotypic and HETerotypic). Synonyms are assigned to either the accepted name or (in case of homotypic names only) to other synonyms of that accepted name, as appropriate. With help of the year of publication, which determines the chronology, a correct list of synonyms is constructed once the nomenclature of the accepted name is again generated. This can be amended continuously as new information (e.g. typification) becomes available.*

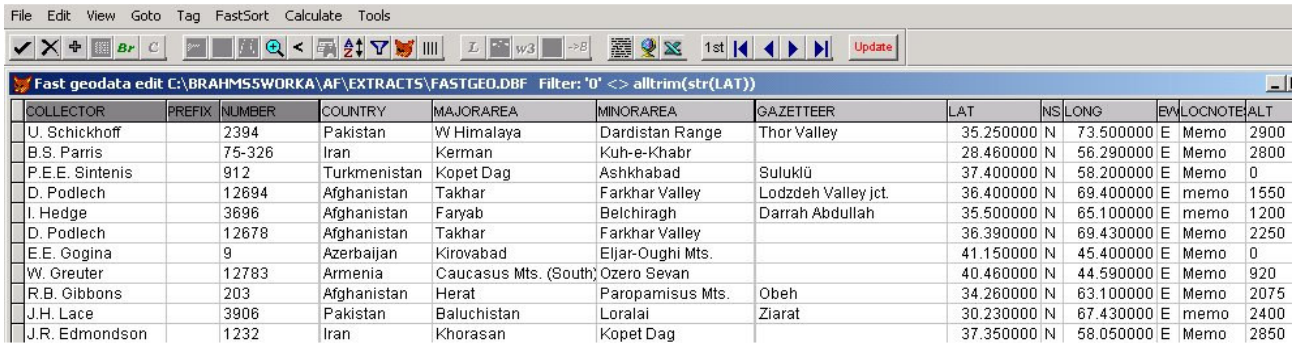


2210	syn	HOM	Cupressaceae	Juniperus	deppeana	Steud.	ssp.	sperryi			Memo	0	1983	
2211	**acc**		**Cupressaceae**	**Juniperus**	**excelsa**	**M.-Bieb.**	**ssp.**	**polycarpos**			**Memo**	**0**	**1972**	
2212	syn	HOM	Cupressaceae	Juniperus	excelsa	M.-Bieb.	var.	polycarpos			Memo	0	1984	
2214	**acc**		**Cupressaceae**	**Juniperus**	**flaccida**	**Schltdl.**	**var.**	**martinezii**			**Memo**	**0**	**1985**	
2215	syn	BAS	Cupressaceae	Juniperus	martinezii	Pérez de la Rosa					Memo	0	1985	

Subgenus	Section	Subsection	Habit	Iucn	Criteria	Descrip	Taxnotes	Distrib	Tdwg	Ecology	Conserve	Uses	Taxdiscuss	Vernacular	Col	Sym
			TR	LC		Memo	memo	Memo	Memo	Memo	Memo	Memo	memo	Memo	21	43

Juniperus excelsa ssp. polycarpos / code: 2211

Fig 3*. The above screen shows the lower part of the main species file in BRAHMS with species link file opened. The link file acts as an appendix to the main file - new fields can be added as needed. The developer of this database has defined character fields such as Subgenus, Section, Subsection, Habit, IUCN and Criteria and memo fields such as Descrip, Taxnotes, TDGW, Ecology, Conserve, Uses, Taxdiscuss and Vernacular.*



COLLECTOR	PREFIX	NUMBER	COUNTRY	MAJORAREA	MINORAREA	GAZETTEER	LAT	NS	LONG	EW	LOCNOTE	ALT
U. Schickhoff		2394	Pakistan	W Himalaya	Dardistan Range	Thor Valley	35.250000	N	73.500000	E	Memo	2900
B.S. Parris		75-326	Iran	Kerman	Kuh-e-Khabr		28.460000	N	56.290000	E	Memo	2800
P.E.E. Sintenis		912	Turkmenistan	Kopet Dag	Ashkhabad	Suluklü	37.400000	N	58.200000	E	Memo	0
D. Podlech		12694	Afghanistan	Takhar	Farkhar Valley	Lodzdeh Valley jct.	36.400000	N	69.400000	E	memo	1550
I. Hedge		3696	Afghanistan	Faryab	Belchiragh	Darrah Abdullah	35.500000	N	65.100000	E	memo	1200
D. Podlech		12678	Afghanistan	Takhar	Farkhar Valley		36.390000	N	69.430000	E	Memo	2250
E.E. Gogina		9	Azerbaijan	Kirovabad	Eljar-Oughi Mts.		41.150000	N	45.400000	E	Memo	0
W. Greuter		12783	Armenia	Caucasus Mts. (South)	Ozero Sevan		40.460000	N	44.590000	E	Memo	920
R.B. Gibbons		203	Afghanistan	Herat	Paropamisus Mts.	Obeh	34.260000	N	63.100000	E	Memo	2075
J.H. Lace		3906	Pakistan	Baluchistan	Loralai	Ziarat	30.230000	N	67.430000	E	memo	2400
J.R. Edmondson		1232	Iran	Khorasan	Kopet Dag		37.350000	N	58.050000	E	Memo	2850

Fig 4*. BRAHMS has various editing tools to help tidy geographic data, locate latitude and longitude values and edit these as efficiently as possible into the collection file. Amongst these are the ability to link large external reference gazetteers (often available on the web) to BRAHMS.*

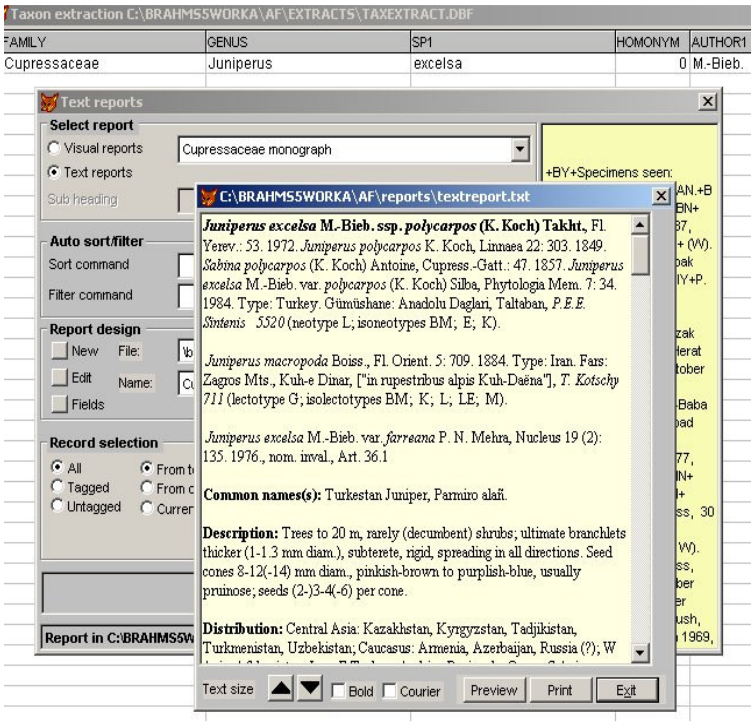


Fig 5. *Screen showing a section of a generated report (some synonyms excluded here). Here, the report template 'Cupressaceae monograph' brings together three main strands of data: taxonomic treatment, descriptive text and a list of specimens.*

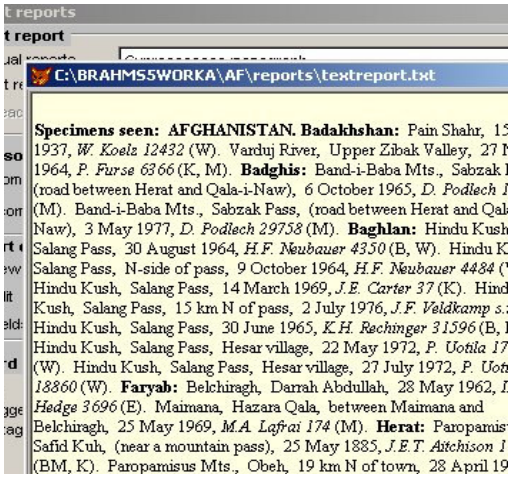
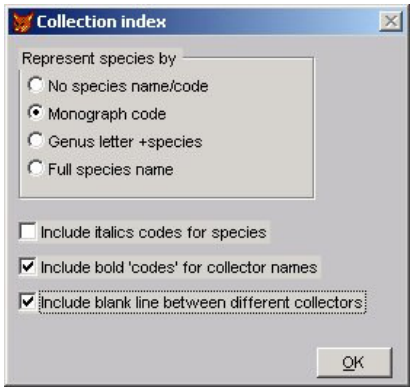


Fig 6. *Specimen lists, such as that shown here, can be formatted to include the required fields. Configuration options are available to choose complex sorting on records; collector names format; and to process special collections such as types, illustrations and others.*

Indexes and summaries

Most monographic works include various lists, tables and indexes at the end. One example is an indexed list of exsiccatae. These can be produced with no further data entry or editing, by choosing the appropriate report template. See Fig. 7.



Cabrera E 495, 1459, 1530, 1575, 1578, 2002 (6a); 2050 (19); 2329 (6a); 2986 (8); 7308 (15a); 9835, 10977 (6a); 14417 (19); 15100 (6a); 15204 (19)
Calderon S 336 (19); 1359 (8); 2031 (22); 2105, 2245 (19)
Caldwell DH 8796 (6a)
Cabrera E 495, 1459, 1530, 1575, 1578, 2002 (6a); 2050 (19); 2329 (6a); 2986 (8); 7308 (15a); 9835, 10977 (6a); 14417 (19); 15100 (6a); 15204 (19)
Calderon S 336 (19); 1359 (8); 2031 (22); 2105, 2245 (19)
Caldwell DH 8796 (6a)
Calzada JI 1525 (6a); 1682 (17b); 1968, 2102 (5); 2195 (6b); 2201 (15a); 2339 (6a); 2518 (4); 3141 (5); 4245 (17b);

Fig 7. *Collection indexes, such as the small sample shown here, can be lengthy and laborious to produce manually in a word processor. When creating an index, the species can be represented in one of four ways as indicated on the Collection Index setup form.*

Conclusion

Whilst data collection, input and editing are facilitated and streamlined substantially, the real gain for monographic work is with the generation of the final product. Time spent on careful data entry with the widest possible variety of output in mind is paid back at the end, when one finds the need to check and correct or edit the genera and species accounts – now produced within a few seconds – to be reduced to a minimum. Electronic preparation of taxonomic work really makes a difference and is an important contribution to alleviate the predicament mentioned in the introduction.

Denis Filer (Oxford) and ***Aljos Farjon*** (RBG Kew)

Systematics Journal Club – Autumn 2002

Getting into print is like entering a minefield, except that one has a hundred limbs not just four which may be blown off. This is especially true within the confines of the departmental Systematics Journal Club which provides a venue for unfettered discussion of current developments and literature in systematics, encourages everyone to read more papers, and allows graduate students to hone their critical skills and place their work in a wider context. During the Autumn 2002 term we discussed the following papers:

Anderson, S. (1974). Patterns of Faunal Evolution. *Quarterly Review of Biology* **49**: 311-332. and Willis, J.C. and Yule, G.U. 1922. Some statistics of evolution and geographical distribution in plants and animals and their significance. *Nature* **109**: 177-179.

- Delving back to the roots of the hollow curve provided the basis for a discussion about the significance of the hollow curve in relation to a phylogenetic tree.

Cronn, R.C., Small, R.L., Haselkorn, T. and Wendel, J.F. (2002). Rapid diversification of the cotton genus (*Gossypium*: Malvaceae) revealed by analysis of sixteen nuclear and chloroplast genes. *American Journal of Botany* **89**: 707-725.

- With 18kb of sequence one might have hoped for an unambiguous tree, but not so for cotton. Our discussion homed in on the criteria used to choose between the combined cpDNA and combined nDNA gene trees which were incongruent with each other. But who else has so much sequence data for a pantropical plant group, indeed for any plant group? One of these papers that seems to be out ahead of the crowd.

Cuenoud, P., Del Pero Martinez, M., Loizeau, P.A., Spichiger, R., Andrews, S. and Manen, J.F. (2000). Molecular phylogeny and biogeography of the genus *Ilex* L. (Aquifoliaceae). *Annals of Botany* **85**: 111-122.

- A Christmas special with holly from Rodolphe, which led to a discussion about successive weighting, and also the other sort of weighting, *i.e.* waiting until there is enough suitable data to actually answer the fascinating questions investigated in this paper.

Martin, A.P. and Burg, T.M. (2002). Perils of paralogy: using HSP70 genes for inferring organismal phylogenies. *Systematic Biology* **51**: 570-587.

- Interesting paper on the extremes of paralogy, but why did the term "MHC-linked" appear three times in Fig. 5? Could HSP70 genes be linked to MHC loci? Perhaps the more apt title would have been '*The perils of failing to embrace equally plausible hypotheses*?' A good example of how not to determine a species phylogeny.

Olsen, K.M. (2002). Population history of *Manihot esculenta* (Euphorbiaceae) inferred from nuclear DNA sequences. *Molecular Ecology* **11**: 901-911.

- *Milking the rhythm* – i.e. the same thing under a different guise. Like many things these days this one doesn't appear to be single-copy.

Richardson, J.E., Pennington, R.T., Pennington, T.D. and Hollingsworth, P.M. (2001). Rapid diversification of a species-rich genus of Neotropical rainforest trees. *Science* **293**: 2242-2245.

- Taxonomists under pressure to publish in higher impact journals might pick up some tips from this paper.

Simmons, M.P., Ochoterena, H. and Freudenstein, J.V. (2002). Amino acid vs nucleotide characters: challenging preconceived notions. *Molecular Phylogenetics and Evolution* **24**: 78-90.

- Amino acid or nucleotide data? In the context of taxonomic sampling, resolution and clade support the results presented in this paper suggest that there are no straightforward answers to this question.

Lutzoni, F., Pagel, M. and Reeb, V. (2001). Major fungal lineages are derived from lichen ancestors. *Nature* **411**: 937-940.

- Interesting paper using Bayesian analysis to determine the probability of symbiosis at nodes on a fungal tree.

Wiens, J.J. and Servedio, M.R. (2000). Species delimitation in systematics: inferring diagnostic differences between species. *Proceedings of the Royal Society of London B* **267**: 631-636.

- This paper presents statistical tests that might be used to assess the strength of evidence for species distinctions in relation to sample size. While making species delimitation more objective would indeed seem like a good thing, our discussion concluded that geographic coverage of samples is far more important than sample size alone.

Don't worry though, we haven't forgotten that *'while it is easy to ridicule or condemn the misconceptions or the excesses of one's predecessors, it is another matter entirely to modify the old system or construct a new one'* (Rupert Barneby, 1964).

Herbaria

Visitors

From 1 October 2001 and throughout 2002, 80 people made visits to the herbaria despite the fact that FHO was closed until May 2002 and OXF was closed from July 2002 for refurbishment work (see below). In addition a number of invited guests came for the re-opening of the Daubeny Herbarium by Lord Sainsbury of Turville in June (see page 2).

A group of M. Sc. Students on a Genetics and Conservation Course at the University of Birmingham made a visit in May for a tour of the herbaria. Two curatorial staff from the Oxford University Natural History Museum and two visitors from Brooklyn Botanic Garden, New York also came for general tours.

Apart from those making single day visits, Dr Heidi Hartmann from the Institute of Botany in Hamburg visited for a week in April 2002 to study Aizoaceae particularly from the Dillenian Collection. Mary Dean from Edge Hill College, Olmskirk, Lancashire made a three day visit in May to study *Carex* material and during December Chris Fagg arrived from Brazil to continue his work on African acacias. In addition Caroline Pannell has been given academic visitor status by the Department to enable her to work in the herbarium.

Fielding-Druce (OXF)

From the beginning of July 2002, OXF was officially closed to visitors in preparation for the refurbishment of the herbarium to take place. There were therefore fewer visitors to the herbarium during the year. However, as the commencement of the refurbishment work was delayed due to unforeseen circumstances, access to a large part of the collections was still possible and several visitors came after the official closure.

Much time was spent in considering a revised plan for the herbarium within the existing space limits and constraints to give easier access to the collections, to enable enough cupboard space for all un-incorporated material with some space for expansion (where necessary), as well as allowing for a working area apart from the main collections. The revised plans have now been approved by all concerned and the programme of work is likely to take another six months (during this time the collections will be totally inaccessible). We hope to re-open the herbarium in September 2003. The date of re-opening will be posted on the Department's web site in due course at www.plants.ox.ac.uk/ We will however do our best to answer any queries relating to the collections during the closed period.

Accessions

New material for the Druce Herbarium included 89 sheets of British plants collected mostly by Mr. John Killick from the counties of Oxfordshire and Berkshire. These specimens had previously been sent by Mr Killick to be determined by different specialists and many of the plants have been cited in the *Flora of Oxfordshire* by Killick, Woodell & Perry (1998). 24 miscellaneous British plants collected by Mr R.C. Palmer mostly during 1998 were also incorporated. Members of the Rare Plants Group of the Ashmolean Nautural History Society of Oxfordshire donated 39 specimens of *Taraxacum* collected in Oxfordshire and Berkshire during a weekend workshop meeting. Dr. A.J. Richards had confirmed the identifications of this material. Other accessions to the Druce Herbarium included specimens of the British rarities *Apium repens* and *Bupleurum rotundifolium*.

42 specimens were also added to the Lichen collection. This material consisted of 13 specimens from the Seychelles collected by Prof. M.R.D. Seaward (2000), 15 specimens from Scotland collected By E. Rutovitz (1992), 5 specimens from Aldabra collected by F.A. Harrington (1992), plus other specimens collected by A. Tehler including 4 from Mexico (1993 & 1996), 4 from California (1993 & 1994) and one specimen from South Africa (1996).

125 sheets from previously designated accessions were incorporated into the Fielding Herbarium. These included 109 specimens of the Flora of the Netherlands and 16 specimens of Australian plants.

Loans

During the year two special loans of historic material were made for exhibition purposes. One specimen of *Rhododendron* possibly attributed to Engelbert Kaempfer (1651-1716) from the Sherardian Herbarium was lent to the Japan Society for their exhibition entitled "A Garden Bequest – Plants from Japan". The herbarium specimen was sent with two volumes containing paintings of Japanese plants from the Sherard manuscript collection in Plant Sciences Library. The Japan Society's exhibition ran from 7 December 2001 to 12 January 2002 in the City Art Centre Edinburgh, and then from 31 January – 22 March 2002 at the Brunei Gallery, University of London. The exhibition was opened in Edinburgh by the Scottish Minister for Leisure and Culture and was closed in London by a representative on behalf of the UK Minister for Tourism, Film and Broadcasting. Approximately 10,000 visitors viewed the exhibition in London and an estimated 3,000 people visited it in Edinburgh.

The second of the special loans of historic material consisted of three specimens of *Primula* and *Polyanthus* (Primulaceae) from the Herbarium of Jacob Bobart (the Younger) dating back to the second half of the 17th century. Jacob Bobart (the Younger) was the second Keeper of the Oxford Botanic Garden. The specimens were lent for the exhibition entitled "Gregor Mendel : The Genius of Genetics" taking place at the Abbey of St Thomas in Brno, Czech Republic. The exhibition opened on 15 May 2002 and is now scheduled to run until November 2003.

Outgoing general loans also included specimens from the following genera and families: *Sorendeia*, Anacardiaceae; *Brachystelma*, Asclepiadaceae; *Lactuca*, Asteraceae; miscellaneous genera from the Combretaceae; *Brassica*, Cruciferae; *Anisantha*, *Bromus*, *Ceratochloa*, Gramineae; *Dactylorhiza*, Orchidaceae; *Salix*, Salicaceae. 1319 specimens were returned to OXF from loan during the period from 1 October 2001 to the end of December 2002. 6% of these returned specimens were types.

Serena Marner

Daubeny (FHO)

The refurbishment of FHO was successfully completed in March 2002. It is difficult to believe that this is the same room that the collection was housed in previously, now being light, airy and spacious as opposed to dark and cramped, with difficult access to the collection.

The installation of a rolling-stack system, with its own integral lighting, enabled all the collection to be housed on one side of the herbarium, freeing up space on the other side for white benching for use by our own staff and students as well as visitors. The carpological cupboards provide useful specimen laying-out space between the two. Newly painted walls and ceiling along with a new lighting system brightened up the whole room. The two offices were also refurbished and the whole entity has enabled the space to be used much more efficiently for current activities.

Returning the collection to the herbarium was achieved in a remarkably short time given the amount involved (see OPS 9), and was largely due to the herculean efforts of the Curator, Stephen Harris. We decided to take this opportunity to update the family names and reorganise the families in alphabetical order. All the green boxes containing the specimens had been numbered and their contents noted on a database that could be easily sorted to provide the exact, new location of each box on the compactor shelves. Some small adjustments have been necessary but, on the whole, this method allowed a speedy return of the collection. During the 9 months that FHO has been functioning again, the new system has met with approval from users.



Newly refurbished FHO, May 2002

Curation

Curatorial work has gone on apace since the return of the collection, with major rearrangements undertaken in the Sapotaceae, Rubiaceae, Rutaceae, Celastraceae and the Monocotyledons, along with more minor curation to the Fabaceae, Moraceae and Myrtaceae. Some of this updating was instigated by the commencement of the incorporation of J.D. Chapman's Mt. Mulanje collection into FHO in order that specimens could be filed under their current, new names.

Loans

Despite the refurbishment, a large amount of loan material was processed through FHO, with over 2,500 specimens being returned to other herbaria and well over 1000 specimens being received for study. Incoming material was mainly for commencing research on *Agathis* (Araucariaceae) by Timothy Waters and *Senecio* (Asteraceae) by Stephen Harris and undergraduate projects, and continuing work on *Strobilanthes* (Acanthaceae) by Dr. John Wood. Outgoing material consisted mainly of Cyperaceae and the partial return of Acanthaceae at the close of work by Julian Starr, Jonathan Bennett and Elizabeth Moylan, respectively.

Alison Strugnell

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