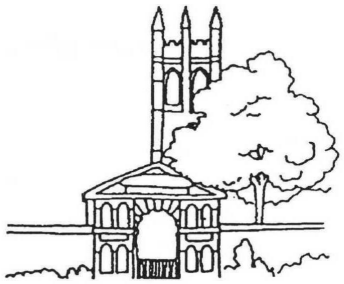
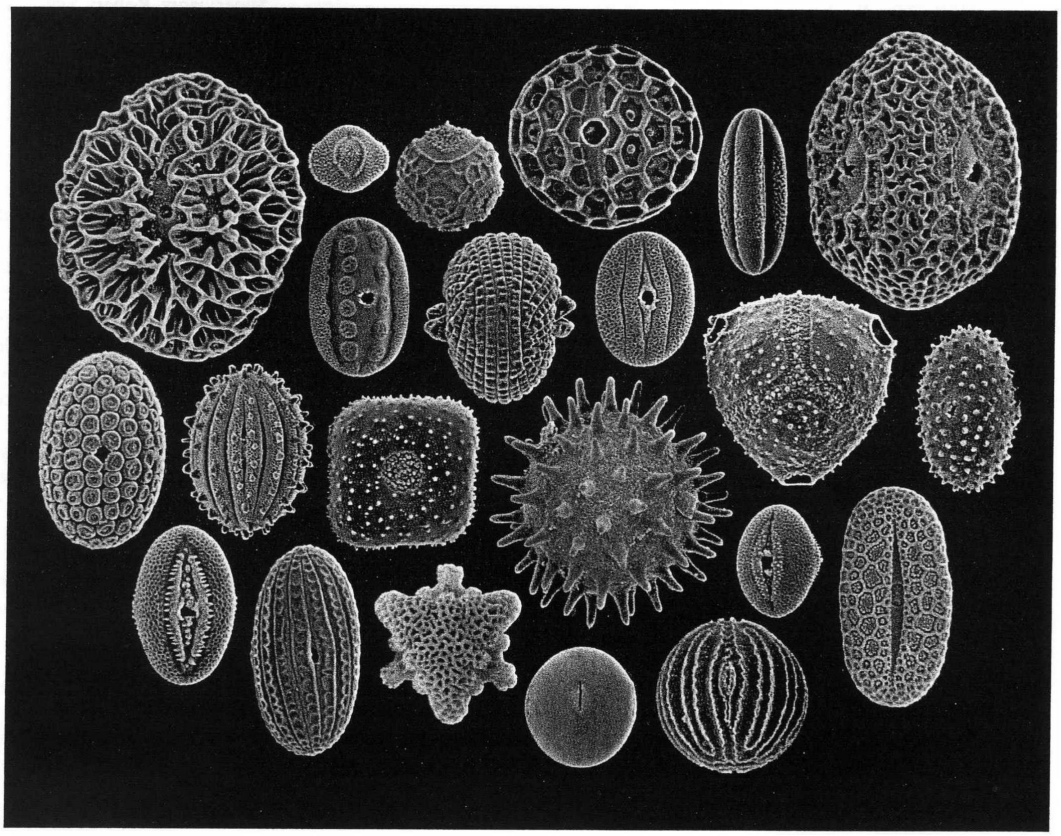
Oxford Plant Systematics



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

OPS 8 December 2000



Pollen Diversity in the Acanthaceae

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Editorial

In this issue we highlight the research activities of my lab on Acanthaceae systematics. I have written a short anecdotal article on the classification of Acanthaceae that has just been published in Kew Bulletin in collaboration with Kaj Vollesen. A new classification is long overdue as this represents the first explicit scheme placing most genera in a classification since Gustav Lindau in 1895. At the same time it is worth acknowledging that more explicit methods and DNA data have merely confirmed that many of the taxa recognized in the 19th century are natural groups. In addition to research on Acanthaceae our monographic research of *Strobilanthes* continues and the first batch of publications are beginning to emerge. This will continue in the next year with publication of taxonomic accounts focussed upon *Hemigraphis* from the Philippines and *Strobilanthes* from Java. It is tremendous news that Colin Hughes has now secured long term funding for his monograph of *Lupinus* and this gives our systematic research a distinct monographic focus on large genera.

Also in this issue are articles by Jamie Gordon and William Hawthorne indicating the breadth of our research activities. In addition Denis Filer provides another update on BRAHMS and we include annual news from our herbaria. We are delighted to receive an article by a current Oxford undergraduate (Timothy Waters) on the collections of Augustus Fendler.

Robert Scotland

Typesetting and layout of this issue of OPS by Serena Marner.

News Items

Appointments and awards

Colin Hughes was awarded a Royal Society University Research Fellowship (from 1 October 2000) to work on the systematics of *Lupinus* (Leguminosae). Current knowledge of diversity within *Lupinus* remains fragmentary with no accurate view of how many species there are, nor any currently acceptable infrageneric classification. Initial work will focus on delimitation of the confused and poorly known Andean species.

Donovan Bailey joined the Department in November as a new post-doctoral researcher funded by the Leverhulme Trust. He will be working on a new research project investigating hybridisation and polyploid origins in *Leucaena* (Leguminosae) in relation to its indigenous domestication as a minor food plant in Mexico. Donovan joins the Department from Cornell where he completed his PhD on the Mexican endemic genus *Sphaerocardamum* (Brassicaceae).

Prizes

Mark Carine has been awarded the Brian Styles Memorial Prize for his thesis entitled: *A systematic study of the southern Indian and Sri Lankan Strobilanthinae (Acanthaceae)*. Also congratulations to Mark who has taken up a three year position at the University of Reading on the Euro+Med PlantBase Project.

Julian Starr was awarded the Alf Erling Porsild Memorial Prize for the paper entitled: *The phylogenetic position of* Carex *section* Phyllostachys *and its implications for phylogeny and subgeneric circumscription in* Carex *(Cyperaceae)*. The award is presented annually by the Canadian Botanical Society for the best paper published by a Canadian student as senior author in the fields of plant systematics and/or phytogeography.

Expeditions, visits and talks

Stephen Harris gave invited talks at the UK meeting of the Ecological Genetics Group in April 2000 and at the Brazilian Botanical Congress held in Brasilia in July 2000.

Jamie Gordon has spent considerable time during the year at the National Herbarium (MEXU), Mexico and made brief visits to the Paul Standley Herbarium (EAP), Honduras to continue dry forest conservation research. With colleagues from the Overseas Development Institute of London, he has given talks and run training workshops on dry forest conservation issues to the annual congress of the Sociedad Mesoamericana para la Biología y la Conservación in Panama and to various conservation and development organisations in Mexico and Honduras. Whilst in Panama he also attended a course run by WWF on the methodology used to assign IUCN threat categories for red data books.

Elizabeth Moylan gave talks to the Micromorphology Section and Molecular Section of the Jodrell Laboratory, RBG Kew to present the findings of anatomical sectioning and results of DNA sequencing on the systematics of *Hemigraphis*.

Serena Marner gave invited talks, with reference to the Australian botanical collections of William Dampier, on the occasion of the 150th anniversary of George Claridge Druce's birthday in May 2000, to the Ashmolean Natural History Society of Oxfordshire, and to the Society for Graduates (Oxford University) in November 2000.

Student Progress

Jonathan Bennett (D. Phil.). Systematics of *Strobilanthes* Blume (Acanthaceae). Supervisors Robert Scotland (Oxford) and Alan Paton (Kew). BBSRC studentship.

Species delimitation of *Strobilanthes* from Java is now complete, and a taxonomic account of the 27 species, complete with keys, distribution maps and illustrations, is now in preparation. A molecular data set using sequence data from *trn*LF and ITS has been assembled in collaboration with Elizabeth Moylan. This has provided evidence for the first time that the Strobilanthinae (i.e. *Strobilanthes* and its segregate genera) are a monophyletic group. A detailed survey of the pollen morphology of *Strobilanthes* from outside of southern India and Sri Lanka is currently being completed and interpreted in light of the molecular phylogeny. During the summer I attended the second conference of the southern African society for systematic biology, held in Mtunzini, South Africa, where I gave a talk entitled *Systematics of large genera: an example from* Strobilanthes *Blume (Acanthaceae)*.

Elizabeth Moylan (D. Phil., third year). Systematics of *Hemigraphis* Nees (Acanthaceae). Supervised by Robert Scotland (Oxford), Paula Rudall (Kew) and Toby Pennington (Edinburgh). Druce Scholarship.

Work during the past year has focused on investigating the phylogenetic relationships among *Hemigraphis* and related genera in the Strobilanthinae subtribe. The ITS region of nrDNA and the *trn*L-F region of cpDNA were sequences for a number of genera including *Hemigraphis*, *Sericocalyx* and *Strobilanthes* during a collaborative study at the University of Washington, supervised by Professor Richard Olmstead. Combining sequence data with data generated by Jonathan Bennett and Mark Carine enabled data sets of 90 taxa for ITS and 43 taxa for *trn*L-F to be compiled. Separate and combined analyses of both data sets indicate that *Hemigraphis* and *Sericocalyx* comprise polyphyletic groups nested within a monophyletic Strobilanthinae.

Julian Starr (D. Phil., fourth year). A systematic study of the genus *Uncinia* Pers. (Cyperaceae). Supervised by Stephen Harris (Oxford) and David Simpson (Kew). Commonwealth Scholarship.

DNA analyses of combined internal transcribed spacer (ITS) and 5' external transcribed spacer ($^{5'}$ETS) sequences of ribosomal DNA (rDNA) in selected *Cariceae* indicate that tribal members should be treated as a single generic lineage under *Carex*. Universal primers for the Cyperaceae and *Cariceae* have been developed for the $^{5'}$ETS and $^{3'}$ETS of rDNA. Combining these spacers with ITS in *Uncinia* provides 78 times more phylogenetically informative characters than non-coding chloroplast sequences of the same length. In addition, topological differences between ITS and combined spacer analyses appear to be the result of random error. These differences lead to significantly different taxonomic and biogeographic conclusions, stressing the need for caution when interpreting lone ITS phylogenies. Analyses of relationships in *Uncinia* using ITS, $^{5'}$ETS and $^{3'}$ETS sequences, and morphology largely correspond to the traditional division of the genus into two sections, although sectional and series limits will need to be redefined. Phytogeographical analyses of the genus do not conform to the classic geological model of Gondwanan continental break-up, but support the pattern discovered by Linder and Crisp (1995) for numerous plant groups. Silica body data, in conjunction with DNA sequences, suggest that *U. compacta* and *U. riparia* are legitimate species.

Alex Wortley (D.Phil., first year). The phylogenetic and taxonomic status of *Thomandersia* Baill. Supervised by Robert Scotland (Oxford), Paula Rudall (Kew) and David Harris (Edinburgh). Burtt-Davy studentship.

Thomandersia comprises shrubs and small trees forming a significant part of the vegetation of tropical West Africa. While traditionally placed in the Acanthaceae, the position of the genus has never been certain and it has been described as aberrant for almost every group with which it has been associated. Recent advances in molecular systematics of the Lamiales provide an opportunity to reanalyse the phylogenetic affinities of *Thomandersia*, which appears from preliminary studies not to group within the Acanthaceae. Detailed anatomical investigations may be necessary to determine whether there are true homologies between the fruits of *Thomandersia* and the Acanthaceae. A taxonomic revision of the genus, currently comprising 6 species, may also be necessary. Fieldwork in Gabon will provide material for these morphological and molecular analyses.

1999 - 2000 publications

Carine, M.A. & Scotland, R.W. (2000). The taxonomy and biology of *Stenosiphonium* Nees (Acanthaceae). *Botanical Journal of the Linnean Society* **133**(1): 101-128.

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Classification of Acanthaceae

After graduating from Kings College, University of London, in 1987 I was awarded a British Museum studentship to study Acanthaceae at the British Museum (Natural History), which subsequently became simply the Natural History Museum. I remember my interview at the museum during that summer by a panel of botanists including Steve Blackmore and Chris Humphries, who both became my supervisors. During the interview Chris Humphries asked me something or other about phylogeny and I naively, as I later discovered, waxed lyrical about the merits of Spornes advancement index. Nevertheless I survived the gaff and began my PhD in October 1987.

There were several aspects to life at the museum that I came to understand in a short period of time. First, what a great place it is. I particularly remember the great pleasure in finding out that the giraffe in the corridor of the basement covered in plastic was the type specimen. It seemed that there was something to see, and a story to tell, in almost every corner including the actual desk of the great Robert Brown. I remember getting my first invitation to the cool and exclusive fossil fish Christmas party *rediscover your ancestry get legless.* Second, 1987 was a time in which systematic methods were actively discussed, usually in the Cranley Arms which was generally referred to as *the cladist arms.* Cladistic methodology was becoming mainstream and the museum was a hotbed of a particular type of cladist referred to as pattern cladists. Hanging out at the Cranley Arms with Colin Patterson, Peter Forey and Brian Gardner all of *Salmon, Lungfish and Cow* fame turned my head. I left Kenneth Spornes advancement index truly behind and fully embraced the branching diagram, character congruence and special similarity (homology-synapomorphy) as best indicators of systematic relationship. All was well in South Kensington.

After the first few months of head-scratching, insecurity and a few tears I decided on *systematics and the role of pollen morphology in Acanthaceae.* Acanthaceae pollen grains were diverse and had been used extensively in Acanthaceae taxonomy. I set about sampling all genera (c. 220) and ended up with a pollen slide collection numbering several thousand and many (c.1500) a great scanning micrograph. Unfortunately my claim to fame in life was to become *the guy who did that amazing pollen picture* (front page) rather than any of my other qualities (real or imagined). In 1990 I tossed a thesis together and was examined by Peter Crane (then at the Field

Museum, Chicago) who introduced me to the uncomfortable viva, rigor, being thorough, and the importance of spell check. Some of the pollen images were published but many remained unpublished.

In 1990 I left London for Oxford obtaining the Claridge-Druce Junior Research Fellowship in Plant Taxonomy. As well as the longest post-doc title in the world the position offered me three further years studying Acanthaceae which resulted in a move away from pollen data, in collaboration with Peter Endress and Dick Olmstead. In 1995 I obtained my Royal Society Fellowship and began to monograph *Strobilanthes* and thought my contribution to the big-picture classification of Acanthaceae had come to an end. In 1998 I was invited to give an overview of Acanthaceae systematics at the International Botanical Congress in St Louis. I accepted and began to consolidate my data and the literature in what I thought would be a review written over a few long weekends. It became a much more extensive piece of work and resulted in a new classification that was published this year in the *Kew Bulletin* 55: 513-589, in collaboration with Kaj Vollesen from Kew. The paper includes 40 plates and finally the bulk of the pollen images from my thesis were published and consolidated in one place. The pollen images and classification (see back page) are available on our web site:
http://users.ox.ac.uk/~dops0152/

Robert Scotland

The taxonomy and biology of *Strobilanthes cernua* Blume (Acanthaceae)

The mountains of West Java were first explored by European botanists in the late Eighteenth century, when Carl Pehr Thunberg, a pupil of Linnaeus, visited the island. A permanent research centre for the succession of visiting Dutch botanists was established at Bogor in 1817 by Casper Reinwardt, a highly appropriate location given its proximity to the richly forested mountains of Mt. Salak, Mt. Gede and Mt. Pangrango. Carl Blume, Reinwardt's deputy at Bogor, was a prodigious collector and explored many of the mountains of West and Central Java. His expeditions resulted in the publication of *Bijdragen* (Blume, 1832), in which he gave accounts of 2400 species in 700 genera (Van Steenis, 1989). One of the new genera described in *Bijdragen* was *Strobilanthes* Blume of the Acanthaceae, which occurs gregariously in the mountain forest undergrowth.

Strobilanthes cernua, one of the species originally described by Blume from Mt. Salak, is a prominent forest plant, forming dense monotypic stands up to 3 m high. The short spicate inflorescences are conspicuous by their white obovate bracts, which have a green apical band (Figure 1). It is by far the most common of the Javanese *Strobilanthes*, and is represented by numerous collections in the herbaria of Leiden and Bogor. A second species, *S. hirta* (Vahl) Blume was also described by Blume which, apart from the prominently hairy leaves and bracts, is otherwise indistinguishable from *S. cernua*. The frequency with which *S. cernua* and *S. hirta* were collected in Java led subsequent taxonomists to produce increasingly finer divisions of the morphological variation. In the most recent revision of *Strobilanthes* by Bremekamp (1944), 10 additional species and four varieties allied to *S. cernua* were described to account for the wide range of variation. A summary of the characters used by Bremekamp to distinguish between these taxa is shown in Table 1.

Flora of Java (Backer & Backhuizen van den Brink, 1965) closely followed Bremekamp's (1944) treatment of *Strobilanthes*. However, in a footnote, the first author suggested that they may all be regarded as a single Protean species, after the Greek sea-god *Proteus* who was able to take various forms at will. A thorough investigation into the variation shown by *S. cernua* and its allied species has been undertaken as part of a revision of the Javanese *Strobilanthes*. The results show that the characters on which Bremekamp based his species are extremely variable, sometimes within a single specimen, rendering Bremekamp's key unworkable. Many characters are continuous and cannot be divided into discrete, non-overlapping states. Characters of the indumentum, which feature prominently in his key, are notoriously difficult to quantify and are, in any case, often subject to environmental influence. The patterns of variation do not show any geographical correlation, and consequently only a single, variable species is recognised.

Van Steenis (1940) provided a detailed account of the life cycle of *S. cernua*. The stands of *S. cernua* form a 'monotonous' cover in the forest under growth and all plants grow to the same height, as if they had been sown at the same time. All plants flower synchronously, usually during or just after the dry monsoon in May to August. They shed their seeds and die, *en masse*. The woody stems remain, while new seedlings sprout amongst them to begin the next generation. It has been widely reported that the interval between successive flowerings of *S. cernua* is nine years (Bremekamp, 1944; Van Steenis, 1940, 1942, 1972, 1985; Whitten et al., 1997). This is based on observations on Mt. Gede where mass flowering was recorded in 1902, 1911, 1920, 1929, 1938 and 1983. However, Van Steenis (1940) noted that flowering was also observed above Cibodas Botanic Garden (a reserve on Mt. Gede) in 1922 and 1926. These are in obvious conflict with a supposed nine year flowering cycle.

The mass flowering of *Strobilanthes* was termed *plietesial flowering* by Bremekamp (1944: 20). It has been suggested that many of the erect species of *Strobilanthes* are plietesial. In southern India and Sri Lanka, where *Strobilanthes* also forms a major component of the vegetation, plietesial flowering has been reported for several species (reviewed in Carine, 1999). In addition, reliable flowering reports exist for species of the segregate genus

Character	Character States
Leaf margin	Curled versus flat; serrate vs. callosely crenate or crenate or crenate-dentate; veins 9—10 vs. 11—13 pairs; 2 kinds of cystolith vs. 1 kind
Shoot, petiole, underside of leaves	Glabrous vs. puberulous or hirsute
Number of bracts in spike	4 vs. greater than 4
Calyx lobes	Ciliate vs. glabrous
Bracts	White with a small green patch at tip vs. white with a green margin; 7.5 x 7 mm vs. 12 x 13 mm; glabrous vs. hairy; glandular vs. eglandular; 5-veined vs. 3-veined
Bract margin	Recurved vs. non-recurved
Corolla apex indumentum	Glabrous vs. sparsely pubescent
Ovary	Comose vs. entirely glabrous

Table 1. Characters and character states used by Bremekamp (1944) in delimiting *S. cernua* and allied species.



Figure 1. *Strobilanthes cernua* Blume (Acanthaceae). A, habit of glabrous specimen. B, upper leaf surface. C, lower leaf surface. D, habit of densely pubescent specimen. E, habit of specimen with larger elliptic bracts. F, bract. G, bracteole. H, calyx. I, ovary. J, flower section. K, detail of bundle of hairs which retain style against corolla. L, bract. M, bracteole. N, capsule. O, seed before wetting. P, seed after wetting. (A-C, F-K, N-P from *Bennett* 38; D from *Okada & Terao* 3344; E, L-M from *Balgooy et al* 2942).

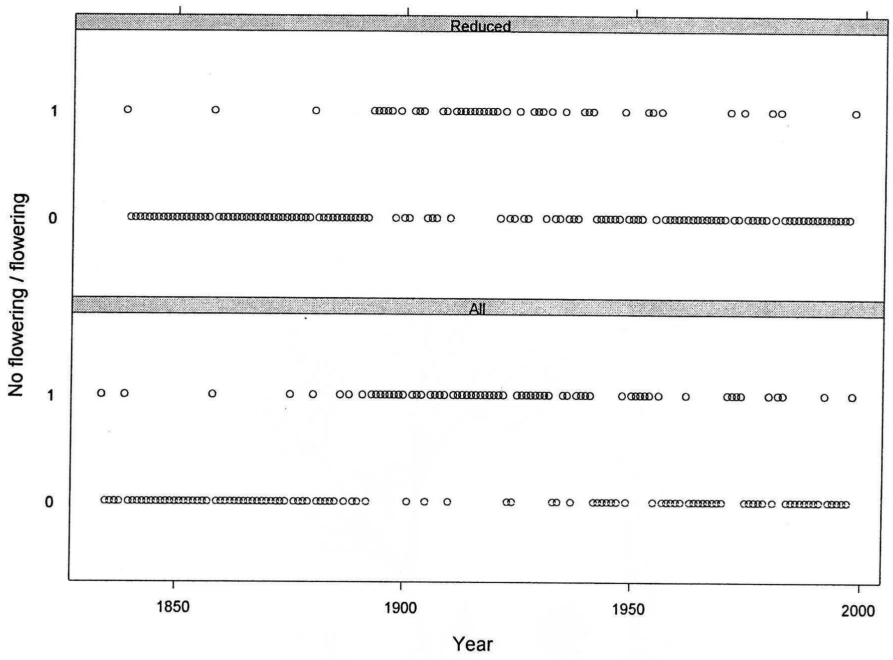


Figure 2. Data plots for the reduced data set (top) and total data set (bottom). In the top plot years for which only a single flowering specimen are coded as zero (*no flowering*). All data points, regardless of the number of specimens recorded in a particular year, are included. See text for further explanation.

Stenosiphonium Nees, also from southern India and Sri Lanka. An interesting phenomenon has been reported in the Himalayan species *S. wallichii* Nees by Wood (1994). In the eastern part of its range it behaves as an annually flowering perennial, whereas in the western part it is plietesial. In general, the current state of our knowledge of plietesial flowering for the majority of species is poor or non-existent, often relying on unsubstantiated reports.

However, for some species we do have access to a significant bank of information in the form of herbarium specimens. It is possible that these may be able to shed light on the phenomenon of plietesial flowering by answering the simple question of whether there are any cyclical patterns to flowering. As part of the taxonomic revision of the Javanese *Strobilanthes* a database of specimens from herbaria worldwide was assembled using BRAHMS (Filer, 1996). Collection details were extracted for *S. cernua*. For the sake of convenience, the data was encoded such that each year (from 1839 to 1998) is associated with a number, 1 meaning a flowering specimen was collected (*flowering*) and 0 meaning no flowering specimen was collected (*no flowering*). Furthermore, years for which only one flowering specimen was collected were eliminated, since it has been suggested that occasional specimens may flower one or two years preceding or following mass-flowering events. It is recognised that the data is effectively censored, since the value 0 may indicate that either no flowering took place or that no flowering specimen was collected. The intrinsic problem with the data is not censoring, however, but the uncertainty associated with each observation. It is unclear how years with multiple collections should compare with years when only a single specimen was collected. For instance, are years where five flowering specimens were collected, five times more reliable as years where only one flowering specimen was collected? Any weighting performed would be arbitrary.

The data are shown above in Figure 2, where 0 and 1 correspond to *no flowering* and *flowering*, respectively. In the top plot (labelled *reduced*), single observations have been excluded, whereas all observations are considered in the lower plot (labelled *all*).

The reduced and total data sets were analysed to test whether the data could be considered to be generated by a completely random process using a runs test (Sprent, 1993). The null hypothesis of randomness was clearly rejected at the usual 5% level of significance (p-value < 0.001). For a similar problem, Cox & Snell (1989) considered a two-state Markov chain (the two states being *no flowering* and *flowering*). The matrix of one-step transition probabilities are computed and the corresponding frequencies comprise a 2 x 2 contingency table. A standard chi-square test for the null hypothesis of no dependence was also rejected (p-value < 0.001). Both these statistical tests indicate that the data is not generated by a random process, i.e. flowering specimens were not collected at random times. However, neither do they indicate a cyclical pattern, but rather large clusters of 0s and 1s, as is evident from the original data (Figure 2).

Figure 3 shows a histogram of the distribution of the number of years between recorded flowering events. A cycle of nine years, for instance, would reveal itself as having a peak around nine years. It is evident that no such feature can be derived from the graph. To confirm this observation, a simple spectral analysis of the binary time series was performed. The spectral density was estimated using a periodogram (Priestly, 1981). Smoothed versions of the periodogram are often used to study cyclical patterns in time series data. From the smoothed periodograms no distinct cyclical pattern can be discerned. Weighted versions of the time series were also considered. Instead of considering the outcome as binary (*flowering* vs. *no flowering*), the number of records for a given year may be modelled. For instance, in 1911 a total of 5 flowerings were recorded. However, such an analysis would render interpretational problems owing to the ambiguity associated with the recordings. It is unreasonable to conclude that such data points are five times more reliable than a single record.

These results suggest that a simple cyclical pattern cannot be identified merely by analysing information derived from herbarium specimens. If *S. cernua* does flower on a nine-year cycle then there are several possible reasons for this:

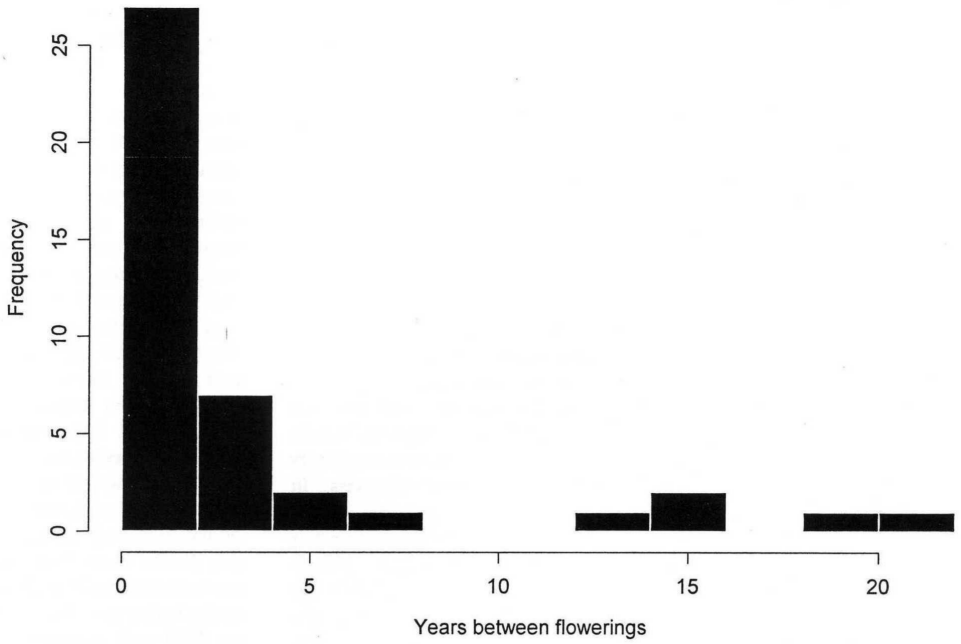


Figure 3. Histogram showing the distribution of the number of years between recorded flowering events.

1. Different populations flower non-synchronously, although each may independently operate a nine year cycle.
2. Data from herbarium specimens are too 'dirty' to reveal a cyclical pattern because of the tendency for some individuals of a population to flower one or two years before or after the main population.
3. Statistical analyses are problematic to uncertainty as to whether a *no flowering* datapoint represents a missing observation or certain knowledge that the population did not flower in that particular year.

By far the most convincing evidence in favour of a nine year flowering cycle are the observations cited by Van Steenis (1940). This underlines the importance of accurate, detailed field records which are maintained over a period of time, as recommended by Van Steenis (1940, 1978).

Acknowledgements

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Assessing bioquality in Mesoamerican dry forest

Introduction

The tropical dry forests of Mesoamerica (southern Mexico and Central America) rank among the most threatened of ecosystems. Janzen (1988), writing of these forests estimated that less than 2% of the original forest is in a state 'sufficiently intact to attract the attention of the traditional conservationist', with only 0.09% having official reserve status. Historically, human settlement has been biased towards seasonally dry areas rather than more humid areas. The dry season favours burning, and tropical diseases of both humans and their livestock are less virulent in seasonally dry areas. What remains in much of the Mesoamerican 'dry zone' is an agro-ecosystem composed of a mosaic of land use types. These types include patches of forest of varying size as well as fallows, maize and bean fields (here referred to as *milpas*), pastures and home gardens. In the more humid areas coffee is also produced. It is often assumed that such a landscape has no conservation value, that there are few trees and that those that remain are relics in an inevitable state of decline. However, previous work at the Department of Plant Sciences has shown that there are trees scattered in this landscape, some planted, others the result of natural regeneration. Many of these trees are used for shade, fruit and timber production and a variety of other uses. Given that few large areas of forest remain that might realistically be conserved as traditional protected areas we set out to investigate to what extent the woody diversity found in this agricultural landscape should continue to be conserved there. Such consideration raises complex issues. Before deciding to conserve such diversity we must first determine which of its components, if any, merit some form of conservation effort. Further, given the prevailing socio-economic conditions in this region we need to consider to what extent diversity conservation is compatible with the needs of resource poor farmers.

Study Area

For the sake of manageability our investigations were limited to two case study areas on the Pacific coast of Mesoamerica - the coast of Oaxaca in southern Mexico and the coastal departments of Choluteca and Valle in southern Honduras. The Pacific coast of Mesoamerica once contained probably the largest area of seasonal forest in the region, stretching from the province of Guanacaste in northern Costa Rica to Baja California Sur in northern Mexico. The two case study areas were chosen for their distinctness. In Oaxaca some relatively large areas of dry forest remain, whilst in Honduras forest is limited to the smallest of patches. Socio-economically, both areas are notable for their levels of poverty, ranking amongst the poorest in their respective countries. However there are important differences in social organisation; in Oaxaca communal management is frequent whilst in southern Honduras farming land is typically privately owned.

Our research can be divided into botanical and socio-economic components. The aim of the botanical component was to compare patterns of tree diversity and tree *quality* between the case study areas and between land uses (forest, fallow, *milpa*, pasture and home garden) to determine where scarce conservation resources might most efficiently be spent. The socio-economic component aimed to elucidate the dynamics of land management in the two areas and the needs and preferences of poor farmers with respect to tree resources. It is the botanical research which is the focus of this essay.

The methodological approach

There exists an ever expanding literature on methods to sample and measure biodiversity so inevitably approaches and techniques vary. In our study we adopted and adapted the methods developed by Dr. William Hawthorne (also of the Tropical Forest Biodiversity Group, Department of Plant Sciences) for rapid botanical surveying and diversity assessment (described in detail in Hawthorne 1996). One of the principal advantages of this approach is that it is a 'cradle to grave' method covering field techniques, species weighting, data management and analysis. It is also very rapid, requiring no plots to be established and being instantly adaptable to the various vegetation types (land uses) in which we were interested. Species weighting is a key part of the methodology, reflecting an interest not in numbers of species *per se* (biodiversity) but emphasising rare and threatened species, i.e. *bioquality*. However, like any other species based assessment technique, plant identification is key. For botanical survey on the scale required for this sort of study, large quantities of sterile material must be identified either in the field or the herbarium. This requires an emphasis on field and vegetative characters whose value is not always appreciated by taxonomists who generally rely heavily on fertile morphological characters.

The principal method of comparison between samples was by the calculation of *genetic heat indices* (GHIs: Hawthorne 1996). GHIs are a measure of the relative importance of vegetation samples as measured by their content of narrowly distributed species. Samples with the highest GHIs are 'hottest', i.e. of greatest conservation concern. To calculate a GHI, species must first be assigned to one of four 'star' categories; *black star* for the most narrowly distributed species (defined in this context as endemic to the dry forest zone of Oaxaca or Honduras) then, with increasing distribution but still of concern, *gold star* and *blue star*. Finally the *green star* category (defined here as species occurring in eight or more Central American countries/Mexican states) is for species too widely distributed to warrant concern. This methodology therefore takes global

Table 1. Calculation of weightings for star categories

	Black	Gold	Blue	Green
Area of occupancy				
(Mean no degree squares: n)	1.67	4.5	10.33	53.68
n/53.68 (=x)	0.031	0.084	0.192	1
1/x	32.14	11.93	5.19	1
weighting	32	12	5	0

distribution (area of occupancy) to be the primary indicator of conservation concern. This may appear to be an over simplification; abundance per unit area, rate of habitat loss etc, are usually considered when evaluating the threat status of a species, however for most of the 600 species we deal with such information is simply not available. The area of occupancy can be readily determined principally from herbarium specimen data but also supported by monographs, reliable checklists (e.g. Reyes-García & Sousa 1997) and from on-line databases such as w^{3}Tropicos (undated). Whilst global distribution is the primary determinant of star rating, adjustments may be made for other factors. In this case, species were moved to a category of greater concern if they were congeneric with an economically important species or were considered taxonomically unique. Species observed to be particularly weedy were moved down; Hawthorne (1996) used species guild and local abundance for similar fine tuning.

Discrete categories cannot alone be used to construct indices - each category needs a weighting reflecting its degree of conservation concern that can then be used to calculate a single weighted mean (the GHI) for the entire sample. This was done by calculating the mean number of degree squares occupied by species in each category, as revealed by that subset of species whose most recent monographs have distribution maps (e.g. Hughes 1998). The ratio of average distributions of each star rating was then inverted to give the black stars the highest score, proportional to green stars having a temporary score of 1. Finally the green star score is arbitrarily converted to zero (see Table 1).

The formula then used to calculate a GHI is given below

$$GHI = \frac{[(A \times 32) + (B \times 12) + (C \times 5)] \times 100}{N}$$

A is the number of black star species, B is the number of gold star species and C is the number of blue star species. N represents the total number of species.

Two points about the above formula are worth emphasising. Firstly, the zero weighting for green star species ensures that they make no contribution to the numerator, thus reflecting the lack of conservation concern we wish to attach to such species. Secondly, because the denominator, N, is all species in the sample, there results an 'average' that allows comparison of samples with different numbers of species. Ideally N should be reasonably large (> 30) to ensure GHIs are not overly sensitive to the inclusion or loss of single black or gold star species.

Table 2. Black star species

Bunchosia discolor Turcz. ex Char., MALPIGHIACEAE
Caesalpinia coccinea Lewis & Contreras, CAESALPINIACEAE
Carlowrightia sp. nov. (?) ACANTHACEAE
Castela retusa Liebm., SIMAROUBACEAE
Jacquinia seleriana Urb. et Loes, THEOPHRASTACEAE
Jatropha alamanii Muell. Arg., EUPHORBIACEAE
Jatropha sp. nov., EUPHORBIACEAE
Jatropha sympetala Standl. & Blake, EUPHORBIACEAE
Licania sp. nov., (?) CHRYSOBALANACEAE
Lonchocarpus sp. nov., PAPILIONACEAE
Manihot oaxacana Rogers & Appan, EUPHORBIACEAE
Megastigma sp. nov., RUTACEAE
Thouinia sp. nov., SAPINDACEAE
Trixis silvatica Rob. & Greenm., COMPOSITAE
Waltheria conzatii Standl., STERCULIACEAE
Zapoteca tehuana H. Hern., MIMOSACEAE

Thus GHIs were calculated and direct comparison of samples taken from different land units in different countries and with different species were possible.

What does rapid sampling and GHIs tell us about Mesoamerican dry forest?

In all some 260 land units were sampled for tree diversity and over 9000 records of trees were taken. Nearly 90% of records were identified to species and some 640 tree and shrub species were found. A similar number of samples were taken in southern Honduras and Oaxaca, with 319 and 481 species found in each respectively.

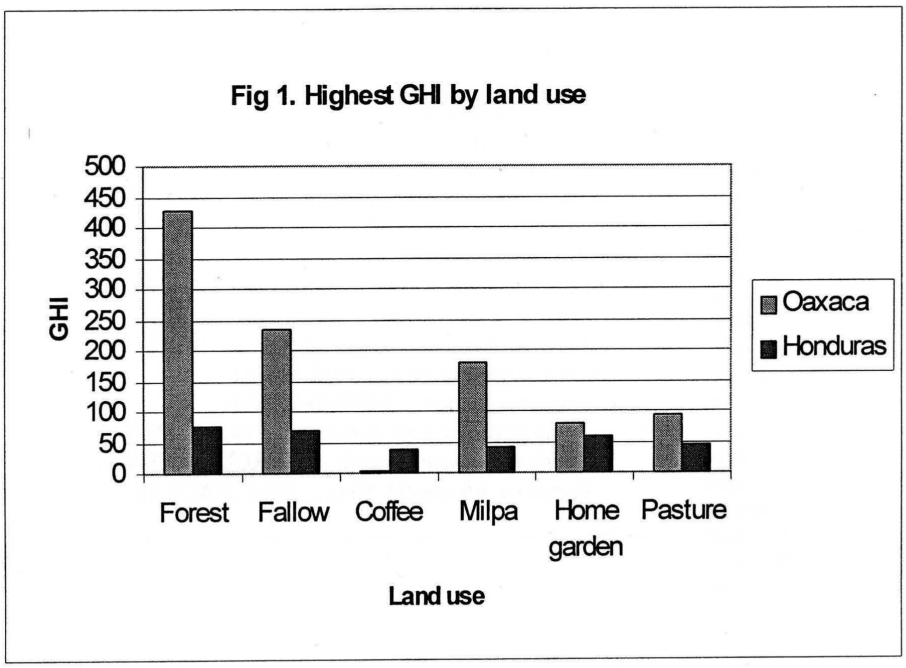
The distribution of black star species gives us some indication of the relative conservation significance of each of the case study areas. Table 2 above shows all the species classified as black stars, note that in this case potentially new species were always placed in this category. What is revealing is that all black star species were in Oaxaca, none were found in Honduras (see Table 2). The other two categories of conservation concern (gold star and blue star) also contain far more species from Oaxaca than Honduras.

Inevitably this bias in the distribution of the black, gold and blue star species is reflected in the GHIs calculated for individual land units. In southern Honduras very low GHIs were found for all land use types. No land use type was outstanding or of high conservation value. This resulted from a marked similarity in species composition (as revealed by ordination methods) between land use types. Despite fallows, forests, pastures etc having very different vegetation structures and species abundances, the constituent species were found to be similar and widespread. It appears that the tree component of the agro-ecosystem is mainly composed of natural, secondary regeneration. No mature forest patches remain in southern Honduras and the swidden fallow agriculture still practised encourages a constant turnover of similar disturbance tolerant species. Such species are typically wide spread and thus fall into the green star category.

In Oaxaca a different pattern emerged. Ordination scores revealed much more variation in species composition between samples, not least because in some areas swidden fallow is no longer practised and natural regeneration almost absent. All the highest GHIs were found in Oaxaca (Fig 1.) with some of the better preserved forest fragments having the greatest conservation significance. Some of the fallows around those patches were also found to have high GHIs. Mature forest (we avoid the use of primary or pristine in this context) is absent from Honduras.

What can we conclude?

This work indicates that mature forests in Oaxaca are the most important sites for tree diversity conservation in these dry forest areas. We cannot be sure that this conclusion would hold elsewhere in the region but suggest that the bias in future sampling activities be towards such areas. The socio-economic research suggested that the persistence of such forest in Oaxaca is related to relatively low population densities and communal forms of management. This also permits, in some instances, the persistence of forest fallows for 15 to 20 years in some communities. It was these fallows that were found to have high GHIs.



This suggests a role for such management practices in maintaining local corridors between mature forest patches.

Indeed, trees found scattered in many parts of this dry forest mosaic may have an important role maintaining *connectivity*. Many of our green star species owe their continued widespread distributions to the current farming practises which permit and utilise natural regeneration within this landscape.

We do not conclude that areas such as southern Honduras where GHIs are low are of no value. Certainly we doubt that protected areas are appropriate there; Oaxaca would represent a far better 'conservation investment' in this respect. However, we are concerned that the use of natural regeneration by resource poor farmers in these areas be recognised for its high socio-economic value. Development activities that encourage intensification or the use of exotic tree species should be appraised in the light of the number of forest products poor farmers already get, at low cost, from natural regeneration.

Acknowledgements

Amongst the many people and institutions who collaborated in this research I would like particularly to thank Antonio Molina R. (EAP) and Alberto Reyes-García (MEXU) for leading the way in the identification of so many (sterile!) specimens; and also to Adrian Barrance, Kate Schreckenberg and Michael Richards of the Overseas Development Institute of London for leading the socio-economic components.

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w^{3}Tropicos (undated) http://mobot.mobot.org/W3T/Search/pick.html

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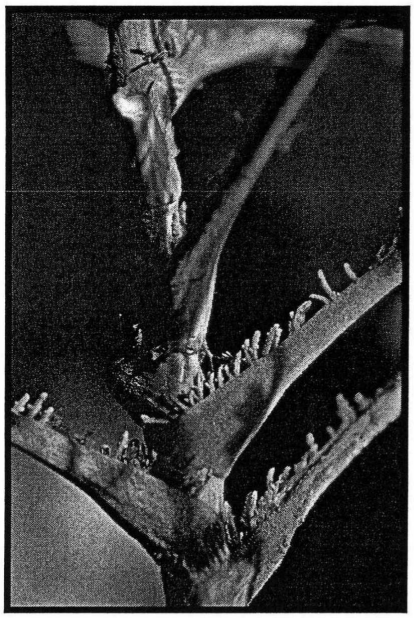
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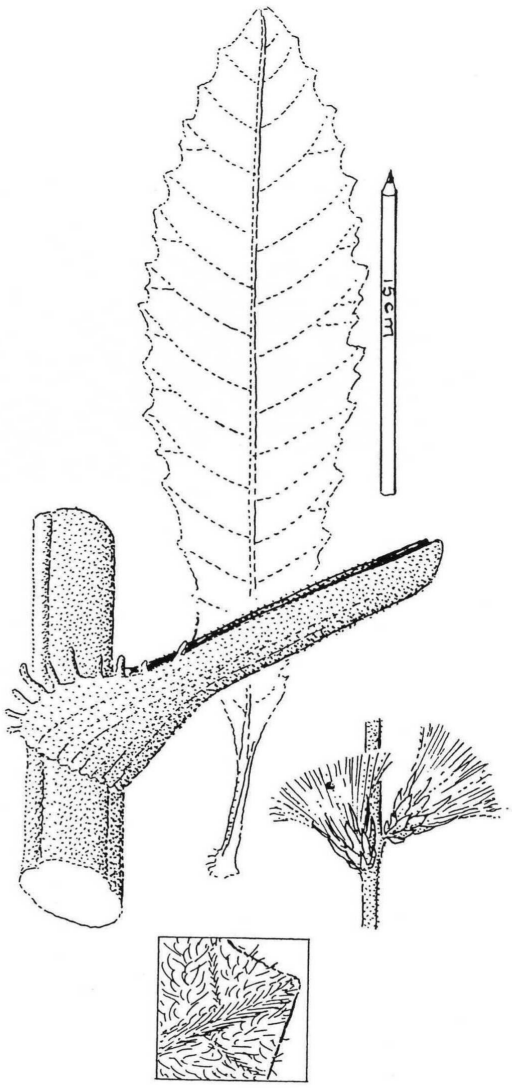
Tropical forest plant field guide project

Most countries of the world have signed up to the Convention on Biological Diversity and therefore have a commitment to conserve and monitor biodiversity and local knowledge about it, and to support sustainable management of biodiverse ecosystems. For this reason, if no other, it is now more important than ever that a wide range of people should be able to work out the scientific names of plants, even if local names are well-known, to facilitate a dialogue with the rest of the world about them.

The botanical world has considerable experience in producing field guides for scientists, and others that are more accessible to the general public, but authors of such guides often have to relearn old lessons from their own experience. Furthermore, although many botanists have their own beliefs about what sort of guide is better for whom ('line drawings are better for showing details; illiterate farmers do better with photographs than with line drawings') there is very little data to back such claims up or to show the extent to which they are true. Producers of field guides rarely appreciate at the start the resources that will be required to produce the various formats of guide.

The 'Field Guides' project in the Department of Plant Sciences is funded by the UK Department for International





Vernonia titanophylla – a small tree in upland forests of West Africa. Which format (photograph or line drawing) suits which use? The FRP Guides project is addressing questions such as this.

Development (DFID), under their Forest Research Programme (FRP). The aim is to produce a handbook to facilitate production of field guides suitable for various groups of users, based partly on the results of empirical trials with various user groups, guide formats, and sets of species. We will incidentally produce a range of small guides ('guidelets') to groups of plants as a basis for empirical testing of the relative values of various formats. There are actually two DFID-funded FRP projects working on field guide production, both based in Oxford University. The Plant Sciences project is naturally focussing on 'botanical aspects' of guide production. The other project, based in Green College, is concentrating on various non-botanical aspects of guide production. The two projects are independent, but collaborate, and will co-produce certain project outputs, in particular, the manual for guide production.

William Hawthorne and Rosemary Wise are carrying out the botanical aspects research. Colin Hughes, who has taken up a research fellowship on lupins, has left the project and is to be replaced by a research assistant yet to be selected. We are developing guides in three countries:

In Ghana we are collaborating with the Botany Unit of the Forest Service. This is the centre of applied botanical expertise for the forests of Ghana, where inventories of all sorts constantly require botanical skills, yet entropy and ageing is constantly eroding, and where there is increasing demand for production of more locally or narrowly applicable 'guidelets' for local use or resale. We are also collaborating with the Protected Areas Development Project in Takoradi who are responsible for the development of two biodiverse national parks, including the development of informative posters and local guides. We shall be refining guide formats and methods for 'large trees', 'non-timber forest products', and 'rare plants' in Ghana. Target users for the various guides include farmers, students, technical staff and tourists.

In Grenada we are working with the Forestry Department, Ministry of Agriculture, Lands, Forestry and Fisheries. The main demand here is for guides linked to ecotourism, to encourage the greater use of, and interest in the forests of the island. This is an area with no local herbarium and very limited existing on-island identification skills.

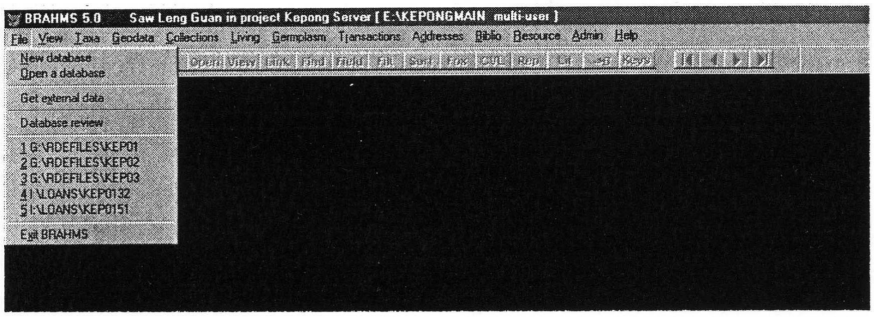
In Cameroon we are collaborating with the Mt. Cameroon Project at Limbe botanical garden and herbarium. We shall be working on comparisons of guides to the very difficult and conservationally important genus *Cola* (as in Coca-Cola). There are about 25 *Cola* species known on the mountain, many narrowly endemic, and participation in forest management increasingly obliges non-scientists to identify them, yet even specialists have a hard time identifying the sterile plants that one normally encounters during inventories. We shall also be dealing here with issues about facilitation of herbarium use by a broader public and issues about communication of guide-related information between international and national herbaria.

The main output of the projects will therefore be a manual detailing methods for developing guides, and describing case studies in which different options have been tried. Key information will be presented to help authors access scientifically accurate information. The completed manual will be ready by September 2002.

William Hawthorne

BRAHMS

Brahms Version 5



Brahms 5, built using Visual FoxPro, is entering the final stages of development. Some modules are already in use and the full system will be phased in early in 2001.

Version 5 is very different to the previous incarnations of Brahms, as one may expect from a DOS to Windows translation. The system has an entirely new interface with new menus and messaging, forms, toolbars, reporting options, printer links and network capabilities. Aside from the new interface, there are substantial additions to its data storage capabilities and functionality. A summary of new features follows:

Modules for Literature, Living Collections and Germplasm management have been added. These modules are integrated with the other system components and share a common taxonomic and geographic framework. The *Reflink* feature enables any record in any file to be linked to one or more references. The development of the literature module was funded through the National Herbarium of the Netherlands in Leiden.

A separate database called *Seed Manager* has been incorporated within Brahms as the new Germplasm module, promoting closer links between seed lots and botanical vouchers.

Toolbars, mouse clicks and module-specific menus replace 4.8 function keys - although for data entry speed, function keys can be assigned to perform common tasks. As an example, the Version 4.8 F9 *lookup* key has been replaced by a right-click in a data field – although any F key could be assigned to do the same.

There has been substantial data file re-structuring throughout. A trend has been the removal of non-essential fields from core dictionaries (*e.g.* species, gazetteer, collector and collection files), markedly reducing their size. These non-core fields have been moved into user-defined 'link' files.

Link files allow users to store and utilise data that does not fit into a pre-defined Brahms field. Data in link files can be used to filter and query and can be included in tables and reports. Non-standard fields from version 4.8 are automatically stored in link files during the upgrade process. In the case of the species link file, a user may care to store lengthy descriptive notes on habit, taxonomy, conservation, eco-geography and uses, special codes for habit, IUCN and local conservation score; and other fields to store image file references, DNA data and the like. A similar principal applies to the collections link file. As an example, a moss specialist could add a list of data fields specific to moss collections.

New file and record level editing tools for standard operations and specific botanical tasks have been added. These include find and replace, new tag functions, improved record delete and merge functions, record zoom, improved filter functions, extended import and export options, including options to import data from useful web sites (*e.g.* Kew Taxonomic Record and IPNI).

Synonymy can now be stored at all taxon levels and also in the collector name, herbarium and gazetteer modules. Thus, old gazetteer names can be maintained but point to the name in use.

The VisualFox reporter can be activated in any module or data file. It is no longer necessary to make an extract to produce a report and there is no limit to the number of report formats created. A simple example is the ability to print labels directly from Rapid Data Entry (RDE) files.

RDE '$' files for associated collections and synonymy have been discontinued and are now incorporated within the main RDE file.

Greater password control combined with user access levels is provided. The system can be tailored for beginners or advanced users. Individual menu options can be assigned password access level and menus can be selectively thinned for beginners.

Menus, forms and system messaging are fully translatable – a Portuguese version has already been drafted.

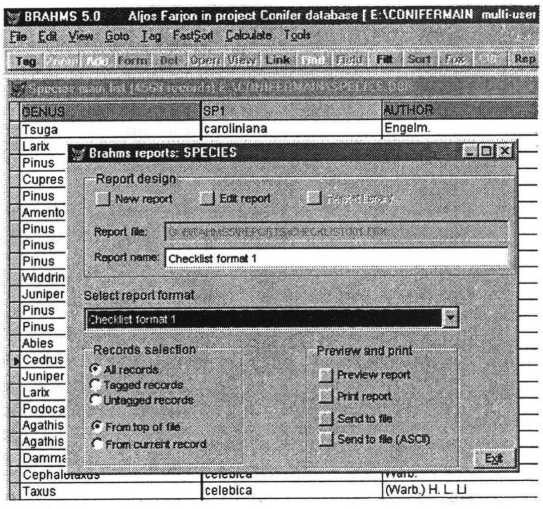
The ***Brahms 5 for Beginners*** tutorial guide will be available on www.brahms.co.uk in February 2001.

Brahms projects 2000

Outside the UK, Brahms herbarium database projects are now active in Europe (Baltic States, Germany, Netherlands, Portugal); Africa (Benin, Cameroon, Gabon, Ghana, Kenya); Asia (Bangladesh, Malaya, Sabah, Sarawak, Singapore) and South and Central America (Brazil, Honduras, Panama, Puerto Rico). Each of these sites and the larger number of individual research databases will be upgraded to Brahms 5 early in 2001. In Amazônian Brazil (IAN, INPA, MG), Malaysia (KEP, SAN, SAR) and the Netherlands (L, WAG, U), regional networks are in the pipeline.

Oxford

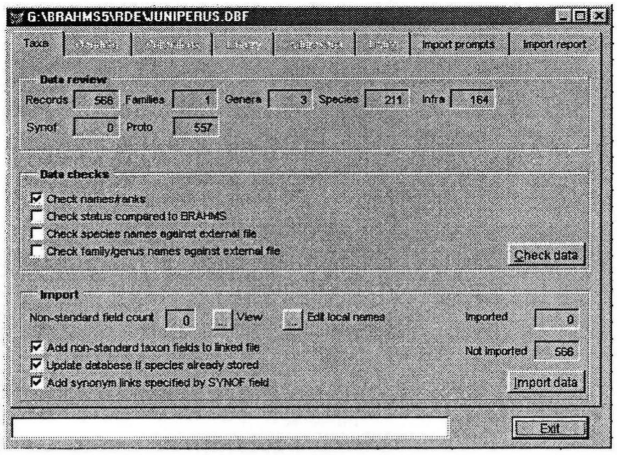
Aside from the steady entry of the FHO collections, two substantial database projects leading to publication are approaching completion: a revision of Javanese *Strobilanthes* by Jonathan Bennett (http://users.ox.ac.uk/~dops0152 well worth a visit) and the Checklist of Mount Mulanje, Malawi being prepared by Alison Strugnell. Alison has also mastered the Brahms Transactions module for the FHO loans. Towards the end of the year, Colin Hughes made a start on his revision of *Lupinus* – making a start by importing names



Preparing to print a checklist using the new Brahms 5 reporter.

downloaded from the IPNI web site (http://www.ipni.org) into a Brahms 5 RDE taxon file.

Preparing to import a taxon RDE file, in this case Juniperus *taxa downloaded from the IPNI web site.*



Brazil - Amazônia

Four herbaria in the Amazonian region of Brazil are now using Brahms. These are Embrapa Amazônia Oriental (IAN) and the Museu Goeldi (MG) herbaria in Belém, Pará the Instituto Nacional de Pesquisas da Amazônia (INPA) in Manaus, Amazonas, and the HAMAB herbarium in Macapá, Amapá. Together, these herbaria house over 600,000 collections. Coordinated by Regina Martins da Silva, Ricardo Secco and Rosângela Sarquis, with funding support from UK DFID and Superintendência do Desenvolvimento da Amazônia (SUDAM), over 100,000 collections have already been databased at the IAN, MG and HAMAB herbaria, covering 48 families, mostly Angiosperms. At INPA, where some 30,000 collections have been already entered, Rogério Gribel and Cid Ferreira are organising a Brahms course to be held at INPA early in 2001. A proposal to expand the database work across the region is now being prepared.

Puerto Rico

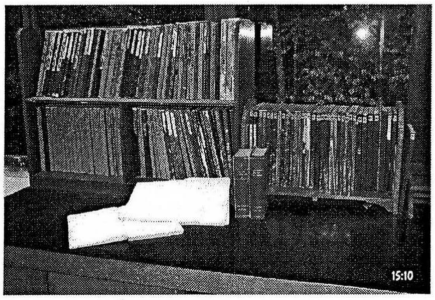
In August, a short visit was made to the MAPR herbarium in Mayagüez where the University of Puerto Rico and the US Fish and Wildlife Service are funding herbarium database development, co-ordinated by Jeanine Vélez-Gavilán. She has also largely completed the translation of the Brahms web site into Spanish. The MAPR database is rapidly developing into a valuable source of species and collections data for the island.

Malaysia and Singapore

The Malay peninsula together with Sabah and Sarawak to the East, is one of the world's biodiverse regions with perhaps 15,000 species of vascular plants alone. Three main herbaria, Kepong in Malaya (KEP), Sandakan in Sabah (SAN) and Kuching in Sarawak (SAR) house some 600,000 collections in all. The herbarium of the Singapore Botanical Garden houses a further 650,000 specimens.

The database work now underway at each of these herbaria started at the Kepong herbarium, part of the Forestry Research Institute of Malaysia (FRIM). This work was started by the current KEP curator Saw Leng Guan.

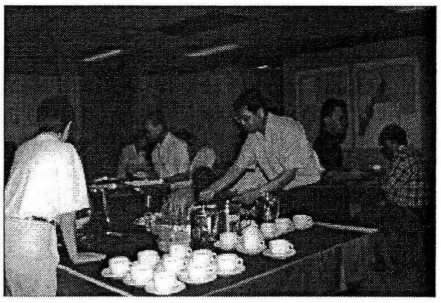
The KEP herbarium began in the early 1900s and has since grown to be the largest on the Malay peninsula (excluding Singapore) with some 200,000 collections of which over 500 are types.



The now discontinued accession registers held in the library at Kepong. The registers, even though meticulously kept up to date, had minimal value for searching or reporting.

Brahms operates on a local network linking 5 herbarium computers. Two technical staff have been hired for data entry – which has now reached over 100,000 collections. Barcodes, introduced in 1998, are printed in-house using a Printronix T2204 thermal Label printer which creates durable labels and provides control over label design and barcode numbers.

Last year, a FRIM Fellowship grant was awarded to the Brahms project to support training visits and database development at Kepong and foster regional collaboration.



Saw Leng Guan, curator at KEP, enjoying a small snack at the '100,000 specimens in Brahms' herbarium celebration.

ITTO course, Kuching, Sarawak

In November 2000, a training course for 22 curators and botanists from Malaysia and Indonesia was held in Kuching, Sarawak. The course was funded by the International Tropical Timber Organisation (ITTO). One of the course objectives was to help to standardise databasing procedures in the three major Malaysian herbaria.

Netherlands – bibliographic module

The recently established National Herbarium of the Netherlands (NHN) with its Leiden, Wageningen and Utrecht branches are working towards the creation of a unified NHN collections database, this co-ordinated by Luc Willemse at Leiden. An additional contribution made through the Leiden library has been to support the development of the new Brahms 5 Bibliography module. This has now been largely completed and provides the system with a comprehensive literature storage facility.

Portugal – legumes of Angola

The herbaria of Portugal hold a large number of specimens collected in Angola. Most of this material is unique and many of the collections are types. Although many duplicates of these specimens exist in Angolan herbaria, many are in need of updating of their determinations, a task that requires access to recent literature, mostly unavailable in Angola. The project *Leguminosae of Angola*, co-ordinated by Estrela Figueiredo at LISC, is assembling data from all the collections of Leguminosae kept in two Portuguese herbaria COI (University of Coimbra) and LISC (Centro de Botânica) using Brahms. Through this project, it will be possible to make these data available to the Angolan herbaria - and also to the scientific community worldwide, in the form of a Brahms database, checklists and publications.

Denis Filer

Herbaria

Visitors

During the period from 1 October 1999 to 30 September 2000, 133 visitors came to the herbaria to consult specimens or to be given guided tours around the collections. A number of group visits were made. 20 students from the Oxford University Department for Continuing Education studying conservation and environmental biology visited in July and the staff from the Oxford Botanic Garden came to view the collections in January. In September a group of retired Forest Officers visited during a Commonwealth Forestry Association Re-union Meeting. In addition M.Sc. students studying in both Forestry and Zoology (Conservation) at the University were given tours.

Fielding-Druce (OXF)

The Druce Herbarium

On 20 July, a study day focussing on *Carex vulpina* (the True Fox Sedge) was held in the Herbarium. The Ashmolean Natural History Society of Oxfordshire organized the day in collaboration with Ron Porley from English Nature. 10 students attended.

The Lichen Herbarium

Professors Mark Seaward, from Bradford University, and Teuvo Ahti, from the University of Helsinki, spent a week in February working on the General, Sherardian and Dillenian lichen collections. Professor Ahti typified many *Cladonia* species particularly in the herbarium of the *Historia Muscorum* of Dillenius. For details of the contents of the lichen collections see: http://www.plants.ox.ac.uk/herbarium/lichens.html

Accessions

Almost 500 specimens were accessed and incorporated into the collections during the year, some of these resulting from tackling the backlog of unincorporated material destined for the Fielding Herbarium. The Fielding Herbarium, the original worldwide collection of the former Department of Botany (now part of Plant Sciences), was closed to new accessions in 1992 but a large number of specimens presented before that time remain unincorporated.

268 specimens collected in Trinidad by Augustus Fendler between 1877-80 (see article on page 15) were incorporated thanks to the help of Timothy Waters, an undergraduate who came to work in the herbarium for 4 weeks during the Long Vacation. Dr. C.D. Adams of the Natural History Museum London had recently supplied determinations for these plants while compiling a checklist for the Flora of Trinidad. Some additional sheets collected by Fendler in Venezuela were also added as names were found for them. Further Fendler collections from Trinidad were sent on loan to Dr. Adams for identification.

40 specimens collected by H.C. (Fortune) Hopkins & M.J.G. Hopkins in the Seychelles in 1980 were also incorporated. These collections mostly consisted of leguminous plants. A further 28 specimens collected by Alex George and Serena Marner in August 1999 from Western Australia, duplicating the species collected by William Dampier 300 years earlier, were accessed as a special case to keep with the Dampier sheets.

New accessions also included 122 lichens. The lichen material consisted of 87 specimens mainly collected during the Oxford University Greenland Expedition of 1936, presented by BM, 23 specimens collected by R.J. Chancellor in Italy, a few recently collected specimens by Professor Seaward in Brazil, plus a few collected by Anita Segar in Alaska.

An additional 42 miscellaneous British specimens (collected by former students of Botany) were incorporated in the Druce Herbarium.

Loans

Requests for loans resulted in 943 specimens from the Fielding and Druce collections being sent out during the year from 1 October 1999 to 30 September 2000. The loans comprised material from the following genera and families: *Leuconotis*, *Melodinus*, Apocynaceae; *Centaurea*, *Erigeron*, Asteraceae; *Colobanthus*, *Sagina*, Caryophyllaceae; *Carex*, *Scirpus*, Cyperaceae; *Syngonanthus*, Eriocaulaceae; *Erythroxylum*, Erythroxylaceae; *Macrocarpaea*, Gentianaceae; *Erodium*, Geraniaceae; *Bromus*, Gramineae; *Astragalus*, Leguminosae: Papilionoideae; *Lecythis*, Lecythidaceae; *Loranthus*, *Phoradendron*, *Phthirusa*, *Struthanthus*, Loranthaceae; *Eugenia*, Myrtaceae; *Pisonia*, Nyctaginaceae; *Tilia*, Tiliaceae; *Sciaphila*, *Seychellaria*, *Soridium*, *Triuris*, Triuridaceae; *Eryngium*, Umbelliferae; plus miscellaneous material collected in Trinidad and a few miscellaneous lichens. During the same period 1133 specimens were returned to OXF from loan and, of those, 5% were types.

One special loan of historic specimens was also made this year to the Middlesbrough Museums and Galleries. Three specimens collected by William Dampier, which had recently been returned from exhibition in Perth, Australia, were sent on loan again for inclusion in a special exhibition at The Captain Cook Birthplace Museum.

Serena Marner

Daubeny (FHO)

Accessions

Accessions of African Acacias were incorporated into the herbarium during the year. These consisted of Acacias from Somalia collected by Abdisalam Hassan, Brian Styles and Chris Fagg, from Zimbabwe collected by Richard Barnes, as well as those included in a larger number of Namibian plants collected by Chris Fagg and Gillian Maggs (of WIND).

A substantial number of *Lupinus* (Leguminosae: Papilionoideae) specimens were accessed into the herbarium for Colin Hughes at the start of his study of the genus funded by a Royal Society Fellowship.

Loans

Incoming loans were received for ongoing studies by Jonathan Bennett (*Strobilanthes*, Acanthaceae); Elizabeth Moylan (*Hemigraphis*, Acanthaceae); Julian Starr (Cyperaceae); Alison Strugnell (Flora of Mt. Mulanje, Malawi) and William Hawthorne (Flora of West Tropical Africa). Specimens of Irvingiaceae, Sapotaceae, Euphorbiaceae and Sterculiaceae, along with FHO material, were received for a study, by Kristina Plenderleith, on the state of knowledge of four non-timber product trees in the Congo Basin as a preliminary to future projects.

Curation

The curation of the *Brachystegia* (Leguminosae: Caesalpinioideae) section was completed during the year, including the carpological collection, the latter being possible by employing an undergraduate student, Timothy Waters, for 2 weeks during the long vacation. This also completed the overhaul and updating of the carpological collection.

The incorporation of a large number of African Acacias into the collection provided the opportunity to update the FHO *Acacia* holdings according to published accounts and to refolder the specimens. To date, the East and South Tropical African and the southern African sections have been completed. Similar curatorial activities were necessary for other sections of the herbarium. These were identified when specimens were returned to FHO or during ongoing work by William Hawthorne on the West African Forest Flora. They included *Premna* (Verbenaceae), *Euphorbia* (Euphorbiaceae) from south tropical Africa, *Millettia* and *Afzelia* (Leguminosae), *Cola* (Sterculiaceae), Irvingiaceae, Capparidaceae, Ochnaceae and other genera in the Leguminosae and Rubiaceae.

Other activities

A month-long visit to the U.K. by Dr. Hazel Chapman from Christchurch in New Zealand in order to produce a report on the forests of Gashaka Nigeria, funded by the World Wide Fund for Nature, using the raw data and specimens collected by her father, Mr. Jim Chapman, necessitated studying the unidentified material held at Oxford.

Alison Strugnell is arranging the data for the checklist of the Flora of Mt. Mulanje, Malawi into publication format. In the meanwhile, a paper on those species endemic to the massif has been prepared.

The Neotropical Ebenaceae and woody legumes, African woody legumes, the West African forest flora, African ferns and medicinal plants and the identification of Egyptian tomb remains were the main areas of interest of visitors to the Daubeny Herbarium during the year.

Alison Strugnell

The collections of Augustus Fendler in the Fielding - Druce Herbarium (OXF)

"a close, accurate observer, a capital collector and specimen maker" Asa Gray on Augustus Fendler (Gray 1893).

Augustus Fendler (1813-1883), a Prussian-born botanist who emigrated to the USA in 1836 and who when not a plant collector supported himself by distilling fuel for gas-lamps, brewing beer and distilling brandy, was one of the most able plant collectors and botanists of the nineteenth century. He spent much of his career in various parts of the Americas, collecting sets of herbarium specimens and selling them to European and North American herbaria to make a living, at a time when the flora of the areas he explored was very little known. He started collecting plants in North America after a visit to Europe in 1844, selling the specimens to European herbaria to raise money. Finding this insufficiently lucrative, he moved to Memphis and did sufficiently well out of the gas-lamp trade to enable him to consider travelling to Venezuela to collect plants once again, and he duly sailed for Caracas in December 1853 (Todzia 1989). At a time when most botanical collections were made by botanists engaged on great journeys (Ruíz & Pavon's collections in OXF, for example), Fendler was comparatively unusual in staying in one place for so long as to be able to make a fairly complete collection of the flora. Like Alfred Russel Wallace, also collecting to support himself, he needed after a time to move on to new areas, driven by the difficulty of finding ever more novelties that would pay his expenses. The more difficult it became to supplement his large sets of new plants for sale to the herbaria of Europe and North America, the greater the financial incentive for him to travel further and further afield. But what made Fendler such an exceptional plant collector was not just that he collected from so many places, but that his collections from each area were so very thorough and so very good; over 200 of his specimens from Venezuela alone have subsequently been designated types (Todzia 1989).

The Fielding-Druce Herbarium (OXF) has a large collection of Fendler's material from New Mexico, Panama, Trinidad and Venezuela, which exemplifies some of the problems of working with his specimens. Collecting in an era before the modern emphasis on good label data, most of Fendler's herbarium labels give no information beyond where he was living at the time. All his Venezuelan specimens in OXF say simply "Plantae Venezuelanae", a number, and that they were collected near the town of Colonia Tovar. All his Trinidadian specimens have simply "Plants of Trinidad" and a number on them. The numbers themselves are not consecutive collection numbers, but instead are numbers allocated to the specimens based on the taxonomic order of Asa Gray's *Botany of the Northern United States* and Lindley's *Vegetable Kingdom* (Todzia 1989). Because he could get a better price for bigger sets of plants, he would often supplement a set with new collections which he believed to belong to the same taxon as a specimen he had already collected and gave them the same number. His own 'top' set of Venezuelan plants contains 2630 specimens (Todzia 1989), and herbaria such as OXF with a large but incomplete set have many missing numbers, which tend to be the species he found it most difficult to obtain. As his notebooks make clear (Todzia 1989), Fendler very often gave the same number to specimens, which, although from the same plant in the same place, were collected months or even years apart. His notebooks, which he gave to Asa Gray, and his 'top set' of herbarium specimens (which he initially kept himself but eventually sold to Gray (Todzia 1989)), preserved at the Gray Herbarium, give much more useful information. They reveal very precise locality data, which has now been extracted from published accounts (Todzia 1989; Smith & Todzia 1989) and added to the relevant sheets in OXF, a process which revealed several new possible isotype specimens which had spent most of the last 120 years wrapped in newspaper.

Fendler's Trinidadian specimens in OXF, among which are a few previously undetected type specimens and a wide variety of other specimens of both native and naturalized vegetation, are presently being investigated by Dr C. D. Adams at the Natural History Museum in London. Clokie (1964) remarks that there are perhaps 160 unincorporated Trinidad specimens in OXF, but over 350 specimens in several bundles were found this summer, and these have now been either sent for determination to the Natural History Museum or named and incorporated according a list of *exsiccatae* kindly provided by Dr Adams. The flora of Trinidad being smaller, Fendler collected fewer specimens in Trinidad than in Venezuela, and the set in OXF is again incomplete, although there are good collections of a few families, notably the Gramineae and the Melastomataceae. Fendler's collections represent an interesting mix of introduced pantropical weeds and cultigens, species known from all over tropical South America and also a good proportion of Trinidad's native flora. While Fendler's Venezuelan collections were made in the 1850s, his Trinidad specimens date from around 1880, and the contrast in the Trinidad folders of OXF with George Claridge Druce's specimens from his trip to the island a little over twenty years later in 1913 is often striking. Fendler was, as Gray might have guessed, much the better specimen-maker of the two, and by distributing his specimens so widely Fendler did a tremendous service to South American botany, even if his collection numbering was more than a little irregular by modern standards.

A list of **known** Fendler specimens from Trinidad held in OXF is available on request from OXF (there may well be more that were incorporated in the late nineteenth century). A partial list of Venezuelan and Panamanian collection numbers held in OXF is also available.

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Timothy Waters

Classification of Acanthaceae

Acanthaceae Juss.
Nelsonioideae Pfeiff.
Thunbergioideae Kostel.
Acanthoideae Link
Acantheae Dumont.
Ruellieae Dumont.
Ruelliinae Nees
Justiciinae Nees
Barleriinae Nees
Andrographiinae Nees

Nelsonioideae [retinacula absent, cystsoliths absent, descending cochlear aestivation]
Anisosepalum E. Hossain
Elytraria Michx.
Gynocraterium Bremek.
Nelsonia R. Br.
Ophiorrhiziphyllon Kurz
Saintpauliopsis Staner
Staurogyne Wall.

Thunbergioideae (including *Mendoncia*) [Primarily lianes, bristled anthers, poricidal opening of thecae, capsules or drupes]
Anomacanthus R.D. Good
Mendoncia Vell ex Vand.
Meyenia Nees
Pseudocalyx Radlk.
Thunbergia Retz.

Acanthoideae [retinacula and explosive capsules]
Acantheae [Cystoliths absent, colpate pollen, 4 monothecate anthers]
Acanthopsis Harv.
Acanthus L.
Achyrocalyx Benoist
Aphelandra R. Br.
Blepharis Juss.
Crossandra Salisb.
Crossandrella C.B. Clarke
Cynarospermum Vollesen
Cyphacanthus Leonard
Encephalosphaera Lindau
Geissomeria Lindl.
Holographis Nees
Neriacanthus Benth.
Orophochilus Lindau
Rhombochlamys Lindau
Salpixantha Hook.
Sclerochiton Harv.
Stenandrium Nees
Streptosiphon Mildbr.
Strobilacanthus Griseb.
Xantheranthemum Lindau

Ruellieae [Cystoliths]
Ruelliinae [Left-contort aestivation and filament curtain]
Acanthopale C.B. Clarke
Aechmanthera Nees
Apassalus Kobuski
Beniocanthus Heine & A. Raynal
Blechum P. Brown
Bravaisia DC.
Brillantaisia P. Beauv.
Brunoniella Bremek.
Calacanthus T. Anderson ex Benth.
Clarkeasia J.R.I. Wood
Dischistocalyx T.Anderson ex Benth.
Duosperma Dayton
Dyschoriste Nees
Echinacanthus Nees
Epiclastopelma Lindau
Eranthemum L.
Eremomastax Lindau
Eusiphon Benoist
Hemigraphis Nees
Heteradelphia Lindau
Hygrophila R. Br.
Ionacanthus Beniost
Kosmosiphon Lindau
Leptosiphonium F. Muell.
Louteridium S. Watson
Lychniothyrsus Lindau
Mellera S. Moore
Mimulopsis Schweinf.
Pararuellia Bremek.
Petalidium Nees
Phaulopsis Willd.
Physacanthus Benth.
Polylychnis Bremek.
Pseudoruellia Benoist
Ruellia L.
Ruelliospis C.B. Clarke
Sanchezia Ruiz & Pav.
Satanocrater Schweinf.
Sautiera Decne.
Spirostigma Nees
Stenosiphonium Nees
Stenothyrsus C.B. Clarke
Strobilanthes Blume
Strobilanthopsis S. Moore
Suessenguthia Merm.
Trichanthera Kunth
Trichosanchezia Mildbr.
Zygoruellia Baill.

Andrographinae [Daubenpollen, Ascending cochlear aestivation, usually many ovules]
Andrographis Wall.ex Nees
Cystacanthus T. Anderson
Diotacanthus Benth.
Graphandra J.B. Imlay
Gymnostachyum Nees
Haplanthodes Kuntze
Indoneesiella Sreem.
Phlogacanthus Nees

Justiciinae [Ascending cochlear aestivation, 2- 4 ovules, *Rhamen/Spangen/Knötchen/Gür tel* pollen]
Afrofittonia Lindau
Ambongia Beniost
Ancistranthus Lindau
Angkalanthus Balf.f.
Anisacanthus Nees
Anisotes Nees
Anthacanthus Nees
Aphanosperma T.F. Daniel
Ascotheca Heine
Asystasia Blume
Ballochia Balf.f.
Brachystephanus Nees
Calycacanthus K. Schum.
Carlowrightia A.Gray
Celerina Benoist
Centrilla Lindau
Cephalacanthus Lindau
Chalarothyrsus Lindau
Chamaeranthemum Nees
Chileranthemum Oerst.
Chlamydocardia Lindau
Chlamydostachya Mildbr.
Chorisochroa Vollesen
Clinacanthus Nees
Clistax Mart.
Codonacanthus Nees
Conocalyx Benoist
Cosmianthemum Bremek.
Cyclacanthus S. Moore
Cylindrosolenium Lindau
Danguya Beniost
Dasytropis Urb.
Dichazothece Lindau
Dicladanthera F. Muell.
Dicliptera Juss.
Ecbolium Kurz
Filetia Miq.
Fittonia Coem.
Forcipella Baill.
Glossochilus Nees
Graptophyllum Nees
Gypsacanthus Lott, Jarmillo & Rzed.
Harpochilus Nees
Henrya Nees
Herpetacanthus Nees
Hoverdenia Nees
Hypoestes Sol. Ex R.Br.
Ichtyostoma Hedren and Vollesen
Isoglossa Oerst.
Isotheca Turrill
Jadunia Lindau
Juruasia Lindau
Justicia L.
Kalbreyeriella Lindau
Linariantha B.L. Burtt & Ros.M.Sm.
Mackaya Harv.
Marcania J.B. Imlay
Megalochlamys Lindau
Megalostoma Leonard
Megaskepasma Lindau
Mellitacanthus S. Moore
Metarungia Baden
Mexacanthus T.F. Daniel
Mirandea Rzed.
Monechma Hochst.
Monothecium Hochst.
Odontonema Nees
Oplonia Raf.
Oreacanthus Benth.
Pachystachys Nees
Pelecostemon Leonard
Peristrophe Nees
Phialacanthus Benth.
Podorungia Baill.
Poikilacanthus Lindau
Populina Baill.
Pranceacanthus Wassh.
Pseuderanthemum Radlk.
Pseudodicliptera Benoist
Psilanthele Lindau
Ptyssiglottis T. Anderson
Pulchranthus V.M. Baum, Reveal and Nowicke
Razisea Oerst.
Rhinacanthus Nees
Ritonia Benoist
Rungia Nees
Ruspolia Lindau
Ruttya Harv.
Samuelessonia Urb. & Ekman
Sapphoa Urb.
Schaueria Nees
Sebastiano-Schaueria Nees
Spathacanthus Baill.
Sphinctacanthus Benth.
Stenostephanus Nees
Streblacanthus Kuntze
Tessmanniacanthus Mildbr.
Tetramerium Nees
Thysanostigma J.B. Imlay
Trichaulax Vollesen
Trichocalyx Balf.f.
Xerothamnella C.T. White
Yeatesia Small

Barleriinae [Quincuncial aestivation]
Barleria L.
Barleriola Oerst.
Borneacanthus Bremek.
Boutonia DC.
Chroesthes Beniost
Crabbea Harv.
Hulemacanthus S. Moore
Lepidagathis Willd.
Lophostachys Pohl.

Unplaced within Acanthoideae
Acanthostelma Bidgood and Brummitt
Acanthura Lindau
Aphelandrella Mildbr.
Camarotea Scott Elliot
Chlamydacanthus Lindau
Dolichostachys Benoist
Golaea Chiov.
Idiacanthus Leonard
Kudoacanthus Hosok.
Lankesteria Lindl.
Lasiocladus Bojer ex Nees
Leandriella Benoist
Morsacanthus Rizzini
Neuracanthus Nees
Perenideboles Ram. Goyena
Pericalypta Beniost
Vavara Benoist
Vindasia Benoist
Whitfieldia Hook.

Excluded genera
Thomandersia Baill.

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