



AUSTRALIAN SYSTEMATIC BOTANY SOCIETY

N E W S L E T T E R

Newsletter No. 25

December 1980.

ASBS Council

President	Dr. John Jessop, State Herbarium of South Australia, North Terrace, Adelaide, S.A. 5000.
Vice President	Professor Roger Carolin, School of Biological Sciences, University of Sydney, Sydney, N.S.W. 2006.
Secretary	Ms. Judy West, Herbarium Australiense, C.S.I.R.O. P.O. Box 1600, Canberra, A.C.T. 2601.
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Councillors	Mr. Andrew Mitchell, Territory Parks and Wildlife Commission, P.O. Box 1046, Alice Springs N.T. 5750. Dr. Roger Hnatiuk, Western Australian Herbarium, George St, South Perth, W.A. 6151.

This publication, the official newsletter of the Society, is produced four times each year, and deadlines for copy are the last day of February, May, August and November.

Please send contributions, preferably typed in duplicate and double-spaced, to the Editor, at the address below. Items from any source and of interest to members are acceptable. Items incorporated in the newsletter will be duly acknowledged.

Please note : Next deadline is 18 February, 1981.

Subscriptions for 1981 are due 1st January.

Both Australian and overseas members :

Aus. \$8.00 if paid by 31st March
Aus. \$10.00 thereafter

Editor, c/- Western Australian Herbarium,
George Street
South Perth
WESTERN AUSTRALIA, 6151.

Affiliated Society : Papua-New Guinea Botanical Society.

EDITORIAL

This is my last Number as Editor. It is time for change, both for me and for the Newsletter.

The task has been enjoyable and by no means onerous, the only problem having been a few issues when insufficient items were received. The recent plea for articles has succeeded to the extent of this oversized Number. I thank those who have contributed and ask all members to support the next Editor by continuing to write useful, informative, thought-provoking or just interesting articles.

A. S. George.

Offers to assume the Editorship of the Newsletter will be welcomed by John Jessop!

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CORRECTION

An error in the last Newsletter (No. 24) made nonsense of the article by Laurie Adams on Wilhelm Bauerlen. The last line should read: "Thus the correct commemorative epithet spelling should be baeuerlenii in all cases." I apologise for this mistake.

- A. S. George, Editor.

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REMINDER: SUBSCRIPTION CHANGES FOR OVERSEAS MEMBERS

At our last General Meeting (6th G.M., held at the University of Adelaide, 14.v.1980, see A.S.B.S. Newsletter 23:3) it was decided to reduce the overseas subscription for 1981 so that it is equal to the subscription for Australian members (AUS. \$8.00 before 31st March, AUS. \$10.00 thereafter).

I must stress that it is important that all subscriptions be paid in Australian dollars. In the past, we have absorbed all bank handling charges incurred in the conversion of overseas currencies to Australian dollars. Unfortunately, we will not be able to cover these extra costs in the future.

- Barry Conn, Treasurer.

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FINANCIAL ASSISTANCE FOR LOCAL CHAPTERS

I have proposed that at our next A.S.B.S. Council meeting, the Council discusses the extent and form of financial assistance that should be made available to the local Chapters. At present, there are only rather obscure guide lines laid down on this matter. This is largely because there have only been three such requests for financial assistance from local Chapters since the Society was established in 1973. Therefore, there has been little need to formulate a policy. However, as a national society, our funds should be equally available to all Australian members of our Society. Therefore, one of the reasons why I would like this issue discussed by Council is so that a policy can be published in the Newsletter. In this way, all members will then be aware of the type of financial assistance which is available to each chapter. At the moment, this information is not readily available to non-council members (in fact, it is not very readily available to council members!).

If any Chapters anticipate that they will require financial assistance for 1981, please address such requests to the Treasurer before the next A.S.B.S. Council Meeting, which will be held in early February, 1981.

If any members wish to make any comments on this topic, please send these also, so that the Council can consider your views when formulating a policy.

- Barry Conn, Treasurer

NANCY BURBIDGE MEMORIAL PLAQUE

The following people have donated money to the N.T. Burbidge Memorial Plaque in Canberra :

Professor. N. C. W. Beadle	\$20.00
Mr. B. J. Conn	5.00
Dr. S. L. Duigan	10.00
Mr. L. A. R. Haegi	5.00
Dr. J. P. Jessop	4.00
Mr. J. R. Maconochie	16.00
Mrs. K. L. Wilson	<u>10.00</u>

Total received \$70.00

- Barry Conn, Treasurer

A.S.B.S. DINNER

The Australian Systematic Botany Society, in association with Section 8 of the International Botanical Congress, will hold a dinner (with an after-dinner speaker) on Thursday, 27th August 1981. Cost will be A\$18. Anyone wishing to attend please pay Mrs. K. Wilson, (Royal Botanic Gardens, Sydney N.S.W. 2000) by 1st May 1981. Cheques/drafts should be made payable to "Australian Systematic Botany Society".

CAXTON UNCONTROLLED

By Roger Carolin, Sydney

Lately we have seen a very considerable increase in the cost of publication, so much so that many Australian journals are taking leaves from their American counterparts' book and charging authors for publishing through their pages. Not only this, of course, the Industrial Assistance Commission has recommended that publication subsidies be withdrawn from scientific journals, apparently under the impression that authors alone benefit since it helps with their promotion.

I do not want to enter into that argument but let us not forget that not so very long ago, authors did in fact pay for their own publications by banding together as a Society, part of the subscriptions of which went towards the production of a journal. Some of these journals are still extant although many appear to be tottering towards extinction. May I suggest that the reason for this is the fragmentation of scientific societies in the last few years? For instance, the activities and much of the publication potential of the Linnean Society of N.S.W. have been usurped by Ecological Society of Australia, A.S.B.S., Society for Growing Australian Plants and other groups. I do not want to enquire into the reasons for this here, but it is, however, a fact, and no doubt similar situations exist in other States. A consolidation of our effort and of our subscriptions might take us back to the time when we had control over our own publications rather than the present system in which we have abdicated our rights to C.S.I.R.O. or the appointed boards of the house journals.

Personally, I have always been treated fairly well by most house journals but this fragmentation of our effort has produced a change in publishing habits particularly with those workers not connected with

government instrumentalities.

One of the particular problems of taxonomists is the publication of large revisions. Possibly those of you with a house journal located at your institute have no problem in this regard although I understand that even some of these are in financial trouble. Many of us do not have that outlet and have to hawk our product around the journals - and if it is large, we are asked to pay. Again, many of us find it almost impossible to find that money. Even given that money, I hate to think how long it would take Brunonia to publish the three revisions, with ca. 250 species, we have almost ready at SYD.

I think it is high time we examined the way in which revisional information is disseminated and try to find the way which combines availability and cost-efficiency. I do not think the present methods do this.

First I suggest we stop publishing lists of specimens. I doubt their use since all the specimens therein should have been annotated and point distribution maps have given their locations. Anyone interested in the group at a revisionary level will look at the specimens again and not accept the previous worker's word. The needs of curators can be accounted for by providing xeroxed lists, if necessary, supplied at cost by the revisor.

Secondly the cost of publication could probably be reduced substantially by making plates from the original typescript supplied by the author. There is no need for an orthodox type-setting process, the information is the same and with the limited sale and use of revisions, this seems to me a much more cost-efficient system. I fancy it may merely be our own vanity which might prevent us from accepting such a scheme. Let us go a step further. Possibly microfiche is a satisfactory way of publishing these revisions. Precursor papers may be necessary for the purposes of the Int. Code of Botanical Nomenclature but the microfiche would be the way in which the important information would be disseminated. I understand there are archival problems with microfiche but these are not insurmountable. Possibly a revision could be stored on tape or disc and only printed when a request was made for it, charged at cost. It might even be possible in this way to have a continuous up-date.

None of these methods need, I think, detract from the quality of the product, its dissemination or its use, or indeed its use as a test of a worker's productivity and ability for promotion purposes. The referee system can still be applied and acceptance for storage or microfiche publication can still be subjected to the same professional tests and safe-guards.

Well now, I hope that has given you something to talk about at the Christmas party. And before too many start throwing flak back, thank you, all of you, who sent me your good wishes during the recent stumble in my fortune.

THE LACK OF FIELD OBSERVATIONS AND COLLECTING TECHNIQUES
WITH REFERENCE TO PROSTANTHERA

By Barry Conn, Adelaide

David Symon's recent article on 'Rationalising Plant Collecting Field Trips' (A.S.B.S. Newsletter 24:11) has prompted me to express my views on two other aspects of plant collecting - the Field Label and Collecting Techniques.

I have been continually frustrated by the lack of adequate field information recorded on much of the Herbarium material of the genus Prostanthera. Of course, we have all been guilty, at some time or other of not recording adequate field information. This often results from occasional lapses into laziness, lack of time, or ignorance as to what is required for a particular plant group. However, I also suspect that in some cases, the lack of field information on Herbarium labels is not so much an accidental omission, as it is a habit. Although it is annoying, one can forgive early collectors. However, there are far too many recent collections with only very meagre field labels. Frequently, the only information given is limited to number (not always given!), date and locality. Although I hesitate to criticise the length of the description and the level of accuracy often seen in the citation of the locality (occasionally, latitudes and longitudes even to the nearest second!) it seems to be close to useless information if the monographer does not have the funds and/or time to visit this particular locality. Furthermore, if adequate field information had been recorded, it may not have been even necessary for the monographer to visit that particular locality. However, my reason for writing this article is not to criticise the information given, but rather to draw attention to the lack of information.

Naturally, the information required varies, to a certain extent, from one plant group to another. However, irrespective of the plant group, there is one basic rule: RECORD EVERYTHING THAT MAY NOT or CAN NOT BE ADEQUATELY PRESERVED ON THE HERBARIUM MATERIAL.

1. Habitat: the herbarium specimen cannot give any information pertaining to the structure or composition of the plant community from which the sample was collected. At least, the common species should be listed. If there are several levels in the community, then the most common from each should be listed.

A brief description of the soil and rock type (if known) should be given.

A statement on the frequency is also useful, since it indicates how important the plant species is in the community.

Frequently, the species being collected is associated with certain features of the environment. For example, one taxon of Prostanthera in the Gawler Ranges (S. Aust.) appears to always occur at an altitude higher than that of Dodonaea. Although this had been apparently noticed by some collectors, it had not been recorded on any field labels that I have seen.

2. Habit: unless the entire plant is collected (small herbs), the herbarium

specimen cannot supply information on the shape of the foliage (crown in trees), the type and degree of branching (whether open spreading shrub or a dense compact shrub), or even how large it is. The length of the bole and the diameter at breast height (d.b.h.) of a tree, plus the overall height will allow the Monographer to estimate the age of the plant at the time of collection.

Both the above points (1 and 2) cannot be included with the herbarium specimen. The following points can be included with the specimen or they may be preserved along with most of the structure of the plant.

3. Description of the wood and bark should be included for trees and the larger woody shrubs. A wood and bark sample should be collected, ensuring that at least a small sample is included with each duplicate. Remember, wood and bark samples are rarely sent on loan to Monographers.
4. The colour of the flower should always be recorded. Frequently, the colour of the flowers is not recorded even for species which have "showy" flowers. I had to re-collect one new species of Prostanthera so that I could include the colour of the flower in the description. This new taxon had been collected several times before. Colour is frequently not preserved accurately. For example, the corolla of many red-flowered Prostanthera species turn blue-green when pressed and dried, while the blue-green ones may appear maroon in herbarium material. A few yellow flowered forms turn blue-green when dried.

Since the colour patterns are quite complicated in Prostanthera, more detailed information concerning colour is preferable to merely stating whether the specimen has, for example, blue or red flowers. I would like to know -

- (a) the colour of the calyx (when in fruit, as well as in flower if both are present);
 - (b) the colour of the outer surface of the corolla;
 - (c) the colour of the inner surface and whether there are any markings present (such as dots and other pollination guides);
 - (d) the colour of the staminal filaments and the anthers (the anthers often have some coloration laterally).
5. The dimensions of certain reproductive parts, especially for fleshy flowers and fleshy fruits, are particularly useful when the material is pressed and dried. In Prostanthera, the width of the corolla mouth is difficult to determine from dried material. Spirit material (70% Ethyl Alcohol) is another way of preserving features which are not preserved well in the dried pressed state. However, measurements should still be made since many features also become distorted in spirit collections. Spirit collections should be used more frequently as a supplement to dried pressed material.
 6. The presence of a scent (faint, strong, distinct, pleasant, etc.) in leaves, flowers, fruits, bark and wood is rarely recorded. It is surprising that few collectors have recorded the scent of the leaves of our Native Mint

Bushes! It is important to record the presence or absence of these odours because some species of Prostanthera do not have a scent.

Collecting Techniques

I have the impression that most collectors have a preconceived number of duplicates in mind when they collect a particular species (mine is - very few for spiny beasties!). Whatever this number might be, frequently the collection will come from one individual if possible, or most from one individual plus a few from others to make up the number required.

I would like to suggest that collectors consider the technique of collecting on a population basis. Of course, this is done for small herbs when the entire plant is collected, but it seems to be rarely done for larger plants. Population collections can be done in two ways.

- (1) For the purists who believe that each collecting number must refer to only one particular plant - collect one fragment from several (5-12) plants in the population, each separate individual being given a separate number. If this technique is used then the field labels which cover these numbers should clearly state that they have been collected from the same population (e.g. 3576-3581:1 collection per plant from same population).
- (2) For the not-so-purists: use only one number and make one collection from a number of plants in the same population. This should be clearly stated on the field label. If it is subsequently discovered that the collector has inadvertently collected more than one species, an alphabetical suffix can be added to distinguish the taxa involved, just as is normally done for mixed collections.

With respect to Prostanthera, I have used both techniques at different times, depending on the purpose of the particular collection. Since most species of Prostanthera are reasonably well collected, I would be most grateful if future collections could be made on a population basis so that an insight into the structure of the populations may be gained.

Conclusion

Collections which only record collector, date and locality (no matter how accurately) are often little more than museum pieces which are only useful for adding dots to distribution maps. We urgently need 'scientific collections' which supply information which gives a Monographer an insight into the organisms as a living unit, interacting with other organisms in the community.

Naturally, it takes longer to write a detailed field label. It also takes more thought. The only other problem that I have encountered is "How to keep the typist happy?" It is truly an exercise in public relations!

I feel that it would be very useful if other specialists could outline the collecting techniques and field information which are necessary for their particular group. This would help to improve the information recorded on field labels. For example, I always feel a little silly when I record the flowers of Solanum as calyx green, corolla blue, anthers yellow, style and stigma green! What should one record when collecting lichens? How does one consistently collect good herbarium material of Nymphoides?

LOCALITIES ON LABELS

By G. M. Chippendale, Canberra

I have always felt strongly that herbarium label information should be highly accurate, for it is the data which make the specimen worthwhile. There should be no guesswork on labels. With a little forethought, any collector can make the specimen a reliable bit of information.

In dealing with all of the specimens of Eucalyptus in herbaria for my EUCALIST project in recent years, I met many vague localities on labels. Some were understandably so, if collected by early explorers, but even some of those were more easily found than some later ones. Many of the difficult places, of course, can be found given a knowledge of botanical history plus time for research. But, today's labels should carry accurate information.

I know that when I was in the Northern Territory, I used some locality names which, on retrospect, were not known elsewhere. This has, I guess, happened with many of us.

A recent example of a tricky locality is Pioneer Rock (C. A. Gardner, in 1953). There is no such place, but my query to Alex George who checked a collecting book showed it to be 'Pioneer rock' meaning on a rock at or near Pioneer. Another example is Powlett Plains (A. Kitson, in 1903). There is a place called by this name in Victoria which is the State where the species concerned (Euc. kitsoniana Maid.) occurs, but it seemed somewhat out of place. A label in NSW Herbarium more recently annotated by Lawrie Johnson showed it to be east of Wonthaggi where there is a Powlett River, so this must have been meant to be Powlett (River) plains.

When trying to locate collecting points accurately, there have been great difficulties because of collectors who give localities as follows :

1. Near, or vicinity of
2. X miles (or km) from (which way?)
3. Forest Reserve 1234
4. State Forest 5678
5. Bill's block
6. 456 miles south of
7. 345.6 mile post on Highway.
8. River (which may be a river several hundred miles long, a town of 30 000 people, or a property of 1000 square miles)
9. North east of (on what road? how far?)
10. Base camp, expedition (or, for that matter, any other non-map names).
11. (a town, when actually it was during a trip from that town, perhaps 50 miles away.)

It is interesting but often useless to wonder how far is 'near', because it is quite obvious that it varies from one person to another and in time and place.

Following are some suggestions I offer to try to attain the result that the locality information on a label should make it possible for the collection to be duplicated by using the given details:

- (a) Accurate distances in a compass direction from a fixed point, perhaps from a railway station, a post office or some comparatively stable point. The direction of the road should be given, such as 4 km SW PO towards
- (b) Latitudes and longitudes should be given. These should be fixed as soon as possible after collecting.
- (c) In the case of watercourses, mention a definite area such as Creek crossing 10 km SW of towards
- (d) When collections are well off roads, give some indication of locality e.g. 200 metres N from road 6.5 km SW of towards
- (e) While travelling, base points should be established as often as possible by constant recording of landmarks to the nearest 0.1 km.
- (f) Locality names must be accepted geographic names, and never a locally used non-map name.
- (g) The State or Territory should always be given.
- (h) Regional names may be given.

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THE USE OF AMINO ACID SEQUENCES IN STUDYING PLANT PHYLOGENY

By P. G. Martin, Adelaide

The problem can be summed up by two recent quotations from V. H. Heywood. "Practically nothing is known about the course of evolution in the angiosperms". "Whilst there is basic agreement between different authors as to the 200 or so 'core' families to be recognised, there is no such consensus as regards the next higher level, the order, and the different systems of classification differ widely." Amino acid sequences of plant proteins offer an objective solution to this problem.

In a protein like cytochrome c there are 35 sites at which the amino acid is invariant while at the other 69 sites, variation occurs. The invariant sites contribute to our certainty about homology while the 69 variable sites can be used as 69 characters for analysis by the methods of numerical taxonomy. Computer generated family trees over the whole range of living things conform closely with classical taxonomy at the levels of kingdoms and classes. Within all four angiosperm families in which more than one species has been studied there is close grouping. Thus at two different levels of

classification at which we can be fairly sure that our taxonomy is right, cytochrome c data agree well with classical ideas. The method should therefore be reliable at the intermediate levels of orders and sub-classes.

There is a consensus that data from a single protein are inadequate but rather that several, say 3 or 4, should be studied. It is argued that for a study ranging over all families, the only practical source of these proteins is photosynthetic tissue. While proteins can be purified with ease from the leaves of some species, the presence of secondary plant products (e.g. tannins) often makes extraction difficult though not impossible. Ideally a team would include a specialist in this area. Given pure proteins, sequencing is fairly straight-forward but needs a skilled specialist and is expensive. With an automatic sequencer a "first forty" sequence can be routinely obtained in a few days, and this is all that is needed. The third skill required is computer analysis and this is complex and difficult.

In the most recent study, Boulter et al. have extracted plastocyanin from leaves and obtained "first-forty" sequences. The study has covered 40 species in 10 families. The computer analysis is noteworthy because, for the first time, a method is used to detect and eliminate the high proportion of sites at which convergent evolution has occurred. This small pilot study suggests at least one major error in most classical phylogenies, viz. that the Asteraceae are markedly different from other families with which they are usually grouped in the Asteridae.

I have just completed a "first-forty" study of eight species for which Boulter already has sequences for one or two other proteins. There are plans for a joint analysis of three or four proteins from these species and this will hopefully indicate a good operational approach to a survey. In the course of such a study it should be possible to construct a "molecular evolutionary clock" relating amino acid differences to time elapsed since evolutionary divergence.

References :

Boulter, D. et al. (1972). A phylogeny of higher plants based on the amino acid sequences of cytochrome c and its biological implications. Proc. Roy. Soc. Lond. 181 441-455.

Boulter, D. et al. (1979). Relationship between the partial amino acid sequences of plastocyanin from members of ten families of flowering plants. Phytochemistry 18 603-608.

Fitch, W. M. (1976). Molecular Evolutionary Clocks. In "Molecular Evolution". Ed. F. J. Ayala (Sinauer, Massachusetts.)

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TRANSPARENCIES FOR INTERNATIONAL BOTANICAL CONGRESS

The Sydney Committee of the 13th I.B.C. has decided to produce some sets of colour transparencies of the Australian flora for sale to delegates at the Congress in Sydney next August. Because this entails a large stock being built up before the Congress, a sizeable capital is necessary. Financial backing has been obtained for this enterprise from Unisearch Ltd., the research company associated with the University of N.S.W. It is planned to produce five different sets each of twenty slides and explanatory notes presented in a plastic slide sachet and folder. The sets will deal with the following aspects:

- 1) Major plant communities in Australia (eg. arid communities, rainforest communities, sclerophyll woodlands and forests).
- 2) Important plant species or representatives of distinctive Australian families (eg. members of the Proteaceae, Myrtaceae, Epacridaceae as either close-ups of the flower or studies of the whole plant as seems best suited to the particular case).
- 3) The alpine flora, including both individual species and whole community studies.
- 4) Botanical curiosities in Australia, such as notable endemics or plants of unusual morphology or life history (eg. Imesipteris, Marsilea, Macrozamia).
- 5) Marine Botany in Australia, including marine algae and coastal and estuarine communities.

As chairman of the sub-committee set up to handle the production of these slide sets, I am now soliciting original slides from botanists who are prepared to support this attempt to promote the Australian flora at the IBC. It is, of course, imperative that the original slides be of the highest quality, as well as of maximum botanical interest to overseas visitors. For this reason, I would ask members to look through their collection and see if they have some slides that would fit into any of the sets listed. Most of us have some outstanding slides, either as a result of years of perseverance or just plain fluke! Then, drop me a line with brief details of the slides you can offer. We hope then to be able to make a short-list of possible slides to be viewed in detail, and will write to the owners asking for them to be sent in. Please do not leave it to the others. Unless we get co-operation, we will not be able to produce a top quality product, and of course they will be on sale to Australians as well. Let us know before Christmas, please. It takes time to get these things together, and the Congress is getting closer all the time.

Now, to encourage donations, it is planned to pay a royalty on all slides sold. Because of the unknowns of just how well they will sell, it is impossible to state a firm figure, but if they sell well, it is planned to pay a royalty approaching that for commercial use of slides. In addition,

all owners will be acknowledged for the original slide in the notes sold with the sets. Owners will waive copyright for the one printing, and will retain copyright for any subsequent use. The original slides will be returned with all haste. Extreme care will be taken at all stages, but remember that there is always a risk of damage or marking no matter what precautions are taken.

Please do not send any slides as yet - just send details of the slides you are offering to enable us to select a suitable range (removing duplication).

The committee already has some very generous offers, but more slides are needed.

- Christopher Quinn
Botany School
University of New South Wales
P.D. Box 1, Kensington
N.S.W., 2033.

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CURRENT PUBLICATIONS

SOUTH AUSTRALIA

Publications by the Government Printer, Adelaide, are not often carried by commercial booksellers and perhaps do not get the publicity and exposure they deserve. They may be obtained from the Government Printer, 282 West Beach Road, Netley, South Australia 5037, who will invoice costs with orders.

It is hoped that the new book "Mosses of South Australia" by Professor D. G. Catcheside will be published before Christmas. Price not known at the moment.

Some recent volumes include the following:-

JESSOP, J. P. (Edit). "Flora of South Australia" Part 1, Third Edition 466 pp. \$16.90. For earlier note see A.S.B.S. Newsletter 16 (1978)8-9.

FILSON, R. B. & ROGERS, R. W. "Lichens of South Australia". Govt. Printer 1979. 197 pp. \$10.50.

This is the first regional lichen flora compiled in Australia. Over 270 species are described after an Introductory Section covering structure, chemistry, ecology, distribution, collection, curation and keys. The book contains many illustrations, black and white, and colour photographs and line drawings. A few select collections are cited for most species.

WHIBLEY, D. J. (Ed.) "Acacias of South Australia".

Govt. Printer 1980. 240 pp. \$7.90.

This book contains descriptions of 97 species of Acacia in South Australia in the form of a page of text facing a page of illustrations, which consist of 1-2 photographs and a line drawing showing leaves, flowers, pods and often details of seeds. With the text is an inset map of South Australia, showing distribution by dots of the species. In addition, there are standard keys and effective and useful visual keys based on small sketches.

BOOMSMA, C. D., & LEWIS, N. B. "The native forest and woodland vegetation of South Australia". Woods & Forest Bulletin No. 25, 1980. 313 pp. \$9.00.

This new "Bulletin" better described as a book, contains 37 colour plates illustrating different forest and woodland communities in South Australia. These are followed by a brief account of twelve habitat zones in S. Aust. The main section of the book being an account of the principal tree species, describing the formations in which they occur and including a map showing generalised distribution of each in the State. Finally there is an index to species, a list of common names, localities, and references. In a back pocket is a large coloured map of the vegetation formations in South Australia. Available from Woods & Forest Dept., 135 Waymouth Street, Adelaide. Postage extra \$2.40!

- David Symon, Adelaide.

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SYSTEMATIC BOTANY RESOURCES IN AMERICA

PART II - THE COST OF SERVICES

This is the title of a recent (1979) publication by the Advisory Committee for Systematic Resources in Botany, which is a Committee of the American Society of Plant Taxonomists.

Without going into too much detail, I found the 116-page document of great interest.

There is a 16-page section on "The Roles of Herbaria in American Society" which is an excellent justification document on the need for Herbaria and Botanical Services. Areas covered are Plant Identification, Conservation and Land Use Planning, Education, National Defence, Medicine and Public Health, Business and Industry, and Agriculture and Forestry. Very good for thrusting at the doubting Thomases in Politics and Bureaucracy (mind you, it never did the Herbarium of the NT any good!)

The very detailed section on Costs of Herbarium Services was derived from questionnaires from the 105 "most important" of the 1,127 Herbaria in the U.S.A. In the summary, what appear to be fairly accurate costings are presented. The "face value" of an average specimen which has been identified, mounted, accessioned and filed (inclusive of overheads) is \$US5.45. This rises, through various stages, to \$US6.68 for a specimen that has been

both loaned and exchanged. This does not include storage costs (16¢ a specimen) nor the costs of computer data accessioning (if applicable). The cost of collecting the specimen in the field, pressing it, and transporting it, adds about another dollar. And this is, of course, only the "face value". There is no loading for its intrinsic or specific scientific value.

Some interesting facts that arise are that the US botany collections represent a quarter of all natural history museum holdings and the value of specimens in the 105 most important Herbaria ("National Resource Collections") is \$US250 million. Average growth of collections is in the region of 2% a year.

Among the appendices are the "Report on Herbaria Practice and Ethics" (Brittonia 25(3): 307-310; 1973), the "Survey of Herbarium Problems" (Taxon 27(2/3) : 203-218; 1978), and a copy of the Questionnaire. (The taxon article also mentions that glue can be prevented from setting in the nozzle of a glue bottle by "inserting a partially opened paperclip" - such is the advance of science!)

Quite a valuable document and one which would have at least some relevance to the Australian situation. One wonders, though, how much of the impact is lost in preaching to the converted.

- Andrew Mitchell, Alice Springs.

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GUIDES TO RAIN FOREST PLANTS

Members undoubtedly know of the comprehensive Students Flora of North Eastern New South Wales by N. C. W. Beadle, being published in parts by, and available from, the Botany Department, University of New England, Armidale, N.S.W., 2351. However, they may not be aware of the several other small botanical booklets produced by the same department and providing very practical, well-illustrated, and informative accounts of their respective topics. These booklets are designed for use by the Department of Continuing Education and are very helpful guides for professional as well as amateur botanists. Two examples are :-

Rainforest Climbing Plants - A field guide to the rainforest climbing plants of New South Wales using vegetative characters. A key to the 140 species with drawings of each species. By J. B. Williams and G. J. Harden. 47pp. Price \$2.50.

Rainforest Trees and Shrubs - A field guide to trees and shrubs of rainforests in N.S.W. and S.E. Queensland, using leaf features. Authors as above. 57pp., 348 drawings. Price \$2.50.

A full list of available booklets can be obtained from the Botany Department.

- Helen Aston (MEL)

CHAPTER NEWS

CANBERRA CHAPTER

At the June meeting, the film "On the edge of the forest", the last film made by world renowned ecologist E. F. Schumacher, was shown. This film which was made in the Jarrah and Karri forests of W.A. was highly praised by those present.

Dr. Ian Common from CSIRO Division of Entomology spoke at the July meeting on "Australian Insect and Plant Associations, especially in Lepidoptera" and some of his excellent slides were shown.

The topic of the August meeting was "Tertiary Floral History in Arid Australia", with Dr. Elizabeth Truswell from the Bureau of Mineral Resources speaking.

Dr. David Moran from CSIRO Division of Forest Research spoke on "Genetic Diversity and Conservation of Eucalypts" at the September meeting.

On the October long weekend the Canberra Chapter organised a trip to the Edith and Joy London Foundation at Kioloa. The Foundation is a field station of some 350 hectares on the N.S.W. coast which was given to the ANU in 1975 and which is now used for teaching and research purposes.

At the October meeting, a discussion on "Plant Taxonomy - the user's point of view" was held, and four botanists, who are not taxonomists, but who use floras and keys as part of their work, spoke on the adequacy of modern taxonomic treatments. The speakers were : Dr. David Coates, Dr. Ian Noble, Mr. Bruce Wellington and Dr. Nigel Wace.

The final meeting for 1980 will be held on December 3rd, and will consist of a talk about a recent survey of the botany and horticultural potential of the Kakadu National Park flora. The speakers will be Darryl Miller (Australian National Parks and Wildlife Service), Mike Lazarides (Herbarium Australiense) and John Wrigley (National Botanic Gardens). Colin Totterdell (C.S.I.R.O.) will show some of his slides of the area.

The meeting will be followed by a gathering at the home of the convener Mike Crisp, to wrap up the year.

- Craigh R. Marsden, Secretary.

SYDNEY CHAPTER

Program

Meetings of the chapter continue to evoke interest among both members and non-members. The visit by Dr. Jeremy Smith, of the Department of Geography, University of New England, drew record numbers and provoked a lively discussion on the subject of the evolution of high mountain floras. He

presented a refreshingly honest analysis of endemic and cosmopolitan taxa in the New Guinea and Tasmanian montane floras - an area of armchair science that has so often been noted for its circular arguments and lack of critical approach. A sizeable number of people joined us in a dinner afterwards at the local Chinese restaurant to continue the discussion. We are grateful to Jeremy for making the trip to Sydney for the meeting. The annual dinner, on September 9th, was attended by 29 members. It was held in the Mandalay Restaurant in Sydney's rejuvenated Chinese quarter, after a period of initial lubrication in the Covent Garden Hotel. The Burmese food was an interesting variation. The evening climaxed with a toast to absent friends and especially Roger Carolin, who had just come out second best in a tussle with his orthopaedic surgeon. Many will have heard of Roger's accident in Bali last January, which laid him up for some months. Later he became a regular feature carting a huge lump of plaster around between props. Well, the tussle referred to above, rather than speeding his recovery as intended, put Roger back into a cast. I am happy to report he has now cast off this added burden again. We all hope he will continue his recovery without further set back.

The October meet heard Dr. Jocelyn Powell, of the National Herbarium speak on the progress of her revision of the Styphelieae (Epacridaceae). Readers will be pleased to learn that Jos sees no need for radical changes in nomenclature, but rather a careful redefinition of many of the existing genera.

On November 10th, Peter Myerscough, of School of Biological Sciences, Sydney University, spoke on "Plant Strategies". Peter gave us a critical review of the work of Grimes, Horn and Harper with particular reference to the difficulty of applying the concepts developed on northern hemisphere examples to the Australian situation - particularly the balance between wet sclerophyll and rainforest communities. The difficulty of making clear distinctions between stress and disturbance (eg. in the case of fire - when does it cease to be a disturbance and become a stress factor), as well as the limitations of plotting many different stress factors along the one axis, were highlighted in the ensuing discussion.

The final meeting of the year will be on December 8th, when Dr. Helen Ramsay will give an account of some of her experiences in Canada. At that meeting, the writers will also shed their administrative burden. We hope our successors will keep up the good work of reporting through the newsletter.

Personal News

Laurie Haegi, National Herbarium, is presently on a six-month "secondment in situ" to the Flora of Australia project to help with the preparation of the Solanaceae. Peter Wilson (the *Metrosideros* Wilson) received his Ph.D. at a ceremony at UNSW on 9th October 1980, and currently holds a post as temporary botanist at the National Herbarium to help carry the load in Laurie's absence. David Bedford, late of Sydney University, has been appointed a General Services Botanist at the National Herbarium, and is celebrating this with a wedding - congratulations on both counts. I hear his intended intends to take typing lessons, with David's thesis hanging above

their future. Marilyn Fox (Nat. Herb.) travelled to South Africa in September to attend the 3rd International Conference on Mediterranean-type Ecosystems at Stellenbosch. This conference was organised jointly by the University of Stellenbosch and the University of Cape Town, and was attended by botanists and zoologists from Israel, Chile, California and Britain (do they have Medit. veg.?), as well as Australians (including Marilyn's husband, Barry of Zoology School, UNSW) and South Africans. Marilyn reports that the invited review papers and the contributed posters were very interesting, and that the former will be published as the Proceedings of the Conference. Marilyn also attended a four-day workshop following the conference, the results of which will shortly appear in a book entitled "The Role of Nutrients in Determining the Structure of Mediterranean Ecosystems". Both Marilyn and Barry had a good look around the Cape Province, spent some time in Kruger National Park, and fitted in three days on Mauritius on the way home. John Waterhouse (UNSW) is nearing the end of his Special Studies Program. He is carrying out a survey of the flora of the Magela Creek Catchment Area in the Northern Territory, and will be returning to duties at the end of January. He reports a great improvement in his blood pressure and temper in the calming atmosphere of Ja Ja Camp, despite working a six or seven day week. Oh, for the life of the happy primitive!

Both Helen Ramsay (UNSW) and Laurie Johnson (Nat. Herb.) attended the "Botany 80" meeting of the Botany Societies of the USA and Canada at the University of British Columbia, Vancouver, in July. Helen also took a tour from Edmonton to Vancouver before the meeting, and found this gave an excellent coverage of the vegetation of the Rockies. Both also attended the ICSEB II meeting that followed on from "Botany 80" (Second International Congress of Systematic and Evolutionary Biology). Laurie took a post-congress tour to Alaska organised by ICSEB. He reports that while it took him to a botanically fascinating region, the virtual absence of informed botanical guides prevented members getting full value from what was indeed a very expensive trip. He tells me that members pooled their information on the region with some success, but it was a frustrating experience. There is a lesson here for all of us concerned with organising field trips for IBC next August. Jocelyn Powell (Nat. Herb.) has just returned from a trip to New Guinea.

- Christopher Quinn, Sydney.

PERTH CHAPTER

An all-day symposium on Banksia was held at King's Park on 10 November 1980, and was attended by about 50 people. The following are abstracts of the papers and posters presented.

The Taxonomy and distribution of the genus Banksia L.f. by A. S. George, Western Australian Herbarium, George Street, South Perth, 6151.

The genus Banksia contains 71 species of which 56 occur in south western Australia, 14 in the east and south east (including Tasmania), and one in tropical Australia, Papua-New Guinea and the Aru Isles. The genus is divided into 2 subgenera; one contains only 2 species, the other 69 further classified into 2 sections and 12 series. Both sections are represented in

south western and eastern Australia. Most species occur within 150km of the coast, a few species in south western Australia extending to 300km inland. Rainfall is over 200 mm. Several species are widespread and polymorphic, others of restricted range and morphologically consistent.

Poster Abstract - "The Banksias"

These two proofs are examples of the plates in a fine-art work currently under way at Monash University, Melbourne. The artist, Celia Rosser, is painting all 71 species which will be published in three parts. They will be arranged in the order in which they were named. The accompanying text, written by Alex George of the Western Australian Herbarium, covers the history of each species together with its biology, taxonomy and a formal description. Publication, by Academic Press, London, will commence in 1981.

Breeding systems of Banksia By G. J. Keighery, King's Park and Botanic Garden, West Perth, W.A. 6055.

The genus Banksia is composed of relatively long-lived (20-100 years) woody plants, which bear numerous small sessile flowers arranged spirally in complex inflorescences, generally referred to as cones which are the functional floral unit. All species have minute stigmatic regions which are generally small slits on the style end. Flowers are highly proterandrous, and some species have high numbers of male flowers in the inflorescence.

Species may have straight or curved styles, with pollen covering all the stigma or placed on special stylar grooves below it. In all Banksia species examined selfed pollen was found to germinate on the stigma.

Species may bear large conspicuously displayed ovoid-oblong cones, with straight or hooked styles. Many of this group (B. ashbyi, B. attenuata, B. grandis, B. hookerana, B. menziesii, B. prionotes) appear to be obligate outbreeders. The hook styled members of this group (B. littoralis, B. occidentalis, B. tricuspis, B. ericifolia) are also largely outbreeding, but can display partial self-fertility. Some species (B. praemorsa, B. quercifolia, B. integrifolia and B. verticillata) related to members of this group are highly self-fertile.

The prostrate Banksias also are partially self-fertile, as are members of the ilicifolia section. Species with large coarse pendulous inflorescences (B. calayi, B. lemnihana and B. elderana) are also partially self-fertile.

One group has small round or top shaped cones (B. baxteri, B. candolleana, B. coccinea, B. dryandroides and B. elegans). These are all outbreeders with the exception of B. dryandroides. Banksia dryandroides with its hidden, dull coloured, small relatively inconspicuous inflorescences may be the only Banksia which is inbreeding to any marked degree. Banksia elegans is one of the few Banksias displaying extensive vegetative reproduction.

The final group is the "sphaerocarpa" complex, which have spherical cones with hooked styles. All members of this complex are capable of inbreeding, but due to a complex series of events after fertilization most resulting seed is probably outcrossed.

As a generalization Banksia species are typically outbreeding, though some may display high levels of self fertility. Probably in the wild most seed giving rise to the next generation is the result of outcrossing.

Vertebrate pollination of Banksias, by S. D. Hopper, Western Australian Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A. 6065.

Numerous species of birds and a few of mammals have been observed feeding at Banksia inflorescences. Several studies have now documented that these vertebrates carry pollen of banksias in their feathers or fur. One study has shown that pollen is deposited on stigmas when honeyeaters feed at flowers.

Relationships between banksias and their vertebrate pollinators appear generalized. Contrary to claims of some recent authors, convincing evidence of species that are exclusively or even predominantly mammal-pollinated is not yet available. Several related problems deserve future study, including (i) determining the relative importance of invertebrates, birds and mammals as pollinators, (ii) documenting the advantages to banksias of vertebrate pollinators, and (iii) establishing whether any of the diverse morphological, phenological or ecological features of banksias have evolved as adaptations for pollination by particular vertebrates.

Poster Abstract - Vertebrate Pollinators

The photographs illustrate honeyeaters, honey possums and pygmy possums feeding on inflorescences of a range of Banksia species. The poster highlights the fact that birds and mammals will feed on the same banksias in a community. Specialized feeding by birds or mammals on particular Western Australian banksias has not yet been documented.

The Effects of the Banksia grandis understorey on Spread and Intensification of Phytophthora cinnamomi Infections in the Jarrah (Eucalyptus marginata) Forest.

By S. R. Shea^A, D. Schild^B, and B. Shearer^A.

^AW.A. Forests Department, Dwellingup

^BMurdoch University.

P. cinnamomi, the agent causing jarrah dieback is an ephemeral soil inhabitant on free drained sites in the jarrah forest. The fungus is unable to survive in soil over the summer months because of the unfavourable soil physical environment. The fungus increases its propagule density in the soil in spring and to a lesser extent in autumn when the soil microbiological and physical environment is suitable for sporangial formation. The fungus survives over summer in susceptible plant tissue which is not subject to drying.

The root system of B. grandis is highly susceptible to P. cinnamomi and the large horizontal roots permit lateral extension by mycelial growth. P. cinnamomi can invade the stump and lower stem of B. grandis of all sizes and this together with the infected root system provides a large reservoir of inoculum which is buffered from the external soil environment. The fungus

can persist in dead B. grandis tissue for at least two years. Although the density of fungal infection in dead B. grandis tissue is reduced over the summer months, re-invasion does occur in autumn when the tissue is rewetted. High propagule densities have been recorded in soil adjacent to recently killed B. grandis in autumn and adjacent to old deaths (> 1 year) and recently killed trees in spring. The fungus cannot survive in proteoid roots over the summer months but these roots provide a ubiquitous and highly susceptible food base during the periods when the fungus is present in the soil. Reduction of the density of the B. grandis understorey to pre-disturbance levels is an essential pre-requisite to control of the disease.

Development of silvicultural techniques to reduce the density of the B. grandis component of the E. marginata Sm. Forest.

By S. R. Shea^A, R. Buehrig^A, D. Bell^B, and L. Watson^B.

^A Forests Department, Dwellingup, W.A. 6243.

^B Botany Department, University of W.A., Nedlands, W.A. 6009.

The density of B. grandis in the E. marginata forest has increased markedly following exploitation of the forest for timber. This increase is attributed to soil disturbance and reduced competition resulting from logging and the imposition of a firing regime which does not disfavour this species. Reduction and maintenance of the B. grandis component of the forest to a low density is an essential pre-requisite to control of Phytophthora cinnamomi, the soil borne pathogen causing Jarrah dieback.

Control of the B. grandis understorey cannot be achieved by single event treatments, for example high intensity fire or herbicides, because re-growth to pre-treatment densities occurs within 10 to 20 years. Hence, the biology and population dynamics of the species have been studied in an attempt to devise a management regime which would maintain the density of the B. grandis understorey at a desirable level.

Growth rates of B. grandis in stands of different densities were determined by dating trees using a combination of internode and growth ring counts. The relationship between cone production and tree size/age, seed production per cone, seedling survival and the structure of the B. grandis understorey in jarrah forest stands with different burning and silvicultural treatments has been determined.

The effect of fire of different intensities on survival of B. grandis seedlings, lignotubers, and trees in 1cm size classes was determined from field plots which had been subjected to a range of fire intensities.

The data has been incorporated in an interactive Fortran stand computer model which is being calibrated by comparing simulated stand structures at different stages of development with comparable natural stands. The model has the capacity to simulate the effect of different burning regimes along and in combination with other silvicultural treatments on the density, structure and development of the B. grandis understorey.

A *Banksia grandis* Population Model to Assess Forest Management Options

By D. T. Bell^A, S. R. Shea^B and L. E. Watson^A

^ADepartment of Botany, University of Western Australia, Nedlands 6009.

^BWestern Australia Forests Department, Dwellingup Research Station, Dwellingup, W.A. 6243.

Population dynamics in stands of *Banksia grandis* in the northern jarrah forest ecosystems are simulated in an interactive FORTRAN computer model. The starting input is a size-class distribution of *Banksia* seedlings, lignotubers and trees. During each annual cycle, the computer "grows" trees and imposes mortality according to rates determined from field plots. These rates vary depending on stand density. The new population of seedlings is estimated from data on the relationship of tree size to potential cone production, potential seed to cone values and percentage survival of seedling measurements determined from field samples. Initial emphasis has been to compare the simulated output with existing field collected population data. Once a reliable "natural conditions" simulation has been developed, various forest management impacts on the population can be simulated. Data on the response of *Banksia grandis* trees, lignotubers and seedlings to fire now resides in a sub-programme and the simulation of various fire regimes is providing knowledge for future recommendations for the periodicity and intensity of control burns in the northern jarrah forest.

The process of constructing the model has highlighted :

- (1) the importance of 'word model' as a starting point;
- (2) that the study of complex ecological processes can benefit from the modelling technique;
- (3) the computer is but a tool to better understanding; and
- (4) the accuracy of simulation improves by using the model to point out areas of additional required field data.

Ecology of Mangite, *Banksia grandis* Willd.

By Ian Abbott, Institute of Forest Research and Protection, Hayman Road, Como, W.A. 6152.

1. Mangite is the principal understorey species in jarrah forest. It may reach densities of 4000 plants ha⁻¹ in the northern jarrah forest. Standing crop rarely exceeds 2m²ha⁻¹.
2. Survival of plants over summer is high : 7% of 1800 tagged plants died. Survival is related to size, being lowest for seedlings (mortality = 25%).
3. Growth rates of individuals of dbhob \geq 16cm are of the order of 2cm diameter increment per 12yr. Few trees with dbhob \geq 30cm can be found in jarrah forest. Ring counts and historical evidence suggest that plants of dbhob = 30cm are at least 100 years old. Field experiments being conducted to evaluate the relation of soil moisture, light and insect attack with growth rate are outlined.

4. Reproduction. Flowering occurs in August-December. Seed is shed in autumn 2 years later. A laboratory experiment established that moisture and solar heating are sufficient to initiate shedding of seeds; fire is unnecessary. Experiments suggest that 30-100% of seeds fail to germinate. Trees first flower at mean dbhob = 4.6cm and those producing fertile fruit for the first time have mean dbhob = 7.2 cm. Flowering peaks for trees with dbhob = 5-7cm. Mean number of follicles per fruit = 51; mean number of seeds per follicle = 0.9. A weevil which attacks flower buds causes a majority of conflourescences to form barren fruits. In 1979, recruitment = 46 seedlings per 100 reproductive trees.

5. Community Ecology. Mangite tends to be spatially segregated from jarrah. Both have clumped patterns of distribution. Regressions between diameter sums and nearest neighbour distances provide evidence of competition between mangite and jarrah. Intra-specific competition in mangite is apparently weak.

6. The effects of fire and cutting of forest on the abundance of mangite will be discussed briefly.

Environmental Relations of Banksia Woodlands of the Swan Coastal Plain

By J. Dodd and D. T. Bell, Department of Botany, University of Western Australia, Nedlands, W.A. 6009.

Regional variation in species composition of Banksia woodlands and low open forests of the Swan coastal plain was assessed using Polar and Principal Component Analysis Ordinations. Variation in the understorey component appeared to be correlated to variations in soil nutrient status, leaching, topography and distance to the water table. Variation in the canopy stratum, however, was less clearly defined.

Cultivation of Banksia

By I. R. Dixon, King's Park and Botanic Garden, West Perth, W.A. 6005.

In general, Banksia species require a free draining sandy soil, in a sunny but not exposed position. Most species are grown from seed, which is sown in autumn to allow plants to become established before the onset of hot weather. Seed is generally easy to germinate. Growth rates and flowering are improved by the judicious use of fertilizers (avoiding phosphates).

Once established a regime of hand weeding (to avoid root disturbance), mulching and regular pruning after flowering (for the terminal flowering species) should maintain healthy adult plants.

Cultivation problems (nutrition and diseases) and potential will be discussed.

Insects associated with seed production in *Banksia*

By John K. Scott, Entomology Branch, Department of Agriculture, South Perth, W.A. 6151.

Insects were examined on reproductive structures of *Banksia attenuata*, *B. grandis*, *B. ilicifolia*, *B. littoralis*, *B. menziesii* and an undescribed species at Cannington and Jandakot near Perth, Western Australia. The insects occurred in four groups: insects found on the outside of reproductive structures, insects that eat the inside of the conflorescence (flowering spike), insects that eat seed inside the infructescence (fruit) and insects associated with the decomposition of reproductive structures. Insects on the outside of reproductive structures possibly acted as pollen vectors, i.e. bees, or protected flowers from destructive insects i.e. ants. Insects inside the conflorescence and infructescence were larvae of moths and weevils. About a third of conflorescences were destroyed by these insects. Up to 70 per cent of seed may be eaten but *B. grandis* and *B. ilicifolia* lacked damage. The insects tend to be specific to a particular species of *Banksia* except for the moth larvae, *Arotrophora arcuatalis*, which was found in five of the six species of *Banksia*. Generally seed was dispersed from plants before damage could occur due to insects that aid the decomposition of reproductive structures. This last group were usually larvae of weevils.

Poster Abstract

Fossil fruits of *Banksia* from Eocene deposits in the Kennedy Range, Western Australia

Ken J. McNamara, Western Australian Museum, Francis Street, Perth W.A. 6000.

John K. Scott, Entomology Branch, Department of Agriculture, South Perth W.A. 6151.

Fossil fruits of *Banksia* which closely resemble modern forms, occur in the Merlinleigh Sandstone of the Kennedy Ranges near Carnarvon, Western Australia. The deposit containing the fossils is dated at approximately 45 million years before present. The sandstone is a marine deposit which indicates that the *Banksia* plants were growing next to either the ocean or an estuary. The fossils are the earliest positive evidence of *Banksia*.

Poster Abstract

Pollination Ecology of Co-occurring *Banksia* species at the Yule Brook Botany Reserve

By J. Lewis, L. J. Stephens and D. T. Bell, Department of Botany, University of Western Australia, Nedlands, W.A. 6009.

Four species of *Banksia* occur in the sand plain swamp and ridge communities of the Yule Brook Botany Reserve, Kenwick, Western Australia. *B. attenuata* and *B. menziesii* inhabit the sand ridges, while *B. aff. sphaerocarpa* and *B. littoralis* occur in the low-lying areas, but all are within close proximity to one another. Honey bees were observed foraging for nectar and pollen on the flowers of each species and could be vectors for interspecies cross-

pollination. Several lines of investigation, however, revealed that the potential for successful cross-pollination between species was extremely unlikely.

Flowering in the straight-styled B. attenuata was restricted to late spring and summer. Flowering periods for the straight-styled B. menziesii and the hooked-styled B. littoralis and B. aff. sphaerocarpa occurred in autumn and winter. Insect pollinator constancy greatly restricted potential inter-species pollen transfer. In artificially-pollinated flowers, pollen grain germination was achieved for self-pollination and between the species with similar style morphology; however, crosses between the straight-styled and hooked-styled species resulted in no germination. In all cases where pollen germination was achieved, the number of germinating pollen grains was very low in comparison to the total number of grains present in the preparation. Location of the pollen on the stigma appeared to be critical for pollen grain germination.

In addition to the described mechanisms to prevent interspecific outcrossing involving phenology and pollination ecology, undoubtedly other genetic and ecological barriers exist. The combined effect makes the successful establishment of interspecific Banksia hybrids in the Yule Brook Reserve highly unlikely.

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