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Geographical variation, subspecies discrimination and evolution in fruits, leaves and buds of *Eucalyptus caesia* (Myrtaceae)

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Abstract

Hopper, S. D., Campbell, N. A. and Caputi, N. Geographical variation, subspecies discrimination and evolution in fruits, leaves and buds of *Eucalyptus caesia* (Myrtaceae). Nuytsia 5(2): 179-194 (1984). Two races of *Eucalyptus caesia*, well known in the nursery trade as "Gungurru" and "Silver Princess" and recently given formal taxonomic status as subspecies *caesia* and subspecies *magna* were investigated to determine whether they are morphometrically distinguishable throughout their known ranges. Each of five fruit, three leaf and three bud measurements provides from 2-68% correct allocation to subspecies of the 138 plants measured, whereas multivariate analysis of three fruit and two leaf measurements achieves 98% successful allocation. Fruit, leaf and bud character subsets all make significant contributions to discrimination between the subspecies. Size differences in fruit and leaf characters account for 75% of the discrimination achieved. It is likely that subspecies *magna* was derived from an ancestral population (probably at Yanneymooning Hill) resembling subspecies *caesia*. A number of selective factors may have favoured the robustness of subspecies *magna* although adaptation to mobile bird pollinators is the only one for which some evidence is available at present.

Introduction

Eucalyptus caesia Benth. is a rare Western Australian mallee that is now well established as an ornamental garden plant. In the wild it occurs in small populations of 1-580 plants restricted to isolated granite outcrops in the central wheatbelt region inland from Perth (Figure 1, Chippendale 1973, Gardner 1979, Moran and Hopper 1983).

Two races of the species are known and are widely grown in cultivation under the names "Gungurru"* (which has relatively small fruits, flowers and leaves, and an upright habit), and "Silver Princess" (which has larger fruits, flowers and leaves, and a weeping habit). Brooker and Hopper (1982) have given these races formal taxonomic status as subspecies *caesia* (= Gungurru) and subspecies *magna* (= Silver Princess).

In 1978 a proposal was put to the Western Australian Wildlife Authority's Flora Committee that subsp. *magna* should be gazetted as rare under the Wildlife Conservation Act 1950-79 in order to curtail harvesting of seed from the small known wild populations by commercial seed collectors. If such a proposal was to be adopted, it could only be policed effectively by officers of the Department of Fisheries and Wildlife if specimens from subsp. *magna* populations could be distinguished consistently from those of subsp. *caesia* populations. To establish whether this is possible, a multivariate morphometric study of geographical variation in the species was carried out.

Apart from the solution of this applied problem it was anticipated that the study would be of general interest in elucidating the pattern of variation in a species of the informal subseries *"Orbifolinae"* (Pryor and Johnson 1971). Members of this subseries are remarkable

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*"Gungurru" is now known to be a misapplied common name. It was actually used for *E. woodwardii* Maiden rather than for *E. caesia* by Aborigines of the Fraser Range district (Rye and Hopper 1981).

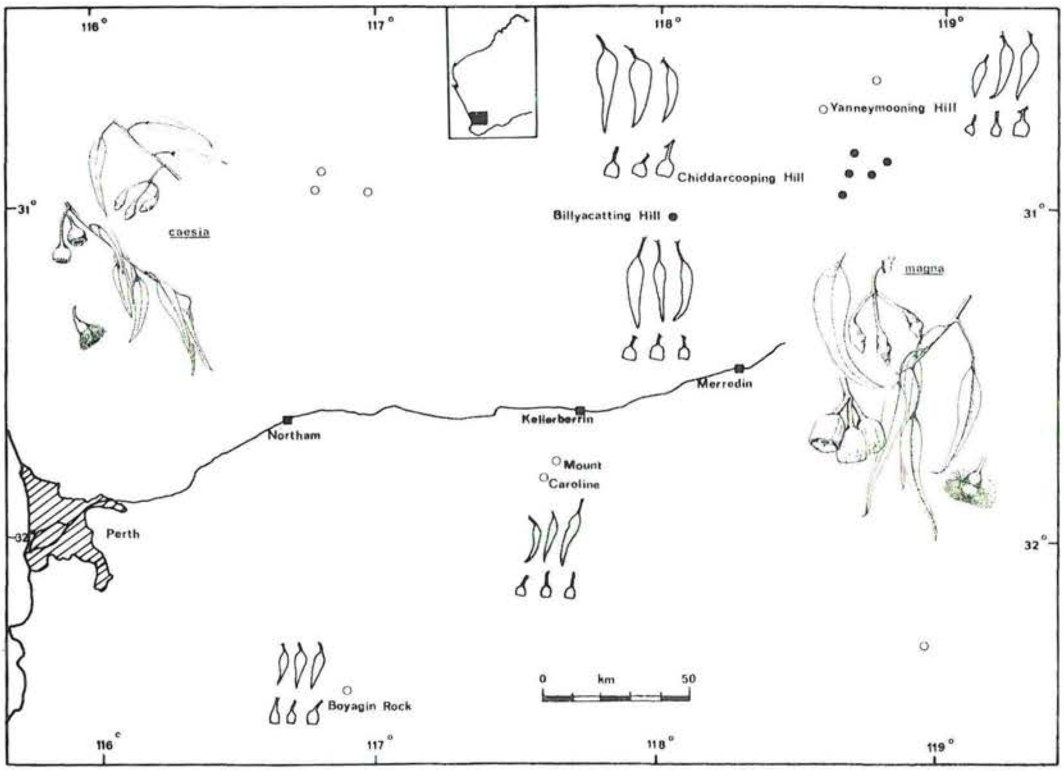


Figure 1. Geographical distributions of subsp. *caesia* (o) and subsp. *magna* (●) in south-western Australia. Tracings from a leaf and fruit from three plants from a sample of populations are given. Note the variability of plants from Yanneymooning Hill (see text). Drawings (by S. J. Patrick) illustrate typical fruits, buds, flowers and leaves of the two subspecies.

among eucalypts in the insularity and geographical separation of their populations, and therefore might be expected to show unusual patterns of evolution.

This morphometric study complements other work on *Eucalyptus caesia*, including a survey of allozyme variation (Moran and Hopper 1983), cladistic and phenetic analyses of phylogeny (Hopper and Burgman 1983), an investigation of nectar flow and pollinators (Hopper 1981, Wyatt and Hopper unpubl.), the formal description of the two races as subspecies (Brooker and Hopper 1982), notes on the species' distribution and use of the name "Gungurru" (Rye and Hopper 1982), and an assessment of *E. caesia*'s conservation status (Hopper et al. 1982).

Materials and methods

Field sampling and measurements taken. Known locations of *Eucalyptus caesia* were established through a literature search (e.g. Blakely 1965, Chippendale 1973, Gardner 1979), from specimen labels at the Western Australian Herbarium, and from information supplied by professional and amateur botanists in Western Australia. Each location was then surveyed in 1978 or 1979. Suitable granite rocks near to the known locations were also surveyed exhaustively for new populations of the species.

The species was found at 15 major locations (Hopper et al. 1982) and material was sampled from 11 of these. Two populations separated by a few hundred metres were sampled at two locations (Chutawalakin Hill and Chiddarcooping Hill), while only a single sample

Table 1. Summary of data for 11 measurements on 13 populations of *Eucalyptus caesia*. Characters are denoted as follows — Fruit: F1 — mid-fruit diameter; F2 — fruit top diameter; F3 — fruit length; F4 — pedicel length; F5 — pedicel thickness; Bud: B1 — operculum length; B2 — hypanthium length; B3 — bud diameter; Leaf: L1 — leaf length; L2 — leaf width; L3 — petiole length.

Population			Character means (mm)										
No.	Name	Number of plants	F1	F2	F3	F4	F5	B1	B2	B3	L1	L2	L3
	E. caesia subsp. *caesia*												
1.	Mount Caroline	14	18.9	18.5	19.1	17.4	2.6	9.3	11.9	11.1	108	23.8	23.2
2.	Boyagin Rock	13	19.3	17.4	23.3	16.3	2.4	11.1	16.8	13.1	93	23.9	20.9
3.	Yanneymooning Hill	12	20.8	19.2	20.7	19.2	2.9	9.9	12.8	12.6	135	32.9	26.0
4.	Mount Stirling	15	21.8	19.9	23.0	18.9	3.2	-	-	-	115	23.1	21.1
5.	Walyahmoning Rock	5	20.9	20.9	23.1	24.7	3.3	-	-	-	109	30.2	25.4
6.	The Humps	15	19.2	18.2	21.3	22.3	2.7	-	-	-	123	28.4	26.1
	E. caesia subsp. *magna*												
7.	Billyacatting Hill	7	22.9	24.1	21.1	22.0	3.0	-	-	-	158	33.3	45.8
8.	S of Chutawalakin Hill	11	27.4	26.3	26.0	21.7	4.6	13.9	16.2	17.0	171	32.5	44.0
9.	Chiddarcooping Hill	4	26.7	26.0	25.7	22.1	3.6	12.3	16.1	16.7	161	31.6	42.7
10.	W of Chutawalakin Hill	13	27.6	25.9	27.5	23.0	4.3	13.1	17.7	17.4	146	28.1	41.5
11.	Coorancooping Hill	11	30.6	28.8	27.7	22.1	4.9	12.1	16.1	16.2	137	36.0	40.5
12.	SW of Chiddarcooping Hill	13	25.5	24.7	26.4	21.3	3.9	-	-	-	159	39.8	41.6
13.	NW of Chiddarcooping Hill	5	27.7	26.6	24.3	19.8	4.0	-	-	-	122	29.2	36.7
	pooled standard deviation		2.5	2.3	3.1	4.7	0.6	1.8	1.7	1.4	22	6.9	6.3
	subsp. *caesia*												
	mean		20.0	18.7	21.6	19.3	2.8	10.1	13.8	12.3	114	26.3	23.5
	range		16.1-27.8	13.3-25.3	14.7-30.8	9.5-36.5	1.9-4.3	5.3-13.9	10.0-19.7	10.5-15.5	71-163	14.7-53.8	14.4-41.7
	subsp. *magna*												
	mean		27.0	26.0	25.9	21.9	4.1	12.9	16.5	16.8	153	33.3	42.0
	range		20.7-39.6	20.8-36.0	18.1-36.5	11.3-32.8	2.7-6.6	10.2-19.0	12.2-20.4	11.9-20.5	97-239	15.7-50.0	24.5-58.9
	% plants in subspecific range overlap (i.e. % doubtful allocation)		47.6%	31.7%	87.6%	97.9%	60.0%	71.6%	83.2%	36.8%	71.7%	97.9%	43.5%

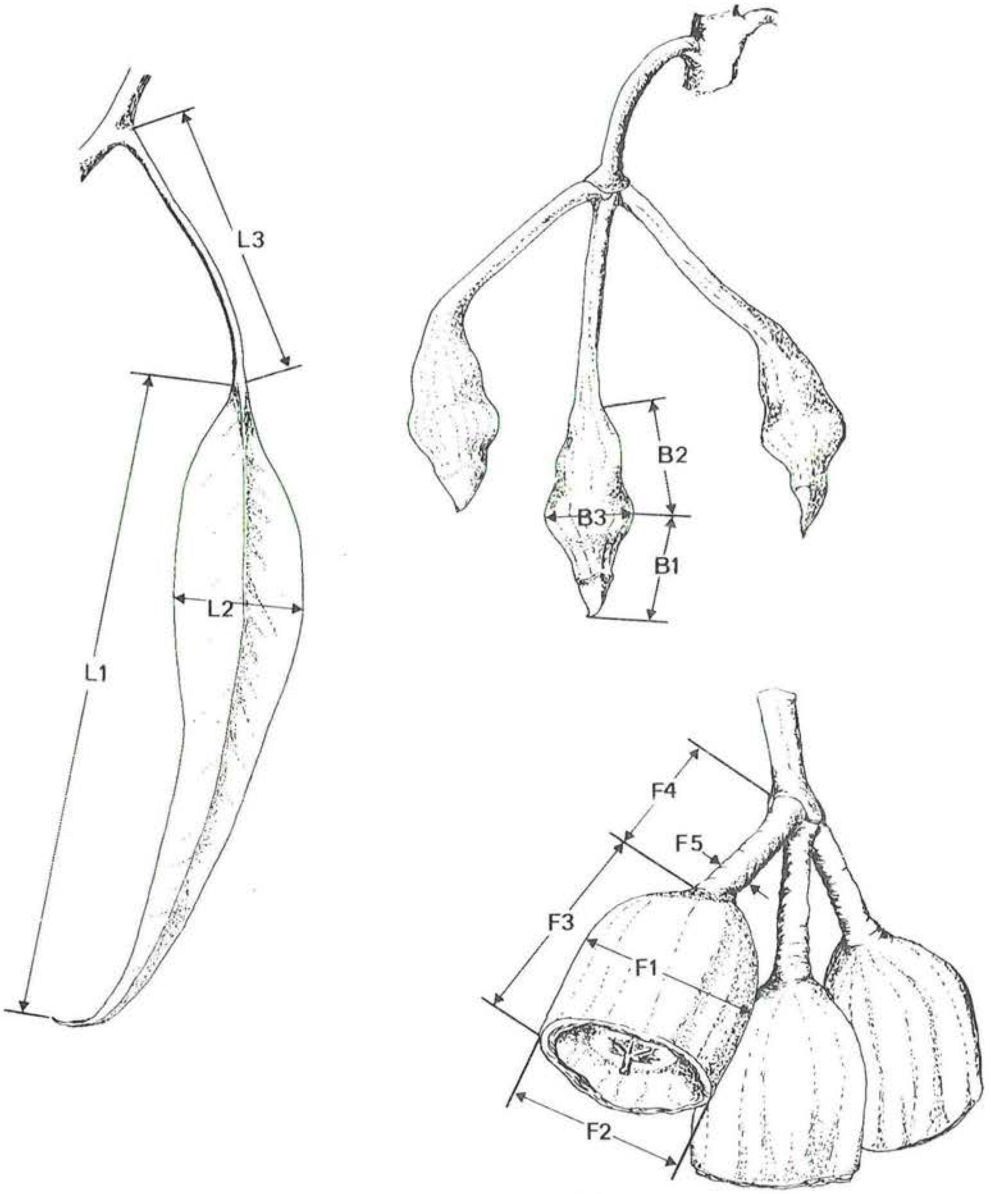


Figure 2. Fruit, leaf and bud measurements taken in the study. Fruit: F_1, mid-fruit diameter; F_2, fruit top diameter; F_3, fruit length; F_4, pedicel length; F_5, pedicel thickness. Leaf: L_1, leaf length; L_2, leaf width; L_3, petiole length; Bud: B_1, operculum length; B_2, hypanthium length; B_3, bud diameter. Drawing by S. J. Patrick.

was taken elsewhere, giving a total of 13 populations sampled (Table 1). A sprig with leaves and fruits was selected from each of up to 15 plants on line transects in each population. Seven of the populations were visited sufficiently early (May-July) in the flowering season to include mature buds as well as leaves and fruits on the sample sprigs.

The longest leaf, fruit and bud on each sprig were selected for measurement of the eleven characters illustrated in Figure 2. Only a single organ per plant was measured since preliminary studies indicated that variation within plants was minimal compared with that between plants and between populations.

Material from each population was pressed and dried prior to measurement, since a preliminary examination showed significant differences in all measurements taken on the same specimens when fresh and dried. There was no significant measurement error when the same dried specimens were remeasured. Voucher specimens from each population have been lodged with the Western Australian Herbarium.

Statistical techniques. Multivariate differences between and within populations were investigated primarily through canonical variate analysis (Bartlett 1947, Rao 1952, Phillips et al. 1973). This technique is used to define linear combinations of the original measurements that maximize variation between populations relative to the variation within populations. The first linear combination (canonical variate) maximizes the ratio of the between- to within-populations sums of squares of the resulting canonical variate scores. This ratio is usually referred to as the canonical root.

The basic aim of canonical variate analysis is one of separation or description of population differences. In many cases, a scatter diagram of the scores for the first two (or few) canonical variates conveys much of the information about the population separation achievable for the characters measured.

The overall separation between the populations can be partitioned into components reflecting variation in size and shape. The approach adopted in this paper is to define a suitable size variable, and then use regression-based techniques to define shape variables. The size variable is defined as the sum of the original characters on the logarithmic scale.

Shape is commonly defined in terms of proportions or ratios (Mosimann 1970, 1975, Mosimann and James 1979, Mosimann and Malley 1979). When the original data are expressed on a logarithmic scale, proportions become differences and the usual linear techniques of multivariate analysis are applicable.

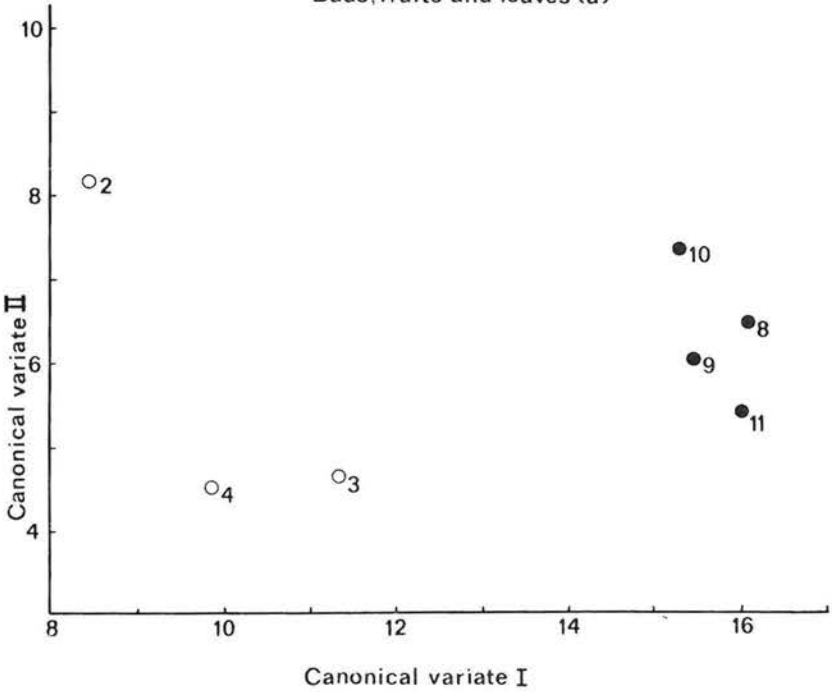
Shape variables are defined here by projecting the data orthogonally to the vector associated with the size variable, or by taking the residuals from the within-groups regressions of the original characters on the size variable. The analysis of the projected data removes that component of size which is independent of shape — the *isometric* component. Size-related shape changes — the *allometric* effects — may still be present. The analysis of the residuals removes both the isometric and the allometric effects, at least to the degree that the linear regressions summarize this latter effect. [Williams et al. (1981) discuss the use of polynomial regressions to describe allometry]. Comparison of the ordinations and canonical vectors from these two analyses will give some insight into the contribution of allometric effects to the overall population separation.

Allocation of plants not included in the reference populations is here based on the total Mahalanobis distances. Leave-one-out calculations are used for the reference populations. The calculations for the probabilities of membership of each population are based on multivariate Student densities (see equations (2.7) and (2.1) of Aitchison et al. 1977). Typicality probabilities are first calculated (see equation (2.12) of Aitchison et al. 1977) by referring the Mahalanobis distances to the F-distribution.

These allocation procedures assume underlying multivariate Gaussian distributions. Probability plots of the Mahalanobis distances are used to examine this assumption (see, e.g. Gnanadesikan 1977 p. 172, Campbell 1980).

Three sets of analyses are reported here. One details the analyses for those populations for which all fruit, leaf and bud characters are available (Table 1). Another details the analyses for leaf and fruit characters for all populations (except those with few individuals).

Buds, fruits and leaves (a)



Fruits and leaves (b)

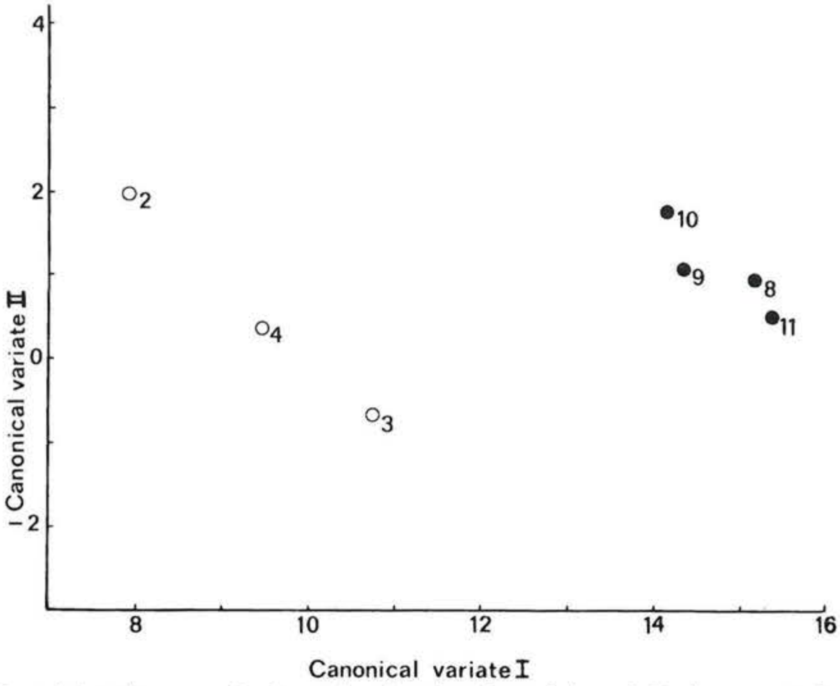


Figure 3. Canonical variate means for the analyses based on 7 populations of *Eucalyptus caesia* for (a) bud, fruit and leaf characters, and (b) fruit and leaf characters. The canonical vectors are standardized so that scores have unit variance within populations. Population identification is given in Table 1. o - subsp. *caesia*, ● - subsp. *magna*.

In the third set of analyses, populations are bulked into those of subsp. *caesia* and those of subsp. *magna* to examine subspecific relationships. The bulking is on the basis of *a priori* taxonomic judgements, complemented by the results from the first two sets of analyses.

Results

Univariate allocation of plants to subspecies. Means, pooled standard deviations and minimum/maximum values for all characters measured are given in Table 1. The best univariate discrimination between subspecies occurs for mid-fruit diameter, fruit top diameter, pedicel thickness, bud diameter and petiole length. The ranges of all characters overlap between the two subspecies (from 32% to 98%). Hence allocation of plants to subspecies on single measurements (using resubstitution calculations) is, at best, only 68% successful.

Multivariate analyses of fruit, leaf and bud characters. A preliminary canonical variate analysis was undertaken on those seven populations (Table 1) for which bud measurements, as well as fruit and leaf measurements, were available. The first canonical variate of this analysis accounts for 74.6% of the total population separation. It effectively separates populations of subsp. *caesia* from populations of subsp. *magna* (Figure 3a). Characters important in achieving this separation include fruit length, mid-fruit diameter, bud diameter and operculum length. Leaf length, petiole length and fruit top diameter are also important. Leaf width and hypanthium length make the least contribution to separation along this canonical variate.

A second analysis omitting bud characters results in a similar ordination of the seven populations (compare Figure 3b with Figure 3a). Total separation along the first canonical variate is reduced by only 13.1% of that achieved when bud measurements are included (canonical roots of 8.66 and 9.97 respectively for the two analyses). Consequently, no further analyses involving bud measurements are undertaken. This allows an additional six populations (for which no bud measurements were taken) to be included in the ensuing analyses.

Multivariate analyses of population divergence in fruit and leaf characters. An analysis of fruit and leaf characters for 13 populations again separates populations of subsp. *caesia* from populations of subsp. *magna* along the first canonical variate (76.6% of the total variation; Figure 4a). Characters important for separation of populations along this variate are mid-fruit diameter, fruit top diameter, fruit length, leaf length and petiole length. Deletion of the remaining three characters (pedicel length, pedicel thickness and leaf width) from a subsequent analysis reduces population separation along the first canonical variate by only 3.5% (canonical root of 6.12 compared with 6.34 when all eight characters are analysed). All of the five important discriminating characters except for fruit length have positive coefficients for the first canonical variate, indicating that size is important in discriminating between the subspecies. This is analysed further below.

Separate analyses of fruit characters and of leaf characters for the 13 populations (Figures 4b and 4c) result in similar ordinations of populations into the two subspecies along the first canonical variate. However, separation of populations in the fruit analysis along the first canonical variate is 57% of that achieved when fruit and leaf characters are analysed together. For leaf characters the separation achieved is 42%. Hence both the fruit and the leaf character subsets each make a significant contribution to the discrimination between the subspecies.

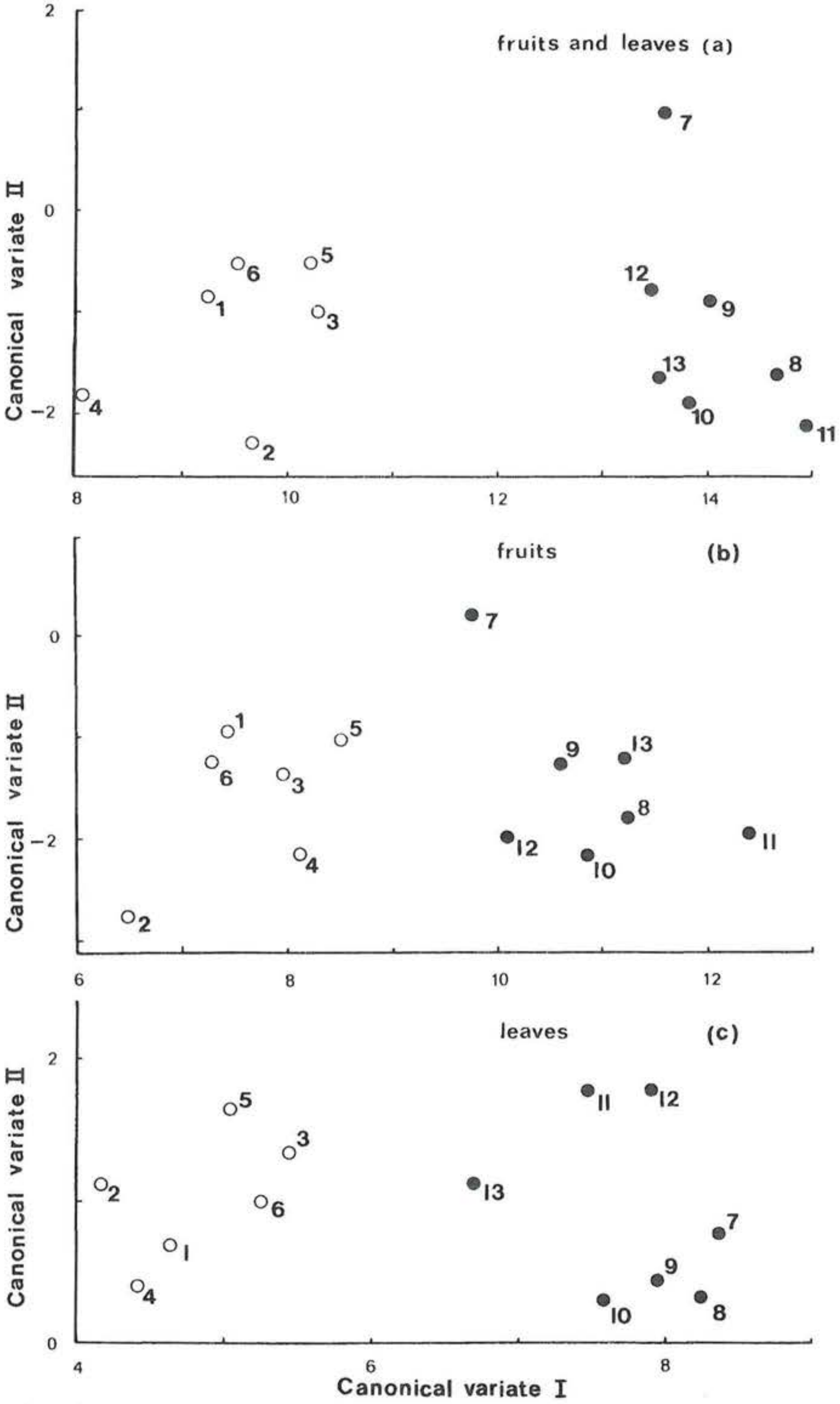


Figure 4. Canonical variate means for the analyses based on 13 populations for (a) fruit and leaf characters, (b) fruit characters and (c) leaf characters. The canonical vectors are standardized so that scores have unit variance within populations. Population identification is given in Table 1. o - subsp. *caesia*, ● - subsp. *magna*.

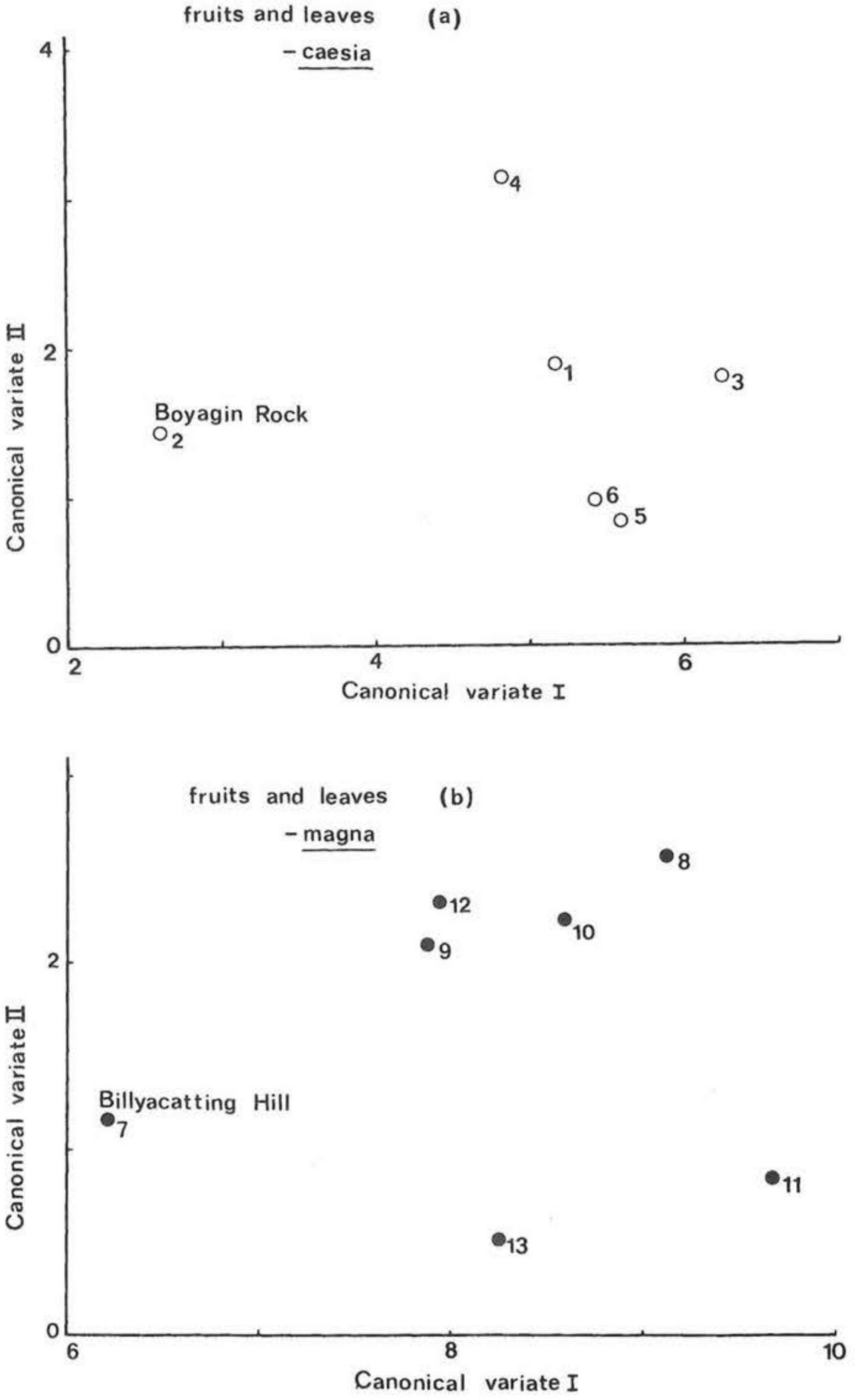


Figure 5. Canonical variate means for the analyses based on fruit and leaf characters for (a) subsp. *caesia* and (b) subsp. *magna*. The canonical vectors are standardized so that scores have unit variance within groups. Population identification is given in Table 1.

Analyses of populations of subsp. *caesia* and of subsp. *magna* by themselves (Figures 5a and 5b) show that in each case, discrimination is confined largely to the first canonical variate, with one population being separated from the rest. For subsp. *caesia* plants from the Boyagin population have longer narrower fruits, shorter pedicels and shorter leaves than those from other populations (Table 1). For subsp. *magna*, plants from Billyacatting Hill have smaller fruits on thinner pedicels and longer leaves than those from other populations.

Multivariate analyses of subspecific divergence. Previous analyses have shown that populations of the two subspecies are almost completely separated by a single canonical variate. In the following analyses, populations of each subspecies are pooled to allow for detailed investigation of size and shape differences between the two subspecies and to allocate individual plants to subspecies.

For two groups, canonical variate analysis becomes the traditional discriminant analysis of Fisher (1936). Table 2 gives standardized character coefficients and discriminant roots for analyses of the two subspecies of *Eucalyptus caesia* based on the five best discriminating characters identified above.

Figures 6a and 6b show probability plots of the Mahalanobis distances for the log-transformed data. The linearity of the plots for the two subspecies indicates good agreement with underlying multivariate Gaussian distributions.

The discriminant root for the analysis of the log-transformed data is 4.44 (that for the untransformed data is 4.80). Table 2 gives the corresponding discriminant vector. The discriminant root and vector for the size/shape partition based on the log data are also given in Table 2.

Table 2. Standardized character coefficients and discriminant roots for the size and shape analyses of the two subspecies of *Eucalyptus caesia*. Characters are denoted as: F1 — mid-fruit diameter; F2 — fruit top diameter; F3 — fruit length; L1 — leaf length; L3 — petiole length.

	Character coefficients					
	original data			log-transformed data		
		corrected for			corrected for	
	usual	isometry[a]	allometry[b]	usual	isometry[a]	allometry[b]
F1	0.23	0.28	- 0.14	0.32	0.48	0.06
F2	0.62	0.58	0.64	0.52	0.42	0.48
F3	- 0.15	- 0.95	- 0.91	- 0.15	- 0.97	- 0.92
L1	0.19	- 0.55	- 0.23	0.12	- 0.60	- 0.36
L3	0.62	0.64	0.64	0.64	0.68	0.74
discriminant root	4.80	1.28	1.18	4.44	1.27	1.01

[a] i.e. corrected for size — see Methods

[b] i.e. corrected for size and for size-related shape differences — see Methods.

The discriminant roots for the analysis of the isometrically-corrected and allometrically-corrected shape data are very similar. In each analysis, the shape discriminant vector results from a contrast between the fruit diameter and fruit length, and between the leaf length and petiole length. The fruits of subsp. *caesia* are narrower, relative to their length, than those of subsp. *magna*. The petioles of subsp. *caesia* are also shorter relative to leaf length than those of subsp. *magna*.

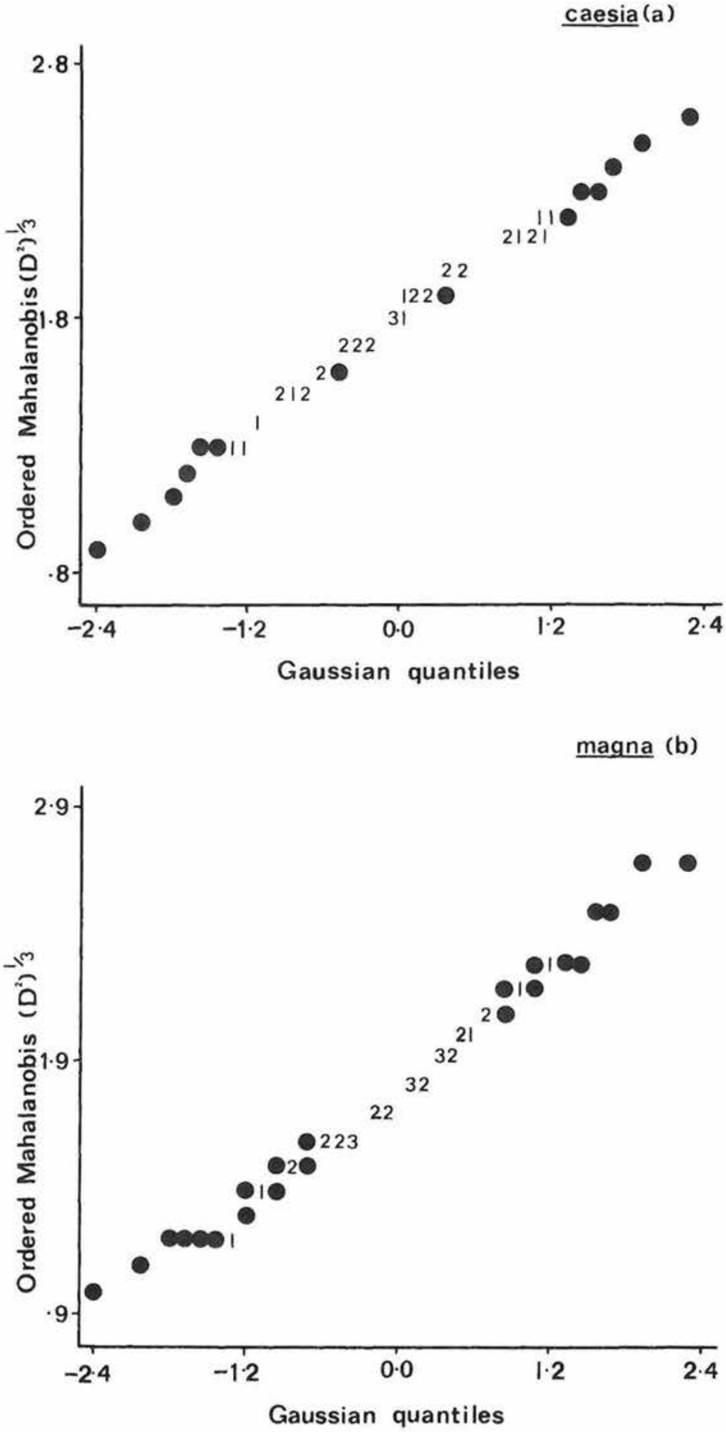


Figure 6. Q-Q plots of cube root of squared Mahalanobis distances against Gaussian quantiles for (a) subsp. *caesia* and (b) subsp. *magna*. Calculations are based on log data. Each dot represents one observation, while numbers represent the number of observations additional to the first that occur at the same position on the plot.

Size differences account for about 75% of the overall divergence between subspecies, with marked separation of populations of subsp. *caesia* from populations of subsp. *magna*. This marked separation is not evident for the shape vector, though the population means for subsp. *caesia* are smaller than those for subsp. *magna*. The nature of the shape vector contrasts with that of the overall vector; the latter has positive components for all but fruit length. Shape differences account for only about 25% of the overall divergence.

Multivariate allocation of plants to subspecies and their populations. Allocation of plants using Mahalanobis distances for the five best discriminating characters shows that only three individuals (2%) out of 138 are allocated to the wrong subspecies. All three occur in populations of subsp. *caesia* one from Yanneymooning Hill and the other two from Mount Stirling. The correct allocation of a further two plants (one each from the Billyacatting Hill and SW Chiddarcooping Hill populations of subsp. *magna*) is doubtful. Eleven plants are atypical for all populations but each is closer to its correct subspecies. Some plants are nominally allocated to other populations of their subspecies, but all are also typical of their own population.

The wrongly allocated plants are in this case also clearly identified by a visual appraisal of histograms of first canonical variate scores for each of the 13 populations included in the analysis of fruit and leaf measurements (Figure 7). The Yanneymooning Hill population differs from others of subsp. *caesia* in having several plants with fruits and leaves bordering on the size seen in subsp. *magna*. It also has plants typical of subsp. *caesia*. This range of variation is evident in the histogram of canonical variate scores in Figure 7.

Discussion

Success of the multivariate approach. This study demonstrates that two morphometrically distinguishable races exist in *Eucalyptus caesia*. A multivariate analysis of five characters (mid-fruit diameter, fruit top diameter, fruit length, leaf length and petiole length) results in only three (2%) of the 138 plants measured being allocated to the wrong subspecies. Such a low rate of misallocation justifies the formal recognition of the races as subspecies (Brooker and Hopper 1981).

The multivariate analyses have shown that most (c. 75%) of the differences between subsp. *caesia* and subsp. *magna* are related to size, with subsp. *magna* being larger in all measured dimensions. It also has been demonstrated that measurements taken on both fruits and leaves all make a significant contribution to the discrimination between the subspecies.

Measurements of individual characters show relatively poor discrimination between the two subspecies with, at best, only 68% of plants falling outside the subspecific range overlap for any single measurement. A multivariate approach to discriminate between subspecies is clearly necessary to improve on this situation.

We conclude that it is possible to distinguish reliably between subsp. *magna* and subsp. *caesia*, and that the gazettal of subsp. *magna* as rare under the Wildlife Conservation Act 1950-79 would not create an unworkable identification problem for officers of the Department of Fisheries and Wildlife who police the activities of commercial seed collectors. However, it is now clear that both subspecies require special legislative protection because of their rarity in the wild. This would alleviate any difficulties arising in those very few instances where the allocation of plants to subspecies by morphometric procedures is doubtful. The Western Australian Wildlife Authority has already accepted the latter proposal, and *Eucalyptus caesia* (together with 99 other taxa) was gazetted as rare on November 14, 1980 (Rye and Hopper 1981).

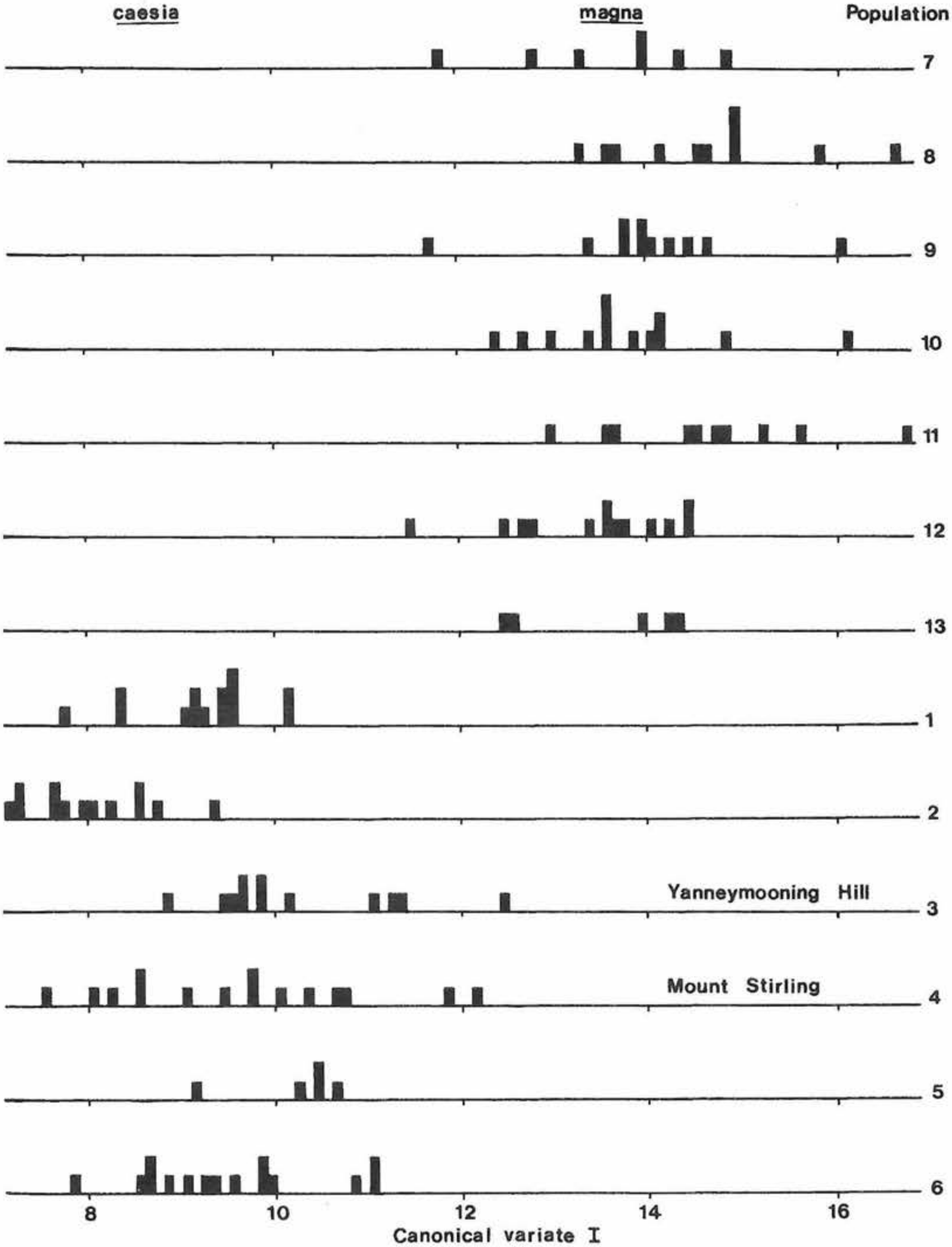


Figure 7. Histogram of scores for the first canonical variate for fruit and leaf measurements for all 13 populations. The canonical vectors are standardized so that scores have unit variance within groups. Population identification is given in Table 1.

Evolutionary aspects of geographical variation. Several lines of evidence suggest that subsp. *magna* was derived from ancestral populations resembling subsp. *caesia* rather than vice versa. Flowers and fruits smaller than those of *Eucalyptus caesia* are typical of most eucalypts, and are found in all its closest relatives in the subseries *"Orbifolinae"* (cf. photos in Chippendale 1973). Phylogenetic parsimony, therefore, would dictate that small flowers and fruits are closer to the ancestral condition in *Eucalyptus caesia* than are large flowers and fruits. Hopper and Burgman (1983) have confirmed this using cladistic techniques. Secondly, subsp. *caesia* has a much broader geographical distribution (Figure 1) and shows greater divergence between populations in allozyme frequencies (Moran and Hopper 1983) than does subsp. *magna*. The simplest explanation for these patterns is that subsp. *magna* has been in existence for a shorter period than subsp. *caesia* and, consequently, it has had less opportunity for population divergence and to expand its distribution from its point of origin.

The derivation of subsp. *magna*'s robust features from those of the ancestral subsp. *caesia*'s could have occurred under a number of selective regimes. Large woody fruits presumably provide increased protection to seeds from seed predators such as parrots. Woody fruits are also more resistant to fire than are non-woody fruits. Large flowers may increase the effectiveness of birds as pollinators and thereby maintain high levels of outbreeding (Hopper and Moran 1981). This would be of considerable importance to a species distributed in small isolated populations prone to genetic drift and inbreeding depression. Large leaves may increase photosynthetic and transpiration rates, favouring rapid growth in communities where fast regeneration from fires is a decided advantage. Further work is needed to determine which of these hypotheses is relevant to the origin of subsp. *magna*.

It seems likely that the Yanneymooning Hill population of subsp. *caesia* has been of fundamental importance in the origin of subsp. *magna* (Hopper and Burgman 1983). As shown in Figure 1, Yanneymooning Hill is geographically the closest population of subsp. *caesia* to populations of subsp. *magna*. Yanneymooning Hill is unusual among populations of subsp. *caesia* in having plants ranging from the typical morphology of this subspecies to a few approaching the large form of subsp. *magna*. Moreover, Moran and Hopper (1983) have shown that the Yanneymooning Hill population is exceptional in showing a greater allozymic similarity to populations of subsp. *magna* than it does to populations of subsp. *caesia*. Indeed, the Yanneymooning Hill population is more similar in its allozymes to the central core of subsp. *magna* populations than is the geographically-outlying Billyacatting Hill population of subsp. *magna*. We postulate that subsp. *magna* arose by the dispersal of seed to the Cooranooping Hill-Chiddarcooping Hill area from a large fruited plant in the polymorphic Yanneymooning Hill population.

If such a course of events led to the origin of *magna* why has further morphometric differentiation not occurred within the two subspecies? Their isolated and small populations appear to be ideal for genetic divergence through the operation of genetic drift and/or natural selection according to current evolutionary theory (Dobzhansky et al. 1977). This prediction is borne out by the pattern of allozyme divergence in the species (Moran and Hopper 1983). *Eucalyptus caesia* shows a fairly high level of divergence between populations in allozyme frequencies for a eucalypt. Its populations are characterised by many alleles that have reached complete fixation or extinction, a predictable feature of small populations undergoing genetic drift.

In contrast to this differentiated mosaic of allozyme variation, populations of *Eucalyptus caesia* are morphometrically stabilised as either subsp. *caesia* or subsp. *magna* (except for the Yanneymooning Hill stand). This morphometric stability must have a genetic base that is not influenced by genetic drift due to small population size. Carson's (1975) concept of a section of the genome closed to recombination and other factors generating genetic divergence may well explain this striking difference between morphometric and allozymic variation in the species. Alternatively, strong uniform selection may underlie the morphological stability of each subspecies. An experimental test of these contrasting hypotheses would be instructive.

Acknowledgements

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Eucalyptus stoatei as a subspecies of *Eucalyptus forrestiana*

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Abstract

Robinson, C. J. *Eucalyptus stoatei* as a subspecies of *Eucalyptus forrestiana*. Nuytsia 5(2): 195-200 (1984). Morphometric data were collected from specimens across the known ranges of *Eucalyptus stoatei* and *Eucalyptus forrestiana*. Phenetic and numerical cladistic analysis of these data revealed *E. stoatei* to be more closely related to *E. forrestiana* subsp. *forrestiana* than is subsp. *dolichorhyncha*. This fact, combined with the observation that *E. stoatei* was originally described without a complete knowledge of the variation of *E. forrestiana*, has resulted in *E. stoatei* being reduced to the rank of a subspecies of *E. forrestiana*.

Introduction

During a survey by the author in 1979 to determine the conservation status of *Eucalyptus forrestiana* Diels, subspecies *forrestiana* and subspecies *dolichorhyncha* Brooker, it was observed that toward the western extreme of the range (Beard 1973) the bud and fruit morphology became progressively similar to, if not indistinguishable from that of *E. stoatei* C. A. Gardner. This situation was highlighted further when Hopper and Moran (1981) mapped eight populations of *E. stoatei* inside the western edge of Beard's range for *E. forrestiana*. Previously *E. stoatei* was considered to occur some forty kilometres west, only in the immediate vicinity of Jerdacuttup River (Chippendale 1973). Within the horticultural industry there has been confusion between the two species.

Eucalyptus stoatei differs from *E. forrestiana* in having irregular ribs on the hypanthium between four wings. The wings of *E. stoatei* are only discernible at the base of the hypanthium, just below the point of pedicellar attachment, becoming indistinguishable from the ribs at the staminal rim. The operculum in both *E. stoatei* and *E. forrestiana* subsp. *forrestiana* is domed while that of *E. forrestiana* subsp. *dolichorhyncha* is narrowly elongate. When Gardner (1936) described *E. stoatei*, he was not familiar with *E. forrestiana* as described by Diels (1904). Gardner (1933) considered the form with a long rostrate operculum (later described as subsp. *dolichorhyncha* by Brooker (1973) to be typical *E. forrestiana* and that Diels had described an aberrant form or that the long operculum beak had apparently been lost from the type specimen. The operculum apex of subsp. *forrestiana* is usually naturally scarred which Gardner (1933) misinterpreted as a scar of detachment of the beak. It is not surprising, therefore, that Gardner considered *E. stoatei* to be sufficiently different from *E. forrestiana* to warrant the rank of species.

This paper reports an investigation into the taxonomic relationship of specimens collected across the continuous range of both *E. stoatei* and *E. forrestiana* (including subspecies).

Method

For morphometric analysis, eighteen characters (Table 1) from up to twenty individuals from twenty-three populations (Figure 1) across the combined ranges of *E. stoatei* and *E. forrestiana* were measured. The gap between populations 1 to 4 and population 5 is due to extensive clearing for agriculture. The data were range coded (Hopper and Burgman 1983, p.37) and subjected to computer programs for:

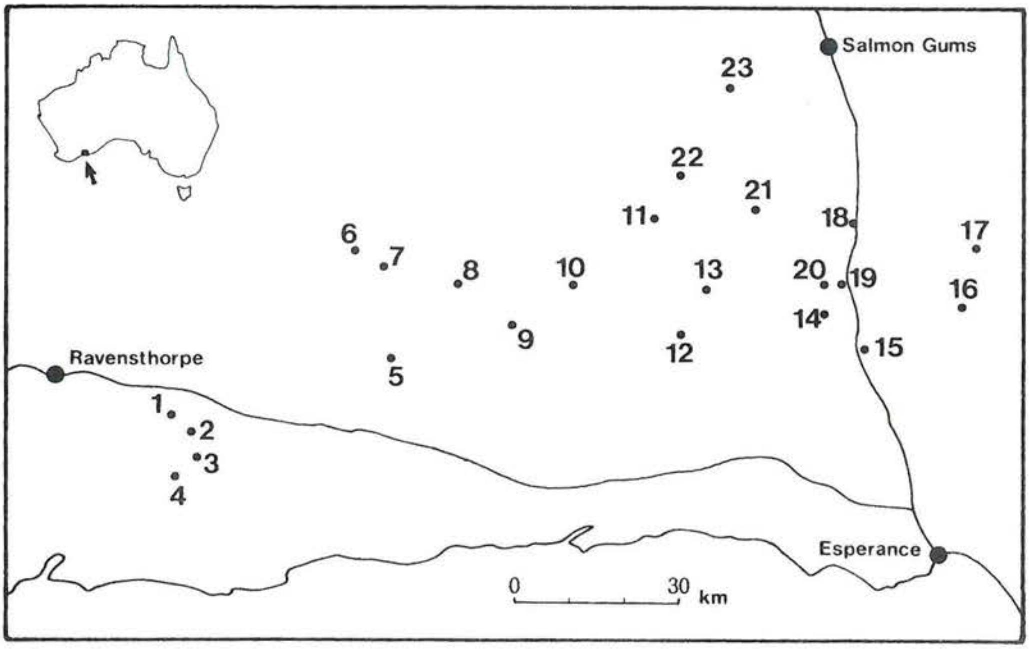

Figure 1. Map showing the locations of the numbered populations of *Eucalyptus forrestiana* s. lat.

1) phenetic analysis: the Euclidian distance measure was calculated between populations and a phenogram (Figure 2) was constructed using the WPGMA algorithm (Hopper and Burgman 1983, p.41).
2) numerical cladistic analysis: a Wagner network (Figure 3) was constructed using the shortest length approach (Hopper and Burgman 1983, p.37). The tree was rooted at the midpoint between the two most distant populations, which assumes rates of evolution are approximately equal along the two phyletic branches.

Leaf venation and seed characters were compared between all populations. Seeds from each population were germinated to compare cotyledon morphology. A voucher specimen from each population is lodged at PERTH.

Results and discussion

Phenetic analysis (Figure 2) separated the populations with grossly elongated opercula (i.e. *Eucalyptus forrestiana* subsp. *dolichorhyncha)* at a greater level of dissimilarity from all other populations. The remaining populations are separated into two further groups. The smaller group (populations 1 to 7) include populations from the Jerdacuttup River area and those further to the north east which Hopper and Moran (1981) considered to be *E. stoatei.* The remainder are populations of *E. forrestiana* subsp. *forrestiana.*

Numerical cladistic analysis (Figure 3) has resulted in a Wagner tree rooted such that the left and right branches contain approximately equal numbers of populations (eleven and twelve respectively). Populations from the range of *Eucalyptus stoatei* are at one branch end, whilst populations of *E. forrestiana* subsp. *dolichorhyncha* terminate the other. Populations of *E. forrestiana* subsp. *forrestiana* are spread evenly either side of the root. This suggests that both *E. stoatei* and *E. forrestiana* subsp. *dolichorhyncha* are monophyletic taxa with putative ancestors within *E. forrestiana* subsp. *forrestiana.*

Both the phenetic and cladistic analyses show *Eucalyptus stoatei* to be either more closely or equally related to *E. forrestiana* subsp. *forrestiana* than subsp. *dolichorhyncha.* No qualitative differences were observed in leaf venation, seed characters or seedling morphology.

It is apparent that all three taxa should have equal status. The rank of subspecies is appropriate since this study has revealed a species with a continuous range, without major topographical disjunction (excepting areas cleared for agriculture) over which minor morphological variation is maintained. Within the species range, three major groups (subspecies) are recognised and these are clearly linked by continuous intergradation. In the light of these results, plus the misinterpretation by Gardner (1933) of the nature of the operculum of typical *Eucalyptus forrestiana*, it is appropriate to reduce *E. stoatei* to the rank of a subspecies of *E. forrestiana*. The change is here effected:

Eucalyptus forrestiana subsp. **stoatei** (C. A. Gardner) C. J. Robinson comb. et stat. nov. Basionym: *E. stoatei* C. A. Gardner, J. Roy. Soc. W. Austral. 22: 126 (1936).

Obvious characters for distinction between the subspecies in the field are operculum length, rib number, rib depth, wing depth and leaf width. Subspecies *dolichorhyncha* has an elongated operculum (c. 20 mm long), no ribs, well developed bud wings (4-5 mm) and narrow leaves (17-20 mm wide). Subspecies *forrestiana* has a domed or bluntly pointed operculum (7-10 mm long), up to three or four poorly developed bud ribs (1-2 mm) between moderate wings (3-4 mm). The leaves are 20-25 mm wide. Subspecies *stoatei* has a similar operculum to subsp. *forrestiana,* but with 6-10 well developed ribs (3 mm) between wings of the same size and appearance as the ribs. The leaves of subsp. *stoatei* are broad (25-30 mm) and often shorter (65 mm) than the leaves of the other two subspecies (70-75 mm).

The three subspecies are geographically based with subsp. *stoatei* occupying the western part of the range, subsp. *forrestiana* the central and eastern part, and subsp. *dolichorhyncha* the northern fringe. Gradation between subspecies is illustrated in Figure 4, which clearly shows intermediate forms. The general habit of all subspecies is identical and all grow on sandy or gravelly clay over a clay subsoil.

Table 1. Characters measured for morphometric analysis.

Bud	Fruit	Leaf
peduncle length	no. ribs to staminal ring	thickness
hypanthium length	no. ribs to hypanthium shoulder	lamina length
operculum length	hypanthium length	lamina width
no. ribs to staminal ring	wing depth	petiole length
no. ribs to hypanthium	no. locules	
shoulder	staminal ring diameter	
wing depth		
rib depth		
operculum diameter		

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M. I. H. Brooker and M. A. Burgman provided valuable comments on a draft manuscript. Burgman also assisted in the data processing and interpretation. The Western Australian Department of Fisheries and Wildlife provided facilities for field work and access to their mini computer. Field assistance was provided by R. B. Allen, J. M. Brown and G. J. Keighery. A. J. M. Hopkins gave logistic support and general encouragement.

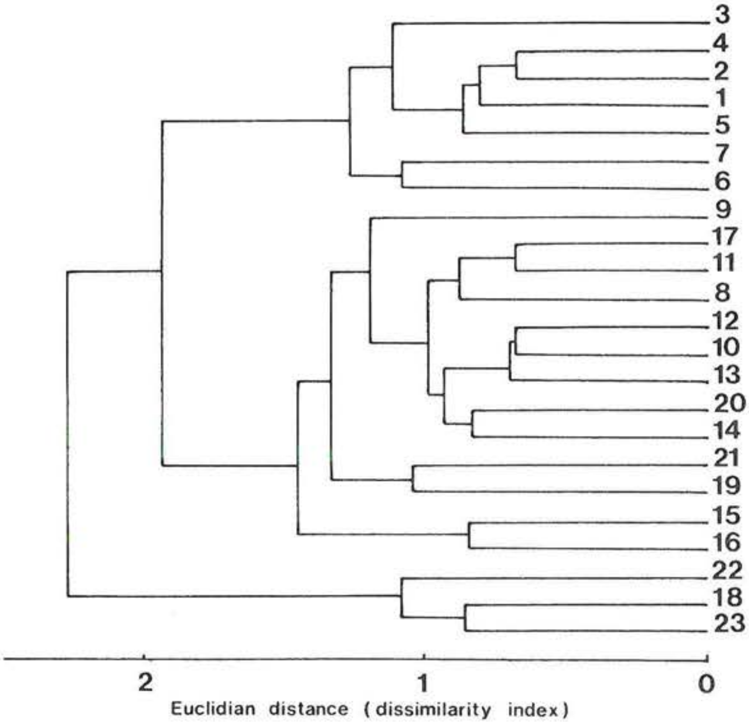

Figure 2. Phenogram of the numbered populations of *Eucalyptus forrestiana* s. lat.

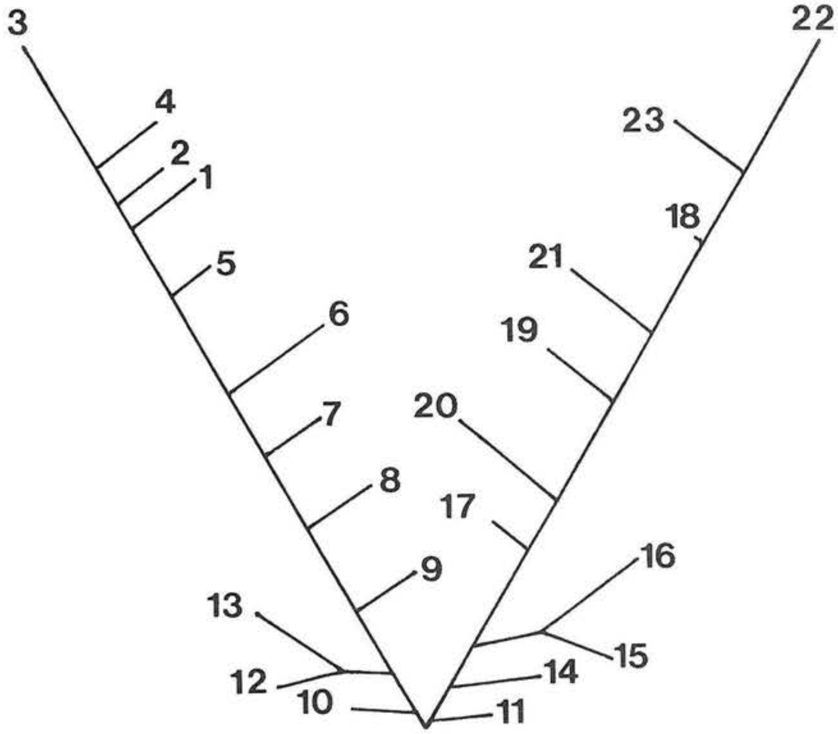

Figure 3. Wagner tree of the numbered populations of *Eucalyptus forrestiana* s. lat.

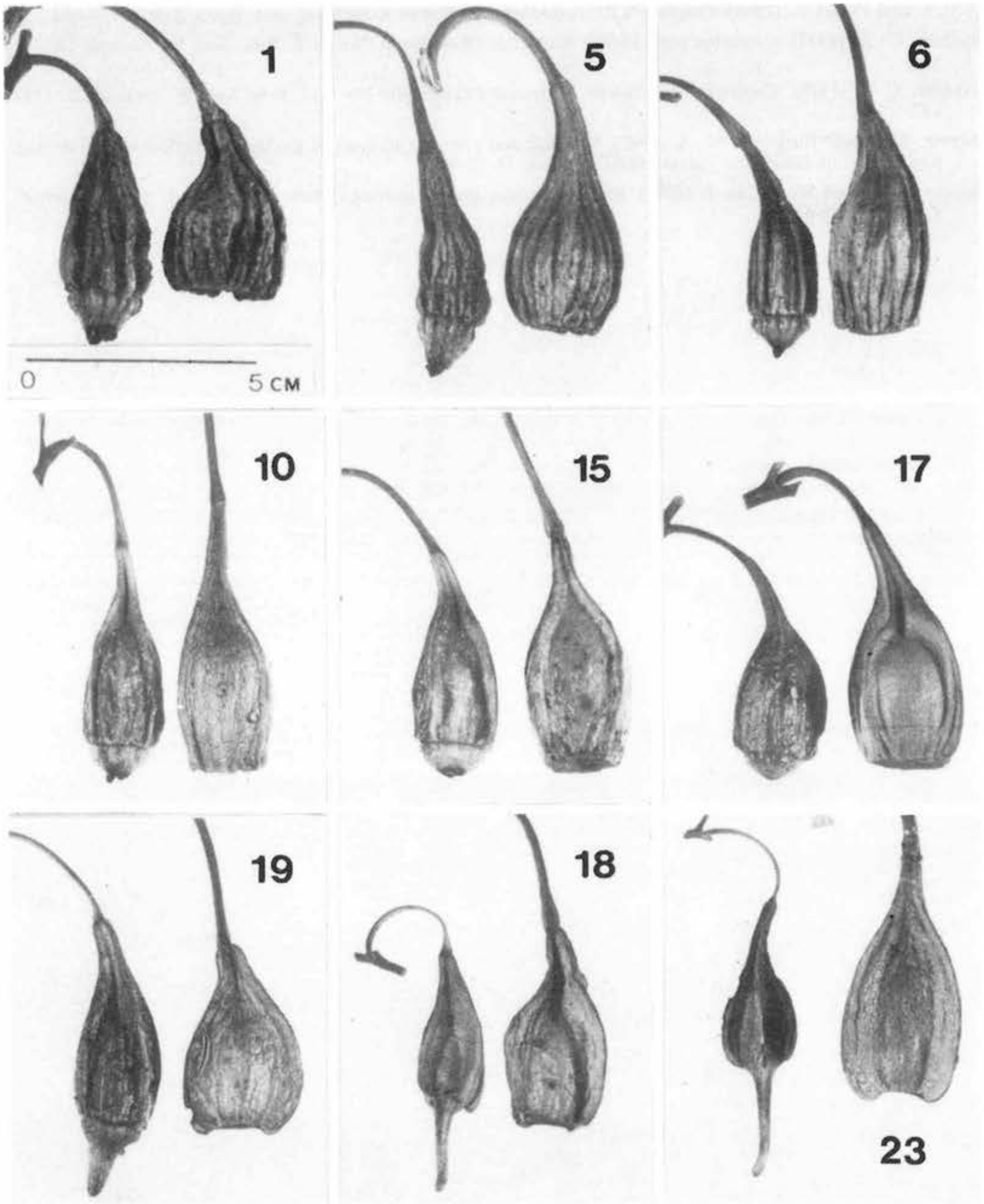

Figure 4. Bud and fruit pairs, each pair representing one of the numbered populations of *Eucalyptus forrestiana* s. lat.

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Revision of the Australian genus *Lawrencia* Hook. (Malvaceae: Malveae)

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Abstract

Lander, N. S. Revision of the Australian genus *Lawrencia* Hook. (Malvaceae: Malveae). Nuytsia 5 (2): 201-271 (1984). *Lawrencia* Hook. (including species formerly placed in the genus *Selenothamnus* Melville) is revised. The genus contains 12 species; four of these are described for the first time: *L. buchananensis* from north-eastern Queensland, *L. viridi-grisea* from Western Australia and the Northern Territory, and *L. chrysoderma* and *L. cinerea* which are both endemic to Western Australia. A new infrageneric classification is presented and its taxa described. Each species is fully described; its distribution, habit and flowering period are indicated where appropriate; its conservation status is assessed. Several species are illustrated. A key to infrageneric taxa and species of *Lawrencia* is provided. The comparative morphology of the genus is discussed and related to that of the tribe Malveae in general and the *Plagianthus* alliance in particular. It is suggested that dioecy in the genus has evolved in response to pollinator-mediated selection. The dispersal mechanisms of species of *Lawrencia* are discussed. It is hypothesized that the genus had a littoral origin where its initial diversification occurred followed by dispersal to the margins of inland salt lakes, further diversification and colonization of the arid zone. *Plagianthus monoicus* Helms ex Ewart is excluded from the Malvaceae and synonymized with *Ricinocarpos velutinus* F. Muell. (Euphorbiaceae).

Contents

Introduction

The taxa considered in this study are Australian members of the so-called *Plagianthus* alliance in the tribe Malveae of the family Malvaceae (Bates 1968). In the last definitive treatment of this group, Melville (1966) distributed its species amongst six genera. Perhaps because of the limited material at his disposal, Melville's generic descriptions are rather brief and provide an insufficient basis for more than a superficial comparison of morphological features or for proper circumscription of his taxa. Species descriptions were not presented by Melville. The lack of effective keys together with the presence in Australia of several hitherto unrecognized species has led to much confusion in herbarium collections.

The present revision is based on a reassessment of morphological characters of species previously consigned to the genera *Lawrencia* and *Selenothamnus*. Despite considerable variation in habit, trichome type, sexuality and fruit and seed morphology, it is considered that the division between *Lawrencia* and *Selenothamnus* can no longer be upheld and that the 12 species concerned are best placed in a single genus. Although clearly delimitable groups emerge, these do not correspond to previous generic concepts, nor does the evidence seem strong enough to support their recognition at generic level. A possible exception is *L. berthae*, a species so much at variance morphologically with those remaining in the genus that a strong case could be made for its segregation. This has been deferred pending further investigation of the genera of the *Plagianthus* alliance.

Taxonomic History

The genus *Lawrencia* was erected by Hooker (1840) to accommodate a single species, *L. spicata*, specimens of which had been sent to him from Tasmania by Ronald Gunn. Hooker (1842) described a second species, *L. glomerata*, sent to him from Western Australia by James Drummond. A third species, *L. squamata*, was added to the genus by Miquel (1845).

Bentham (1862) united under *Plagianthus* J. R. & G. Forst. (1776) non Jaub. & Spach (1845) species variously placed until that date in *Asterotrichion* Klotzsch, *Blepharanthemum* Klotzsch, *Halothamnus* F. Muell., *Hoheria* A. Cunn, *Lawrencia* and *Plagianthus*. This action was followed by subsequent authors, including Bentham in Bentham & Hooker (1862), Bentham (1863), Baker (1892), Schumann (1890), Dalla Torre & Harms (1900-7), Lemeé (1934) and Burbidge (1963). Several new species of *Plagianthus* sensu lato were described during this period.

In January of 1909, O. Stapf exhibited specimens and lantern slides of *Plagianthus helmsii* to members of the Linnean Society of London pointing out that it appeared more natural to him to treat that species together with *P. microphyllus* and *P. squamatus* as members of a distinct genus for which F. Mueller's name *Halothamnus*, orginally applied to *P. microphyllus*, would have to stand (Anon. 1909). Amongst those participating in the ensuing discussion were E. G. Baker and T. A. Sprague.

Sprague and Summerhayes (1926) examined the New Zealand representatives of *Plagianthus* sensu lato which they assigned to two genera, *Plagianthus* sensu stricto and *Hoheria*, noting in passing that the Australian species of *Lawrencia* and *Halothamnus* should be excluded from *Plagianthus*.

In the late 1930s, E. G. Baker prepared the draft for a paper which described three putative new species of *Lawrencia* and provided a partial key to the genus. From his draft it is clear that Baker intended to reinstate the genus *Lawrencia*. It is worthy of note that *Plagianthus berthae* and *P. helmsii* were excluded from consideration, although the significance of this is not explained. Copies of his unpublished manuscript are held at BM and PERTH. Baker annotated specimens held at BM, K and PERTH.

In a more comprehensive study of the *Plagianthus* complex, Melville (1966) divided its species amongst six genera. In particular, species placed by Bentham (1862) in *Plagianthus* section *Lawrencia* were now allocated to two separate genera, namely *Lawrencia* sensu stricto and *Selenothamnus*, founded, as Stapf had originally suggested, on Mueller's

Halothamnus, first described in 1862. These two genera were distinguished by Melville on the basis of differences in habit, vestiture and the nature of the thickening of the mericarp walls. Melville's classification was adopted by Hutchinson (1967), Baines (1981) and Mitchell (1983). In his review of generic relationships in the tribe Malveae of the Malvaceae, Bates (1968) declined to comment on Melville's realignment of the *Plagianthus* complex, although he accepted it as one of his informal sub-tribal alliances, the *Plagianthus* alliance.

Barker (1981) drew attention to the overlapping of Melville's floral diagnostic characters and questioned the separation of *Selenothamnus* and *Lawrencia.*

Materials and Methods

The taxonomic decisions made in this paper were based upon a study of the gross morphology of all available herbarium specimens examined at or loaned by the major Australian and relevant British herbaria, and on collection and field observation of species present in Western Australia. The methods and procedures adopted were those summarized by Leenhouts (1968). Measurements listed are based upon the total variation observed in the herbarium specimens cited at the end this paper.

The total geographic range of *Lawrencia* illustrated in Map 1 and the distribution of all the species in Maps 3-8 respectively were compiled by recording their occurrence in one degree squares superimposed on a Bonnes Equal Area Projection of Australia or on a Lambert Zenithal Equal Area Projection of Western Australia where a species is confined to that state. In the taxonomic treatment that follows, the distribution of each species is indicated by reference to the maps and to the geographical sub-divisions generally adopted by botanists in each state, namely Anon. (1972) for Queensland, Anon. (1979) for South Australia, Beard (1980) for Western Australia, Beauglehole (1980) for Victoria, Chippendale (1971) for the Northern Territory, and Pickard & Dlugaj (1981) for New South Wales. There is no comparable treatment of Tasmania.

A complete list of herbarium specimens examined and annotated in the course of this study is provided in abbreviated form at the conclusion of this paper. The more detailed lists in the following taxonomic treatment are intended primarily to permit the location of populations at sites throughout the range of each species. With the exception of *Lawrencia viridi-grisea,* all available specimens of species newly described here are cited in full. Localities given in single inverted commas are pastoral stations. In the absence of a collector's number the date of collection is cited where available; herbarium register or sheet numbers are cited only in otherwise ambiguous cases.

I regret to have to report that all the specimens, including types, from both the National Herbarium of Victoria (MEL) and the Tasmanian Herbarium (HO) cited in this paper were destroyed when the truck returning loan material to their home states left the road and caught fire. Fortunately, all the type specimens involved are represented either by isotypes or syntypes elsewhere. In the text, recently distributed duplicates not involved in this accident are indicated by an asterisk. A comprehensive list of all the destroyed specimens with localities, collectors' names and dates of gathering, together with an indication of available duplicates may be found in Lander (in press).

Comparative Morphology

This section is concerned with comparative aspects of morphology rather than attempting to provide an exhaustive account of the morphology of *Lawrencia.* Emphasis is placed on the range of variation of significant morphological patterns common to all members of the genus. The morphological traits considered here provide a basis for the ensuing classification of *Lawrencia* and for the general discussion of their taxonomic and evolutionary significance which follows the formal taxonomic presentation.

Habit and duration. The branching pattern of *Lawrencia* is monopodial. In the seedling stage all species produce a single actively growing main stem. The main axis of the young plant normally soon loses its dominance and several to many primary branches, often basal, achieve the same stature. Secondary branching is particularly frequent as the inflorescences are produced and during the second year.

Six species are suffrutescent: *Lawrencia diffusa* is diminutive and prostrate, *L. repens* is decumbent, *L. densiflora* (Figure 6A), *L. cinerea, L. glomerata* (Figure 4) and *L. spicata* (Figure 3) are conspicuous, erect sub-shrubs. The herbaceous stems of these species become soft-woody with age. Occasionally, such plants die back or are burnt or grazed back to a ligneous branched caudex at ground level from which new growth is initiated.

The remaining six species are small shrubs which may be weakly ascending little-branched plants, such as *Lawrencia buchananensis* and *L. viridi-grisea* (Figure 5), or divaricate shrubs, such as *L. berthae* (Figure 2A) and *L. squamata.* In *L. helmsii* and, to a lesser extent, in *L. chrysoderma* (Figure 7A) marked contracton of densely ramulose secondary stems gives the plants their distinctive appearance. Shrubby species normally produce new growth from erect woody stems.

Although various species of *Lawrencia* have been reported on labels of some herbarium specimens to be annual, it appears that all species are perennial, the few instances of annual duration being attributable to the plants flowering in their first year. All of the taxa observed in the field appear to reach reproductive maturity in their first year with adequate rainfall.

Thorns. All but one species of *Lawrencia* are unarmed. Specimens of *L. squamata* often have prominent thorns. These are tapered, depauperate branches.

Vestiture. Variation in trichome types and their distribution is invaluable in recognizing taxa at all levels in *Lawrencia.* In this genus, as in many others in the tribe Malveae, the usual multiradiate stellate hair of the Malvaceae has apparently been modified to produce a wide range of forms which grade imperceptibly into one another.

The commonest hair type encountered is represented by the haplomorphic (multiangulate), multicellular stellate hairs found in all species with the exception of the glabrous *Lawrencia spicata* and glabrous plants of *L. diffusa* and *L. glomerata.* Haplomorphic stellate hairs (Figure 1A) are the predominant hair type found in *L. berthae, L. cinerea, L. densiflora, L. diffusa, L. glomerata* and *L. repens* in which they occur on stems, stipules, leaves and the abaxial surfaces of calyces, invariably in conjunction with bifurcate and simple hairs into which they merge.

Haplomorphic stellate hairs are found on the abaxial surfaces of petals in *Lawrencia cinerea, L. densiflora* and *L. glomerata.* They are present to a lesser extent on all other pubescent species of *Lawrencia,* although nearly lacking in some.

On the stems, petioles and peduncles of *Lawrencia berthae,* haplomorphic stellate hairs are often distinctly raised on wart-like mounds of epidermal and possibly sub-epidermal tissue thus forming tufted stellate hairs (Figure 1D), a phenomenon observed in no other species of *Lawrencia.* Haplomorphic stellate hairs are also found in *L. berthae* at the junction of the style branches and on the surface of the pericarp.

Actinomorphic (flattened radiate), multicellular stellate hairs with more or less basally coalescent rays on a multicellular base or stalk (Figure 1E) are the predominant hair type found in *Lawrencia viridi-grisea* and in many populations of *L. squamata.* In these species, such hairs are found on stems, stipules, leaves and the abaxial surfaces of calyces, occurring

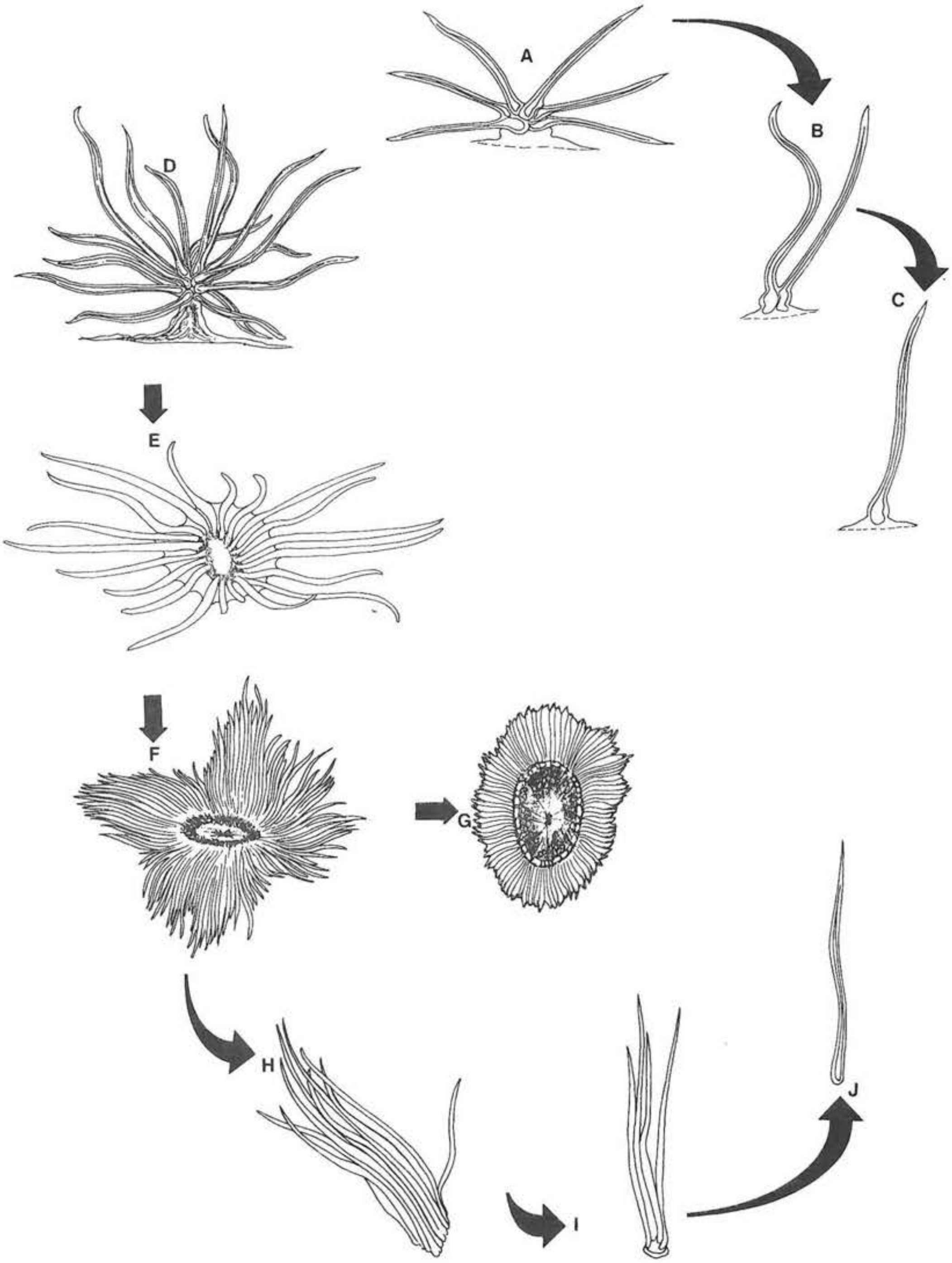


Figure 1. Elaboration and reduction of stellate hairs in *Lawrencia.* A — Unspecialized haplomorphic stellate hair of *L. densiflora.* B — Reduction: birfurcate hair of *L. densiflora.* C — Simple hair of *L. densiflora.* D — Multiplication of rays: haplomorphic stellate hair with raised base *L. berthae.* E — Plantation and reorientation: actinomorphic stellate hairs of *L. viridi-grisea.* F — Coalescence of rays: fimbriate peltate scale of *L. chrysoderma.* G — Entire peltate scale of *L. helmsii.* H — Reduction and reorientation: palmate scale of *L. chrysoderma.* I — Palmate scale of *L. chrysoderma.* J — simple hair of *L. chrysoderma.*

in conjunction with haplomorphic stellate, bifurcate and simple hair types into which they merge.

Actinomorphic stellate hairs are present to a lesser extent in *Lawrencia buchananensis* in which they occur in conjunction with peltate scales and bifurcate and simple hair types.

Bifurcate and simple hairs (Figure 1B, C & J) are found to some degree in all pubescent species. They are often the dominant hair types present on stipules, but can be readily observed on the margins of leaves and calyx lobes. Intermeshing simple hairs are often found at the base of the petals of male flowers of *Lawrencia berthae*.

Minutely fimbriate or entire multicellular peltate scales (Figure 1F & G) are the predominant trichome type found in *Lawrencia buchananensis, L. chrysoderma* and *L. helmsii,* and in many populations of *L. squamata.* Such trichomes may cover stems, stipules, leaves and the abaxial surfaces of calyces. In *L. buchananensis,* peltate scales occur in conjunction with stellate, bifurcate and simple hair types into which they merge. In the three other species with peltate scales, these occur in conjunction with palmate scales, and stellate, bifurcate and simple hair types into which they merge.

Bract-like palmate scales (Figure 1H & I) are found on *Lawrencia chrysoderma, L. helmsii* and *L. squamata* in which they often dominate the vestiture of stems and branches, extending onto the basal portion of stipules and leaves where they can clearly be seen to merge into peltate scales.

Glandular hairs (Figure 2I) are found only in the sepaline nectaries of *Lawrencia berthae* (see below).

In some forms of *Lawrencia glomerata,* in most populations of *L. diffusa,* and in all of *L. spicata,* all vestiture has been lost. In other taxa the above-ground vegetative and reproductive parts are variously clothed. Thus the vestiture gives the plants or plant parts their characteristic textures: smooth and glabrous, scabrous, velvety or shiny and armour-like. Most of the trichomes are colourless, vitreous and rigid at maturity; none can penetrate skin.

Leaves. As in many genera of the Malvaceae, the leaves of *Lawrencia* are spirally disposed, stipulate, petiolate, subsessile or sessile, and have actinodromous venation. Although spirally arranged, reduction and contraction of lateral branches, observed to a greater or lesser extent in all species, often results in the leaves appearing fasciculate, sometimes densely so. The leaf form varies according to the taxon and placement on the stem.

All species bear persistent, paired lateral stipules which are shortly adnate to the base of the petiole, or to the base of the leaf blade of sessile leaves, and appressed to the stem or slightly reflexed. These stipules are translucent and colourless, or opaque and brown or pale green, membranous, succulent and leaf-like, or dry and spongy. They may be filiform, triangular, elliptic, obovate or sub-orbicular in shape. They are minute or conspicuous, 0.4-10.0 mm long x 0.2-3.6 mm wide at the base, and symmetrical or somewhat falcate. Their margins are entire or more or less ciliate and they are apically acuminate, acute or obtuse. Their vestiture resembles that of the stem and leaves, but there is often a greater frequency of simple and bifurcate hairs as is noted above. With the exception of *L. spicata* and glabrous plants of *L. glomerata,* both abaxial and adaxial stipule surfaces are usually hairy, but the adaxial surface is typically less densely hairy and often glabrous or nearly so. Stipules may be rather variable in any one species.

By virtue of their presence or absence, length, cross-sectional outline and vestiture the petioles of *Lawrencia* are of considerable diagnostic value. The leaves may be distinctly petiolate throughout as in *L. diffusa* and *L. repens,* or else distinctly petiolate basal leaves merge into subsessile or sessile floral leaves as in *L. berthae, L. cinerea, L. densiflora, L. glomerata, L. spicata* and *L. viridi-grisea,* or the leaves may be more or less subsessile throughout as in *L. buchananensis* or sessile throughout as in *L. chrysoderma, L. helmsii* and *L. squamata.* Petioles may exceed the leaf blade by as much as four times, notably in *L. spicata.*

The petioles are basically triquetrous in cross-section. Those of *Lawrencia berthae* and *L. viridi-grisea* are triquetrous throughout. Whilst mostly triquetrous, those of *L. densiflora* and *L. glomerata* are often canaliculate; in the latter species they are often quite flattened. Those of *L. diffusa* and *L. repens* are canaliculate throughout, becoming flattened only towards the base. In *L. spicata* the petioles are either triquetrous or else somewhat swollen and hence trigonal. The latter tendency is most pronounced in *L. cinerea* in which the petioles are semiterete throughout.

Leaf blades of *Lawrencia* are symmetrical and variously linear, elliptic, cuneate, deltoid, spathulate, obovate, ovate or orbicular in outline, with the size range 1-70(115) mm long x 0.7-35(60) mm wide in size. In most species the blades are flat, but in *L. chrysoderma* (Figure 7B), *L. cinerea* and *L. helmsii* they are more or less conduplicate throughout. In *L. squamata* the leaf blades may be flat or conduplicate. The blade-bases are variously cuneate, acute, obtuse, truncate or cordate. The blade margins may be entire, shallowly lobed or more or less coarsely dentate. In general, they are entire towards the base of the blade with shallow lobing or toothing becoming prominent and more frequent towards the apex. A notable exception to this is *L. cinerea* in which the blade margin is dentate throughout. The blade apices may be acute, obtuse, rounded or truncate; they are often lobed.

Leaf venation is actinodromous in *Lawrencia.* The mid-vein is the most strongly developed and there are 1-3 additional pairs of veins radiating from the base of the blade. These primary veins extend towards the margins, often terminating in marginal lobes or teeth. Secondary veins branch from the primary veins and may also terminate in lobes or teeth. Smaller reticulate veins occur throughout the remainder of the leaf blade. The primary veins are sometimes completely obscure, sometimes indistinct, sometimes conspicuously raised on the abaxial surface of the blade and slightly impressed above in both fresh and dry specimens.

The leaves of several species of *Lawrencia* exhibit heteroblastic development. This phenomenon was observed in *L. cinerea, L. densiflora* (Figure 6A), *L. glomerata* (Figure 4), *L. repens, L. spicata* (Figure 3) and *L. viridi-grisea* (Figure 5). In these species the leaves vary in their degree of petiolation and their blade size and shape corresponding to their placement on the plant. Mature vegetative leaves produced on the primary stems during periods of most active growth are distinctly petiolate, the blades are at their largest, and lobing or toothing of the margins is at its maximum extent. In comparison, leaves produced on primary stems later in the season or on lateral branches have shorter petioles and their blades are smaller and narrower with marginal lobing or toothing reduced in prominence and frequency, particularly towards the base. The final leaves produced with the flowers are usually subsessile or sessile and their blades are by far the smallest on the plants with lobing or toothing highly reduced, often confined to the apical region. These tendencies are most dramatically expressed in *L. spicata* (Figure 3), most subtly in *L. repens.*

Heteroblastic leaf-development was not observed in the remaining species in all of which the leaves are more or less uniform throughout in any one plant. The leaf blades of all but one of the species without developmental heterophylly lack marginal lobes or teeth, the only exception being certain populations of *L. squamata* in which they are 3-5-dentate towards the apex.

Inflorescences. Like other genera in the tribe Malveae, inflorescence patterns in *Lawrencia* are rather plastic and hence easily modified according to the age and vigour of the individuals. Thus, inflorescences often exhibit striking differences in expression when compared at different stages of development, even on a single plant.

With the exception of a single species, the flowers of *Lawrencia* are subsessile or sessile, solitary, born in the axils of leaves and their associated stipules. Flowers produced later in the season are often congested towards the stem apices. In many species reduction of floral leaves and of the internodes produce terminal and axillary sub-spicate inflorescences. Further reduction of axillary sub-spicate inflorescences located in the upper part of the plant results in the congested terminal spicate inflorescence observed in fully mature individuals of *L. densiflora, L. glomerata* and *L. spicata* (Figure 3), as indeed the names of these species suggest. In all of these species each flower is subtended by a single leaf.

One species is exceptional: the flowers of *Lawrencia berthae* are long-pedicellate. The first flowers are borne near the base of the plant and are usually solitary in the leaf-axils, but later in the season they are borne in axillary fascicles of 2-5 subtended by a single leaf (Figure 2A).

Flowers. An epicalyx is lacking in all species of *Lawrencia.* Peculiarities of calyx, corolla, androecium and style morphology are discussed below.

It is worth noting at the outset that three stages of sexual differentiation are found in *Lawrencia:*

1. Hermaphroditism: flowers of all plants bisexual. This condition is found in *L. buchananensis, L. diffusa, L. repens, L. spicata* (Figure 3) and *L. viridi-grisea.*

2. Polygamodioecy: flowers of male plants with larger spreading calyx and corolla and a sterile vestigial gynoecium; flowers of female plants with smaller erect calyx and corolla, with or without sterile anthers; flowers of bisexual plants with erect calyx and corolla, as large as those of males or almost so, with fertile anthers and gynoecium. This condition is found only in *L. glomerata.*

3. Complete dioecy: flowers of male plants with larger spreading calyx and corolla, either lacking gynoecium or with a sterile vestigial gynoecium; flowers of female plants with smaller erect calyx and corolla, with or without sterile anthers. This condition is found in *L. berthae* (Figure 2B & C), *L. chrysoderma* (Figure 7C, D & F), *L. cinerea, L. densiflora* (Figure 6B, D & E), *L. helmsii* and *L. squamata.*

All bisexual flowers of *Lawrencia* are protandrous. The style branches are closely appressed in early flower and are exserted from the filament tube. Anther dehiscence occurs well before the stigmas separate and become receptive. As the flower begins to wilt the style branches reflex into the anther cluster: it is thus theoretically possible for self-pollination to occur at this stage.

Calyx. The persistent calyx in *Lawrencia* is composed of five sepals that are plicate and valvate in bud and connate for part of their length. At anthesis the basal united portion is turbinate or broadly to very broadly obconic; the lobes are flat, erect, narrowly to broadly triangular, and obtuse, acute or acuminate, and they lack accessory teeth.

The calyces range from 1.5-4.8 mm in length from pedicel to lobe apex. Species may sometimes be distinguished on the basis of calyx length alone. For example, *Lawrencia viridi-grisea* has calyces 3.8-5.3 mm long and *L. buchananensis* has calyces 7.0-10.0 mm long. Since the range in calyx length in most species overlaps either in whole or part that in other species, size alone is of limited use diagnostically.

The degree of fusion of the sepals varies widely between species, ranging from 1/4-9/10 their length. The extent of overlap is so great that this character also is of little value diagnostically. However, it is usually possible to separate *Lawrencia densiflora,* with its sepals connate 1/2-4/5 their length, from *L. repens,* with its sepals connate 1/4-1/2 their length.

In dioecious species there is a significant difference in both the calyx length and the degree of connation of the sepals between male and female flowers. The calyces of male flowers are generally longer than those of female flowers and tend to be fused for a greater proportion of their length. This syndrome is seen at its most extreme in *Lawrencia cinerea* in which male calyces are 5.0-7.5 mm long with sepals connate for 1/2-3/4 their length, whereas female calyces are 3.0-5.0 mm long with sepals connate for only 1/10-1/4 their length.

Externally, calyces may be glabrous as in *Lawrencia spicata* and some forms of *L. glomerata* and *L. diffusa,* but usually they display the full species-specific range of hair types. Internally, calyces are glabrous with the exception of female calyces of *L. spicata* which are sometimes densely stellate-hairy and both male and female calyces of *L. berthae* which have a few scattered apical hairs. *L. berthae* is also exceptional in possessing tufts of multicellular papillae on the basal adaxial surfaces of male calyces which appear to be glandular and are interpreted here as nectaries (Figure 2I & J).

The venation of the sepals is actinodromous and reticulate. It may be obscure or distinct with 3-5 primary sub-parallel veins.

Corolla. The corolla of *Lawrencia* consists of five antisepalous petals which are adnate to the filament tube above and connate below to form a delicate, membranous, transparent ovary cup. As the fruit ripens the connate region of the petals dehisces along its sutures to release the spent corolla which remains loosely attached merely by means of the style passing through the staminal tube. At anthesis the corolla is campanulate or more or less rotate.

Measured from base to lobe apex the corolla length ranges from 2-12 mm. Although there is a mode characteristic of each species, the degree of overlap is such that it is not usually possible to distinguish between species on the basis of this measurement alone. However, *Lawrencia buchananensis,* with a corolla length of 6-8 mm, can easily be separated from *L. chrysoderma* (3.0-5.0 mm), *L. repens* (3.0-5.0 mm) and *L. squamata* (1.7-5.6 mm).

The degree of fusion of the petals varies widely between species. Petals may be free almost to their base or connate for as much as 4/5 their length. This character overlaps too often to be of much value diagnostically, although each species has its characteristic mode.

Corolla lobes of *Lawrencia* are imbricate in bud. At anthesis they may be obovate, ovate or elliptic, and spreading and flat or more or less erect and carinate. In width (measured at the widest point) corolla lobes range from 0.6-7.0 mm. Despite considerable overlap between species this measurement is of somewhat more use diagnostically than corolla length or the degree of fusion of petals. In particular, it serves to distinguish *L. berthae* (2.7-7.0 mm) from *L. buchananensis* (2.2-2.5 mm), *L. cinerea* (0.9-2.5 mm), *L. chrysoderma*

(0.8-2.0 mm), *L. diffusa* (1.2-1.5 mm), *L. helmsii* (0.5-2.0 mm), *L. repens* (1.1-1.8 mm) and *L. viridi-grisea* (1.6-2.6 mm).

Auricles, basal wing-like outgrowths at the base of the petals of many species of Malvaceae, are entirely lacking in *Lawrencia.*

The apices of corolla lobes are acute, obtuse or truncate and may be entire, emarginate or irregularly dentate. The last feature was observed only in *Lawrencia squamata* and *L. chrysoderma.*

The corolla lobes are usually glabrous on both surfaces. There are several notable exceptions to this: corolla lobes of *Lawrencia berthae* sometimes have scattered, intermeshing simple hairs in the basal area on both abaxial and adaxial surfaces; those of *L. cinerea* are stellate-hairy along the mid-veins on the abaxial surface, weakly so in male fowers, strongly in females; those of *L. densiflora* are often sparsely stellate-hairy abaxially in male flowers, densely in females; those of *L. glomerata* can be stellate-hairy along the abaxial mid-vein.

In dioecious species there are striking differences between male and female flowers in corolla length, the degree of fusion of the petals, corolla lobe width, shape and orientation, and, in species with stellate-hairy petals, in the extent of their vestiture. The corollas of male flowers are generally larger than those of female flowers; their petals, which are almost free or only slightly fused, are flat and spreading at anthesis and, if stellate-hairy, then sparsely so. Corollas of female flowers are smaller by comparison; their petals, which are fused to a far greater extent, tend to be carinate and erect at anthesis and, if stellate-hairy, then densely so.

In colour, the corollas are white, cream-coloured, pale yellow or pale green, and may be tinted red or purple. Corolla colour is often quite variable within a single species.

The petals are membranous and elaborately vascularized with actinodromous reticulate veins which anastamose before reaching the margins. They thus resemble to a remarkable degree the wings of certain insects.

One species, *Lawrencia berthae,* is notable for its sweetly scented flowers, a character detected in no other species in the genus.

Androecium. The androecium of *Lawrencia* is composed of monadelphous stamens which arise from five groups of primordia (Heel 1966). This five-ranked symmetry is usually not evident at anthesis when it is obscured by the densely packed nature of the anther cluster. Only in *L. glomerata* is the apex of the filament tube ever distinctly five-lobed. In male and bisexual flowers of *Lawrencia,* the filaments are united into a tube 0.4-7.0 mm long and are free at their apices for an additional 0.2-2.0 mm. In female flowers, the filaments are united for 0.1-2.6 mm and, if they have anthers (sterile), are free at their apices for an additional 0.1-0.9 mm. Within these two measurements in each case there is a continuum. The filament tube is identical in colour to the corolla and is glabrous in all species with the single exception of *L. berthae* in which scattered simple hairs are often present.

Often the free portions of filaments are paired. At an extreme, this results in two anthers terminating a single filament, a condition frequently observed in *Lawrencia glomerata* and *L. repens.*

The number of anthers in each flower varies considerably between taxa. The lowest number of anthers encountered is 5, found regularly in flowers of *L. diffusa* and sometimes encountered in specimens of *L. glomerata, L. repens* and *L. helmsii.* The highest number observed is in *L. berthae* which has 10-30 anthers in each flower. Some species have a constant number of anthers in each male or bisexual flower, namely *L. densiflora* (20), *L. diffusa* (5) and possibly *L. buchananensis* (20). The remaining species have a variable number of anthers in each flower. Anthers are normally white but in *L. berthae* they are very occasionally faintly pink.

In three of the dioecious species, namely *Lawrencia chrysoderma, L. helmsii* and *L. squamata,* anthers are present in female flowers, but are smaller in size than in male flowers and lack pollen. In the first two of the above-mentioned species, anthers of female flowers are fewer than in male flowers. In the remaining dioecious species, female flowers lack anthers altogether.

Variation in characters of the androecium of *Lawrencia* can be useful in distinguishing species. Nonetheless, there is a continuum in this variation between the various species in the genus. One species stands apart from the others, namely *L. berthae* with its often simple-hairy filament tube and generally freer filaments.

Styles. As in all genera of the Malvaceae, the style of *Lawrencia* is tubular at the base where it is continuous with the columella; above, it is divided into distinct branches. In *Lawrencia,* the total length of the style varies from 0.4-10.0 mm in bisexual and female flowers. Each species is modally characterized by its style length, and this character can occasionally be of assistance in distinguishing between closely related species, notably *L. chrysoderma,* with styles 2.0-7.0 mm long, and *L. helmsii,* with styles 0.4-3.2 mm long.

The presence or absence of a gynoecium in male flowers is often diagnostic in *Lawrencia.* Of the dioecious species, *L. chrysoderma, L. cinerea, L. helmsii* and *L. squamata* may lack gynoecia in male flowers. Conversely, they are always present in male flowers of *L. berthae, L. glomerata* and *L. densiflora.* When a gynoecium is present in male flowers the styles are much reduced, ranging from 1.2-4.0 mm in length.

Branching of the styles may occur from the base itself to as far as 7/10 of the distance above the apex of the columella. In *Lawrencia diffusa, L. glomerata* and *L. viridi-grisea,* branching always occurs from the base: thus, the presence of branches which are only shortly united or united at some considerable distance from the style base is a useful diagnostic aid. In all species the number of branches equals that of the carpels, that is 2-11. This is, perhaps, the most useful character provided by the styles and is treated further in the consideration of fruit below.

At anthesis the style branches are more or less flattened and divergent. They are most usually filiform, but in four species they are often clavate, namely in *Lawrencia berthae, L. chrysoderma, L. helmsii* and *L. squamata.* The frequently broadly clavate styles of *L. chrysoderma* (Figure 7E) are often apically lobed, a most useful character in distinguishing that species from *L. helmsii.* In width the style branches vary from 0.1-1.0 mm. In colour they may be white, yellow, pink, purple or brown. The dark purple stigmas of *L. squamata* are unique in the genus.

In all but one species of *Lawrencia* the style is completely glabrous externally. That of *L. berthae* is conspicuously stellate-hairy at the junction of its branches.

Fruit. The mature ovary of *Lawrencia* is a complex oblate or ovoid schizocarp. It consists of a single whorl of mature carpels or mericarps supported by a central columella, subtended by a membranous carpocrater (see below) and enclosed by the peristent calyx. The number of mericarps always corresponds to the number of style branches. The pedicel, calyx and columella do not abscise from the inflorescence axis. In most cases the withered corolla persists for a while.

The variable fruit morphology encountered in *Lawrencia* is usefully summarized as follows:

A. Fruit with indehiscent mericarps; pericarp rugose or reticulate.

1. Mericarps 9-11, all fertile; pericarp with apical and distal walls stellate-hairy, lateral walls coriaceous and rugose or obscurely reticulate. This condition is found in *L. berthae*. See Figure 2D, G & E.
2. Mericarps 5, all fertile; pericarp glabrous, lateral and distal-basal walls membranous, becoming distinctly reticulate with fenestrate or alveolate areolae. This condition is found in *L. buchananensis, L. glomerata, L. spicata* and *L. viridi-grisea*. See Figures 3 (4, 6 & 7) and 4 (4 & 5).

B. Fruit with dehiscent mericarps; pericarps unornamented.

3. All mericarps more or less well-developed.
    - (a) Mericarps 5, all fertile. This condition is found in *L. diffusa* and *L. repens*.
    - (b) Mericarps 2-5, only 1 fertile. This condition is found in *L. densiflora* (mericarps 2-5) and *L. cinerea* (mericarps 2-3). See Figure 6F & G.
4. Sterile mericarps undeveloped and obliterated by developing fertile mericarps.
    - (c) Mericarps 2-5, only 1 or 2 fertile. This condition is found in *L. squamata* (mericarps 2-3, 1 or 2 fertile), *L. chrysoderma* (mericarps 2-3, only 1 fertile) and *L. helmsii* (mericarps 2, only 1 fertile). See Figure 7F & G.

The mericarp is traditionally the most important structure used to determine taxa in the tribe Malveae and keys to the taxa are generally dependent on its character. In *Lawrencia* the number of mericarps, their fertility, development, dehiscence, shape and size, and the vestiture, colour, texture and ornamentation of the pericarp are of great diagnostic value.

In number the mericarps of *Lawrencia* vary from 2 to 11 in each fruit. For a particular species this number may be constant or else of limited range.

In a given species of *Lawrencia* all the mericarps may be fertile, or else only one or two mericarps in each fruit produce mature seed. Mericarps containing sterile, aborted or unfertilized seed continue to develop more or less normally in all but three species: in these they regularly fail to develop and are crushed and obliterated by the developing fertile mericarps. In the latter case each developing mericarp assumes the swollen irregularly globular shape of the seed it contains.

In those fruit in which all mericarps are well developed these are shaped roughly like a wedge from an inverted pudding basin. There are four surfaces to each mericarp: two lateral walls, an apical wall, and a continuous distal-basal wall. There is a single, nearly straight proximal margin and two curved lateral margins.

Individual mericarps are either dehiscent or indehiscent. Indehiscent mericarps separate regularly at maturity as their pericarp becomes light, dry and stiff. In one species, *Lawrencia berthae,* the pericarp is black, conspicuously hairy on its apical and distal-basal walls and coriaceous and rugose or obscurely reticulate on its lateral walls. In other species with indehiscent mericarps the pericarp is always glabrous, white or tan, thin and delicate, becoming translucent at maturity with a pronounced reticulum. The areolae enclosed by the thickenings of the reticulum may be of firm texture, but more often are thin and translucent (fenestrate), and in some cases no tissue is evident and the areolae are quite open (alveolate). In species with indehiscent mericarps the lateral margins of the pericarp are often projected slightly to form narrow wings which may connect across the apical-distal region to give the distal wall a distinctive shield-like appearance. The apical region of the pericarp projects somewhat to form a short, acute cusp.

When indehiscent mericarps separate from the columella along the proximal margin an opening forms in the apical proximal region where the funicle is attached to the columella. Thus the seed is no longer connected to the mericarp. This opening is far too small to allow the seed to escape.

In species with dehiscent mericarps, dehiscence takes place by the operation of two mechanisms, namely complete or partial opening of the suture along the proximal edge of the pericarp coupled with disintegration or weakening and rupture of the basal region of the pericarp. These species have a pericarp which is smooth and glabrous and becomes translucent or transparent at maturity.

All mericarps in *Lawrencia* are uniovular. No trace of an endoglossum was observed in any species. An endoglossum is an internal tongue-like appendage dividing the mericarp partially or completely into two cells, present in many Malvaceae.

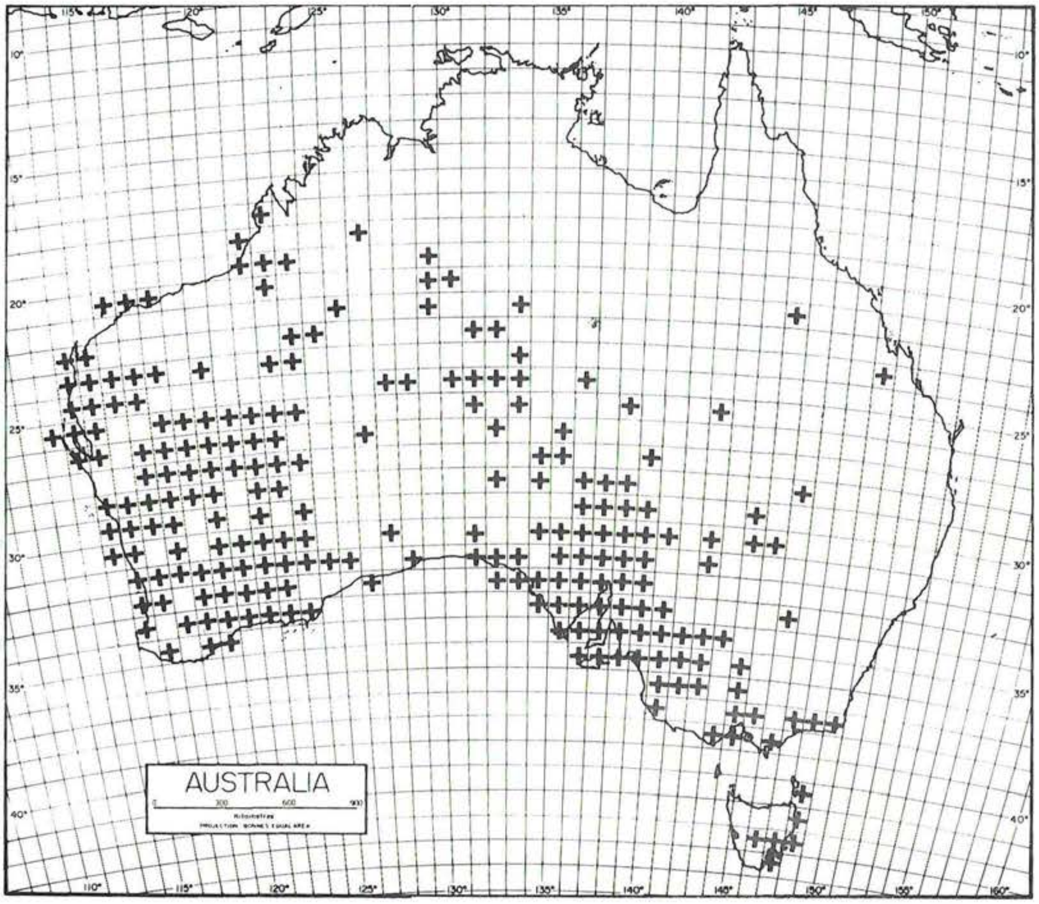
The columella is a generally persistent cylindrical, clavate or peltate structure at the centre of the calyx to which the mericarps and style are attached (Figure 2F). Near its base is an outgrowth which is chartaceous centrally and membranous marginally known as the carpocrater, a term coined by Hochreutiner (1920). The carpels are completely free of this latter structure but are subtended by it.

Seed. Lawrencia seeds are basically reniform in lateral view with their proximal apical lobe projected into a short blunt or acute cusp. They have a thick, firm testa that is completely glabrous. The outer layer of the seed coat may produce a thin waxy layer giving the seed a glaucous appearance. This layer is often lacking or worn away by the time the seed is shed. The colour of the seed coat varies from grey, to light brown, chestnut brown or black. See Figures 2H, 4(6 & 7), 6H & 7G.

In species with fruit in which several mericarps are fertile, seed shape is determined by the shape of the enclosing pericarp and hence is triquetrous. In species in which the pericarp ruptures early and only one or two seeds in each fruit are fertile these seeds become swollen and irregularly globular as they mature. Seeds range in size from 0.6-3.3 mm high x 0.4-2.5 mm wide. Seed size overlaps to such an extent that it is of virtually no use in distinguishing between taxa.

A single seed is produced in each mericarp to which it is attached apically by its funicle. The seed is almost completely filled by the embryo which is apically pendulous with its radicle uppermost. Only a thin layer of endosperm surrounds the embryo. See Figure 3(8 & 9).

In all but three species the seed surface is smooth and featureless. In *Lawrencia densiflora* the entire seed surface is conspicuously rugose (Figure 6H); in *L. repens* only the distal surface is rugose. The lateral seed surfaces of both these species are prominently angular, characteristic also of *L. diffusa* which is otherwise featureless.



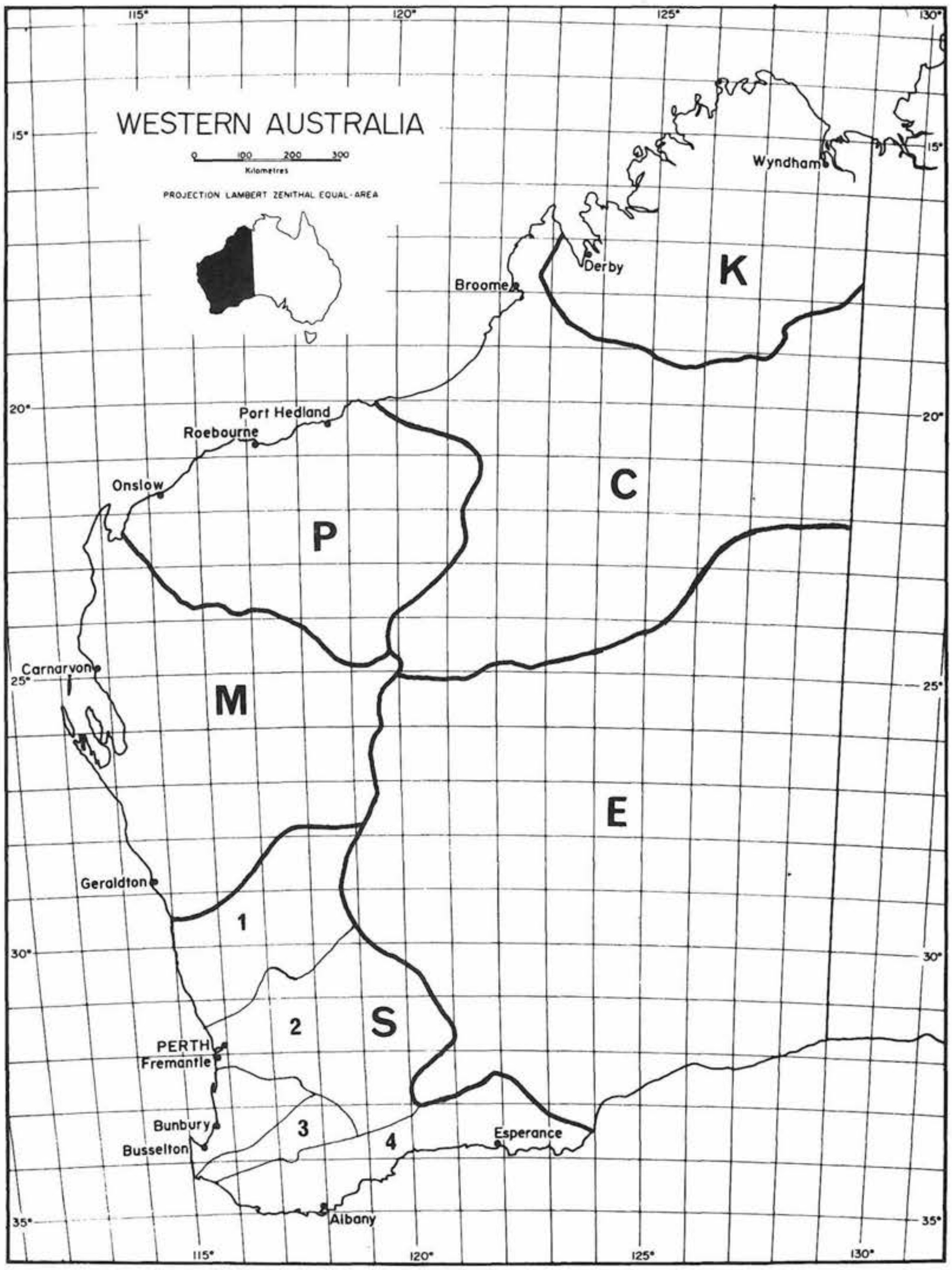
Map 1. Distribution of the genus *Lawrencia.*

Phytogeography

Lawrencia is endemic to Australia, extending from 18° S latitude southwards (Map 1). It occurs in all States but principally in Western Australia where 11 of the 12 species are to be found, six of which are endemic to that State. Its species commonly inhabit the margins of salt lakes, saline depressions and estuaries.

For convenience, in the following taxonomic treatment species distributions are indicated by reference to the sub-divisions indicated above which are generally adopted by botanists in each State. However, it has been found more meaningful in Western Australia to summarize these distributions in terms of the drainage systems they occupy. Mulcahy and Bettenay (1972) recognize six drainage divisions within Western Australia. Their classification is refined by Bettenay and Mulcahy (1972) and further elucidated by Beard (1973). These divisions and the lake systems within the South West Division are indicated in Map 2. *Lawrencia* occurs in all drainage divisions.

Two species are peripheral to the Great Plateau. *Lawrencia cinerea* is confined to the Great Sandy Desert and Little Sandy Desert in the Canning Division (Map 6). *L. viridigrisea* occurs along the coastline of the Monger System of the South West Division, and of the Murchison, Pilbara and Canning Divisions; in the Canning Division it extends inland to the Great Sandy Desert, thence to the Northern Territory (Map 4).



Map 2. Drainage Divisions in Western Australia:
C. Canning Division
E. Eucla Division
K. Kimberley Division
M. Murchison Division
P. Pilbara Division
S. South West Division

Drainage Systems in the South West Division:
1. Monger System
2. Avon System
3. Blackwood System
4. South Coast System

After Mulcahy & Bettenay (1972), Bettenay & Mulcahy (1972) and Beard (1973).

Seven species inhabit the Great Plateau and the coastal plain fringing its eastern margin. *Lawrencia chrysoderma* is found in the Murchison Division and in the Monger System of the South West Division (Map 8). *L. berthae* inhabits the Avon and South Coast Systems of the South West Division, although its distribution is disjunct, reappearing in the Eyre Peninsula of South Australia and extending into western Victoria (Map 3). *L. densiflora* occurs in the north west of the Eucla Division and throughout the Murchison Division, where it extends onto the coastal plain; and there is an isolated collection from between Nickol Bay and the De Grey River in the Pilbara Division (Map 6). *L. diffusa* is found in the far west of the Eucla Division as well as in the eastern part of the Avon System and in the South Coast System of the South West Division (Map 6). *L. helmsii* is restricted to the south-eastern corner of the Murchison Division and the western half of the Eucla Division (Map 8). *L. repens* occupies the far south-western area of the Eucla Division and the eastern part of the Avon System of the South West Division (Map 6). With the exception of an isolated specimen from Loongana on the Nullarbor Plain, *L. spicata* is confined to river banks, swamps and estuaries on the Swan Coastal Plain and South Coast Systems of the South West Division with a disjunction in its distribution until the Eyre Peninsula whence it skirts the coasts of South Australia, Victoria and eastern Tasmania (Map 4).

Two species are particularly widespread within Western Australia and in other mainland states, too. *Lawrencia glomerata* is more or less ubiquitous in saline habitats in Western Australia occurring in all drainage divisions (Map 5). *L. squamata* occupies the Canning, Eucla and South West Divisions but is notably absent from the Murchison, Pilbara and Kimberley Divisions (Map 7).

Lawrencia buchananensis is known only from Lake Buchanan in north-eastern Queensland (Map 4).

Despite the fact that the species occupy substantially the same habitats, that their geographical ranges overlap and that often several are found growing together or in close proximity, no natural hybrids or intermediates have been observed: this suggests that they are reproductively isolated.

Taxonomic Considerations

In this work, taxa have been defined on the basis of correlated morphological characters. Such a procedure is invariably arbitrary in that taxa may be chosen to encompass larger or smaller units of variation. In particular, I have attempted to define species of *Lawrencia* in the light of character variation documented for other of the Malveae, particularly in recently monographed genera such as *Anisodontea* Presl, *Kearnemalvastrum* Bates, *Malacothamnus* E. Greene and related groups (Bates 1967, 1969) and *Malvastrum* A. Gray (Hill 1982 a, b, c). This has resulted in a somewhat broad definition of the species in which many localized variations are not recognized formally.

Taxonomic problems certainly remain in *Lawrencia* below the species level, notably in *L. glomerata, L. squamata* and *L. viridi-grisea* and possibly in *L. densiflora.* Their resolution would require extensive field work supplemented by experimental procedures, both of which are beyond the scope of the present study. Thus the establishment of infraspecific taxa has not been undertaken.

Cytogenetic evidence has not been considered. It is likely that in the wider context of the presently developing classification of the Malveae (Bates 1968, 1969, Bates & Blanchard, 1970, Bates pers comm.) this line of investigation will prove important in elucidating the relationships of the *Plagianthus* alliance to other alliances in the tribe.

Within the sequence of species examined here are major discontinuities in the presence of sepaline nectaries, the presence of a floral scent, the vestiture of the filament tube, style branches and pericarp, and the number of carpels in each fruit. Further, these discontinuities are distinctly correlated and hence have prompted recognition of the new subgenus *Panifex* pending further study of the *Plagianthus* alliance (see Key to Infrageneric Taxa and Species below).

In the subgenus *Lawrencia* there is minor variation in many characters, in some of which discontinuities have been the basis for generic recognition elsewhere in the tribe Malveae. This variation is correlated sufficiently to allow the recognition of several infrageneric taxa serving to emphasize the heterogeneity in these taxonomically important characters as well as providing a useful means of grouping species within the genus (see Key to Infrageneric Taxa and Species below). Species of the series *Selenothamnus* have been segregated as the genus *Selenothamnus* by Melville (1966): I believe his approach to be inconsistent with the morphological evidence presented above and discussed in more general terms below.

The infrageneric classification offered here is phylogenetically based only insofar as the morphological similarities on which it is founded may be interpreted to suggest propinquity of descent.

Taxonomic Treatment

Lawrencia **Hook., Hooker's Icon. Pl. 3: t. 261 & 262 (1840); Melville, Kew Bull. 20: 514** (1966); Hutchinson, Gen. Fl. Pl. Dicot. 2: 52 (1967); J. A. Baines, Austral. Pl. Gen. 338-9 (1981; A. Mitchell, in B. D. Morley & H. R. Toelken, Fl. Pl. Australia 126-9 (1983). *Wrenciala* A. Gray, U.S. Explor. Exped., Bot. 1: 181 (1854), nom. inval. *Plagianthus* section *Lawrencia* (Hook.) Benth., J. Linn. Soc., Bot. 6: 97 (1862); E. G. Baker, J. Bot. 30: 72 (1892). *Type: L. spicata* Hook.

Halothamnus F. Muell., Pl. Victoria 1: 158-9 (1862) non Jaub. & Spach, Ill. Pl. Orient. 2: 50, t. 136 (1845). *Selenothamnus* Melville, Kew Bull. 20: 514-5 (1966); Hutchinson, Gen. Fl. Pl. Dicot. 2: 53 (1967); J. A. Baines, Austral. Pl. Gen. 338-9 (1981). *Type: H. microphyllus* F. Muell. [*Lawrencia squamata* Nees ex Miq.].

Prostrate, decumbent or erect, perennial *sub-shrubs* or *shrubs* to 180 cm tall, monopodial and simple, little-branched and divaricate or else densely ramulose; dioecious, polygamodioecious or hermaphroditic. Above-ground vegetative and reproductive parts glabrous or variously hairy with multicellular stellate *trichomes* often modified to form haplomorphic stellate, actinomorphic stellate, bifurcate or simple hairs and peltate and palmate scales; texture smooth, scabrous, velvety or shiny and armour-like. *Stems* sometimes with a spongy periderm producing dry fibrous or flaky bark. *Leaves* alternate, often fasciculate on much-reduced lateral branches, subsessile, sessile or distinctly petiolate, stipulate, often heteroblastic with large subsessile or distinctly petiolate basal leaves merging into smaller, subsessile or sessile stem and floral leaves; *stipules* persistent, free from petiole when present, shortly adnate to the petiole-base or to the blade-base of sessile leaves, minute or conspicuous, variously filiform, linear, triangular, ovate, elliptic, obovate or suborbicular, 0.4-10.0 mm long x 0.2-3.6 mm wide at the base, colourless, pale green, or brown, delicate and membranous, more or less succulent and leaf-like or dry and spongy, margin entire or more or less ciliate, apex variously acuminate, acute or obtuse; *petiole* lacking, minute or up to 400 mm long, slender or stout, basically triquetrous but often canaliculate, almost flat, trigonal or semiterete; *blade* variously linear, elliptic, cuneate, deltoid, spathulate, obovate, ovate or orbicular, 1-70(115) mm long x 0.7-35(60) mm wide, flattened or more or less conduplicate, sometimes falcate, sometimes swollen and succulent, venation actinodromous, obscure or more or less conspicuously 1-7 veined with one pronounced mid-vein, veins distinctly raised below and somewhat depressed above, base variously cuneate, acute, obtuse, truncate or cordate, margin entire, coarsely dentate or obtusely lobed throughout or towards the apex only, apex variously acuminate, acute, obtuse, rounded or truncate, often lobed. *Flowers* pedicellate to subsessile or sessile, 2-5 in axillary fascicles subtended by a single leaf, or solitary and axillary, often in densely leafy clusters on reduced lateral branches or at stem apices to form congested spicate inflorescences, unisexual or bisexual, more or less sexually dimorphic in dioecious species, usually odourless, rarely sweetly scented. *Pedicels* lacking, very short and stout, or slender and up to 4.5 cm long. Epicalyx lacking. *Calyx* turbinate, 1.0-12.0 mm long at anthesis, green; sepals 5, connate 1/10-9/10 their length, often strongly plicate in bud, adaxially glabrous, rarely densely stellate-hairy or with a few simple apical hairs; lobes erect at anthesis, triangular, 1.0-4.8 mm wide at the base; accessory teeth lacking; apices variously obtuse, acute or acuminate; nectaries usually lacking, rarely with basal tufts of minute, nectariferous, multicellular papillae on adaxial surfaces; venation reticulate, obscure or distinct with 3-5 primary subparallel veins to each lobe. *Corolla* campanulate, broadly campanulate or more or less rotate at anthesis, exceeding or subequal to the calyx, 2-12 mm long, membranous, white, yellow or tinged green, red or purple, entirely glabrous or else abaxially stellate- or simple-hairy, rarely adaxially hairy, adnate to the base of the filament tube to form an ovary cup; petals 5, almost free to their bases or connate up to 4/5 their length, glabrous or else abaxially simple- or stellate-hairy, rarely adaxially hairy; auricles lacking; lobes imbricate in bud, erect or spreading at anthesis, obovate, ovate or elliptic, 0.6-7.0 mm wide, flat or more or less carinate; apices variously acute or obtuse, and entire, emarginate or irregularly dentate. *Androecium* of male and bisexual flowers with 5-30 unranked stamens; filament tube shorter than the petals and matching them in colour, 0.4-7.0 mm long, glabrous or rarely subglabrous with scattered simple hairs; free portion of filaments 0.2-2.0 mm long; anthers dorsifixed, terminal, white, extrorse; androecium of female flowers more or less reduced with anthers lacking or smaller in size, fewer in number and sterile. *Gynoecium* of female and bisexual flowers with a single style branching from its base or from up to 7/10 its length from the base into 2-11 branches equal in number to the carpels; style 0.4-10.0 mm long, glabrous or stellate-hairy at the junction of the branches; branches divergent at anthesis, filiform, linear or clavate, rarely broadly clavate and lobed, 0.1-1.0 mm wide, variously white, yellow, pink or brown; stigmas introrsely decurrent on the style branches which are papillate over their whole length or on the upper portion only; carpels in a single discoid whorl attached by their proximal margins to a central, apically expanded columella, subtended by a thin, membranous carpocrater; ovules solitary in each carpel, pendulous, attached to the columella above the carpel notch; gynoecium of male flowers more or less reduced with carpels lacking or fewer in number, smaller in size and sterile. *Fruit* an oblate or ovoid schizocarp, 1.4-4.7 mm high x 0.8-6.2 mm in diameter, exposed or enclosed by the calyx, readily or tardily shed from the shrunken columella and calyx at maturity; mericarps 2-11, completely to partially dehiscent or indehiscent, free from one another, laterally compressed and wedge-shaped or, if sterile, then often crushed and obliterated by the developing mericarp(s); pericarp coriaceous, chartaceous or membranous, black, tan, white or translucent, becoming rugose, more or less reticulate or smooth and featureless at maturity, glabrous, rarely stellate-hairy, with lateral margins sometimes projected slightly to form narrow wings which may connect apically-distally to form a distinctive shield, and the apical region often projected to form a short, acute cusp; endoglossum lacking. *Seeds* solitary in each mericarp, attached apically to the columella by a funicle, triquetrous and basically reniform in lateral view or irregularly globular, 0.6-3.3 mm high x 0.4-2.5 mm in radial width, variously grey, brown or black, glabrous, sometimes glaucous with a layer of wax, smooth or more or less rugose, sometimes with angular lateral faces, with only a thin layer of endosperm surrounding the embryo. *Columella* filamentous, slender or stout at maturity, 1.2-4.5 mm high x $<$0.1-2.0 mm in diameter. A genus of 12 species confined to Australia.

The name *Lawrencia* honours Robert William Lawrence (1807-1833), a young settler and botanical collector in the northern part of Tasmania who, until his untimely death at the age of 26, communicated specimens to Sir William Hooker (Hooker 1855, Sharr 1978).

Gray (1854 loc. cit.) pointed out that *Lawrencia* Hook. is antedated by *Laurencia* Lemouroux in Ann. Mus. Hist. Nat. Paris 20: 130 (1813), a red seaweed. Gray suggested the anagram *Wrenciala* to replace *Lawrencia*. There is no basis for such a substitution: the names *Lawrencia* and *Laurencia* are not orthographic variants; they have not been a source of persistent error and are most unlikely to become so. This matter is discussed fully by Melville (1966 loc. cit.).

Key to infrageneric taxa and species

1. Erect shrubs; flowers distinctly pedicellate in axillary fascicles of 1-5; petals sometimes with intermeshing simple hairs at the base on both abaxial and adaxial surfaces; sepals of male flowers with basal tufts of minute, nectariferous papillae on adaxial surface; style branches conspicuously stellate-hairy at their junction; mericarps 9-11 in each fruit; pericarps stellate-hairy. (SUBGENUS PANIFEX.) ....1. *L. berthae*

1. Prostrate, decumbent or erect sub-shrubs, or erect shrubs; flowers subsessile or sessile, axillary, always solitary, often in densely leafy clusters; sepals adaxially glabrous; petals never with basal hairs; style branches glabrous at their junction; mericarps 2-5 in each fruit; pericarps glabrous. (SUBGENUS LAWRENCIA.)

    2. Erect sub-shrubs or shrubs; female flowers of dioecious species lacking anthers altogether (in *L. glomerata*, a polygamodioecious species, sterile anthers may be present); mericarps indehiscent, 5 in each fruit, all fertile; pericarps laterally reticulate with fenestrate or alveolate areolae; seed triquetrous, smooth. (SECTION LAWRENCIA.)

        3. Short-lived, suffrutescent, simple perennial; vestiture stellate-hairy or glabrous.

            4. Plant strongly rank-smelling; to 180 cm tall with one or several erect stout stems diverging from a conspicuous basal rosette, slender secondary stems contracted to form dense terminal flowering spikes; glabrous throughout; hermaphroditic. ....2. *L. spicata*

            4. Plant not strongly smelling; to 100 cm tall without obvious rosette, secondary stems not contracted to form dense flowering spikes; vestiture stellate-hairy or glabrous; flowers solitary, often in densely leafy clusters; polygamodioecious. ....3. *L. glomerata*

        3. Small, woody, divaricate, perennial shrub; vestiture stellate-hairy or densely squamulose with peltate scales.

            5. Vestiture stellate-hairy; petiolate basal leaves merging into subsessile or sessile floral leaves, blades with 1-5 prominent veins, margin becoming dentate or lobed towards apex; calyx 3.8-5.3 mm long.............................4. *L. viridi-grisea*

            5. Vestiture densely squamulose with peltate scales; all leaves sessile, blades with a single prominent mid-vein, margin entire throughout; calyx 7-10 mm long. ....5. *L. buchananensis*

    2. Prostrate, decumbent or erect sub-shrubs, or erect shrubs; female flowers of dioecious species with sterile anthers present; mericarps dehiscent, 2-5 in each fruit, all fertile or only 1-2 fertile; pericarps unornamented; seed triquetrous or swollen and irregularly globular, rugose or smooth. (SECTION SELENOTHAMNUS.)

            6. Erect, decumbent or prostrate sub-shrubs; dioecious or hermaphroditic; stems without spongy periderm; leaves distinctly petiolate throughout or petiolate basal leaves merging into subsessile or sessile stem and floral leaves, stellate-hairy or glabrous; female flowers completely lacking anthers; mericarps all well-developed; seed triquetrous, surface smooth or rugose. (Series *Halophyton.)*

- 7. Plant erect; vestiture sparse to dense; leaves conduplicate or flat, distinctly petiolate basal leaves merging into subsessile or sessile stem and floral leaves; dioecious; petals glabrous or sparsely to densely stellate-hairy; fruit with 2-5 mericarps a single one of which is fertile.
  - 8. Plant to 130 cm tall; vestiture shortly stellate-hairy giving plant an ashen-grey appearance; leaves strongly conduplicate along prominent midvein; petals glabrous; fruit with 2-3 mericarps; seed smooth.........6. *L. cinerea*
  - 8. Plant to 60 cm tall; vestiture sparsely to densely loosely stellate-hairy, plant green in appearance; leaves flat with several more or less prominent veins; petals stellate-hairy on abaxial surface, rarely glabrous; fruit with 2-5 mericarps; seed conspicuously rugose on all surfaces. 7. *L. densiflora*
- 7. Plant decumbent or prostrate; vestiture sparse to dense or glabrous; leaves flat, distinctly petiolate throughout; hermaphroditic; petals glabrous; fruit with 5 mericarps all of which are fertile.
  - 9. Plant decumbent, to 15 cm tall x 40 cm wide; vestiture densely stellate-hairy; anthers 5-10; seeds conspicuously rugose on abaxial surface. ....8. *L. repens*
  - 9. Plant prostrate, to 15 cm wide; vestiture sparsely stellate-hairy or glabrous; anthers 5; seed smooth. ....9. *L. diffusa*

6. Erect shrubs; dioecious; stems with spongy periderm producing dry fibrous or flaky bark; leaves sessile throughout, stellate-hairy or with armour-like covering of peltate scales; dioecious; female flowers with or without sterile anthers; sterile mericarp crushed and obliterated by developing fertile mericarp(s); seed swollen and irregularly globular, smooth. (Series ***Selenothamnus.)***
   - 10. Vestiture of young branches sparse to dense with peltate scales or stellate hairs, or glabrous, rarely pannose with palmate hairs; leaves and calyces with dense covering of peltate scales or stellate hairs; thorns often present; secondary branches with leaves in fascicles but not densely leafy or contracted; leaf margin entire or 3-5 dentate towards the apex; 1-2 mericarps fertile in each fruit. ....10. *L. squamata*
   - 10. Vestiture of young branches densely pannose with palmate hairs, dense covering of peltate scales always present on leaves and calyces; thorns lacking; secondary branches densely leafy and much contracted; leaf margin entire throughout; only 1 mericarp ever fertile in each fruit.
     - 11. Secondary stems openly branched or loosely contracted; leaves 4.0-12.0 mm long; corollas of female and male flowers indistinguishable; anthers 10-20 in male flowers, 5-15 in female flowers; pistils 2-3; style of female flowers 2.0-7.0 mm long, branches often briefly lobed towards the apices. ....11. *L. chrysoderma*
     - 11. Secondary stems much contracted giving plant a characteristic cactus-like appearance; leaves 1.5-7.2 mm long; corollas of female flowers c. ¾ length of corollas of male flowers; anthers 5-16 in male flowers, 0-8 in female flowers; pistils 2; style of female flowers 0.4-3.2 mm long, branches always entire. ....12. *L. helmsii*

Subgenus *PANIFEX*

Lawrencia subgenus *Panifex* Lander, subgen. nov.

Frutices erecti, inermes; indumentum e pilis stellatis compositum; flores manifeste pedicellati, 1-5-ni in cymas axillaris dispositi; sepala ventrali basi papillosa; styli rami ad conjunctionem manifeste stellato-pilosi; mericarpia indehiscentia, per fructum 9-11-na, omnia fertilia; pericarpium apicaliter et distaliter pilosum, lateraliter coriaceum et rugosum vel obscure reticulatum; semina triquetra laevia.

Typus: L. berthae (F. Muell.) Melville

Erect shrubs; without thorns; vestiture stellate-hairy; flowers distinctly pedicellate, in axillary cymes of 1-5, sweetly scented; sepals of male flowers with basal tufts of minute, nectariferous papillae on adaxial surface; petals of male fowers often with intermeshing basal hairs; filament tubes often sparsely simple-hairy; style branches conspicuously stellate-hairy at their junction; mericarps indehiscent, 9-11 in each fruit, all fertile; pericarps apically and distally stellate-hairy, laterally coriaceous and rugose or obscurely reticulate; seed triquetrous, smooth.

The name of this subgenus honours the British botanist Edmund Gilbert Baker (1864-1949) a student of the Malvaceae (Stafleu & Cowan 1976) and of *Lawrencia* in particular (Baker unpublished).

1. **Lawrencia berthae** (F. Muell.) Melville, Kew Bull. 20: 514 (1966); Beard, Descrip. Cat. Western Austral. Pl. 84 (1970); J. H. Willis, Handb. Pl. Victoria 2: 381 (1973); J. Green, Census Vasc. Pl. Western Australia 67 (1981); Jessop, List, Vasc. Pl. South Australia 62 (1983). *Plagianthus berthae* F. Muell., Fragm. Phytogr. Austral. 5: 103 (1866); E. G. Baker, J. Bot. 30: 72 (1892); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931); J. M. Black, Fl. South Australia, edn 2, 3: 557 & t. 719 (1952); Blackall & Grieve, How to Know Western Austral. Wildfl. 2. 346 (1956). *Sida berthae* F. Muell., Fragm. Phytogr. Austral. 5: 103-104 (1866), nom. inval. Type: Gardners River, Western Australia, s.dat., *G. Maxwell* s.n. (holo: K; possible iso: MEL, M non vidi).

Shrub to 80 cm tall, spreading with slender branches, dioecious. *Vestiture* of stems, stipules, leaves, pedicels and abaxial surface of calyces sparsely to densely hairy with simple, bifurcate and haplomorphic stellate hairs. *Leaves* alternate, distinctly petiolate basal leaves merging into more or less subsessile floral leaves; *stipules* green and leaf-like, narrowly to broadly triangular or elliptic, 1.0-2.5 mm long x 0.5-0.8 mm wide, margin ciliate, apex acuminate, acute or obtuse; *petiole* slender, triquetrous, to 17(45) mm long; *blade* elliptic, ovate, obovate or deltoid, 5-20(45) mm long x 3-16(35) mm wide, flat, venation distinct with 3-5 conspicuous primary veins, base acute- or obtuse-cuneate, margin coarsely dentate or obtusely lobed, except towards the base, apex acute, obtuse or rounded. *Flowers* unisexual, sweet-scented, born on slender peduncles to 45 mm long, solitary or 2-5 in axillary fascicles. *Calyx of male flower* turbinate, green, 4.2-7.0 mm long; sepals connate 2/5-2/3 their length, each with a basal tuft of minute, nectariferous, multicellular papillae at the base; lobes triangular, 2.0-2.5 mm wide; apices acute. *Corolla of male flower* white, 6.5-12.0 mm long; petals almost free to their bases, connate for less than ⅛ their length, glabrous or with intermeshing simple hairs at base on both abaxial and adaxial surfaces; lobes spreading, obovate to ovate, 4.5-7.0 mm wide; apices obtuse, entire. *Androecium of male flower* with filament tube 1.0-4.0 mm long, glabrous or with scattered simple hairs; free portion of filaments 1.5-2.0 cm long; anthers 10-30, very rarely pink. *Gynoecium of male flower* lacking, or present but sterile and much reduced; style 2.0-4.0 mm long; branches 5-8, connate for ¼ their length, 0.2-0.5 mm wide, conspicuously stellate-hairy at their junction. *Calyx of*

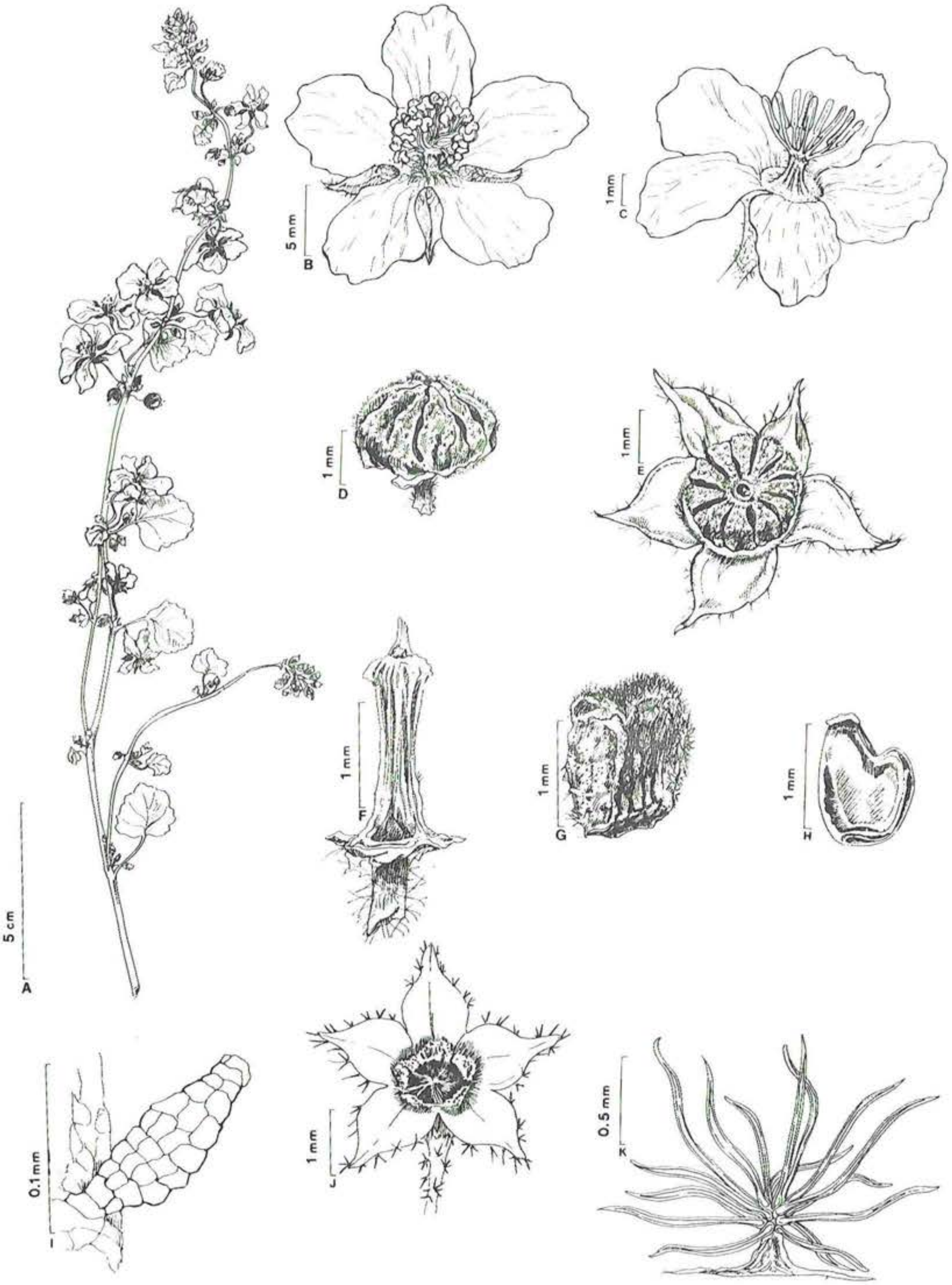


Figure 2. *Lawrencia berthae.* A — Male plant, habit. B — Male flower. C — Female flower. D — Mature fruit, lateral view. E — Mature fruit, apical view. F — Columella. G — Ripe mericarp, lateral-distal view. H — Seed, lateral view. I — Nectariferous papilla. J — Calyx, apical view showing vestigial nectaries. K — Trichome.

Drawn from *George* 5692 (male) and *Helms,* Sept. 1891 (female).

female flower turbinate, green, 4.0-5.0 mm long; sepals connate 1/3-1/2 of their length, adaxially glabrous, sometimes with a few simple hairs towards apices; lobes triangular, 1.4-2.5 mm wide; apices acute. *Corolla of female flower* white, 4.0-4.8 mm long; petals connate ⅛-¼ of their length, glabrous; lobes broadly imbricate, erect, ovate, 2.7-3.0 mm wide; apices obtuse, entire or emarginate. *Androecium of female flower* much reduced; filament tube 1.5-2.0 mm long; anthers lacking. *Gynoecium of female flower* with style 2.5-3.5 mm long; branches 9-11, free to base or connate for up to 2/5 their length, clavate, 0.2-0.5 mm wide, pale yellow, conspicuously stellate-hairy at their junction, introrsely stigmatose on upper 1/2-2/3. *Fruit* oblate, 2.0 mm high x 3.7-6.2 mm wide; mericarps 9-11; pericarp black, coriaceous, lateral walls rugose or obscurely reticulate, apical and distal surfaces densely stellate-hairy, indehiscent. *Seed* triquetrous, smooth, brown, 1.5 mm high x 1.3-1.7 mm in radial width. *Columella* stout, 1.2-1.5 mm high, 0.7-1.2 mm in diameter. Figure 2.

Flowering period. July to December.

Habitat. Occurs on clay soils in open woodland and shrubland adjoining shallow wide depressions, also on disturbed ground by roadsides.

Selected specimens from 45 collections examined. WESTERN AUSTRALIA: N of Borden, *A.M. Ashby* 1940 (AD, PERTH); Israelite Bay, 1893, *Brooks* s.n. (MEL); Bendering, *C.A. Gardner* 1993 (PERTH); Near Salmon Gums, Sept. 1935, *C.A. Gardner* s.n. (PERTH); Northam, 1901, *J.H. Gregory* s.n. (BM); E bank of Swan River, 1889, *M. Heal* s.n. (MEL).

SOUTH AUSTRALIA: Alawoona, c. 30 km S of Loxton, Sept. 1936, *E.H. Ising* s.n. (AD); Hambidge Flora and Fauna Reserve, Eyre Peninsula, *D.E. Symon* 4300 (AD, CANB); Ardrossan, Yorke Peninsula, Oct. 1879, *O. Tepper* s.n. (AD).

VICTORIA: Beside Ouyen Highway, c. 5 km E of Murrayville, *M.G. Corrick* 6239 (AD, MEL); Mildura, Oct. 1932, *W.J. Zimmer* s.n. (MEL).

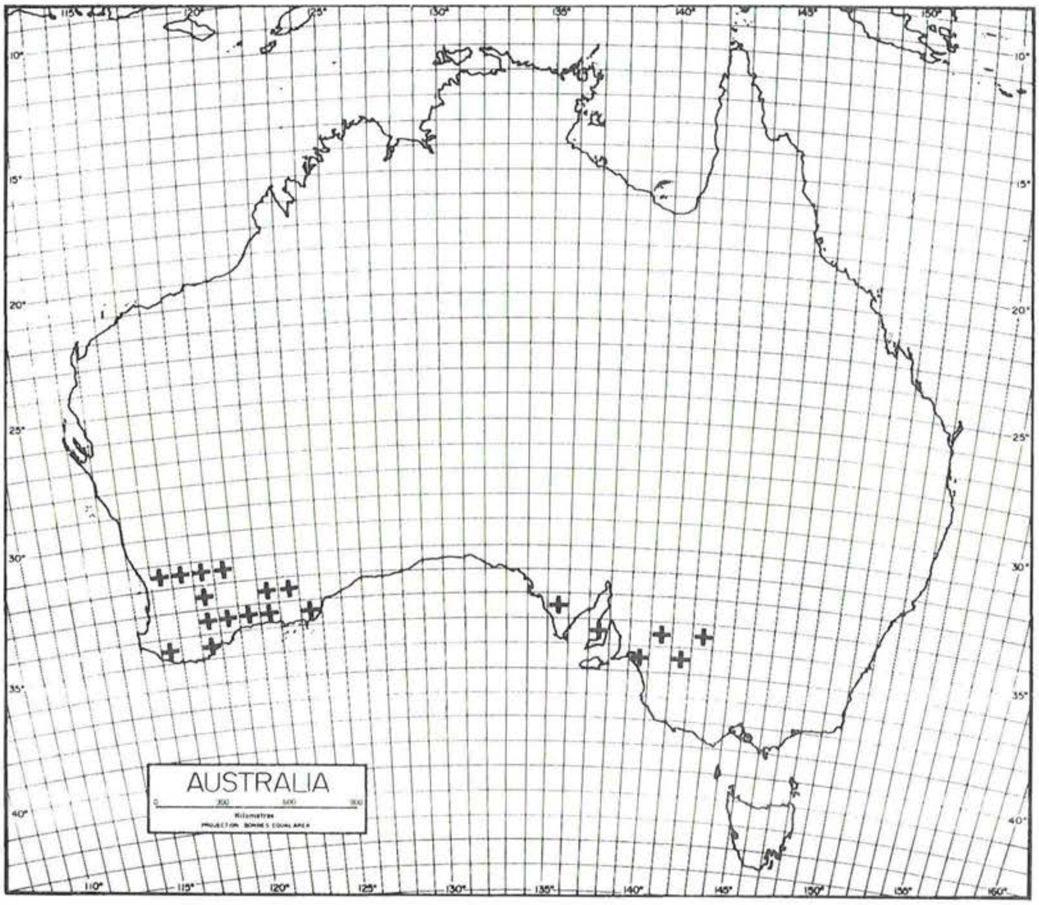
Distribution. Found in the Avon, Coolgardie, Darling (Warren Subdistrict), Eyre and Roe Districts of the South-West Botanical Province of Western Australia; in the Eyre Peninsula, Murray, Yorke Peninsula, Southern Lofty, and South Eastern Regions of South Australia; and in the Mallee Study Area of Victoria. See Map 3.

Etymology. The specific epithet honours Bertha Cosson, daughter of the botanist and famous traveller in Algeria (Mueller loc. cit.).

Notes. It is, perhaps, significant that in the draft of his paper concerning *Lawrencia,* Baker (unpublished) excluded *Plagianthus berthae* from consideration. I have chosen to follow Melville (1966) in retaining this species in *Lawrencia.* The problem remains that *L. berthae* has no close relatives in the genus and most of the character states that separate it from other species are viewed as primitive (see Key to Infrageneric Taxa and Species above and Discussion below). Obviously, a good case could be made for its placement in a monotypic genus: this should, in my opinion, await further investigation of the *Plagianthus* alliance.

The geographical range of *Lawrencia berthae* overlaps with those of *L. glomerata, L. repens, L. spicata* and *L. squamata. L. berthae* has been found growing in close proximity to these other species.

Despite its widespread and disjunct distribution, there is no morphological-geographical variation discernible within *Lawrencia berthae.*



Map 3. Distribution of *Lawrencia berthae*.

Subgenus *LAWRENCIA*

Lawrencia Hook. subgenus *Lawrencia*

Plagianthus section *Lawrencia* (Hook.) Benth., J. Linn. Soc., Bot. 6: 123 (1862); E. G. Baker, J. Bot. 30: 72-3 (1892). *Sida section Lawrencia* (Hook.) F. Muell., Pl. Victoria 1: 162-3 (1862). *Lectotype* (here designated): *Pl. spicata* (Hook.) Benth. [*L. spicata* Hook.].

Prostrate, decumbent or erect sub-shrubs, or erect shrubs; with or without thorns; vestiture stellate-hairy or squamulose with peltate scales; flowers subsessile or sessile, axillary, solitary, often crowded in leafy fascicles, odourless; sepals adaxially glabrous; petals never with intermeshing basal hairs; filament tubes glabrous; style branches glabrous at their junction; mericarps indehiscent or dehiscent, 2-5 in each fruit, all fertile or only 1-2 fertile; pericarps glabrous, laterally reticulate with fenestrate or alveolate areolae or unornamented; seed triquetrous or swollen and irregulary globular, smooth or rugose.

SECTION *LAWRENCIA*

Lawrencia section *Lawrencia*

Erect sub-shrubs or shrubs; without thorns; female flowers of dioecious species lacking anthers altogether (in *L. glomerata,* a polygamodioecious species, sterile anthers may be present); styles filiform; mericarps indehiscent, 5 in each fruit, all fertile; pericarps laterally reticulate with fenestrate or alveolate areolae; seed triquetrous, smooth.

This section comprises two apparently related species pairs. Young plants of *Lawrencia spicata* bear a remarkable resemblance to plants of the glabrous type form of *L. glomerata* which is confined to the Irwin and Austin Botanical Districts of Western Australia, well to the north of the present-day range of the former. These two species are, of course, readily distinguishable in their adult phases by features of odour, habit, leaf shape, inflorescence and sexuality.

Lawrencia viridi-grisea and *L. buchananensis* are superficially similar in that both are hermaphroditic shrubs. However, they are always easily distinguishable by features of vestiture, leaf shape, venation and development, and dimensions of floral parts.

Lawrencia glomerata, L. spicata and *L. viridi-grisea* are extremely widely distributed across Australia; *L. buchananensis* is confined to a single, isolated population in north-eastern Queensland (Maps 4 & 5).

2. **Lawrencia spicata Hook.,** Hooker's Icon.. Pl. 3: t. 262 (1840); Hooker, J. Bot. (Hooker) 2: 413 (1840); J. D. Hooker, Fl. Tasman. 1: 48 (1855); Melville, Kew Bull. 20: 514 (1966); J. Hutchinson, Evol. & Phyl. Fl. Pl. t. 229 (1969); Beard, Descr. Cat. Western Austral. Pl. 84 (1970); J. H. Willis, Handb. Pl. Victoria 2: 382 (1973); W. M. Curtis, Stud. Fl. Tasmania Ed. 2, 1: 88 (1975); J. Green, Census Vasc. Pl. Western Australia 67 (1981); Jacobs & Pickard, Pl. New South Wales 144 (1981); Jessop, List. Vasc. Pl. South Australia 62 (1983). *Sida lawrencia* F. Muell., Pl. Victoria 1: 162 (1862). *Plagianthus spicatus* (Hook.) Benth., J. Linn. Soc., Bot. 6: 103 (1862); Bentham, Fl. Austral. 1: 189-190 (1863); E. G. Baker, J. Bot. 30: 72 (1892); C. Moore, Census Pl. New South Wales 6 (1884); C. Moore, Handb. Fl. New South Wales: 57 (1893); Rodway, Tasman. Fl. 16 (1903); Maiden & Betche, Census New South Wales Pl. 136 (1916); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931); J. M. Black, Fl. South Australia, edn 2, 3: 556 & t. 716 (1952); Hj. Eichler, Suppl. Black's Fl. South Australia: 221 (1965); Blackall & Grieve, How to know Western Austral. Wildfl. 2: 344 (1966). *Neotype* (here designated): Hooker's Icon. Pl. 3: t. 261 (1840).

Sub-shrub to 180 cm tall, ascending, with one to several stout stems diverging from a basal rosette and slender secondary stems contracted to form dense leafy spikes, hermaphroditic. *Vestiture* lacking, plant glabrous throughout. *Leaves* alternate, distinctly petiolate basal leaves merging into subsessile or sessile floral leaves; *stipules* green and leaf-like, narrowly triangular, 2-11 mm long x 0.3 mm wide, margin entire, apex narrowly acuminate; *petiole* stout, trigonal or triquetrous, to 40 cm long; *blade of basal leaves* elliptic, narrowly elliptic or narrowly ovate, often falcate, as large as 11.5 cm long x 6.0 cm wide but generally less than 7.0 cm long x 3.0 cm wide, *blade of floral leaves* narrowly ovate, narrowly elliptic or narrowly obovate, as small as 4.0 mm long x 0.5 mm wide, blades flat, venation distinct with 1-7 primary veins, base obtuse- to acute-cuneate, margin of basal leaves coarsely dentate throughout becoming dentate only towards apex or else entire throughout in floral leaves, apex of basal leaves broadly obtuse to acute, becoming narrowly acute in floral leaves. *Flowers* bisexual, axillary, sessile or subsessile, solitary, often crowded in leafy fascicles. *Calyx* turbinate, green, 5.5-10.0 mm long; sepals connate 1/3-2/3 their

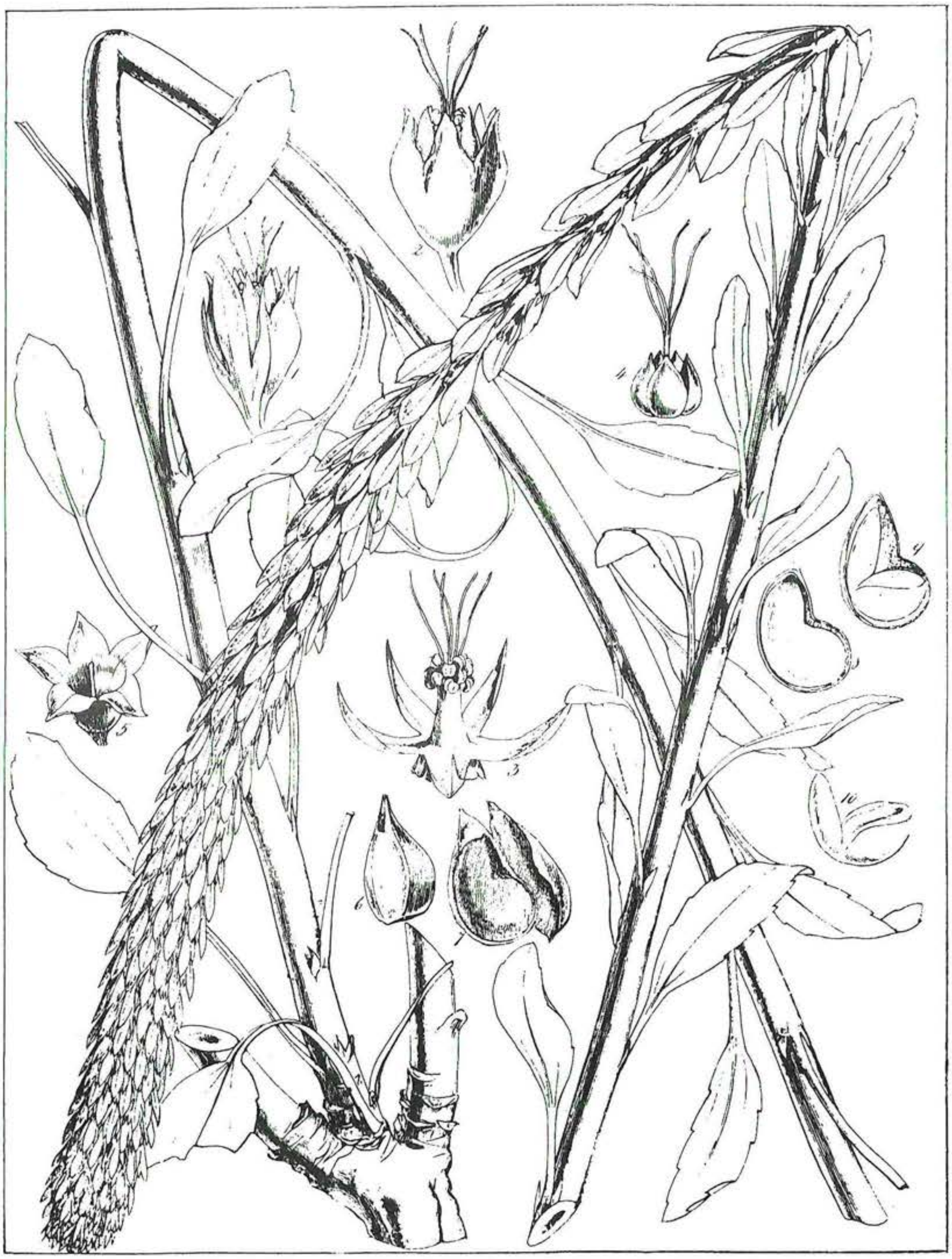


Figure 3. *Lawrencia spicata.* 1 — Flower and subtending leaf. 2 — Flower. 3 — Corolla, staminal column and style branches. 4 — Gynoecium. 5 — Calyx and columella. 6 — Ripe mericarp. 7 — Mericarp opened to reveal seed. 8 — Seed opened to reveal embryo surrounded by endosperm. 9 — Seed opened to reveal embryo itself. 10 — Embryo.

Neotype (see text).

Reproduced from Hooker, Hook., Ic. Pl. 3: t 262 (1840).

length; lobes broadly triangular, 2.5-4.8 mm wide; apices acute or acuminate. *Corolla* white to pale yellow, 4.0-8.0 mm long; petals almost free to their bases or connate to 2/5 their length, erect or somewhat spreading, ovate, 1.8-3.0 mm wide; apices obtuse, usually emarginate, sometimes entire. *Androecium* with filament tube 1.8-3.7 mm long, glabrous; free portion of filaments 0.2-0.8 mm long; anthers 10-20, usually 20. *Gynoecium* with style 4.5-8.0 mm long; branches 5, free to base or united for up to 2/5 their length, filiform, 0.1-0.5 mm wide, pink to dark brown, introrsely stigmatose, often on upper 4/5 only. *Fruit* somewhat oblate to ovoid, 2.2-4.0 mm high x 1.6-4.4 mm in diameter; mericarps 5; pericarp white or tan, membranous, becoming translucent and reticulate on lateral and distal-basal surfaces, margin prolonged to form narrow distal-lateral wings often connected across apical distal region to give the distal wall a distinctive shield-like appearance. *Seed* triquetrous, brown, smooth, 1.6-2.7 mm high x 1.0-2.0 mm wide. *Columella* slender, 2.5-3.8 mm high x 0.2-0.4 mm in diameter. Figure 3.

Flowering period. October to February.

Habitat. Occurs in alluvial soils of temperate coastal salt-marshes, estuaries and river banks, and in peaty swamps, occasionally colonizing clay soils along roadsides.

Selected specimens from 130 collections examined. NEW SOUTH WALES: Sydney, s.dat., *B. Bynoe* s.n. (K) a doubtful record.

SOUTH AUSTRALIA: Bay 10 (Port Lincoln), s.dat. *R. Brown* 5110 (BM, CANB, K, MEL); mouth of Inman River, c. 65 km S of Adelaide, Jan. 1926, *J.B. Cleland* s.n. (AD); E of Reserve, Hundred of Murlong, c. 120 km N of Port Lincoln, Dec. 1959, *J.B. Cleland* s.n. (AD); 15 km S of Streaky Bay, c. 90 km SE of Ceduna, *T. Dennis* 152 (AD); Hundred of Messent, c. 190 km SSE of Adelaide, *T.R.N. Lothian* 1255 (AD); Holdfast Bay, 1850, *F. Mueller* s.n. (MEL); Lake Albert, c. 10 km SW of Meningie, c. 110 km SE of Adelaide, *L.D. Williams* 4102 (AD).

TASMANIA: Flinders Island, 1956 *Anon.* (HO 12972); Port Arthur, 1892, *J. Bufton* s.n. (MEL); Bellaire, Old Canal, *H.F. Comber* 2024 (K); Ralphs Bay Canal, towards Sandford, Feb. 1966, *W.M. Curtis* s.n. (HO); Koonya, at mouth of Newmans Creek, *Hj. Eichler* 16859 (AD); Clarke Island, 1894, *E. Maclaine* s.n. (MEL); Double Creek, on main road between Orford and Triabunna, Feb. 1976, *J.W. Parham* s.n. (HO); Coles Bay, April 1930, *L. Rodway* s.n. (HO, K).

VICTORIA: Melbourne, Feb. 1946, *L.C. Bartels* s.n. (NSW); smaller island near Goat Island, Mallacoota Inlet National Park, *A.C. Beauglehole* 31285 (MEL); Rigby Island, S of Kalimna, *P.K. Gullan* 384 (MEL); Polkemmet, near river, Wimmera, *F.M. Reader* 8 (MEL); Point Lonsdale, *J. Tilden* 797 (BM, K); Lake Tyers, April 1977, *J. Turner* s.n. (MEL).

WESTERN AUSTRALIA: Claremont, *C. Andrews* 72 (BM, K, PERTH); Mandurah, Feb. 1928, *A.J. Hall* s.n. (PERTH); 22.6 km E of Ravensthorpe on road to Esperance, *N.S. Lander* 1166 (BH, K, MEL, PERTH); Loongana, *J. Lowry* 43 (PERTH); near Jurien Bay, Jan. 1963, *F. Lullfitz* s.n. (PERTH); Neendaling, W of Lake Grace, Nov. 1978, *P. Stevenson* s.n. (PERTH).

Distribution. Found in the Avon, Darling (Drummond Subdistrict), Eyre and Roe Districts of the South-West Botanical Province of Western Australia; in the Eyre Peninsula, Northern Lofty, Southern Lofty, and Kangaroo Island Regions of South Australia; in the South West Coranamite, Melbourne, Southern Gippsland, Gippsland Lakes and Eastern Gippsland Study Areas of Victoria; on the east coast of Tasmania and islands of Bass Strait; and possibly near Sydney on the Central Coast of New South Wales. See Map 5.

Etymology. The specific epithet draws attention to the dense spicate inflorescence characteristic of this species.

Notes. In his protologue, W. J. Hooker (1840 loc. cit.) cites specimens sent to him by Ronald Gunn collected at "Port Arthur, Van Diemans Land; and at Port Fairy, South Australia, growing on the side of a salt-water inlet, where the ground was marshy". Neither these specimens nor any duplicates of them have been found in the course of the present study, nor are they cited by Bentham (1863 loc. cit.).

A specimen sent to J. D. Hooker, Gunn 746 (K), has a note in Gunn's hand appended: "Numerous specimens of this plant collected at various times are packed up separately. They are from Port Fairy, South Coast of New Holland, but the Lawrencia spicata occurs at Flinders Island and I doubt not upon our North Coast although I have not yet seen it. Remove Port Arthur from the habitats as I now hardly feel satisfied about having seen it from that place". Further, Hooker (1855 loc. cit.) notes that "Mr Gunn informs me that the Port Arthur Station formerly assigned to this plant by him is doubtful". Clearly, Gunn 746 was dispatched well after publication of *Lawrencia spicata.* It is just conceivable that it is a duplicate of Gunn's original collection from Port Fairy probably made between 1836 and 1838 (see Willis 1949). On the other hand it could as easily have been gathered at some later date on Flinders Island. In view of this uncertainty it seems best to designate the above neotype. Fortunately, *L. spicata* is sufficiently characteristic for there to be no mistaking it from the detailed illustration provided by W. J. Hooker which is reproduced here (Figure 3).

Mueller (1862 loc. cit.) published the name *Sida lawrencia* indicating that it was composed of *Lawrencia spicata* and *L. glomerata* distinguishing a "glabrous erect variety with simple spikes" and a "procumbent or ascendent velvet-downy branched variety with glomerate spikes". Collections cited by Mueller under this name are referred variously to *L. glomerata, L. spicata* and *L. viridi-grisea* in the present treatment.

A specimen of *Lawrencia spicata* from W. J. Hooker's herbarium and now held at K is annotated "Sydney Bynoe." Benjamin Bynoe was a surgeon with H.M.S. 'Beagle' on King's 1837-1843 expedition to survey the north-western coast of Australia. Bynoe made botanical collections on Depuch Island, the Abrolhos, the Victoria River, off Bass Strait and in New South Wales (Maiden 1906). His specimen of *L. spicata* was cited tentatively by J. D. Hooker (1855 loc. cit.) Subsequent authors recorded the occurrence of this species in New South Wales under *Plagianthus spicatus,* including C. Moore (1884 loc. cit., 1893 loc. cit.) and Maiden & Betche (1916 loc. cit.), although no further collections from that state are known. Jacobs & Pickard (1981 loc. cit.) consider its presence in New South Wales unsubstantiated. It is possible that Bynoe encountered *L. spicata* at the Victoria River or off Bass Strait where it is still to be found today.

With the notable exception of a single immature specimen collected at Loongana on the Nullarbor Plain, the distribution of *Lawrencia spicata* shows a pronounced disjunction between south-western and south-eastern Australia. It seems most likely that the Nullarbor specimen is of merely sporadic occurrence from seed dropped by trains, although future collecting from this region may demonstrate otherwise.

Despite its disjunct distribution, there is no morphological-geographical variation discernible in *Lawrencia spicata.*

The geographical range of *Lawrencia spicata* overlaps with those of *L. berthae, L. diffusa, L. glomerata* and *L. repens. L. spicata* has been found growing in close proximity to these other species.

3. **Lawrencia glomerata** Hook., Hooker's Icon. Pl. 5: t. 417 (1842); C. Moore, Handb. Fl. New South Wales 57 (1893); J. H. Willis, Handb. Pl. Victoria 2: 382 (1973); N. Beadle, Stud. Fl. N.E. New South Wales 1: 300 & t. 141 (1976); J. Green, Census Vasc. Pl. Western Australia 67 (1981); Jessop, Fl. Centr. Australia 211-2 (1981); Jacobs & Pickard, Pl. of New South Wales 144 (1981); G. M. Cunningham et al., Pl. W. New South Wales 491-2 (1982); Jessop, List Vasc. Pl. South Australia 62 (1983). *Plagianthus glomeratus* (Hook.) Benth., J. Linn. Soc., Bot. 6: 103 (1862); Bentham, Fl. Austral. 1: 190 (1863); Bailey, Queensland Fl. 1: 110 (1899); Maiden & Betche, Census New South Wales Pl. 136 (1916); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931); J. M. Black, Fl. South Australia, edn 2, 3: 556-7 & t. 717 (1952); Blackall & Grieve, How to Know Western Austral. Wildfl. 2: 345 (1956); Hj. Eichler, Suppl. Black's Fl. South Australia: 221 (1965); Chippendale, Proc. Linn. Soc. New South Wales 96: 248 (1971). *Type:* Swan River, Western Australia, 1843, *Drummond* 55 (holo: K; iso: K, BM, MEL, PERTH).

Plagianthus spicatus var. *pubescens* Benth., Fl. Austral. 1: 189-190 (1863); E. G. Baker, J. Bot. 30: 72 (1892); J. M. Black, Fl. South Australia ed. 2, 3: 556 (1952); Hj. Eichler, Suppl. Black's Fl. South Australia: 221 (1965). *Lectotype* (here designated): Lake Hindmarsh, s. dat., *F. Mueller* s.n. (lecto: NSW; isolecto: BM, MEL 98684, 98686, 986887 pro pte). *Lectoparatypes:* Lake Weering (as "Lake Waringa"), 3 October 1860, *J. Dallachy* 237 (MEL 98687 pro pte); Lake Weering (as "Lake Waringa"), Victoria, 3 October 1860, *J. Dallachy* 238 (MEL); Murray Desert, 14 October 1835, *F. Mueller* s.n. (MEL); Trial Bay, s.dat., *P. W. Warburton* s.n. (MEL).

Sub-shrub to 100 cm tall, ascending, polygamodioecious. *Vestiture* of stems, stipules, leaves and adaxial surfaces of calyces glabrous to densely tomentose with simple, bifurcate and haplomorphic stellate hairs. *Leaves* alternate, distinctly petiolate basal leaves merging into subsessile or sessile floral leaves; *stipules* green and leaf-like, narrowly linear, obovate or broadly triangular, 1.3-10.0 mm long x 0.3-3.0 mm wide, margin often ciliate, apex acuminate, acute or broadly obtuse; *petiole* slender, broadly to shallowly triquetrous, often appearing canaliculate or almost flat, to 60 mm long; *blades* orbicular, broadly to narrowly obovate or broadly to narrowly elliptic, 5-50 mm long x 2-40 mm wide, flat, venation obscure or distinct with 3-7 conspicuous primary veins, base broadly obtuse- to narrowly acute-cuneate, margin coarsely dentate except towards the base of basal leaves, becoming dentate only towards the apex of floral leaves, apex broadly obtuse on basal leaves, becoming narrowly acute or 3-lobed on floral leaves. *Flowers* unisexual or bisexual, axillary, sessile, solitary, often crowded in leafy fascicles. *Calyx* turbinate, green, 2.5-12.0 mm long, sepals connate 1/4-9/10 their length; lobes broadly triangular, 1.5-4.6 mm wide; apices obtuse, acute or acuminate. *Corolla* white or green, 2.5-8.5 mm long; petals almost free to their bases or connate for up to 2/5 their length, glabrous or stellate-hairy along mid-vein; lobes flat and spreading in male flowers, erect and carinate in bisexual and female flowers, elliptic or ovate, 0.9-3.0 mm wide; apices obtuse, usually entire, sometimes emarginate. *Androecium* with filament tube 1.3-7.0 mm long, glabrous; free portion of filaments 0.2-1.0 mm long; anthers up to 25 in male and bisexual flowers, with or without sterile anthers in female flowers. *Gynoecium* with style 1.3-10.0 mm long; branches 5, free to base, filiform, 0.1-0.5 mm wide, salmon pink or yellow, introrsely stigmatose; gynoecium sterile and much reduced in male flowers. *Fruit* somewhat oblate to ovoid, 1.4-4.7 mm high x 0.8-5.0 mm in diameter; mericarps 5; pericarp white or tan, membranous, becoming translucent and reticulate on lateral and distal-basal surfaces, margin often prolonged to form narrow distal-lateral wings sometimes connected across apical-distal region to give the distal wall a distinctive shield-like appearance. *Seed* triquetrous, brown, smooth, 1.0-3.2 mm high x 0.5-2.5 mm in radial width. *Columella* slender, 1.6-4.5 mm high, c. 0.2 mm in diameter. Figure 4.

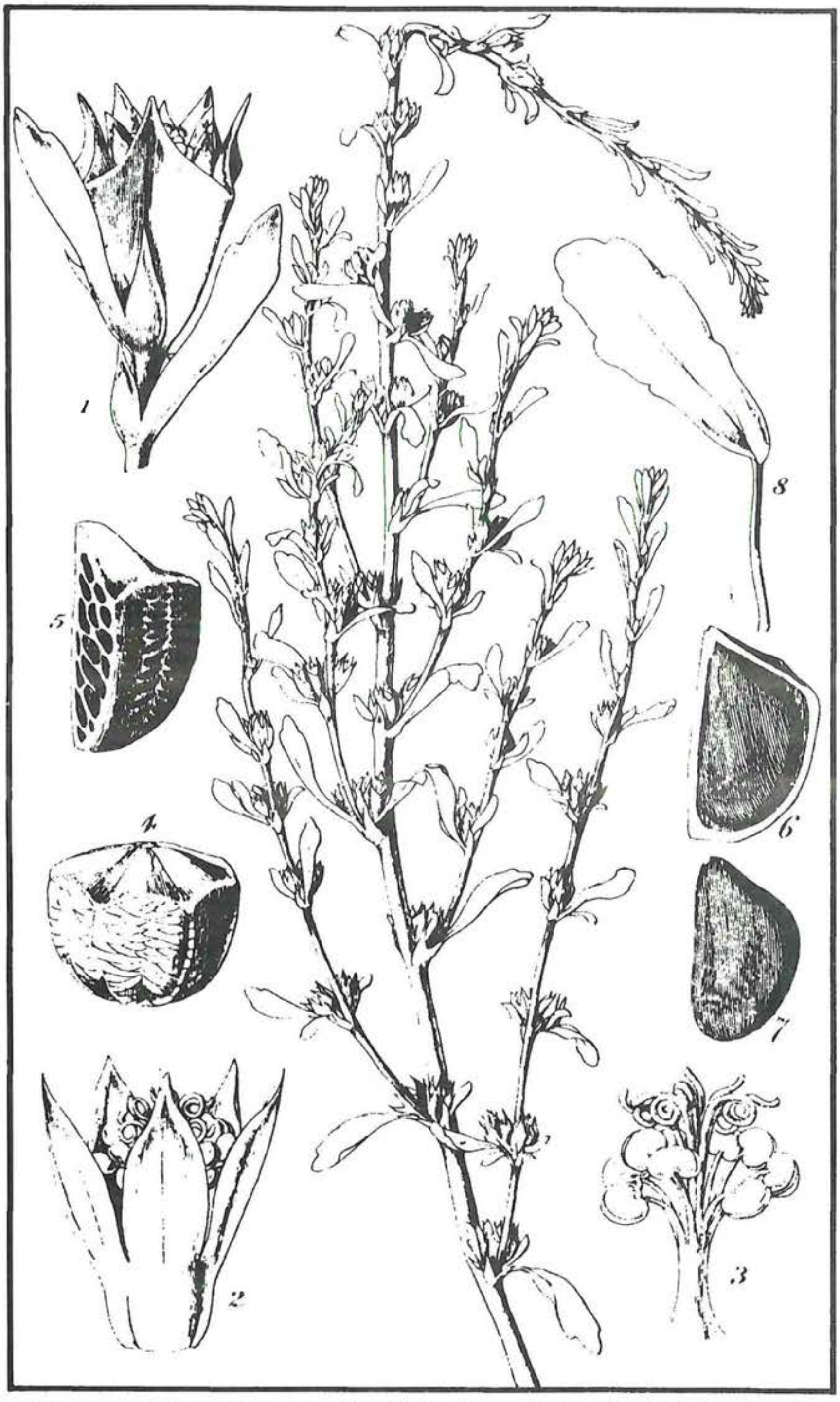


Figure 4. *Lawrencia glomerata*. 1. Flower. 2. — Corolla. 3 — Staminal column and style branches. 4 — Immature fruit. 5 — Ripe mericarp. 6 — Mericarp opened to reveal seed. 7 — Ripe seed. 8 — Lower leaf.

Drawn from *Drummond* 55 (holotype).

Reproduced from Hooker, Hook. Ic. Pl. 5: t. 417 (1842).

Flowering period. May to March.

Habitat. Occurs in subsaline sand or clay in succulent steppe, *Triodia* grassland, low shrubland and open woodland in and around estuaries, coastal inlets, inland playa lakes, saline depressions and watercourses or on gibber plains or gypsum or limestone ridges, occasionally colonizing sand along roadsides.

Selected specimens from 258 collections examined. NEW SOUTH WALES: Cobham Salt Lake, *W. Bauerlen* 256 (MEL); "Barrakee", near Bourke, May 1968, *G.L. Jacob* s.n. (NSW); West Valley, Acacia Vale, 12 km W of Broken Hill, *J.W. Leigh* 2047 (NSW); Nucha Lake (as "Lake Mucha"), near Mootwingee, *P.L. Milthorpe* 576 (AD); Mt Mulyah, c. 60 miles (96 km) NW of Louth, *C.W.E. Moore* 6367 (CANB); Waroo, near Bourke, Oct. 1936, *K.A. Morris* s.n. (BRI).

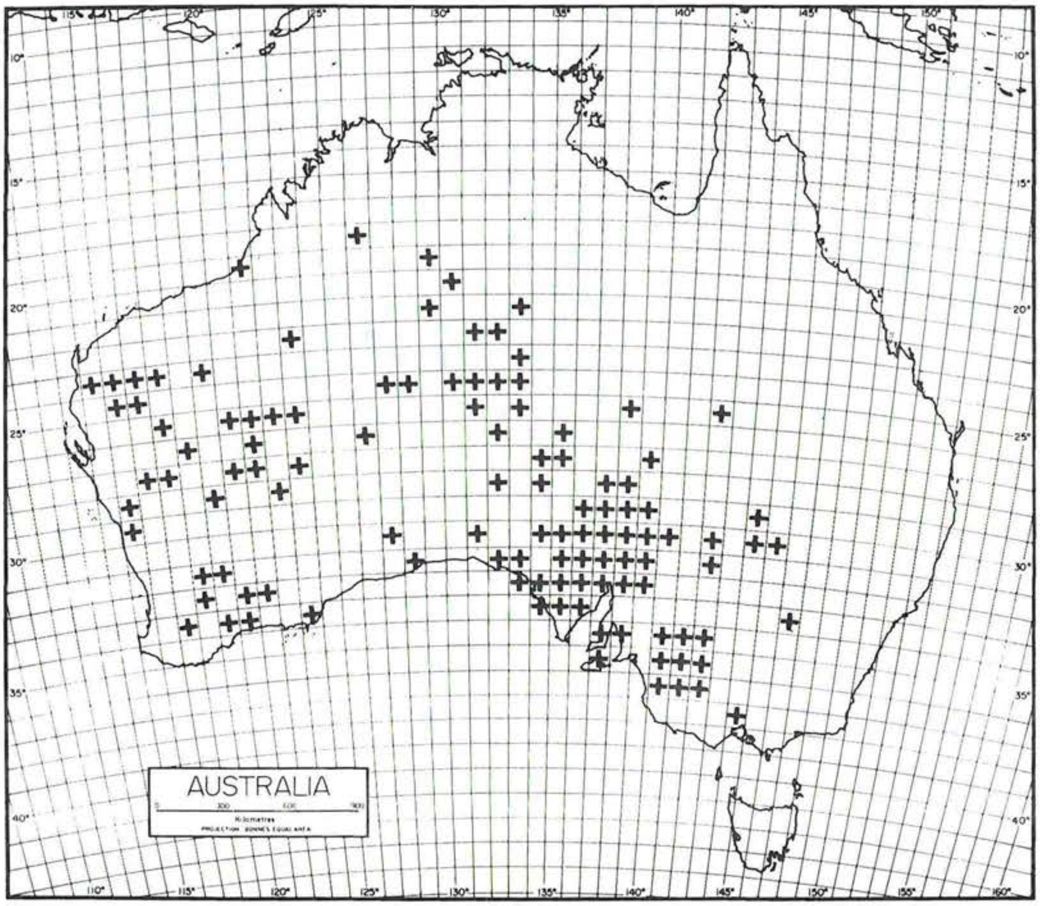
NORTHERN TERRITORY: Palm Valley, *G. Chippendale* 10612, (AD, CANB, MEL, NSW); "New Haven", Lake Bennet, *C. Dunlop* 2541 (AD); Stirling Swamp, *P.K. Latz* 5591 (AD); Lake Neale, *J.R. Maconochie* 1893 (AD, MEL, NT); Little Sandy Desert, *A.S. Mitchell* 995 (NT, PERTH); 1 mile (1.6 km) W of Central Mt Wedge, *A.O. Nicholls* 818 (AD, CANB, K, MEL, PERTH).

QUEENSLAND: Sources of the Thomson River, 1891, *C.W. Birch* s.n. (MEL); Gregory South, *M. Olsen* 717 (BRI).

SOUTH AUSTRALIA: 7 miles (11.2 km) E of Lyndhurst, *J. Carrick* 1802 (AD); Bight Well, near Head of Bight, Nov. 1955, *J.B. Cleland* s.n. (AD); Gawler Ranges, c. 6.5 km NW of Chilpuddie, along the Minnipa-Yardea road, *Hj. Eichler* 19550 (AD); 20 miles (32 km) W of Emu, *N. Forde* 479 (AD, K, MEL); near Arckarunga, *E.N.S. Jackson* 741 (AD, PERTH); Allandale Station, c. 20 km SE of Oodnadatta, *R.H. Kuchel* 659 (AD); "Purple Downs", c. 50 km NNE of Pimba, *R. Swinbourne* 180 (AD); Fenelon Island, c. 60 km SW of Ceduna, *N.M. Wace* 193 (AD); St Francis Island, c. 60 km SW of Ceduna, *N.M. Wace* 219 (AD, MEL); c. 5 km SE of Coward Springs, on gibber plain just E of Blanche Cup Springs, *J.Z. Weber* 5786 (AD, PERTH); Billeroo Creek area, c. 45 km ENE of Frome Downs Homestead, *D.J.E. Whibley* 3425 (AD); c. 18 km S of Mooneree Homestead, near W margin of Lake Gairdner, *P.G. Wilson* 602 (AD); c. 3 km S of Penong, *P.G. Wilson* 1588 (AD).

VICTORIA: Raak Plain, c. 46 km S of Mildura, *M.D. Crisp* 3417 (CBG, MEL); Wyperfeld National Park, 1959, *J.O. Maroske* s.n. (MEL); Junction of the Murray and Darling Rivers, 1887, *J. Minchin* s.n. (MEL); near Lake Hindmarsh, *J.D.M. Pearson* 2024 (MEL); 5.6 km W along road which runs W of the Sunset Tank-Merrinee road, *P.S. Short* 1185 (AD, CBG, MEL); Gypsum workings 4 miles (6.4 km) SW of Nowingl, Aug. 1955, *J.H. Willis* s.n. (MEL).

WESTERN AUSTRALIA: c. 20 km from Mount Augustus Homestead on the Landor road, *A.M. Ashby* 3408 (AD); between "Barren Downs" and Muellers Range, s.dat., *C.W. Birch* s.n. (MEL); 6 miles (9.6 km) N of Salmon Gums, *W.E. Blackall* 1009 (PERTH); "Anna Plains", *N.T. Burbidge* 1433 (PERTH); 78 km ENE of Cosmo Newberry Mission, *R.J. Chinnock* 666 (AD); Calvary Gap, Kennedy Range, *C.A. Gardner* 6075 (PERTH); Lake Auld, *A.S. George* 9132 (MEL*, NSW, PERTH); upper Ashburton River, *W.E.P. Giles* 1876, *W.E.P. Giles* s.n. (MEL); Mt Murchison, 1876, *W.E.P. Giles* s.n. (MEL); Lake Christopher area, *R.H. Kuchel* 271 (AD); Lake Austin, c. 15 km S of Day Dawn on Great Northern Highway, *N.S. Lander* 1113 (BH, CANB, K, MEL*, NT, PERTH); N. end of salt lake extending from Coolimba to Leeman, *N.S. Lander* 1160, (BH, K, NSW, PERTH); Culham Inlet, Fitzgerald National Park, *N.S. Lander* 1168 (BH, BRI, NSW, NT, PERTH); Carnamah, Nov. 1906, *A. Morrison* s.n. (BM, BRI, PERTH); Eucla, 1877, *T. Richards* s.n. (MEL); 1 mile (1.6 km) SW of Southern Cross, on Great Eastern Highway, *M.D. Tindale* 130321 (NSW).



Map 4. Distribution of *Lawrencia glomerta.*

Distribution. Found in the Avon, Eyre, Irwin and Roe Districts of the South-West Botanical Province, in the Ashburton, Canning, Carnarvon, Coolgardie, Eucla, Giles, Helms and Keartland Districts of the Eremaean Botanical Province, and in the Dampier and Fitzgerald Districts of the Northern Botanical Province of Western Australia; in the western half of the Central Australia Pastoral District of the Northern Territory; in each and every Region of South Australia; in the Mallee, Melbourne, South West and Wimmera Study Areas of Victoria; in the Far Western Plains (North Subdistrict) and Western Plains (North and South Subdistricts) Botanical Divisions of New South Wales; and in the Gregory South Pastoral District of Queensland. See Map 4.

Etymology. The specific epithet draws attention to the clustered flowers usual in this species.

Notes. Bentham (1863 loc. cit.) clearly based his *Plagianthus spicatus* var. *pubescens* on the second of Mueller's unnamed varieties of *Sida lawrencia* (*Lawrencia spicata*) discussed above. All of the specimens designated here as lectotype and lectoparatypes were cited by Mueller (loc. cit.) under *Sida lawrencia* and have been examined and initialed by Bentham.

In the draft of a paper made in the late 1930s concerning *Lawrencia,* the British botanist E. G. Baker described and named two putative new species, which were segregates of *L. glomerata.* These putative new species were founded on differences observed amongst the few specimens available to Baker in London supplemented by a small number from Western Australia selected for his examination by Western Australian Government Botanist Charles Gardner. Several specimens held at BM, K and PERTH have been annotated with two manuscript names by Baker which have never been published.

Lawrencia glomerata is a highly polymorphic taxon displaying very considerable plasticity in vegetative and floral characters. Compared on an individual basis specimens from different populations can be strikingly dissimilar. Throughout Central Australia, for instance, are populations of stellate-hairy plants with particularly large juvenile leaves; in the extreme eastern and western reaches of this species' geographical range are to be found populations of glabrous or subglabrous small-leaved forms (the type form, in fact). As dramatic as these and other examples may seem, the present study, involving the examination of all available herbarium specimens from throughout Australia, found them to be merely part of a continuum and that interpopulational variability in this species does not exhibit a morphological-geographical pattern clear enough to be readily exploited taxonomically. Although particular forms do predominate in particular areas of the range of the complex they do not do so to the exclusion of other forms; some forms also recur at different places within the overall range. *L. glomerata* is by far the most widespread species in the genus, but its populations are allopatric: under such conditions one might expect local fixation of character states.

Lawrencia glomerata is also remarkable for its polygamodioecy. Flowers of male plants generally have a larger spreading calyx and corolla and a sterile vestigial gynoecium. Flowers of female plants have a smaller erect calyx and corolla and either lack anthers or have sterile anthers which remain small and closed, producing no pollen. Morphologically, the flowers of hermaphrodite plants are intermediate between these two extremes, but they are as large as those of males or almost so. In view of the continuous morphological variation between them, a distinction between male and female flower-types has not been made in the above description.

The geographical range of *Lawrencia glomerata* overlaps with those of all other species in the genus with the exception of *L. buchananensis*. *L. glomerata* is often found growing in close proximity to these other species.

4. **Lawrencia viridi-grisea** Lander, sp.nov.

Lawrencia viridi-grisea est frutex parce ramosus hermaphroditus, pilis brevibus stellatis dense vestitus. Fructus e mericarpiis quinque indehiscentibus compositus, pericarpio facie laterali et distali-basali hyalino reticulato. *Lawrencia viridi-grisea Lawrencia buchananensi* similis, a qua indumento stellato nec peltato, foliis basalibus petiolatis nec sessilibus floribusque conspicue minoribus facile distinguitur.

Typus: At turnoff to Cardabia Homestead on road to Point Maud, Western Australia, October 1981, *N.S. Lander* 1143 (holo: PERTH; iso: BM, BR, K, NSW, NT).

Shrub to 100 cm tall, little-branched, weakly ascending, hermaphroditic. *Vestiture* of stems, stipules, leaves and adaxial surfaces of calyces densely tomentose with short simple, bifurcate and actinomorphic stellate hairs, the latter with more or less basally coalescent rays, giving the plant a distinctive green-grey appearance. *Leaves* alternate or clustered on reduced branches, distinctly petiolate basal leaves merging into subsessile floral leaves; *stipules* green and leaf-like, filiform or narrowly triangular, 1.5-3.0 mm long x 0.3-0.9 mm wide, margin ciliate, apex narrowly acuminate; *petiole* slender, triquetrous, to 50 mm long; *blade* narrowly linear, narrowly elliptic to elliptic and sometimes falcate, or obovate to broadly obovate,

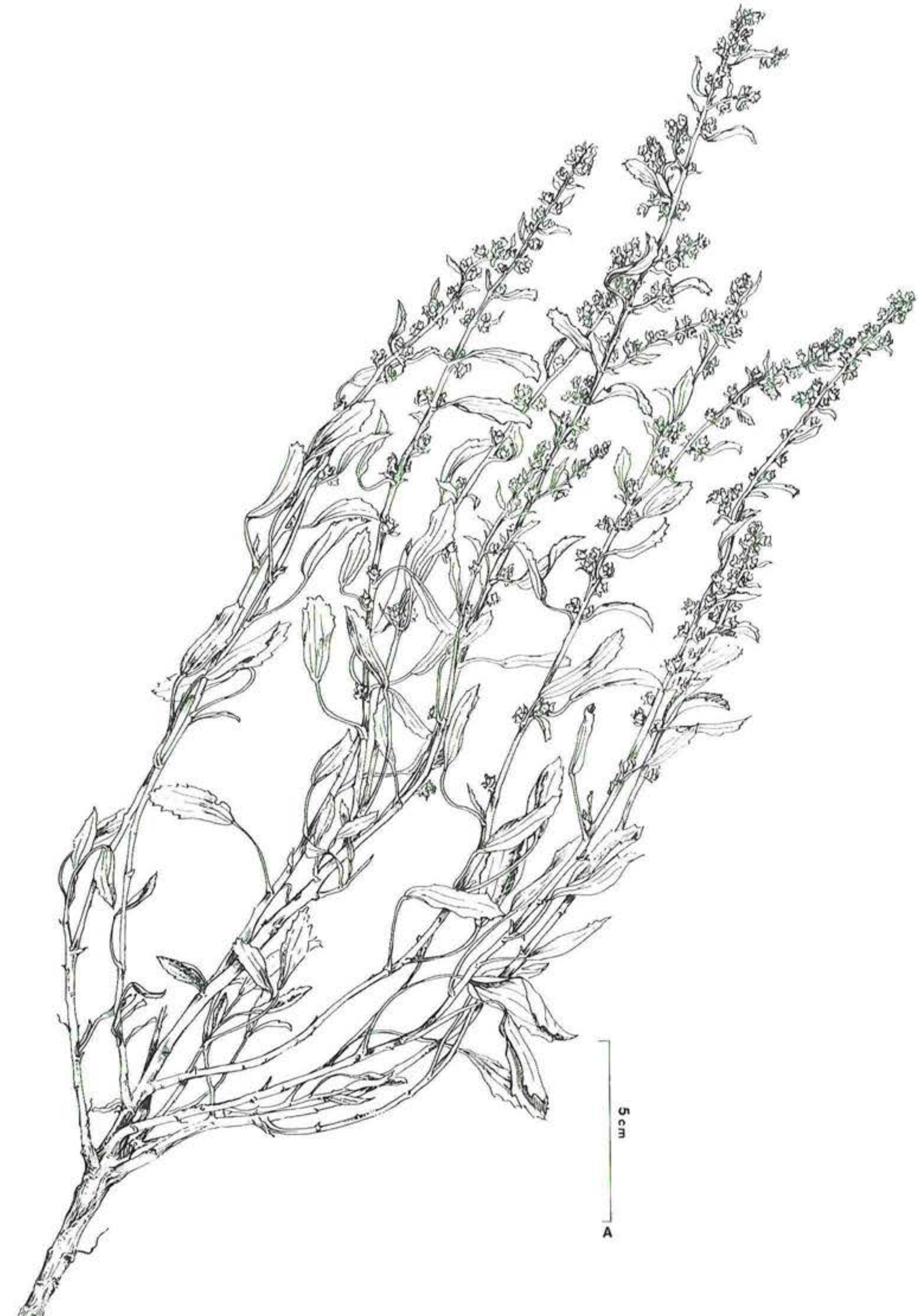


Figure 5. *Lawrencia viridi-grisea.*
Drawn from *Lander* 1149

6-48 mm long x 1-26 mm wide, flat, venation sometimes obscure, usually distinct with 1-5 conspicuous primary veins, base acute- to obtuse-cuneate, margin entire, usually becoming coarsely dentate towards the apex, sometimes merely 3-lobed, rarely entire throughout, apex acute, obtuse or truncate. *Flowers* bisexual, sessile, axillary, solitary, often crowded in leafy fascicles. *Calyx* turbinate, 3.8-5.3 mm long; sepals connate 1/2-2/3 their length; lobes triangular, 2.0-2.5 mm wide; apices broadly acute. *Corolla* white or pale yellow, 4.5-6.2 mm long; petals connate 1/10-2/5 their length, glabrous; lobes slightly carinate, ovate, 1.6-2.6 mm wide; apices emarginate. *Androecium* with filament tube 1.5-3.0 mm long, glabrous; free portion of filaments 0.5-1.0 mm long; anthers 10-20. *Gynoecium* with style 1.2-5.5 mm long; branches 5, free to base, filiform, white or pink, introrsely stigmatose on upper 2/3-3/4. *Fruit* oblate, 2.0-3.1 mm high x 3.0-4.0 mm in diameter; mericarps 5; pericarp white or tan, membranous, becoming translucent and reticulate on lateral and distal-basal surfaces, margin prolonged to form narrow distal-lateral wings, indehiscent. *Seed* triquetrous, brown, smooth, 0.9-2.5 mm high x 0.8-1.5 mm in radial width. *Columella* slender, 1.5-2.5 mm high x 0.2-0.3 mm in diameter. Figure 5.

Flowering period. Throughout the year.

Habitat. Occurs on subsaline sand and clay soils in succulent steppe in and around estuaries, coastal inlets, inland playa lakes and saline depressions. It is also prominent amongst *Spinifex* on the leeward side of coastal sand-dunes.

Selected specimens from 40 collections examined. NORTHERN TERRITORY: Lake Bennett, *N.M. Henry* 378 (MEL); S of "Mongrel Downs", *P.K. Latz* 6567a (NT); Lake Neale, *J.R. Maconochie* 1891 (AD, CANB, CBG, MEL, NT); 45 km SW of Mongrel Downs Homestead, *S. Parker* 280 (AD, K, M).

WESTERN AUSTRALIA: "Frazier Downs" (as "Fraser Downs"), Sept. 1964, *C. De Marci s.n. (PERTH); 18*° 16′ S, 122° 04′ E, 1879, A. *Forrest* s.n. (MEL); Dirk Hartog Island, Sept. 1972, *A.S. George* s.n. (PERTH); Hermite Island, *F.L. Hill* 416 (CANB, K); Claypan adjoining Lyndon River on Exmouth-Minilya road, *N.S. Lander* 1149 (MEL*, NT, PERTH); N end of salt lake extending from Coolimba to Leeman on coast E of Eneabba, *N.S. Lander* 1159 (PERTH); Little Sandy Desert, 23° 05′ S, 123° 22′ E, *A.S. Mitchell* 1010 (NT, PERTH); Lake Tobin, Canning Stock Route, *P. Smith* 53 (PERTH).

Distribution. Found in the Irwin District of the South-West Botanical Province, in the Canning, Carnarvon and Fortescue Districts of the Eremaean Botanical Province, and in the Dampier District of the Northern Botanical Province of Western Australia; and in the Central Australia Pastoral District of the Northern Territory. See Map 5.

Etymology. The specific epithet draws attention to the close, dense indumentum which gives this species its characteristic grey-green appearance.

Notes. Lawrencia viridi-grisea displays considerable morphological-geographical variation, particularly in its vestiture and its leaf architecture. In general, plants from coastal populations in Western Australia have long linear, narrowly elliptic or elliptic leaves, and the arms of the radiate stellate hairs that clothe them are only shortly coalescent basally; those from Central Australia tend to bear short obovate to broadly obovate leaves and are clothed in stellate hairs with strongly coalescent arms approaching the peltate scales of *L. buchananensis* in appearance. Although plants from the two extremes of this range of variation can appear very different indeed, there would appear to be no compelling argument for the taxonomic sub-division of this species. Broadly speaking, there is an east-west continuum between these morphological extremes, all other characters remaining constant.

Herbarium specimens of *Lawrencia viridi-grisea* have been relegated to *L. glomerata* in the past.

Lawrencia viridi-grisea is a conspicuous element of the hind-dune flora along the coastline of Western Australia from Leeman to Broome. Its geographical range overlaps with those of *L. cinerea, L. densiflora, L. glomerata* and *L. squamata*. *L. viridi-grisea* has been found growing in close proximity to these other species.

5. **Lawrencia buchananensis** Lander, sp. nov.

Lawrencia buchananensis est frutex hermaphroditus trichomatibus peltatis dense obsitus. Fructus e mericarpiis quinque indehiscentibus compositus, pericarpio facie laterali et distali-basali hyalino et reticulato. Haec species *Lawrenciae viridi-grisea* simillima, a qua facile indumento peltato nec stellato, foliis basalibus sessilibus nec petiolatis floribusque conspicue majoribus distinguende.

Typus: Lake Buchanan, Queensland, June 1976, *J. Gasteen* 85 (holo: BRI).

Shrub to 100 cm tall, ascending, hermaphroditic. *Vestiture* of stems, leaves and adaxial surface of calyces densely squamulose, predominantly with peltate scales, but also with scattered simple, bifurcate or actinomorphic stellate hairs, the latter with more or less basally coalescent rays. *Leaves* more or less subsessile throughout, alternate or clustered on reduced branches; *stipules* membranous, glabrous, linear, c. 2.5 mm long x 0.5 mm wide, margin ciliate, apex acuminate; *blade* narrowly ovate, obovate or cuneate, 10-30 mm long x 2-60 mm wide, flat, venation obscure except for a prominent mid-vein, base narrowly cuneate, canaliculate, margin entire, apex broadly acute to obtuse. *Flowers* bisexual, subsessile, axillary, solitary, often crowded in leafy fascicles. *Calyx* turbinate, green, 7.0-10.0 mm long; sepals connate 2/5-3/4 their length; lobes narrowly triangular, 2.0-2.5 mm wide; apices acute. *Corolla* white, 6.0-8.0 mm long; petals connate 1/4-1/3 their length, glabrous; lobes erect, ovate, 2.0-2.5 mm wide; apices emarginate. *Androecium* with filament tube 2.4-4.0 mm long, glabrous; free portion of filaments 0.6-1.0 mm long, anthers 20. *Gynoecium* with style 4.5-6.5 mm long; branches 5, free to base or connate for up to 1/3 their length, filiform, dark brown, introrsely stigmatose. *Fruit* oblate, 1.5-3.5 mm high x 2.5-4.2 mm in diameter; mericarps 5; pericarp tan, membranous, becoming translucent and reticulate on lateral and distal-basal surfaces, indehiscent. *Seed* triquetrous, smooth, brown, 2.1-2.4 mm high x 1.2-1.4 mm in radial width. *Columella* slender, 1.5-3.5 mm high x 0.2-0.3 mm in diameter.

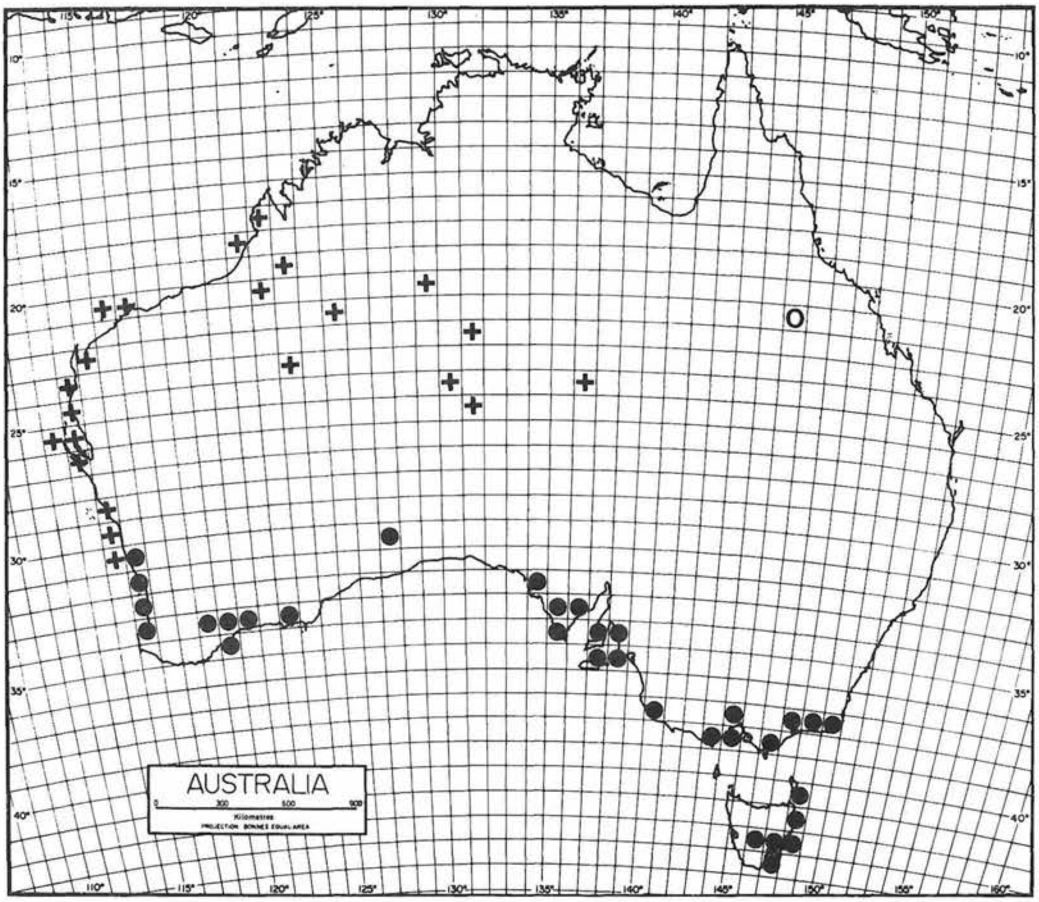
Flowering period. June.

Habitat. ". . . forming clumps in lower part of salt meadows adjacent to lake. Heavily browsed by cattle and roots sought by pigs. Withstands long immersion in salt water."

Conservation status. Lawrencia buchananensis is known only from a single population restricted to a highly specific habitat where both its above-ground and below-ground parts are heavily browsed by cattle and pigs respectively. Thus it must be considered a rare and vulnerable species according to the criteria established by Leigh et al. (1981).

Specimens examined. QUEENSLAND: Lake Buchanan, June 1976, *J. Gasteen* 85 (holo: BRI); Lake Buchanan, c. 130 miles (208 km) SW of Charters Towers, *H.S. Laveny* 52 (BRI).

Distribution. Found only at Lake Buchanan in the South Kennedy Pastoral District of Queensland. See Map 5.



Map 5. Distributions of *Lawrencia buchananensis* (O), *L. viridi-grisea* (+) and *L. spicata*. (●)

Etymology. The specific epithet draws attention to the fact that this taxon has been found only at Lake Buchanan in north-eastern Queensland.

Notes. Lawrencia buchananensis is land-locked and geographically isolated and has been found growing with no other species in the genus.

Section *SELENOTHAMNUS*

Lawrencia sectio *Selenothamnus* (Melville) Lander, stat. nov. *Selenothamnus* Melville, Kew Bull. 20: 514-5 (1966); Hutchinson, Gen. Fl. Pl. Dicot. 2: 53 (1967); Baines, Austral. Pl. Gen. 338-9 (1981). *Type: S. squamatus* (Nees ex Miq.) Melville [*Lawrencia squamata* Nees ex Miq.].

Prostrate, decumbent or erect sub-shrubs, or erect shrubs; with or without thorns; female flowers of dioecious species with sterile anthers present; styles filiform or clavate; mericarps dehiscent, 2-5 in each fruit, all fertile or only 1-2 fertile; pericarp unornamented; seed triquetrous or swollen and irregularly globular, rugose or smooth.

Etymology. The name probably alludes to the moon-like landscapes and gypseous soils preferred by species in this section.

Series *HALOPHYTON*

Lawrencia series *Halophyton* Lander, ser. nov.

Suffrutices prostrati decumbentes vel erecti, glabri vel stellato-pilosi, dioici vel hermaphroditi; flores feminei sine staminodiis; mericarpia omnia fructus bene evoluta; semina triquetra, laevia vel angularia vel rugosa.

Typus: L. diffusa (Benth.) Melville

Prostrate, decumbent or erect sub-shrubs; dioecious or hermaphroditic; without thorns; glabrous or stellate-hairy; stems without spongy periderm; leaves distinctly petiolate throughout or petiolate basal leaves merging into subsessile or sessile floral leaves; female flowers without sterile anthers; style branches filiform; mericarps in each fruit all well developed; seed triquetrous and smooth, angular or rugose.

Etymology. The name refers to the saline soils frequented by species in this series.

The four species in this series are extremely closely interrelated and display a considerable number of independent reductional series in characters such as habit, vestiture, leaf size and marginal incision, mericarp number, anther number, seed sterility and external sculpturing. They have been much confused in the past. Species in this series are confined to Western Australia and exhibit a striking north-south distribution pattern (Map 6).

6. **Lawrencia cinerea** Lander, sp. nov.

Suffrutex erectus dioicus indumento denso e pilis parvis stellatis composito cinereus. Fructus e mericarpiis 2-3 dehiscentibus, pericarpio membranaceo pellucido non ornamentato compositus. Species nova versimiliter *Lawrenciae densiflorae* affinis, a qua indumento denso e pilis parvis stellatis composito potius cinereo quam viridi, foliis conduplicatis nec applanatis seminibusque laevibus nec rugosis facile distinguitur.

Typus: Near Lake Auld, Western Australia, 22° 15′ S, 123° 45′ E, July 1967, *A.S. George* 9137 (holo: PERTH). This sheet includes male and female plants.

Sub-shrub to 130 cm tall, ascending, dioecious. *Vestiture* of young stems, stipules, leaves and adaxial surface of calyces densely cinereous-tomentose with small simple, bifurcate or haplomorphic stellate hairs. *Leaves* alternate or clustered on reduced branches, distinctly petiolate basal leaves merging into subsessile or sessile floral leaves; *stipules* green and leaf-like, soon becoming brown and scarious, triangular to broadly ovate, 2.5-5.0 mm long x 1.8-3.0 mm wide, adaxial surface sometimes glabrous apart from a dense basal tuft of hairs, margin entire, apex acute to obtuse; *petiole* stout, semiterete, to 30 mm long; *blade* narrowly ovate to ovate, elliptic or obovate, 7-35 mm long x 2-23 mm wide, strongly conduplicate, venation indistinct except for a prominent thickened mid-vein, base cordate, truncate, obtuse or acute, margin coarsely dentate throughout, apex broadly obtuse to narrowly acute. *Flowers* unisexual, subsessile to sessile, axillary, solitary, often crowded in leafy fascicles. *Calyx of male flower* turbinate, 5.0-7.5 mm long; sepals connate ½-¾ their length; lobes triangular, 2.0-3.0 mm wide; apices acute. *Corolla of male flower* white becoming purple, 5.0-7.5 mm long; petals free almost to their bases or connate for up to 1/3 their length, weakly stellate-hairy on abaxial surface along mid-vein, otherwise glabrous; lobes spreading, ovate, 2.0-2.5 mm wide; apices narrowly acute to acute; margin entire. *Androecium of male flower* with filament tube 3.1-4.0 mm long, glabrous; free portion of filaments 0.4-1.0 mm long; anthers 10-20. *Gynoecium* of male flower lacking. *Calyx of female flower* turbinate, 3.0-5.5 mm long; sepals connate 1/10-1/4 their length; lobes triangular, 1.3-2.0 mm wide; apices acute to obtuse. *Corolla of female flower* white becoming purple, 3.0-4.0 mm long; petals connate 1/3-5/8 their length, strongly stellate-hairy on abaxial surface along mid-vein, otherwise glabrous; lobes imbricate, erect, carinate, 0.9-1.2 mm wide; apices emarginate; margin entire. *Androecium of female flower* much reduced; filament tube 1.5-2.0 mm long; anthers lacking. *Gynoecium of female flower* with style 4.3-8.0 mm long; branches 2-3, free to base or connate for up to 1/7 their length, 0.1-0.2 mm wide, light brown, filiform, introrsely stigmatose, often on upper 2/3 only. *Fruit* ovoid, c. 2.2 mm high x 1.3-1.5 mm in diameter; mericarps 2-3; pericarp white or tan, membranous, becoming translucent, dehiscing to release naked seed a single one of which is fertile in each fruit. *Seed* triquetrous, smooth, brown, 1.8-2.2 mm high x 0.8-1.5 mm in radial width. *Columella* slender, 1.2-1.5 mm high x c. 0.1 mm in diameter.

Flowering period. July to October.

Habitat. Occurs on subsaline sandy clay or loam along ephemeral watercourses between sand dunes with 'Desert Oak' (*Casuarina decaisneana* F. Muell.), and in the *Melaleuca* zone adjacent to playa lakes.

Specimens examined. WESTERN AUSTRALIA: Well 30, Canning Stock Route, 22° 30′, 124° 08′, *P. de Rebeira* 415 (AD, PERTH); W of Lake Disappointment, 14 km N of Well 19, *P. de Rebeira* 422 (AD, PERTH); Near Lake Auld, *A.S. George* 9137 (holo: PERTH); Just W of Dragon Tree Soak, 19° 40′ S, 123° 21′ E, *A.S. George* 14812 (BH, NT, PERTH); Just W of Dragon Tree Soak, 19° 40′ S, 123° 21′ E, *A.S. George* 14813 (PERTH); s. loc., 1876, *W.E.P. Giles* s.n. (MEL); Well 30, Canning Stock Route, 22° 30′, 124° 08′, *A.S. Mitchell* 1023 (NT, PERTH).

Distribution. Found in the Canning and Keartland Districts of the Eremaean Botanical Province of Western Australia. See Map 6.

Etymology. The specific epithet draws attention to the dense vestiture of small stellate hairs which give this species its characteristic ashen-grey appearance.

Notes. The collection of *Lawrencia cinerea* made by W. Ernest P. Giles in 1876 is without locality details. Giles' Fifth Expedition of 1876 passed across the Little Sandy Desert (Giles 1889) which is in all likelihood the provenance of his specimen.

Herbarium specimens of *Lawrencia cinerea* have been referred to *L. glomerata* in the past.

The geographical range of *Lawrencia cinerea* overlaps with those of *L. glomerata*, *L. squamata* and *L. viridi-grisea*. *L. cinerea* has been found growing in close proximity to these other species.

7. **Lawrencia densiflora** (E. G. Baker) Melville, Kew Bull. 20: 514 (1966); J. Green, Census Vasc. Pl. Western Australia 67 (1981). *Plagianthus densiflorus* E. G. Baker, J. Bot. 30: 72 (1892). *Type:* Nickol Bay (as "Nicol Bay") and De Grey River, Western Australia, April-September 1863, *J. B. Ridley* s.n. (holo: K; iso: BM).

Plagianthus gardneri E. G. Baker ex Blackall & Grieve, How to Know Western Austral. Wildfl. 2: 346 (1956), nom. inval.

Sub-shrub to 60 cm tall, ascending, dioecious. *Vestiture* of stems, stipules, leaves and abaxial surface of calyces sparsely to densely hairy with simple, bifurcate and haplomorphic stellate hairs. *Leaves* alternate, distinctly petiolate basal leaves merging into subsessile or sessile floral leaves; *stipules* green and leaf-like, narrowly elliptic, often falcate, 2.5-4.0 mm long x 0.5-0.8 mm wide, margin ciliate, apex acute; *petiole* slender, triquetrous, to 70 mm long; *blade* obovate or broadly-cuneate in basal leaves, obovate, ovate or narrowly cuneate in floral leaves, 4-25 mm long x 2-23 mm wide, flat, venation obscure or more or less distinct with 1-5 inconspicuous primary veins, base narrowly acute- to broadly obtuse-cuneate, margin coarsely dentate, apex acute obtuse or truncate. *Flowers* unisexual, sessile, solitary, often crowded in leafy fascicles arranged in dense spikes. *Calyx of male flower* turbinate, green, 3.0-6.5 mm long; sepals connate 2/5-4/5 their length, adaxially glabrous; lobes triangular, 1.8-3.5 mm wide; apices obtuse, acute or acuminate. *Corolla of male flower* membranous, white, 4.0-7.5 mm long; petals almost free to their bases or connate for up to 1/3 their length, glabrous or weakly stellate-hairy on abaxial surface; lobes 1.5-2.8 mm wide, spreading, ovate to obovate; apices obtuse, entire; margin entire or conspicuously ciliate. *Androecium of male flower* with filament tube 2.1-3.4 mm long, glabrous; free portion of filaments 0.9-1.5 mm long; anthers 20. *Gynoecium of male flower* lacking, or rarely present but sterile and much reduced; style filiform, 2.5-4.0 mm long; branches 3-5, 0.1-0.2 mm wide, free to bases or connate for up to 1/3 their length, dark brown. *Calyx of female flower* turbinate, green, 2.5-6.0 mm long; sepals connate ½-¾ their length, adaxially glabrous; lobes triangular, 1.5-4.5 mm wide; apices obtuse, acute or acuminate. *Corolla of female flower* white, 2.0-5.4 mm long; petals connate for 1/5-1/2 their length, glabrous to densely stellate-hairy on abaxial surfaces; lobes erect, carinate, ovate, 0.8-2.0 mm wide; apices obtuse to acute, entire; margin entire or conspicuously ciliate. *Androecium of female flower* much reduced with filament tube 0.5-2.6 mm long; anthers lacking. *Gynoecium of female flower* with style 2.0-7.0 mm long; branches 2-5, free to base of style or connate for up to 1/3 its length, filiform, 0.1-0.2 mm wide, brown, introrsely stigmatose. *Fruit* somewhat oblate to ovoid, 2.0-3.0 mm high x 2.0-3.4 mm in diameter; mericarps 2-5; pericarp white, membranous, becoming translucent, dehiscing to release naked seed a single one of which is fertile in each fruit. *Seed* triquetrous, angular on lateral surfaces, rugose on all surfaces, black, 1.3-2.2 mm high x 1.2-2.0 mm in radial width. *Columella* slender, 1.0-2.5 mm high x 0.1-0.3 mm in diameter. Figure 6.

Flowering period. July to October.

Habitat. Occurs on subsaline sand or clay soils in succulent steppe and low shrubland around playa lakes, saline depressions, dry watercourses and on limestone and gypsum ridges, often colonizing disturbed roadsides.

Selected specimens from 56 collections examined. WESTERN AUSTRALIA: c. 16 km SW of Earaheedy Homestead, *R.J. Chinnock* 941, (AD); between Mt Morgans & Laverton, *C.A. Gardner* 2441 (PERTH); 19 km NW of Cue on road to Weld Range, *N.S. Lander* 1125b (BH, BRI, CANB, MEL*, NSW, NT, PERTH); On Giralia road, 28 km E of Exmouth-Minilya road, *N.S. Lander* 1139, (NSW, PERTH); 8 km S of Wooramel Roadhouse, on North West Coastal Highway, *N.S. Lander* 1156, (BH, BM, BRI, CANB, K, NSW, PERTH); Nickol Bay (as "Nicol Bay") & De Grey River, April-Sept. 1863, *J.B. Ridley* s.n. (holo: K).

Distribution. Found in the Ashburton, Austin, Carnarvon, Fortescue and eastern margin of the Helms Districts of the Eremaean Botanical Province of Western Australia. See Map 6.

Etymology. The specific epithet draws attention to the dense inflorescences often observed in this species.

Notes. Several specimens held at BM, K and PERTH have been annotated as *Plagianthus gardneri* by E. G. Baker. However, the paper by Baker in which he set out to describe and name this putative new species (see notes under *Lawrencia glomeratus)* was never

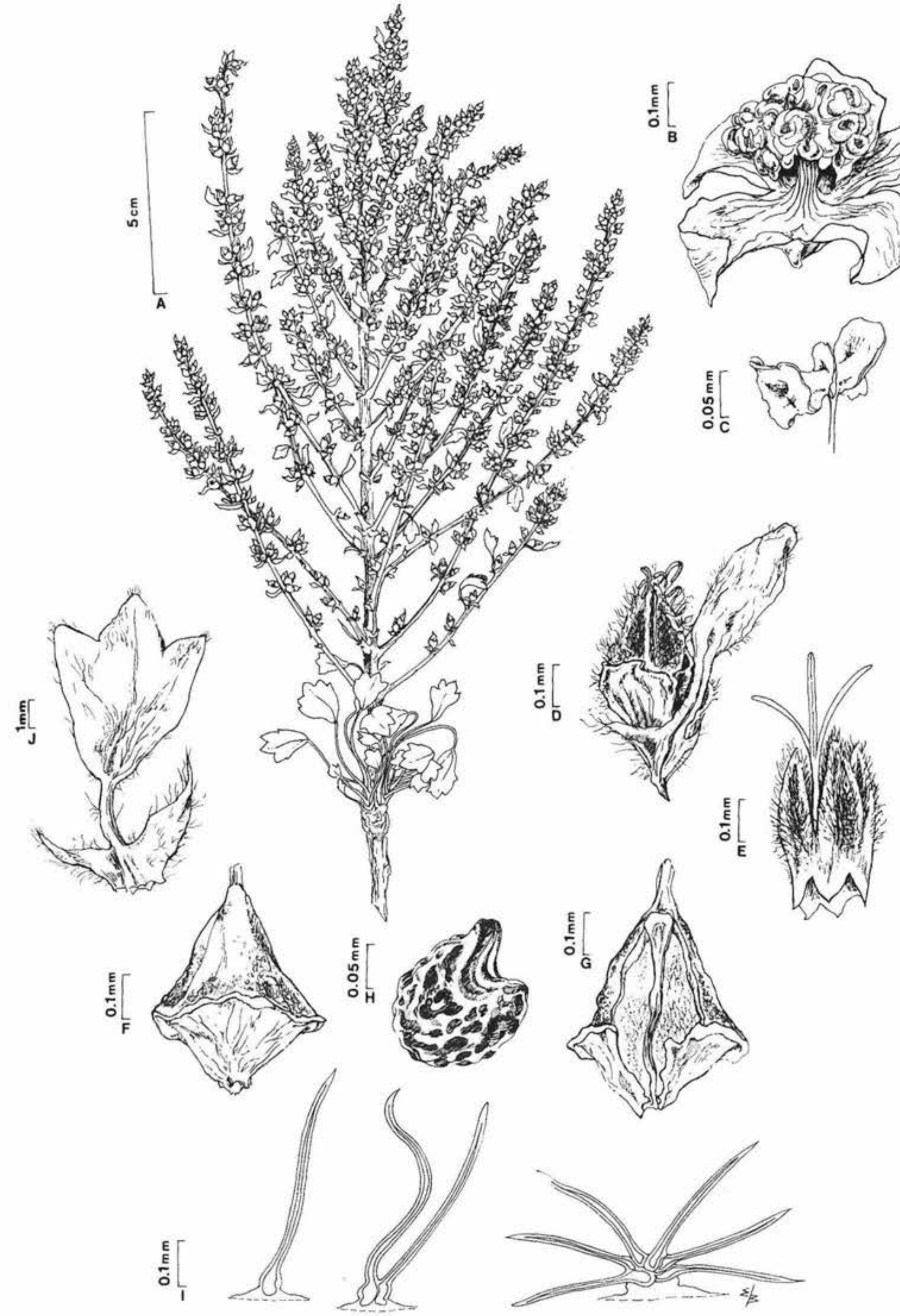


Figure 6. *Lawrencia densiflora*. A — Female plant, habit. B — Corolla of male flower and staminal tube. C — Anther after dehiscence. D — Female flower and subtending leaf. E — Female corolla and style branches after dehiscence of ovary cup. F — Immature fruit. G — Immature fruit with a single mericarp removed to show columella and membranous lateral mericarp walls. H — Ripe seed. I — Trichomes. J — Cauline leaf.

Drawn from *Lander* 1156.

published, hence the combination is invalid under the International Code of Botanical Nomenclature. Curiously, Blackall & Grieve (loc. cit.) adopted this invalid name for specimens of *P. densiflorus* (= *L. densiflora)* occurring in the region covered by their handbook.

Lawrencia densiflora is remarkably constant in its morphology over quite a wide geographical range. Although it varies somewhat in the extent of its branching, the density of its inflorescence and the density of its vestiture, nowhere does this variation appear geographically discrete or extensive enough to warrant sub-division of the species.

The geographical range of *Lawrencia densiflora* overlaps with those of *L. chrysoderma, L. glomerata, L. helmsii, L. squamata* and *L. viridi-grisea. L. densiflora* has been found growing in close proximity to these other species.

8. **Lawrencia repens** (S. Moore) Melville, Kew Bull. 20: 514 (1966); Beard, Descr. Cat. Western Austral. Pl. 84 (1970); Marchant & Keighery, Poorly Col. & Pres. Rare Vasc. Pl. Western Australia 61 (1979); J. Green, Census Vasc. Pl. Western Australia 67 (1981). *Plagianthus repens* S. Moore, J. Linn. Soc. 34: 179 (1899); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931); Blackall & Grieve, How to Know Western Austral. Wildfl. 2: 345 (1956). *Type:* Gibraltar, near Coolgardie, Western Australia, September 1895, *S. Moore* s.n. (holo: BM; iso: K).

Plagianthus repens var. *pentandra* E. Pritzel, Bot. Jahrb. Syst. 35: 361 (1904). *Type:* Bullabulling, Western Australia, 29 October 1901, *L. Diels 5204 (iso: PERTH).*

Sub-shrub decumbent, to 15 cm tall x 40 cm wide, hermaphroditic. *Vestiture* of stems, stipules, leaves and abaxial surface of calyces moderately dense to densely hairy with simple, bifurcate and haplomorphic stellate hairs. *Leaves* alternate, petiolate; *stipules* colourless and membranous or green and leaf-like, narrowly triangular, 1.5-4.5 mm long x 0.3-0.6 mm wide, margin entire, apex acuminate; *petiole* slender, canaliculate, 2-45 mm long; *blade* cuneate or deltoid, 8-10 mm long x 3-12 mm wide, flat, venation obscure or more or less distinct with 1-3 inconspicuous primary veins, base obtuse-cuneate or truncate, margin coarsely dentate, apex obtuse. *Flowers* bisexual, subsessile, axillary, solitary, often crowded in leafy fascicles. *Calyx* turbinate, green, 4.0-6.0 mm long; sepals connate 3/5-4/5 their length; lobes broadly triangular, 2.0-3.5 mm wide; apices acuminate. *Corolla* white, often tinged yellow, 3.5-5.0 mm long; petals connate 1/5-1/2 their length, glabrous; lobes erect to spreading, ovate, 1.1-1.8 mm wide; apices obtuse. *Androecium* with filament tube 0.8-1.0 mm long, glabrous; free portion of filaments 0.5-1.2 mm long; anthers 5-10. *Gynoecium* with style 2.0-2.6 mm long; branches 5, free to their bases or connate for up to 1/5 their length, filiform, light to dark brown, introrsely stigmatose. *Fruit* oblate, 2.2-4.3 mm high x 3.0-4.0 mm in diameter; mericarps 5; pericarp white or tan, membranous, becoming translucent, dehiscing to release naked seed. *Seed* triquetrous, smooth, angular on lateral faces, rugose on distal face only, black, 1.5-2.2 mm high x 1.2-1.7 mm in lateral width. *Columella* slender, 1.8-2.5 mm high x 0.3-0.5 mm in diameter.

Flowering period. August to November.

Habitat. Occurs on subsaline sand, clay and loam soils in succulent steppe on the margins of small playa lakes and saline depressions; less commonly found on lateritic soil in *Eucalyptus* woodland.

Conservation status. On the basis of the single named specimen available to them at PERTH, Marchant & Keighery (1979) noted that *Lawrencia repens* was restricted to the Ravensthorpe area. Subsequent collecting and the determination of previously unidentified material at PERTH and from other herbaria in the course of the present study has shown this species to have a much wider distribution. It can no longer be considered poorly collected or rare and would seem not to be endangered.

Selected specimens from 26 collections examined. WESTERN AUSTRALIA: 5 km NE of Norseman, c. 1 km N of Eyre Highway, *A.C. Beauglehole* 49335 (NT) (NT); Bullabulling, *L. Diels* 5204 (PERTH); Mt Moore, 1889, *E. Merrall* s.n. (MEL); near Lake Mason, June 1982, *A.V. Milewski* s.n. (PERTH); 19 km ENE of Norseman, *K. Newbey* 7537 (PERTH); 14 km NNW of Buningonia Spring, c. 35 km S of Zanthus, *K. Newbey* 7239 (PERTH).

Distribution. Found in the Avon District of the South-West Botanical Province, and in the Austin and Coolgardie Distticts of the Eremaean Botanical Province of Western Australia. See Map 6.

Etymology. The specific epithet draws attention to the prostrate, spreading (though not strictly repent) habit characteristic of this species.

Notes. Pritzel described his *Plagianthus repens* var. *pentandra* to accommodate specimens with 5 anthers. In the present study a continuum between androecia with 5 and 10 anthers was observed. Hence the variety has not been recognized.

The geographical range of *Lawrencia repens* overlaps with those of *L. berthae, L. diffusa, L. glomerata, L. helmsii* and *L. squamata. L. repens* has been observed growing in close proximity to these other species.

9. **Lawrencia diffusa** (Benth.) Melville, Kew Bull. 20: 514 (1966); Beard, Descr. Cat. Western Austral. Pl. 84 (1970); Marchant & Keighery, Poorly Col. & Pres. Rare Vasc. Pl. Western Australia 61 (1979); J. Green, Census Vasc. Pl. Western Australia 67 (1981). *Plagianthus diffusus* Benth., Fl. Austral. 1: 190 (1863); E. G. Baker, J. Bot. 30: 72 (1892); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931). *Lectotype* (here designated): Swan River, Western Australia, s.dat., *J. Drummond* 104 (lecto & isolecto: K). *Lectoparatypes:* Swan River, *J. Drummond* 137 (K-*L glomerata*); Swan River, *J. Drummond* 246 (K, BM-*L. glomerata);* Swan River, *J. Drummond* 275 (K, BM-*L. berthae).*

Diminutive *sub-shrub,* prostrate, compact, to c. 15 cm wide, hermaphroditic. *Vestiture* of stems, stipules, leaves and abaxial surface of calyces moderately densely hairy or subglabrous with simple, bifurcate and haplomorphic stellate hairs, but usually glabrous. *Leaves* alternate, distinctly petiolate throughout; *stipules* colourless and membranous, narrowly ovate, ovate or orbicular, c. 3 mm long x 0.7-1.4 mm wide, margin ciliate, apex obtuse or broadly obtuse; *petiole* slender, canaliculate, 2-15 mm long; *blade* elliptic, ovate, obovate or deltoid, 2.0-8.5 mm long x 2.0-7.0 mm wide, somewhat succulent, flat, venation obscure, base acute- or obtuse-cuneate, margin coarsely dentate, apex acute, obtuse or rounded. *Flowers* bisexual, subsessile, axillary, solitary, often crowded in leafy fascicles. *Calyx* broadly turbinate, green, 3.5-5.5 mm long; sepals connate 1/4-1/2 their length, abaxially glabrous or with a few stellate hairs at the junction of the lobes; lobes broadly triangular, 2.0-3.0 mm wide; apices acuminate. *Corolla* white, 3.0-3.5 mm long; petals free almost to their bases or connate to 2/3 their length, glabrous; lobes erect to spreading, ovate, 1.2-1.5 mm wide; apices obtuse. *Androecium* with filament tube 0.7-1.0 mm long, glabrous; free portion of filaments 0.8-1.0 mm long; anthers 5. *Gynoecium* with style 1.8-2.5 mm long; branches 5, free to their bases, c. 0.1 mm wide, white or light brown, filiform, introrsely stigmatose. *Fruit* oblate, 1.5-2.0 mm high x 2.5-3.0 mm in diameter; mericarps 5; pericarp membranous, becoming translucent, dehiscing to release naked seed. *Seed* triquetrous, angular on lateral faces, black, 1.4-1.7 mm high x 0.8-1.3 mm in radial width. *Columella* slender, 1.5-2.0 mm high x 0.2-0.3 mm in diameter.

Flowering period. September to November.

Habitat. Occurs on subsaline clay soils in succulent steppe in and around playa lakes and saline depressions.

Conservation status. On the basis of the single named specimen available to them at PERTH, Marchant & Keighery (1979) noted that *Lawrencia diffusa* was restricted to the Fitzgerald River National Park. Leigh et al. (1981) categorized it as rare but not currently considered endangered or vulnerable. Subsequent collecting and the determination of previously unidentified material at PERTH and from other herbaria in the course of the present study has shown this species to be of much wider distribution. It can no longer be considered poorly collected or rare and would seem not to be endangered at present.

Selected specimens from 16 collections examined. WESTERN AUSTRALIA: c. 4.9 km N of Lake Cronin Crossroads, *R.J. Chinnock* 4136 (AD); near Woody Lake, NE of Esperance, June 1970, *A.S. George* s.n. (PERTH); 14 km S of Clear Streak Well, c. 70 km SE of Norseman, *K. Newbey* 7575a (PERTH); Hunts Well, Nov. 1891, *R. Helms* s.n. (AD, K, MEL); Yuinmery Homestead, near Youanmi Lake, Oct. 1981, *A.V. Milewski* s.n. (PERTH); Fitzgerald River National Park, c. 20 km N of Bremer Bay on E side of No. 2 Vermin Proof Fence, (*P.G. Wilson* 10163 PERTH); 6 km N of Borden, Sept. 1966, *P.G. Wilson* s.n. (PERTH).

Distribution. Found in the Eyre and Roe Districts of the South-West District and in the Austin and Coolgardie Districts of the Eremaean Botanical Province of Western Australia. See Map 6.

Etymology. The specific epithet refers to the prostrate, spreading habit characteristic of this species.

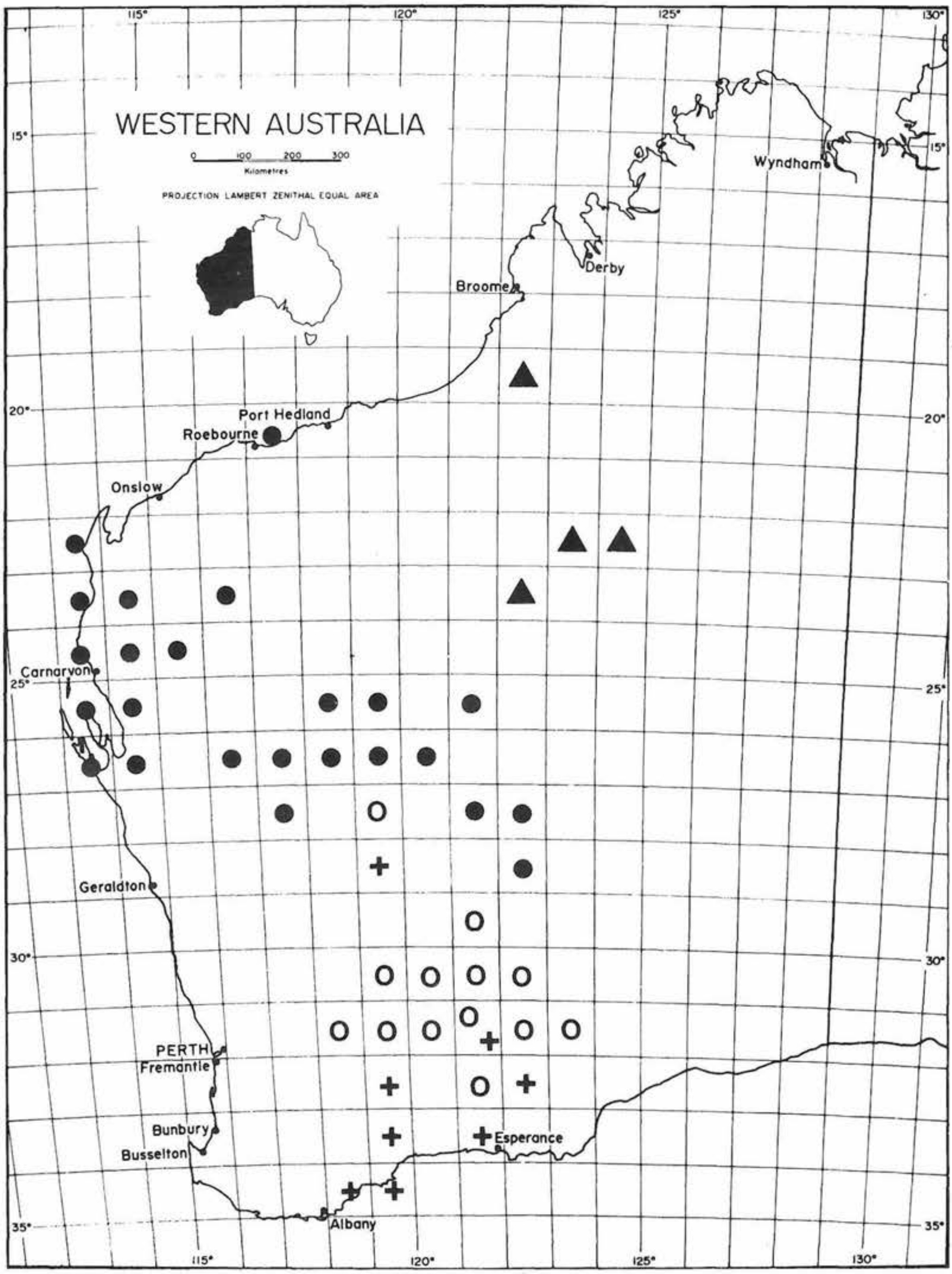
Notes. In his protologue of *Plagianthus diffusus,* Bentham (loc. cit.), listed four syntypes, namely Swan River, Drummond 104 (K), Drummond 137 (K), Drummond 246 (K, BM) and Drummond 275 (K, BM). These specimens comprise three distinct taxa which can easily be separated. Of them, Drummond 104 corresponds most nearly to the protologue and has been designated as the lectotype above. Thus the remaining collections become lectoparatypes. However, Drummond 137 & 246 are clearly specimens of *Lawrencia glomerata* Hook.; likewise, Drummond 275 is clearly a specimen of *L. berthae* (F. Muell.) Melville.

The geographical range of *Lawrencia diffusa* overlaps with those of *L. berthae, L. glomerata, L. helmsii, L. repens* and *L. spicata. L. diffusa* has been found growing in close proximity to each of these species.

Series *SELENOTHAMNUS*

Lawrencia series *Selenothamnus* (Melville) Lander, stat. nov. *Selenothamnus* Melville, Kew Bull. 20: 514-5 (1966); Hutchinson, Gen. Fl. Pl. Dicot. 2: 53 (1967); Baines, Austral. Pl. Gen 338-9 (1981). *Type: S. squamatus* (Nees ex Miq.) Melville [=*Lawrencia squamata* Nees ex Miq.].

Erect shrubs; dioecious; with or without thorns; vestiture stellate-hairy or squamulose with peltate scales, never glabrous; stems with spongy periderm producing dry fibrous or flaky bark; leaves sessile throughout; female flowers with or without sterile anthers; style branches filiform or clavate; sterile mericarps crushed and obliterated by developing fertile mericarps; seed swollen, irregularly globular, smooth.



Map 6. Distributions of *Lawrencia cinerea* (▲), *L. densiflora* (●) *L. repens* (O) and *L. diffusa* (+).

The three species in this section are extremely closely related and careful attention to all the details noted in the diagnostic key is often needed to differentiate between them. Two of these species are confined to Western Australia; one is widespread, occurring in all mainland states (Maps 7 & 8).

10. **Lawrencia squamata** Nees ex Miq., in Lehmann, Pl. L. Preiss. 1: 242 (1845). *Plagianthus squamatus* (Nees ex Miq.) Benth., J. Linn. Soc., Bot. 6: 103 (1862); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931). *Selenothamnus squamatus* (Nees ex Miq.) Melville, Kew Bull. 20: 515 (1966); Cochrane et al, Fl. & Pl. Victoria t. 1677 (1968); Beard, Descr. Cat. Western Australia Pl. 84 (1970); J. H. Willis, Handb. Pl. Victoria 2: 381 (1973); J. Green, Census Vasc. Pl. Western Australia 67 (1981); W. R. Barker, in Jessop, Fl. Central Australia 212 & t. 246 (1981); G. M. Cunningham et al., Pl. W. New South Wales 492 (1982); Jessop, List Vasc. Pl. South Australia 62 (1983). *Type:* Southern River, Perth, Western Australia, *Preiss* 1231, Sept. 1841 (holo: LD non vidi; iso: MEL). Southern River is a branch of the Canning River, near present day Thornlie.

Halothamnus microphyllus (F. Muell.) F. Muell., Pl. Victoria 1: 159 (1862); F. Mueller, Second Gen. Rep. Gov. Parliamentary Papers — Votes & Proc. of the Legislative Council 1854-5 (A. No. 18): 10, sine descriptione. *Plagianthus microphyllus* F. Muell., Fragm. Phytogr. Austral. 1: 29 (1858) Benth., J. Linn. Soc., Bot. 6: 103 (1862); Bentham, Fl. Austral. 1: 190 (1863); E. G. Baker, J. Bot. 30:72 (1892); Bailey, Queensland Fl. 1: 110 (1899); Maiden & Betche, Census New South Wales Pl. 136 (1916); J. M. Black, Fl. South Australia, edn 2, 3: 557 & t. 718 (1952); Blackall & Grieve, How to Know Western Austral. Wildfl. 2: 345 (1956). *Lectotype* (here designated): Murray River, s.dat., *F. Mueller*, s.n. (lecto: K; isolecto: BM, Mel 98788 & 98789). *Lectoparatypes:* Spencers Gulf, October 1857, *F. Mueller* s.n. (MEL 98790, 98812 & 584132); Spencers Gulf near Port Pirie, October 1857, *F. Mueller* s.n. (MEL 584133); Murray, s.dat., *F. Mueller* s.n. (MEL 98791, K); Seaflats on the Murray, s.dat. *F. Mueller* s.n. (MEL 98787); Lake Albert Salt Springs, 1854, *F. Mueller* s.n. (K); Between Guichen Bay and Lake Albert, s.dat., *F. Mueller* s.n. (MEL 584131 — material affixed to sheet only); Guichen Bay, South Australia, s.dat., *F. Mueller* s.n. (MEL 584131 pro pte).

Plagianthus incanus J. M. Black, Trans. Roy. Soc. South Australia 49: 274 (1925); J. M. Black, Fl. South Australia, edn 2, 3: 557 (1952); Blackall & Grieve, How to Know Western Austral. Wildfl. 2: 345 (1956). *Lawrencia incana* (J. M. Black) Melville, Kew Bull. 20: 514 (1966); Beard, Descr. Cat. Western Austral. Pl.; J. Green, Census Vasc. Pl. Western Australia 67 (1981); W. R. Barker, in Jessop, Fl. Central Australia 211 (1981); Jessop, List Vasc. Pl. South Australia 62 (1983). *Type:* Gawler Range, South Australia, September 1912, *S. White* s.n. (holo: AD; iso: K).

Shrub to 100 cm tall, spreading, dioecious, with secondary branches often terminating in a rigid thorn. *Vestiture* of branches glabrous to densely tomentose with simple, bifurcate and actinomorphic stellate hairs, or squamulose with minutely fimbriate peltate scales, rarely pannose with palmate hairs, clothing a thin spongy periderm which produces grey fibrous bark on older stems; leaves and abaxial surfaces of calyces densely tomentose with simple, bifurcate and actinomorphic stellate hairs, or squamulose with minutely fimbriate peltate scales. *Leaves* densely fasciculate on short lateral branches, sessile throughout; *stipules* brown or pale green, membranous, narrowly to broadly triangular, falcate, 0.4-2.1 mm long x 0.2-2.3 mm wide, vestiture of abaxial and adaxial surfaces sparse to dense with peltate scales or palmate hairs, margin ciliate with stellate hairs, apex acuminate or acute; *blade* linear, narrowly elliptic, ovate, obovate, spathulate or suborbicular, flat or conduplicate, 1.6-19.0 mm long x 0.5-11.0 mm wide, abaxial and adaxial surfaces dense with either stellate hairs or with peltate scales, or with palmate scales at the base merging into peltate scales, venation obscure, base narrowly to broadly cuneate, margin entire or coarsely 3-5 dentate, apex acuminate, acute, obtuse or truncate. *Flowers* unisexual, sessile, axillary, solitary, often crowded in leafy fascicles. *Calyx of male flowers* turbinate to broadly turbinate, green, 2.1-4.8 mm long; sepals connate 3/5-9/10 their length, vestiture on abaxial surface dense with stellate hairs or peltate scales, adaxial surface glabrous; lobes triangular, 1.0-2.5 mm wide; apices narrowly to broadly acuminate, acute or obtuse, frequently with a small dark mucro. *Corolla of male flower* white, yellow or reddish, often tinged violet in bud, 2.0-6.5 mm long; petals free almost to base or connate up to 1/2 their length, glabrous; lobes spreading, flat, narrowly to broadly elliptic, ovate or obovate, 0.8-2.5 mm wide; apices acute or obtuse to broadly obtuse, entire or emarginate, often faintly to coarsely irregularly dentate. *Androecium of male flower* with filament tube 0.4-3.6 mm long, glabrous; free portion of filaments 0.2-0.8 mm long; anthers 10-20. Gynoecium of male flower much reduced and sterile or lacking. *Calyx of female flowers* turbinate to broadly turbinate, green, 2.2-5.9 mm long; sepals connate 3/4-9/10 their length, vestiture on abaxial surface dense with stellate hairs or peltate scales, adaxial surfaces usually glabrous, rarely dense with stellate hairs; lobes triangular, 1.0-2.3 mm wide; apices narrowly to broadly acuminate, acute or obtuse, frequently with a small dark mucro. *Corolla of female flower* white or yellow or reddish, often tinged violet in bud, 2.3-6.9 mm long; petals connate 1/5-3/5 their length, glabrous; lobes erect to somewhat spreading, carinate, conduplicate or almost flat, narrowly to broadly elliptic, ovate or obovate, 0.5-3.0 mm wide; apices narrowly to broadly acute or obtuse, entire or emarginate, often faintly to coarsely irregularly dentate. *Androecium of female flower* with filament tube 0.1-1.8 mm long, glabrous; free portion of filaments 0.1-0.4 mm long; anthers 10-20, sterile. *Gynoecium of female flower* with style 1.8-6.1 mm long; branches 2-5, free to base of style or connate for up to 1/3 its length, filiform or clavate, entire, 0.1-0.7 mm wide, introrsely stigmatose. *Fruit* ovoid, 2.3-3.6 mm high x 2.3-3.8 mm in diameter; mericarps 2-5; pericarp tan, membranous becoming translucent, dehiscing to release naked seed a single one of which is fertile in each fruit, sterile mericarps crushed and almost obliterated. *Seed* swollen, irregularly globular, dark brown, smooth, 0.6-3.3 mm high x 0.4-2.5 mm in radial width. *Columella* filamentous, 2.8-3.8 mm high.

Flowering period. Mostly from August to January, sporadically throughout the year.

Habitat. Occurs on subsaline sand or calcareous red soils in succulent steppe, low shrubland or open woodland on the margins of inland playa lakes, saline flats and depressions, ephemeral watercourses, tidal flats and coastal inlets, sometimes amongst coastal limestone or granite debris, occasionally on gypsum or limestone ridges inland.

Selected specimens from 298 collections examined. NEW SOUTH WALES: "Sunnyside", near Balranald, *B.M. Alchin* 13 (NSW); Cobham Salt Lake, *W. Bauerlen* 254 (NSW); "Mt Mulyah", c. 80 km NW of Louth, *C.W.E. Moore* 6760 (CANB, NSW); 17 miles (27 km) W of Euston, *J.H. Leigh* W2O (NSW); Utah Lake, *K. Paijmans* 3319 (CANB).

NORTHERN TERRITORY: Mt Wedge, 22° 48′ S, 131° 44′ E, *C.R. Dunlop* 2452 (K, NSW); "Newhaven", 22° 51′ S, 131° 13′ E, *P.K. Latz* 2129 (AD); "Napperby", 22° 43′ S, 132° 23′ E, *P.K. Latz* 5946 (AD, NT); Dalhousie Springs, 26° 27′ S, 135° 28′ E, *P.K. Latz* 4797 (AD, BH, MEL, NT, PERTH); c. 1 mile (1.6 km) W of Central Mt Wedge, 22° 50′ S, 131° 50′ E, *A.O. Nichols* 808 (K, MEL).

QUEENSLAND: 5 km NE of South Glen Homestead, 28° 11′ S, 146° 33′ E, *R.W. Purdie* 759 D (BRI).

SOUTH AUSTRALIA: c. 7 km SW of Copley, on Coply-Beltana road, *Hj. Eichler* 13001 (AD); Diamond Lake, between Beaufort and Whitwarta, *R. Hill* 1006 (AD); Walkers Flat, c. 93 km NE of Adelaide, *D.N. Kraehenbuehl* 918 (AD); c. 1.6 km W of Coober Pedy, *T.R.N. Lothian* 4346 (AD); c. 20 km W of Oldea, *T.R.N. Lothian* 5508 (AD); Wittons Bluff, Pt Noarlunga, *T.J. Smith* 439 (AD); Royal Park, c. 10 km NE of Adelaide, *T.J.*

Smith 1727 (AD); 9 miles (14.5 km) SW of Malinong Hall, *M.C.R. Sharrard* 1224 (AD); Dalhousie Springs, c. 80 miles (128 km) N of Oodnadatta in the vicinity of Spring Hut, *D.E. Symon* 3251 (CANB, K); Shell Beach, Innes National Park, *J.Z. Weber* 4229 (AD); Head of Bight, *P.G. Wilson* 1621 (AD); St Francis Island, c. 60 km SW of Ceduna, *N.M. Wace* 136 (AD).

VICTORIA: Raak Salt Plains, 9 miles (14.5 km) WNW of Hattah, *A.C. Beauglehole* 40583 (MEL); near Kiatta, *R. Melville* 988 (K, MEL); Wimmera, s.dat., *J. Dallachy* s.n. (K); near Annuello, Sept. 1971, *R. Wade* s.n. (MEL).

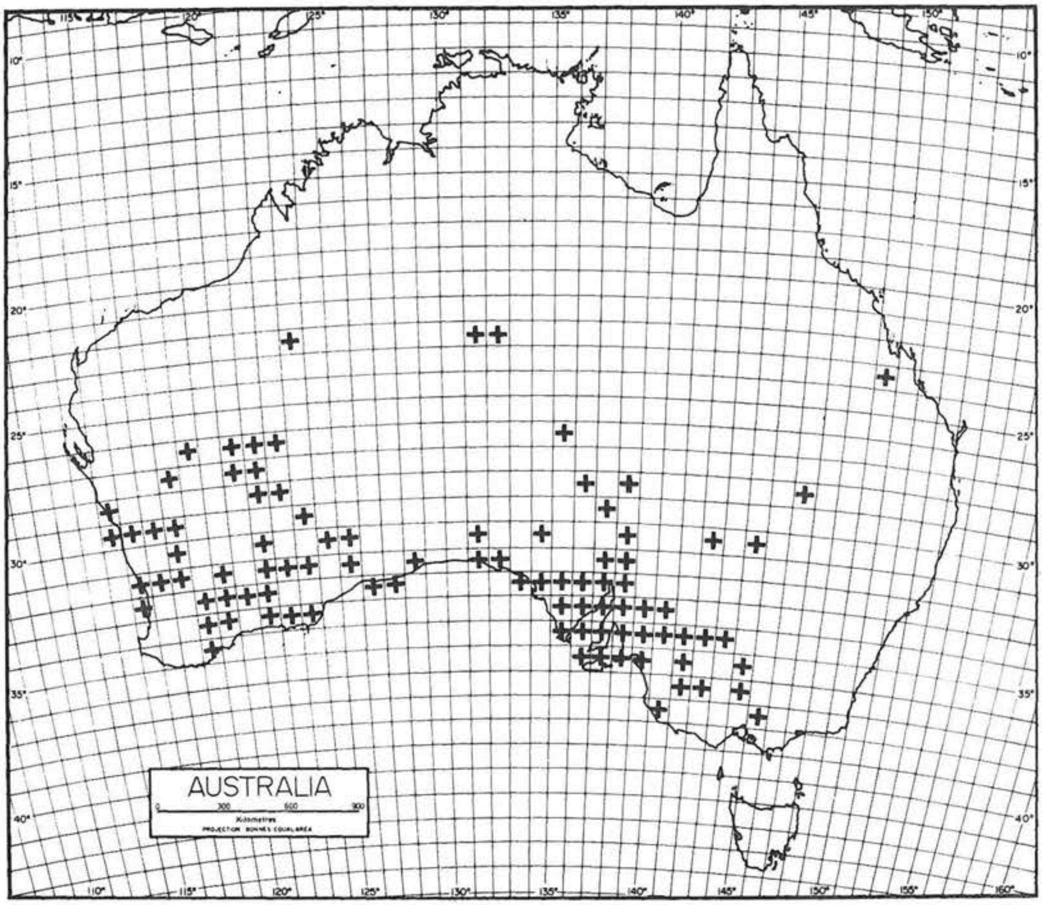
WESTERN AUSTRALIA: 10 miles (16 km) S of Leonora on road to Menzies, *T.E.H. Aplin* 230((PERTH); 17 miles (27 km) N of Melrose Homestead, *J.S. Beard* 6534 (PERTH); Israelite Bay, 1885, *S.T.C. Brooks* (as "Brooke") s.n. (MEL); 6.5 miles (10.5 km) W of Winchester, s.dat., *C. Chapman* s.n. (PERTH); Bern Pool, "Yelma", *R.J. Chinnock* 772 (AD); Cannington Swamp, Wattle Grove, *R. Coveny* 8258 (NSW, PERTH); c. 30 km NNE of Stokes' Inlet, *Hj. Eichler* 20322 (AD, PERTH); Lake Auld, *A.S. George* 9131 (BRI, MEL, NSW, NT, PERTH); 13 miles (20.5 km) from Chester Pass down South Stirlings Road, Dec. 1964, *A.S. George* s.n. (PERTH); 12 km NE of Norseman, *K. Newbey* 8095 (AD, PERTH); Rawlinna, *P.G. Wilson* 5798 (PERTH); 1 km W of Meckering in flood plain of Mortlock River, *P.G. Wilson* 6403 (AD, BH, BRI, MEL, NSW, NT, PERTH). N end of Lake Moore, *P.G. Wilson* 8635 (K, PERTH).

Distribution. Found in the Avon, Darling (Drummond Subdistrict), Eyre, Irwin and Roe Districts of the South-West Botanical Province, and in the Austin, Canning, Coolgardie, Eucla and Helms Districts of the Eremaean Botanical Province of Western Australia; in the western sector of the Central Australia Pastoral District of the Northern Territory; in the Eastern, Eyre Peninsula, Flinders Range, Gairdner-Torrens Basin, Lake Eyre Basin, Murray, Northern Lofty, Nullarbor, south-eastern Southern Lofty and Yorke Peninsula Regions of South Australia; in the Ballarat, Mallee, Murray Valley, South West and Wimmera Study Areas of Victoria; in the Far Western Plains (North and South Subdivisions) and Western Plains (North and South Subdivisions) Botanical Divisions of New South Wales; and in the Maranoa Pastoral District of Queensland. See Map 7.

Etymology. The specific epithet refers to the densely squamulose vestiture of peltate scales found on the stems, leaves and calyces of the type form of this species, giving the plant an ashen appearance.

Notes. Like *Lawrencia glomerata* (see above), *L. squamata* is a widespread and highly polymorphic species comprising many allopatric populations. Nonetheless, it is rather surprising that specimens formerly referred to *L. incana* and *L. squamata* should have been located in different genera by Melville (1966). Barker (1981) has drawn attention to this bewildering anomaly. To be sure, branching pattern, leaf shape and size, thorniness, and hair type are extremely variable, but examination of all available herbarium specimens in the course of this study reveals a continuum in each of these characters. Specimens with predominantly actinomorphic stellate hairs usually have longer, broader leaves than those with predominantly peltate scales, and they have a generally more northerly distribution. Plants at either extreme can look strikingly different, and in the past *L. incana* and *L. squamata* sensu stricto have been distinguished on this basis. However, in their essential characters of flowers, fruit and seed these and other forms are remarkably constant: in keeping with the principles expressed earlier in this paper, I am unwilling to maintain their separation, even at an infraspecific level.

Lawrencia squamata is the only species in the genus to possess thorns. These are not invariably present and their presence or absence seems not to be geographically correlated. R. F. Parsons (pers. comm.) has suggested that small-leaved, non-thorny plants and large-



Map 7. Distribution of *Lawrencia squamata*.

leaved, thorny plants of *L. squamata* may be edaphically segregated, with the former occupying sandy, gypseous soils and the latter inhabiting loamy, non-gypseous soils. Whilst this is evidently the case in New South Wales and Victoria, I have not observed such a pattern elsewhere, nor have other collectors commented on it.

The geographical range of *Lawrencia squamata* overlaps with those of all other species in the genus with the exception of *L. buchananensis*. *L. squamata* has been found growing in close proximity to these other species.

11. **Lawrencia chrysoderma** Lander, sp. nov.

Lawrencia chrysoderma est frutex dioicus ramis secundariis aliquantum contractis caules dense foliatos formantibus, indumento magna pro parte e pilis peltatis consistente. Fructus e mericarpiis 2-3 dehiscentibus compositus, pericarpio membranaceo translucente. Haec species *Lawrenciae helmsii* simillima, a qua ramificatione magis aperta, foliis majoribus, calycibus corollisque uniformibus nec sexualiter dimorphis distinguitur.

Typus: Billi Billi Claypans, W end of Weld Range, Western Australia, 26° 58′ S, 117° 33′ E, October 1969, *R.A. Saffrey* 816 (holo: PERTH). The holotype sheet includes both male and female plants.

Shrub to 100 cm tall, spreading, ramulose and much contracted to form dense leafy stems, dioecious. Vestiture of branches, yellowish, densely pannose with palmate scales clothing an exceedingly spongy periderm which produces conspicuous dry flaky bark on older stems; leaves and abaxial surface of calyces densely squamulose with fimbriate peltate scales. *Leaves* sessile throughout, densely fasciculate; *stipules* pale green, dry and spongy, narrowly triangular, 1.5-7.0 mm long x 0.5-2.3 mm wide, falcate, abaxial surface densely squamulose with palmate scales at the base merging into peltate scales, adaxial surface almost glabrous or with dense vestiture of palmate scales on the mid-rib merging into peltate scales towards the margin and apex, margin ciliate with simple, bifurcate and haplomorphic stellate hairs, apex acuminate; *blade* ovate, narrowly obovate or spathulate, 4-12 mm long x 1.7-3.0 mm wide, conduplicate, reflexed, abaxial and adaxial surfaces dense with palmate scales at the base merging into peltate scales, base narrowly cuneate, margin entire, apex acuminate, acute or obtuse. *Flowers* unisexual sessile, axillary, solitary. *Calyx of male flowers* turbinate, green, 3.4-4.5 mm long; sepals connate 3/5-4/5 their length, abaxial surface densely squamulose with palmate scales merging into peltate scales; lobes triangular, 1.0-1.5 mm wide; apices acute to broadly obtuse. *Corolla of male flower* white, 3.5-5.0 mm long; petals free almost to base or connate for up to 3/5 their length, glabrous; lobes spreading, ovate, 0.8-2.0 mm wide; apices acute, obtuse or truncate, irregularly dentate. *Androecium of male flower* with filament tube 1.7-2.5 mm long, glabrous; free portion of filaments 0.3-1.5 mm long; anthers 10-20. *Gynoecium of male flower* very much reduced and sterile, sometimes lacking. *Calyx of female flower* turbinate, green, 3.3-5.5 mm long; sepals connate 1/2-4/5 their length, abaxial surface densely squamulose with palmate scales at base merging into peltate scales, adaxial surface glabrous; lobes triangular, 0.8-2.0 mm wide apices acute to broadly obtuse. *Corolla of female flowers* white, 3.0-5.0 mm long; petals almost free to base or connate for up to 3/5 their length, glabrous; lobes erect, ovate, carinate, 0.8-2.0 mm wide; apices obtuse to truncate, entire or irregularly dentate. *Androecium of female flower* with filament tube 0.7-1.6 mm long, glabrous; free portion of filaments 0.1-0.9 mm long; anthers 5-15, sterile. *Gynoecium of female flower* with style 2.0-7.0 mm long; branches 2-3, free almost to base of style or connate for up to 7/10 of its length, filiform or clavate, 0.1-1.0 mm wide, apices often briefly-lobed, introrsely stigmatose. *Fruit* ovoid, 2.3-4.0 mm high x 1.8-2.5 mm in diameter; mericarps 2-3; pericarp white or tan, membranous, becoming translucent, dehiscing to release naked seed a single one of which is fertile in each fruit, sterile mericarps crushed and almost obliterated. *Seed* swollen, irregularly globular, smooth, brown, 1.5-2.6 mm high x 1.1-1.5 mm in radial width. *Columella* filamentous, c. 2.0 mm high. Figure 7.

Flowering period. August to January.

Habitat. Occurs on subsaline sand or clay soils in lightly wooded succulent steppe on margins of playa lakes, particularly on gypsum ridges.

Specimens examined. WESTERN AUSTRALIA: 44 miles (70.4 km) NW of Cue on road to Mileura, *T.E.H. Aplin* 2531 (PERTH); "Modoonga", 26° 56′ S, 117° 36′ E, *J.S. Beard* 6612 (PERTH); Eneabba Flora Reserve, Oct. 1967, *C. Chapman* s.n. (BM, BRI, CANB, K, NSW, NT, PERTH); Salt lake SW of Winchester, *J. Coleby-Williams* 117 (PERTH); Salt lake SW of Winchester, *J. Coleby-Williams* 118 (PERTH); 9 km from Winchester along road to Eneabba, 0.5 km S of road, S end of Yarra Yarra Lakes, *M.D. Crisp* 5469 (CANB); "Barnong", *A.W. Humphries* P48 (PERTH); N of Weld Range, opposite Madoonga Homestead beside road from Cue, *N.S. Lander* 1122 (K, MEL*, PERTH); N of Weld Range opposite Madoonga Homestead beside road from Cue, *N.S. Lander* 1123 (CANB, PERTH); locality unknown (as "Puttingup"), s.dat, *G. Maxwell* s.n. (MEL); "Roderick", c. 150 km N of Yalgoo, *A.A. Mitchell* 968 (MEL*, PERTH); Billi Billi Claypans, W end of Weld Range, 26° 58′ S, 117° 33′ E, *R. A. Saffrey* 816 (holo: PERTH); "Barnong", April

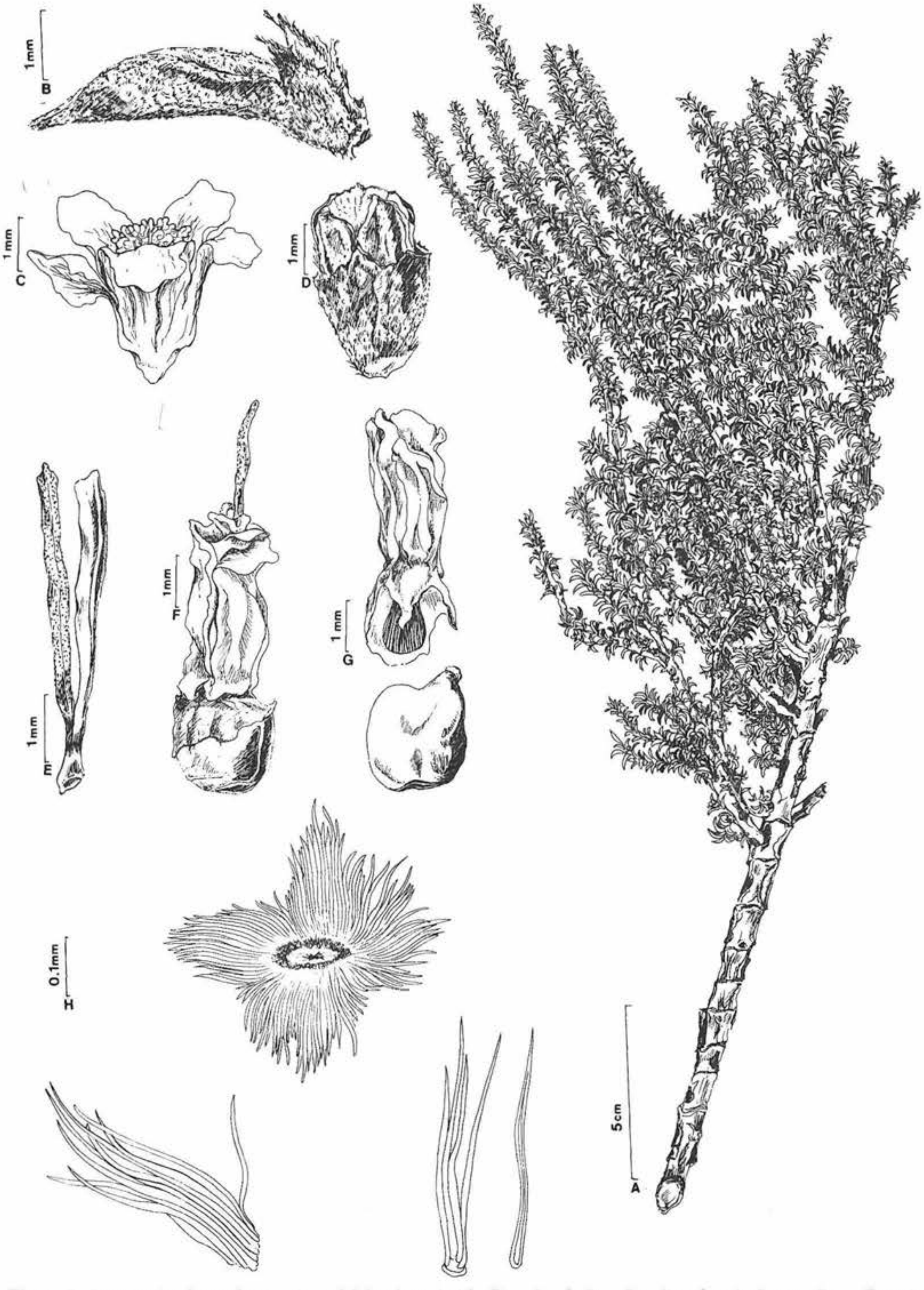


Figure 7. *Lawrencia chrysoderma.* A — Male plant, habit. B — Leaf. C —Corolla of male flower. D — Female flower. E — Style. F — Withered corolla and mature fruit in process of dehiscence. G — Withered corolla, spent fruit retaining crushed mericarp and sterile ovule, and released seed. H — Trichomes.

Drawn from *Saffrey* 816 (holotype).

1954, *D.G. Wilcox* s.n. (PERTH); N end of Mongers Lake, 28° 46′ S, 117° 22′ E, *P.G. Wilson* 8604 (PERTH).

Distribution. Found in the Irwin District of the South-West Botanical Province and in the Austin District of the Eremaean Botanical Province of Western Australia. See Map 8.

Etymology. The specific epithet draws attention to the dense yellow vestiture of stellate hairs on the young branches characteristic of this species.

Notes. A mixed collection of *Lawrencia chrysoderma* and *L. squamata* communicated to Ferdinand von Mueller by G. Maxwell is annotated "Puttingup." This locality is cited by Mueller (1875) under *Plagianthus microphyllus* [*L. squamata*]. A thorough search has failed to reveal that any place name exists in Western Australia with the spelling "Puttingup" and no aboriginal place name anywhere begins "Put..." (Nomenclature Advisory Committee, Office of the Surveyor General, Perth, pers. comm.) From the handwritten label it is possible that "Pullingup" was intended. There is not a "Pullingup" in Western Australia, but there is a Pulingup Spring near Pallinup river at 34° 18′ S, 118° 23′ E. Although *L. squamata* is to be found in that vicinity today it is far removed from the present range of *L. chrysoderma:* it would seem that the attribution of Maxwell's specimen of the latter species to this area is in error.

The geographical range of *Lawrencia chrysoderma* overlaps with those of *L. densiflora, L. glomerata, L. helmsii, L. squamata* and *L. viridi-grisea. L. chrysoderma* has been found growing in close proximity to all these species.

12. **Lawrencia helmsii** (F. Muell. & Tate) Lander, comb. nov. *Plagianthus helmsii* F. Muell. & Tate, Bot. Centralb. 55: 316 (1893); Trans. Roy. Soc. South Australia 16: 339 (1896); Anon., Proc. Linn. Soc. London 1908-9: 9 (1909); Morrison, J. Nat. Hist. & Sci. Soc. Western Australia 3: t.2 (1907); C. A. Gardner, Enum. Pl. Austral. Occid. 78 (1931); Blackall & Grieve, How to Know Western Austral. Wildfl. 2: 346 (1956). *Selenothamnus helmsii* (F. Muell. & Tate) Melville, Kew Bull. 20: 515 (1960); Beard, Descr. Cat. Western Austral. Pl. 84 (1970); Erickson et al., Fl. & Pl. Western Australia 154 & t. 487 (1973); J. Green, Census Vasc. Pl. Western Australia 67 (1981); A. Mitchell, in B. D. Morley & H. R. Toelken, Fl. Pl. Australia t. 79c & d (1983). *Lectotype* (here designated): Lake Lefroy, Western Australia, 7 November 1891, *R. Helms* s.n. (lecto: AD; isolecto: K, NSW), 981553261). *Lectoparatype:* Lake Annean, October 1893, *S. Dixon* s.n. (AD).

Shrub to 100 cm tall, ascending, ramulose and much contracted to form dense leafy cactus-like stems, dioecious. *Vestiture* of branches yellowish, densely pannose with simple, bifurcate and haplomorphic stellate hairs and palmate scales clothing a spongy periderm which produces dry flaky bark on mature exposed branches but normally obscured by dense leafy fascicles; leaves and abaxial surfaces of calyces densely squamulose with minutely fimbriate to entire peltate scales. *Leaves* sessile throughout, densely fasciculate; *stipules* pale green, dry and spongy, narrowly triangular, 1.2-3.5 mm long x 0.9-3.0 mm wide, falcate, chartaceous, abaxially glabrous or sparsely to densely squamulose with palmate scales, often becoming glabrous towards the margin, margin ciliate with simple, bifurcate and haplomorphic stellate hairs, apex narrowly acute to acuminate; *blade* narrowly obovate, elliptic, ovate or orbicular, 1.5-7.2 mm long x 0.7-2.2 mm wide, conduplicate, reflexed, vestiture on abaxial and adaxial surfaces sparse to dense at base with palmate scales merging into peltates scales on lamina, base narrowly cuneate, margin entire, apex acute to broadly obtuse. *Flowers* unisexual, sessile, axillary, solitary. *Calyx of male flowers* turbinate, 1.5-4.5 mm long, green; sepals connate at least 4/5 their length, abaxial surface densely squamulose with stellate hairs merging into palmate and peltate scales; lobes shallow, broadly triangular, 1.0-1.3 mm wide; apices broadly acute to broadly obtuse. *Corolla of male flower* white, or light green, 2.0-5.6 mm long; petals connate for 1/5-3/5 their length, glabrous; lobes flat, spreading, obovate, 0.6-2.0 mm wide; apices acute, obtuse to broadly obtuse, entire or emarginate. *Androecium of male flower* with filament tube 0.5-2.7 mm long, glabrous; free portion of filaments 0.3-0.8 mm long; anthers 5-15, sterile. *Gynoecium of male flower* much reduced and sterile or lacking. *Calyx of female flowers* campanulate, 1.8-3.8 mm, long, green; sepals connate at least 7/10 their length, abaxial surface densely squamulose with stellate hairs merging into palmate or peltate scales; lobes triangular, 0.6-0.8 mm wide; apices acute to broadly obtuse. *Corolla of female flowers* white or light green, 1.7-3.0 mm long; petals connate for 1/3-4/5 their length, glabrous; lobes erect, flat or slightly carinate, ovate, 0.5-1.5 mm wide; apices broadly acute to broadly obtuse, entire or emarginate. *Androecium of female flowers* with filament tube 0.3-1.0 mm long, glabrous; free portion of filaments 0.2-0.3 mm long; anthers 0-8, sterile. *Gynoecium of female flowers* with style 0.4-3.2 mm long; branches 2, filiform or clavate, entire, free to base of style or connate for up to 1/3 its length, 0.1-0.4 mm wide, introrsely stigmatose. *Fruit* ovoid, 1.5-2.4 mm high x 1.6-2.0 mm in diameter; mericarps 2; pericarp tan, membranous, becoming translucent, dehiscing to release naked seed a single one of which is fertile in each fruit, sterile mericarps crushed and almost obliterated. *Seed* swollen irregularly globular, brown, smooth, 0.8-1.7 mm high x 1.0-1.4 mm in radial width. *Columella* filamentous, c. 1.5 mm high.

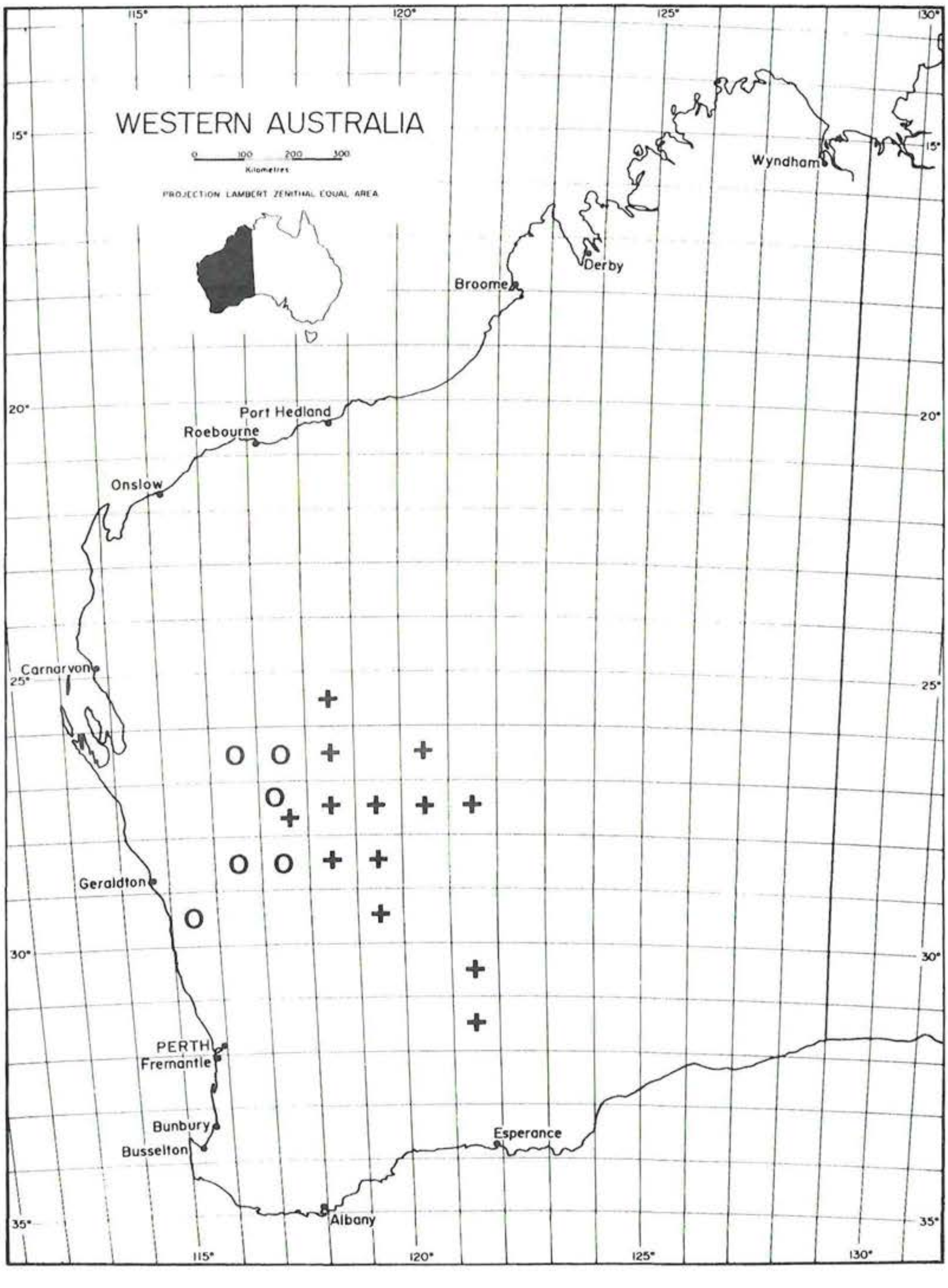
Flowering period. July to April.

Habitat. Occurs on subsaline sand or gypseous clay soils in lightly wooded succulent steppe on margins of playa lakes, particularly on gypsum ridges.

Conservation status. As Rye et al. (1980) note, *Lawrencia helmsii* (as *Selenothamnus helmsii)* is at present commercially exploited for use in dried flower arrangements, doubtless because of its extraordinary cactus-like appearance. Marchant & Keighery (1979) considered its occurrence to be in need of assessment and monitoring. Leigh et al. (1981) categorize it as a species with a range over 100 km but occurring in small populations which are restricted to highly specific habitats, vulnerable but not presently endangered although at risk over a long period through continued depletion. Burgman and Hopper (1982) record a total of 22,000 flowering stems picked for the Western Australian wildflower industry during the period 1980-1981 taken from populations at Mount Sir Samuel, Sandstone and Cue. *L. helmsii* is a highly conspicuous plant and its habitat is readily located. It is gregarious, proliferating readily from seed. From my own observation it would seem to be under no immediate threat, but populations could become vulnerable were the present intensity of bush harvesting to be sustained.

Selected specimens from 66 collections examined. WESTERN AUSTRALIA: 2 miles (3.2 km) S of Mount Sir Samuel, Oct. 1947, *G.E. Brockway,* s.n. (CANB, PERTH); Lake Austin, *L.A. Craven* 5033 (BRI, CANB, MEL, NT, PERTH); Lake Austin, on road from Daydawn to "Lakeside", *N.S. Lander* 1120 (MEL*, PERTH); Lake Annean, Great N. Highway, *N.S. Lander* 1128 (NSW, PERTH); Lake Barlee, *P.G. Wilson* 8866 (BRI, BM, CANB, CBG, K, MEL*, NSW, NT, PERTH); Lake Barlee, *P.G. Wilson* 8867 (BH, BRI, CANB, CBG, K, MEL*, NT, PERTH); S end of Lake Miranda, *H.R. Toelken* 6093 (AD, BH, BM, CANB, PERTH).

Distribution. Found in the Austin and Coolgardie Districts of the Eremaean Botanical Province of Western Australia. See Map 8.



Map 8. Distribution of *Lawrencia chrysoderma* (O) and *L. helmsii* (+).

Etymology. The specific epithet commemorates Robert Helms, naturalist on the Elder Exploring Expedition, 1891-1892, in the north-west of South Australia and across the Victoria Desert of Western Australia (Beard 1970, Eardley 1950).

Notes. The geographical range of *Lawrencia helmsii* overlaps with those of *L. chrysoderma, L. densiflora, L. diffusa, L. glomerata, L. repens* and *L. squamata. L. helmsii* has been found growing in close proximity to these other species.

A note on *Plagianthus monoicus* Helms ex Ewart

In the course of this study it was necessary to examine the types of *Plagianthus monoicus* Helms ex Ewart, a species overlooked by Melville (1966). The type collection, made at Lake Deborah in Western Australia by R. Helms, comprises specimens of *Ricinocarpos velutinus* F. Muell., a species in the Euphorbiaceae, hence the following synonymy:

Ricinocarpos velutinus F. Muell., Fragm. Phytogr. Austral. 9: 2 (1875). *Type:* upper reaches of the Irwin River, Western Australia, March 1874, *J. Forrest* s.n. (holo: MEL, non vidi).

Plagianthus monoicus Helms ex Ewart, in Ewart & Tovey, Proc. Roy. Soc. Victoria 32: 203 (1920), as "monoica"; C. A. Gardner, Enum. Pl. Austral. Occid 78 (1931), as "monoica"; Blackall & Grieve, How to Know Western Austral. Wildf. 2: 346 (1956), as "monoica". *Type* Lake Deborah, November 1891, *R. Helms* s.n. (lecto AD 96628004; isolecto; AD 97714338, MEL). The above lectotypification is necessitated by the destruction of the holotype from MEL (see note p. 203).

Discussion

A. Morphology

Habit. Melville (1966) considered species of the genus *Lawrencia* to be "perennial herbs often woody at the base" and species of the genus *Selenothamnus* to be shrubs. In the course of the present study the full spectrum of growth forms between these two extremes was observed. Whilst differences in habit and duration are certainly invaluable in the delimitation of species, in conjunction with vestiture and fruit characters they also contribute to the syndromes permitting the recognition of series in the section *Selenothamnus.* Bates (1968) suggests that in the tribe Malveae the shrubby habit is primitive, a trait shared by the family as a whole. All other members of the *Plagianthus* alliance are shrubs or trees

Thorns. The thorns of *Lawrencia squamata* are unique in the genus and would seem to be of rare occurrence in the tribe Malveae. Whilst otherwise unremarkable in themselves, it is worth noting that these thorns are not unlike those of *Cratystylis subspinescens* (F. Muell. & Tate) S. Moore, *Chenopodium nitrariaceum* (F. Muell.) F. Muell. ex Benth., *Lycium australe* F. Muell., *Roycea spinescens* C. A. Gardner and *Scaevola spinescens* R. Br., species which also inhabit the margins of salt lakes and ephemeral watercourses and which are often found growing alongside *Lawrencia squamata.* Presumably, such thorns provide protection against browsing by animals visiting these habitats.

Vestiture. The Malvaceae show a rich assortment of hair types: glandular hairs, simple and bifurcate hairs, and, in particular, stellate hairs which have developed into peltate and palmate scales.

Despite their great morphological diversity, these various forms of hair integrade imperceptibly into one another. In *Lawrencia,* this intergradation can often be observed on the same plant, a process seen most clearly in the vestiture of the stipules.

The primitive hair type in *Lawrencia* is taken to be the haplomorphic, multicellular stellate hair common to all but the glabrous species in the genus. Modification of this basic hair type has apparently proceeded in several directions (Figure 1). From the basic haplomorphic stellate hair (Figure 1A or D) can be derived the bifurcate hair (Figure 1B), simply by reduction in the number of rays; further reduction leads to a simple hair (Figure 1C). Planation and fusion of the rays of the basic hair type result in actinomorphic stellate hairs (Figure 1E) and, with complete fusion, peltate scales (1F & G). Subsequent reduction of the fused rays of peltate scales, coupled with a change in orientation of the hair, produces the unique bract-like palmate scales (Figure 1H & I) observed in the series *Selenothamnus*. Continuation of this process produces a simple hair (Figure 1J). Neither peltate nor palmate scales occur elsewhere in the *Plagianthus* alliance.

In *Lawrencia,* the protective role usually attributed to plant hairs is probably three-fold. Firstly, hairs effect water economy by restricting movement of air near stomata and thus reducing transpiration. Secondly, hairs may prevent tissue damage from high incident light by virtue of their great reflectivity and by providing an insulating layer. Thirdly, they may help to avoid damage from salt-spray by preventing droplets of sea-water or salty lake-water from reaching live tissues. Hairs on the flower buds and soft vegetative parts of *Lawrencia* may also discourage insect predation.

The intermeshing basal hairs on the petals of male flowers of *Lawrencia berthae* associated with the sepaline nectaries of that species are discussed below.

The bristle-like hairs on the persistent mericarps of *Lawrencia berthae* probably assist their dispersal (see below).

Leaves. Variation observed in the leaf-characters of *Lawrencia* falls well within the limits recorded for other members of the tribe Malveae (Hutchinson 1967, Bates 1968a).

Although stipules are usually present in the Malvaceae (Cronquist 1981) and in the tribe Malveae, throughout the *Plagianthus* alliance there is a trend towards stipule reduction and loss (Bates 1968): *Gynatrix* Alef., like *Lawrencia,* has conspicuous and persistent stipules; *Plagianthus* sensu stricto and *Hoheria* have stipules which are small and caducous; *Asterotrichion* is exstipulate (Melville 1968). The considerable variation observed in texture, vestiture and size of the stipules of *Lawrencia* is striking.

Melville (1966) and Bates (1968) have noted the trend towards palmati-pinnate venation in the genera of the *Plagianthus* alliance. In the present study venation in *Lawrencia* was observed to be actinodromous throughout, but with a marked tendency towards reduction of the lateral primary veins with only the mid-vein really distinct or with the venation quite obscure. Leaf blades in the intermediate category certainly have the superficial appearance of being pinnate: on closer inspection, faint lateral primary veins radiating from a central point towards the blade base are invariably revealed. Leaf venation is variable even within species and no overall pattern in *Lawrencia* was discerned. In other genera of the *Plagianthus* alliance reduction of the lateral primary veins has proceeded further than in *Lawrencia* and is coupled with the development of stronger secondary veins from the mid-rib giving a distinctly palmati-pinnate venation. This syndrome is most advanced in certain species of *Hoheria* which appear to have pinnate venation.

Heteroblastic leaf development such as that observed in *Lawrencia* is widespread in the tribe Malveae. Elsewhere in the *Plagianthus* alliance it has been reported in *Plagianthus* and *Hoheria* (Allan 1961, Melville 1966, Salmon 1980).

Inflorescences. Lawrencia itself does not display the wide range of variation in inflorescence characteristics found in other genera of the tribe Malveae. However, inflorescence structure within the *Plagianthus* alliance as a whole is highly variable and includes solitary axillary flowers, and axillary racemes, panicles, cymes and fascicles. Despite the complexity of their mature inflorescences both *Hoheria* and *Plagianthus* produce solitary axillary flowers early in their growing seasons.

The seemingly anomalous axillary fascicles of *Lawrencia berthae* probably represent a transitional stage in a reduction series leading from an ancestral cymose condition to the single axillary flowers which serve as basic inflorescence units in all the remaining species of *Lawrencia.*

Epicalyx. In *Lawrencia,* as in all other genera of the *Plagianthus* alliance, an epicalyx is entirely lacking. The presence or absence of this structure has been used to delimit subtribes and to circumscribe the alliances recognized by Bates (1968) in the tribe Malveae. Bates considers the absence of an epicalyx primitive in the tribe and notes that this condition is typical of members of the *Abutilon* alliance from which he postulates the *Plagianthus* alliance was derived.

Calyx. In its basic calyx morphology *Lawrencia* conforms to the pattern observed elsewhere in the *Plagianthus* alliance. Amongst the more generally useful characters in *Lawrencia* are the total calyx length and its ratio with lobe length. Variation in these and other features of the calyx manifests itself only in subtle overall differences which, when considered in conjunction with variation in the characters of other organs, assume importance in the characterization of each species.

Contrary to the general tendency observed by Bates (1969) in the tribe Malveae, in the *Plagianthus* alliance characters of the calyx are clearly of generic significance. Hitherto, they have not been given the attention they deserve. What is important here is that the calyx of *Lawrencia* is decidedly turbinate or obconic and never tubular, campanulate or cupular as reported in other genera of the *Plagianthus* alliance, it lacks the accessory teeth reported in one species of *Hoheria,* and its lobes remain erect at maturity enclosing the ripened fruit rather than becoming widely spreading or strongly reflexed as in species of *Plagianthus* and *Hoheria* (Allan 1961, Melville 1966, Curtis 1975, Moore & Irwin 1978). Further, tufts of multicellular, nectariferous papillae similar in appearance to those found on the adaxial surface at the base of the sepals of *L. berthae* are found elsewhere in the *Plagianthus* alliance only in *Gynatrix,* where they can be observed in both male and female flowers, and in *Asterotrichion* (Melville 1966). Although nectar-secreting hairs are found in this position in many genera of the tribe Malveae and indeed throughout the family, their presence in both *L. berthae* and *Gynatrix* is reported for the first time here. Intermeshing basal hairs on the corolla lobes of male flowers of *L. berthae* appear to be associated with the nectary of this species (see below).

Other genera in the *Plagianthus* alliance for which a perfume similar to that of *Lawrencia berthae* has been noted are *Hoheria* and *Plagianthus.*

Corolla. Despite its relative constancy in the Malvaceae, a few more striking variations of the corolla have been employed in generic definitions.

In *Lawrencia* the petals seem to correspond in form to that typical of the family, that is broadest above the middle and hence basically obovate. However, in many species, even in those with petals almost free to the base (usually male flowers of dioecious species) these are often merely ovate or elliptic. This condition seems to be widespread in the *Plagianthus* alliance.

The lack of auricles at the base of the petals in *Lawrencia* is a feature common to all members of the *Plagianthus* alliance, even in those genera with distinctly clawed petals, namely *Hoheria* and *Plagianthus*.

A greater range of colours is found in the corollas of *Lawrencia* than in other genera of the *Plagianthus* alliance. In particular, the red- or purple-tinted corollas found in several species of *Lawrencia* have not been reported in other genera of the alliance. Only *Plagianthus* shows much variation in the colour of its corolla which may be white, cream-coloured, yellow or green. The corollas of *Asterotrichion, Gynatrix* and *Hoheria* are white or cream-coloured throughout.

Several species of *Lawrencia* have simple-hairy or stellate-hairy corolla lobes. Although this has not previously been reported from any other genus in the *Plagianthus* alliance, the petals of *Hoheria angustifolia* Raoul are densely stellate-hairy, like those of certain specimens of *L. densiflora.* Many genera of the tribe Malveae have hairy petals, particularly in the region of the basal claw and auricles where they intermesh serving to protect the delicate nectariferous sepaline papillae below (Bates 1969, Hill 1982a). Protective hairs similar to these are found on the petals of male flowers of *L. berthae,* the only species in the genus possessing sepaline nectaries (see above). Such hairs are entirely lacking in *Gynatrix,* but in female flowers their function seems to have been assumed by the carpocrater which, although not previously reported, is fleshy and extended, forming a nectariferous collar like that described for *Asterotrichion* by Melville (1966). Curiously, although *Hoheria* apparently lacks nectaries of any kind, some species of this genus have petals which are simple-hairy in the region of the basal claw, also reported for the first time here.

Apical insertion of the corolla lobes on the ovary cup appears to be characteristic of all genera in the *Plagianthus* alliance. Also constant in the *Plagianthus* alliance is the tendency for female flowers of dioecious species to be carinate and erect, forming a campanulate rather than rotate corolla. This tendency has been reported in *Asterotrichion, Plagianthus* and *Gynatrix* (Curtis 1975, Moore & Irwin 1978, Salmon 1981).

As in *Lawrencia,* the corollas of *Hoheria* and *Plagianthus* are released from the maturing fruit by dehiscence of the basal sutures of the ovary cup. The remaining two genera of the *Plagianthus* alliance, *Asterotrichion* and *Gynatrix,* are unusual in that their corollas are regularly circumcissile (Melville 1966, Curtis 1975).

Androecium. Contrary to Heel's observation that in *Plagianthus* sensu lato only half-stamens leave the filament tube, forked stamens and stamens with closely paired (but never actually bilocular) anthers were commonly found in several species of *Lawrencia* in the present study.

Although the five-ranked symmetry of the filaments often evident in the apical lobing of the filament tube of *Lawrencia glomerata,* the frequently simple-hairy filament tube and occasionally pink anthers of *L. berthae* are exceptional in *Lawrencia,* similar variation in one or more of these same characters has been encountered in other genera of the *Plagianthus* alliance, namely *Hoheria* and *Plagianthus.*

Another number varies more widely in *Lawrencia* than in any other genus of the *Plagianthus* alliance. Obviously there has been a marked trend towards reduction of this figure in *Lawrencia.* The same trend may be observed in the *Plagianthus* alliance as a whole: only *Lawrencia* and *Plagianthus* have species with as few as 5 anthers in each flower, the other genera have a minimum of 10 and, like *Lawrencia,* a maximum of 30.

Styles. Style differences have been given much emphasis in the taxonomy of the tribe Malveae at sub-tribal and generic levels. Recently, Bates (1968, 1969) has questioned the extent of this emphasis, nonetheless agreeing that the greatest taxonomic value of style characteristics lies in the delimitation and grouping of genera. In particular, Bates (1969) has identified three basic stigma types. The first of these is elongate and introrsely decurrent on a filiform style branch. The second type is that capping, and decurrent on either edge of, a thickened, laterally compressed style branch. The third type includes a variety of essentially capitate forms. In general, the stigmas of *Lawrencia* conform to the first of these types, but the style branches of several species are decidedly thickened, broadened and, in one species, often apically lobed. As in other genera of the tribe Malveae, the extent of the introrsely decurrent stigmatic area on the branches varies: it may be complete or it may cover only the upper portions.

Bates (1968) has suggested that the styles of the early Malveae had large stigmatic areas decurrent on thickened style branches. In *Lawrencia* there seem to have been independant trends leading to loss of external vestiture, reduction in thickness of the style branches, increasing fusion of the style branches, and reduction in the extent of the stigmatic area. These same trends may be observed in other genera of the *Plagianthus* alliance. *Asterotrichion* has externally pubescent styles with longitudinally decurrent stigmatic areas on free, clavate branches; *Gynatrix* has externally glabrous or stellate hairy styles with longitudinally decurrent stigmatic areas on the upper portions of shortly united filiform, linear or sub-clavate branches; *Plagianthus* has externally glabrous styles with longitudinally decurrent stigmatic areas on almost completely united clavate branches; *Hoheria* has externally glabrous styles with slightly decurrent, obliquely capitate or capitate stigmatic areas on free or shortly united, clavate branches. (Allan 1961, Melville 1966, Curtis 1975).

The apical lobing observed on the style branches of *Lawrencia chrysoderma* has been recorded for no other taxon of the *Plagianthus* alliance.

Fruit. The rather variable fruit morphology of *Lawrencia* clearly involves modification of the basic schizocarp typical of the tribe Malveae. This is manifested in several trends: reduction in mericarp number and fertility and supression of the development of sterile mericarps, reduction in pericarp thickness, loss of vestiture, supression of dehiscence along the proximal suture and abaxial mid-vein, development of pericarp ornamentation, development of a zone of weakness in the basal region allowing dehiscence by gross rupture. Similar variability in fruit morphology and dehiscence is found in other genera in the tribe Malveae and cannot be used as a basis for generic recognition.

The laterally narrow-ridged or winged mericarps observed in several species of *Lawrencia* are quite unlike the abaxially broad-winged mericarps observed in *Hoheria* (see Figure 18B in Schumann 1890). Other genera of the *Plagianthus* alliance are not ridged or winged.

Elsewhere in the *Plagianthus* alliance the external vestiture of stellate hairs observed on the fruit of *Lawrencia berthae* is also found to a greater or lesser extent in *Asterotrichion* (Melville 1966, Curtis 1975), in *Hoheria* (reported for the first time here) and in *Plagianthus* (Allan 1961); the fruit of *Gynatrix* has scattered simple hairs (Burbidge & Gray 1970).

Like *Lawrencia*, the mericarps of other genera in the *Plagianthus* alliance are usually indehiscent or irregularly dehiscent at maturity. The sole exception to this is *Gynatrix* in which the mericarps split open regularly along abaxial and adaxial sutures (Melville 1966, Curtis 1975).

The trend towards reduction in carpel number is found in all genera of the *Plagianthus* alliance (Allan 1961, Melville 1968, Bates 1968), the trend towards reduction in seed fertility is recorded only in *Asterotrichion* (Melville 1966, Curtis 1975) and *Lawrencia* but may be more widespread in the alliance (see Bates 1968).

Of the species considered in this paper known to him Melville (1966) relegated those he believed to have reticulate mericarps to the genus *Lawrencia* and those with unornamented mericarp walls to the genus *Selenothamnus*. Ornamentation of the pericarp probably had its origin in the venation still evident in certain pluriovulate members of the tribe Malveae. Such reticulation of the mericarp walls occurs in many seemingly unrelated or only distantly related taxa in the tribe Malveae and is generally thought to have evolved independently several times. It has not been recorded for other genera in the *Plagianthus* alliance.

On the basis of fruit morphology alone, *Lawrencia berthae* is clearly peripheral to other species in the genus by virtue of its 9-11 indehiscent mericarps which have a stellate-hairy, coriaceous pericarp with little or no reticulation. Further support for division of the genus *Lawrencia* is provided by the axillary fascicles of 1-5 conspicuously pedicellate unisexual flowers, the sepaline nectaries, and the stellate-hairy style bases found only in *L. berthae*. In the present treatment *L. berthae* is placed in the subgenus *Panifex*; the remaining species form the subgenus *Lawrencia*.

In the subgenus *Lawrencia* reticulation of the pericarp is always associated with indehiscent mericarps all of which are fertile. On the other hand, pericarps without reticulation are associated with dehiscent mericarps in which there is a strong tendency towards reduction in number and fertility. These two syndromes provide the basis for the segregation of the sections *Lawrencia* and *Selenothamnus*, respectively, in the present treatment. It should be noted that the section *Selenothamnus* recognized here is considerably broader in concept than Melville's genus *Selenothamnus*.

Within the section *Selenothamnus* two further syndromes involving fruit characters are apparent. Fruit in which all mericarps are well developed are associated with plants of suffrutescent habit which have a vestiture of stellate hairs and which are hermaphroditic or dioecious with female flowers completely lacking anthers. Fruit in which only fertile mericarps develop are associated with plants of a distinctly shrubby habit which have a vestiture of peltate trichomes or stellate hairs and which are dioecious with female flowers often possessing sterile anthers. These two syndromes have prompted the recognition of the series *Halophyton* and *Selenothamnus*, respectively.

Seed. Bates (1969) argues that in the tribe Malveae the uniovulate state is derived from the pluriovulate condition. All species of *Lawrencia* have uniovulate carpels with pendulous ovules as do all taxa in the *Plagianthus* alliance with the possible exception of *P. divaricatus* which rarely has 2 pendulous ovules in each locule, according to Melville (1966). The complete lack of any trace of an endoglossum in *Lawrencia* is a major barrier to speculation on whether its uniovulate condition has been arrived at by loss of the upper or lower ovules in the carpels of the presumed pluriovulate ancestor. The fact that the solitary ovule is pendulous may indicate the latter process, but this condition might conceivably have arisen by reorientation of the basal ascendent ovule following loss of the ovules above it.

Sculpturing such as that found on seeds of species in the series *Halophyton* has not been recorded for other genera in the *Plagianthus* alliance.

B. Sexuality

Melville (1966) noted in the *Plagianthus* alliance "a strong tendency towards dioecy which has nowhere reached the final stage of complete supression of one sex." In the present study of *Lawrencia*, hermaphroditism, polygamodioecy and complete dioecy were all encountered, revealing a trend leading from hermaphroditism to complete dioecy. This trend is expressed morphologically by partial or total supression of the gynoecium in flowers of male plants complemented by sterility and partial or complete supression of the anthers in flowers of female plants.

Dioecy is infrequent in the Malvaceae (Cronquist 1981). Elsewhere in the tribe Malveae similar floral sexual dimorphy to that of *Lawrencia* is found in the *Plagianthus* alliance in *Asterotrichion, Gynatrix* and *Plagianthus* itself (Allan 1961, Melville 1966, Curtis 1975, Moore & Irwin 1978); it is also found in *Napaea* L. and *Kydia* Roxb., the latter a genus of uncertain affinities (Bates 1968, Fryxell 1979). The polygamodioecy observed in *L. glomerata* has also been recorded in both species of *Plagianthus* which, in addition, may sometimes be monoecious (Allan 1961, Melville 1966).

Evolution of dioecy directly from hermaphroditism or via gynodioecy, monoecy or heterostyly has been documented by Bawa (1980) who also allows of the theoretical possibility that dioecy could also be established via androdioecy. In *Lawrencia,* flowers of male plants often possess a vestigial gynoecium and flowers of female plants often possess sterile anthers, but neither gynodioecy nor androdioecy were observed.

It has long been assumed that true dioecy ensures the maintenance of considerable heterozygosity in the population, which is generally considered to be an evolutionary advantage. Although bisexual flowers in all hermaphroditic species of *Lawrencia* are protandrous, as the flowers wilt their style branches reflex into the anther cluster thus apparently increasing the likelihood of self-pollination at this late stage. It is not yet known to what extent self-compatibility and hermaphroditism are linked in *Lawrencia.* In recent years several alternative models have been propounded to explain the evolution of dioecy without invoking the genetic benefits of outcrossing as the selective force of most importance (Bawa 1980, Bawa & Beach 1981).

The sexual systems of plants are fundamentally linked to their pollination biology. Unlike those of most Malvaceae, the flowers of all but one species of *Lawrencia* produce no nectar, so pollen would seem to be the only reward offered visitors. As pollen is vital to the economy of many pollinating insects it may be advantageous for certain plants to produce pollen in excess of that needed for fertilization in order to enhance the activity and maintain the numbers of pollinators over a long time. Supplying the pollen in bisexual flowers may prejudice maternal success, in the sense that pollen and ovules utilize the same energy and nutritional resources and hence limit each other's production, or it may be too short-lived or result in overloading the plant with more fruit than it could normally mature. Such a need for the economical deployment of energy and nutritional resources available for developing embryos, seeds and fruits is indicated by the uniovulate mericarps found in all species of *Lawrencia* and by the strong tendency towards reduction in mericarp number and fertility characteristic of the subgenus *Selenothamnus.*

Since sexual selection must operate via pollinating agents, it is significant that small generalist bees, flies and other insects that are the predominant pollinators of dioecious species respond dramatically to changes in floral resources, particularly changes in flower number (Bawa, 1980). An increase in flower number on hermaphrodite plants may lead to a disproportionate increase in male fitness because plants with larger floral displays may either attract more pollinators and thereby disperse more pollen, or be visited earlier in the day and thereby transmit more genes via pollen than via ovules. As a consequence, males would be established in an initially hermaphroditic population. Similarly, females may become established when individuals increase their fitness due to resources saved from reduced pollen production and dispersal (Bawa & Beach 1981).

In these complementary processes representing a response to pollinator-mediated selection of the kind hypothesized above lies a possible explanation for the evolution of dioecy in *Lawrencia* which may repay further investigation.

C. Dispersal

The single species in the subgenus *Panifex, Lawrencia berthae,* probably exploits hydrochory or epizoochory. Its persistent mericarps are densely stellate-hairy on their apical and distal surfaces. Such hairs may aid flotation by means of air-bubbles adhering to the seed coat in the manner described for species of *Salicornia* L. by Waisel (1972), or they may serve to affix the disseminule to an animal's coat.

The mericarps of all species in the subgenus *Lawrencia* section *Lawrencia* have persistent indehiscent pericarps which become light, dry and stiff at maturity. Their apical- and lateral-distal margins are often projected to form narrow wings, and there is a substantial air-space between the single seed contained in each mericarp and the pericarp. These bladder-like fruit would seem to be well adapted for both hydrochory and for amenochory (see Pijl 1982). The areolae which develop in the reticulate walls of species in this section may further aid hydrochory by trapping air-bubbles.

Species in section *Selenothamnus* appear to have no special aids to dispersal. On the contrary, the early disintegration of the pericarp and the release of naked seeds would seem to favour rapid germination at the parent site. Presumably, further dispersal occurs when seed is released by wind-action on the plant or tumbling of broken branches. The seeds of these species are small and triquetrous, or swollen and irregularly globular, and may be smooth, angular or rugose. The significance of the shallow pits or depressions observed in several species in this section is obscure. Ridley (1930) suggests that such ridges and other emanations found on the seeds of aquatic species may act as anchoring devices serving to fix them to their substrate, thus preventing them from being carried away by water currents. If such seeds do indeed readily adhere to mud then this may also aid their transport on the feet of waterfowl and grazing mammals (see Stebbins 1974). Conversely, such sculpturing may assist the flotation of seeds by means of trapped air bubbles thus favouring hydrochory rather than epizoochory (see Pijl 1982).

Endozoochory is unlikely in *Lawrencia.* The seeds are not particularly hard and would easily be destroyed by a mammal's teeth or a bird's gizzard. The persistent pericarp of species in the section *Lawrencia* would easily be broken in like fashion.

D. Phytogeography

In general, those species of *Lawrencia* with mericarps favouring epizoochory, amenochory or hydrochory are of wide distribution; those lacking specialized aids to dispersal, are of considerably less widespread occurrence. There are two notable exceptions to this. Despite its bladder-like fruit, *L. buchananensis* is restricted to a land-locked and geographically isolated salt-lake system in north eastern Queensland. Its taxonomic affinities would seem closest to *L. viridi-grisea,* a species extending from the western coast of Western Australia across the Great Sandy Desert into the Northern Territory. These two may well represent a vicarious species pair which have diverged morphlogically through long separation by unfavourable edaphic and climatic conditions in the intervening region. *L. squamata,* which releases large naked, smooth seeds, is widely distributed across southern mainland Australia.

Green (1964) mentions that several hundred species of flowering plants have marked disjunctions between south-western and south-eastern Australia; Beard (1969) records 280 such species. *Lawrencia berthae* is clearly a good example of a disjunctly distributed species.

So too is *L. spicata*, apart from a single immature specimen from Loongana, possibly of sporadic occurrence from seed dropped by trains. Green argues that such plant disjunctions are unlikely to be the result of a single separation of eastern and western Australia by, say, the Miocene innundation of the Nullarbor Plain or, alternatively, by late Pleistocene changes. He points out that such disjunctions may also be the result of long-distance dispersal, a view supported by Fryxell (1967). The lack of evolutionary divergence shown by each of these two bicentric species indicates a very recent achievement of their disjunctions; the impressive distance barrier separating their populations points to long-distance dispersal rather than migration. As discussed above, both species have mericarps apparently well adapted for dispersal. Since all *Lawrencia* species frequent saline conditions their seeds may well tolerate immersion in sea water. Thus the absence of *L. berthae* and *L. spicata* from the Nullarbor Plain and the coast of the Great Australian Bight may merely reflect the lack of suitable habitats in this region. It is, of course, conceivable that these disjunctions are ancient and the species highly stable, but in the absence of evidence supporting this view, the alternative is more likely.

Although there is danger in using present-day distributions to identify centres of origin, it does seem likely that the various infrageneric taxa of *Lawrencia* were segregated in and have undergone their principal evolution within Western Australia where the genus has its major centre of diversity today. In particular, there has been an obvious proliferation of taxa of the section *Selenothamnus* in the interior where it appears that the lake systems of Western Australia have furnished opportunities for speciation in *Lawrencia.* In this region it is easy to envisage the isolation of populations not only between divisions but between lake systems as well (Short 1981). Even today lakes within a system may be isolated for extended periods with water linking them only in exceptionally wet years (Beard 1973, Bettenay 1962, Chapman 1962). The very close morphological simlarities between the various species of *Lawrencia,* together with their present distribution patterns, suggest that some have evolved in quite recent times, perhaps in response to the rapid and profound hydrologic oscillations evident over the last 400,000 years (Bowler 1981, 1982), causing isolation of individual lakes and therefore of populations within any one system.

There seems now to be general agreement that the arid zone has been colonized successfully by numerous biotypes selected from adjacent populations growing under favourable conditions rather than producing its own characteristic flora by means of internal evolutionary radiation (Barlow 1981, Beadle 1981, White, 1982). Burbidge (1960) suggested extensive colonization of the arid zone of Australia from populations which first appeared and diversified in strand habitats, a view which, until recently, has met with widespread acceptance (Beard 1976). In his review of studies on the phytogeography of arid Australia, Carolin (1982) finds scant evidence in support of this putative littoral connection: he cites the Salicornieae (Chenopodiaceae) and *Atriplex* (Chenopodiaceae) as possible illustrations and suggests that a consideration of taxa amongst the Caryophyllaceae may also vindicate such a link. *Lawrencia,* too, appears to be relevant in this context.

Lawrencia glomerata, a species with predominantly primitive characters within the genus, is widely distributed throughout the arid zone. Its considerable heterogeneity would seem to indicate active radiation and segregation in the arid environment. To a lesser extent the same is true of *L. viridi-grisea.* On the other hand, *L. squamata,* a taxon with many advanced characteristics, is also highly variable and widely dispersed. These examples may reflect radiation patterns of other taxa in the past.

The hypothesis that *Lawrencia* first appeared and diversified in strand habitats from whence taxa dispersed to colonize the margins of inland salt-lakes the subsequent expansion and contraction of which has provided a mechanism whereby secondary diversification and colonization of the arid zone has occurred deserves further exploration. It seems likely that cytological evidence and cladistic analysis might prove most useful in such a study.

E. Specimens from Giles' Fifth Expedition

Willis (1981) notes that specimens collected by W. Ernest P. Giles during his Fifth Expedition of 1876 are presumed to have been lost. Thus the discovery of Giles' specimens of *Lawrencia cinerea* presumed to have been gathered in the Little Sandy Desert and of *L. glomerata* from the upper Ashburton River and Mt Murchison is significant: ironically, these specimens were amongst those accidentally destroyed (see note p. 203). It is possible that further botanical collections from Giles' last long traverse are to be found at The National Herbarium of Victoria (MEL).

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Exsiccatae

The following list is intended to serve as a record of all specimens of *Lawrencia* studied and annotated by the author together with their contributing herbaria and to facilitate the identification of duplicates of these not examined in the course of this revision. Collectors are listed alphabetically and the initials of all their given names are cited wherever possible. Numbers in parentheses refer to the corresponding numbered species in the text. Abbreviations for herbaria are those given in Holmgren et al. (1981). In the case of Kings Park and Botanic Garden, Perth, there is no abbreviation so KP is used informally here. In the absence of a collector's number the date of collection is cited where available; herbarium register or sheet numbers are cited only in otherwise ambiguous cases. All specimens from HO and MEL examined were destroyed in a road accident during their return to those herbaria. Specimens from MEL marked with an asterisk represent recently distributed duplicates which are still extant. A comprehensive account of the lost specimens may be found in Lander (in press).

Alchin, B.M. 13 (10-NSW). *Alcock, C.R.* 663 (3-AD), 722 (10-AD), 912 (3-AD), 1093 (1-AD), 1096 (2-AD), 1113 (1-AD), 1114 (3-AD), 1255 (2-AD), 2143 (3-AD), 2763 (3-AD), 2764 (10-AD), 4184 (10-AD), 4743 (10-AD), 4758 (2-AD). *Alitt, W.* s.n., s.dat. (2-MEL). *Allan, K.M.* 89 (12-PERTH), 695 (10-PERTH). *Allender, B.M.* s.n., May 1966 (12-UWA). *Amtsberg, H.* s.n., Nov. 1073 (2-AD). *Andrews, C.* 72 (2-BM, K, PERTH), s.n., Sept. 1904 (10-PERTH), s.n., June 1927 (12-PERTH). *Anonymous* Oct. 1877 (4-MEL), Oct. 1877 (7-MEL 98655, 98657), —1897 (12-K), Nov. 1905 (10-MEL), May 1917 (2-AD), June 1917 (2-AD), Oct. 1918 (10-AD), Nov. 1936 (3-AD), Oct. 1949 (10-AD), Oct. 1950 (10-AD), May 1956 (10-AD), — 1956 (1-NSW), Oct. 1966 (3-AD), Nov. 1966 (10-AD), May 1967 (3-AD), s.dat. (2-HO), s.dat. (2-MEL 98747), s.dat. (2-MEL 98756), s.dat. (2-NSW), s.dat. (2-UWA), s.dat. (3-AD), s.dat. (3-MEL), s.dat. (9-MEL 98726), s.dat. (10-AD), s.dat. (10-K), s.dat. (10-MEL 98794), s.dat. (10-MEL 98797), s.dat. (10-MEL 98805), s.dat. (10-MEL 98807), s.dat. (10-MEL 98809). *Aplin, T.E.H.* 1489 (10-PERTH), 2145 (10-PERTH), 2308 (10-PERTH), 2419 (7-PERTH), 2531 (11-PERTH), 2369 (12-PERTH). *Archer, W.H.* s.n., s.dat. (2-NSW). *Armitsberg, H.* s.n., Feb. 1973 (AD). *Armstrong, S.* s.n., July 1966 (12-PERTH). *Ashby, A.M.* 1204 (1-AD), 1940 (1-AD, PERTH), 2214 (10-AD, PERTH), 2969 (7-AD, PERTH), 3408 (3-AD), 3705 (12-AD, MEL). *Atkin, Rev.* s.n., Dec. 1896 (12-NSW). *Backhouse, J.* s.n., s.dat. (2-K). *Bailey, E.T.* 1-22 (12-PERTH). *Barnsley, D.* 971 (10-CBG, NT). *Bartels, L.C.* s.n., Feb. 1946 (2-NSW, PERTH). *Bates, R.* 223 (3-AD). *Batt, J.D.* 64 (3-MEL), 98 (3-MEL), s.n., 1886 (3-MEL), Jan. 1887 (10-MEL), s.n., 1889 (10-MEL), s.n., 1890 (10-MEL. *Bauerlen, W.* 254 (10-MEL, NSW), 256 (3-MEL), s.n., Oct. 1887 (10-BRI). *Beard, J.S.* 6079 (3-NSW, PERTH), 6534 (10-PERTH), 6566 (3-PERTH), 6612 (11-PERTH). *Beauglehole, A.C.* 989 (10-MEL), 28081 (3-NT), 29241 (3-AD), 10048 (3-NT), 12991 (3-NT), 13207 (10-NT, PERTH), 13244 (8-NT), 13361 (8-NT), 16088 (3-MEL), 19403 (2-AD), 21349 (2-MEL), 24451 (3-NT), 29357 (3-MEL), 29614 (12-NT), 29528 (7-NT), 31285 (2-MEL), 32165 (2-MEL), 33027 (2-MEL), 39124 (2-MEL), 39209 (3-MEL), 39210 (10-MEL), 39459 (2-MEL), 40390 (10-MEL), 40453 (10-MEL), 40583 (10-MEL), 40592 (3-MEL), 42985 (3-MEL), 42987 (3-MEL), 42993 (10-MEL), 45704 (4-NT), 46175 (3-NT), 48276 (3-NT), 49093 (12-NT, PERTH), 49335 (8-NT), 49434 (3-NT), 49486 (10-AD, NT) 50759 (3-NT), 50932 (3-NT), 55588 (10-MEL), 55731 (3-MEL), 55867 (3-MEL), 55955 (10-MEL), 59528 (7-NT). *Bechervaise, J.M.* s.n., Sept. 1947 (3-MEL; *Bennett, E.M.* 45 (2-PERTH). *Berston, J.* 7 (7-PERTH). *Bettenay, E.* 172 (10-PERTH). *Birch, C.W.* s.n., 1871 (3-MEL), s.n., s.dat. (3-MEL). *Black, E.C.* Oct. 1917 (3-AD), s.n., Oct. 1947 (3-AD), s.n., Oct. 1948 (3-AD), s.n., Oct. 1950 (3-AD). *Black, R.A.* s.n., April 1922 (2-MEL), s.n., Nov. 1936 (3-AD). *Blackall, W.E.* 390 (3-PERTH), 391 (10-PERTH), 534 (7-PERTH), 1009 (3-PERTH), 1228a (12-PERTH), 1232 (10-PERTH), 3495 (10-PERTH), 4375 (10-PERTH), s.n., Oct. 1931 (3-PERTH), s.n., Sept. 1939 (3-PERTH), s.n., Sept. 1939 (7-PERTH), s.n., Sept. 1940 (7-PERTH), s.n., s.dat. (1-PERTH). *Blackwell, M.* Y 310 (7-PERTH). *Blaylock, B.J.* 639 (10-AD), 1126 (10-AD), 1698 (10-AD). *Blockley, J.V.* 760 (7-KP). *Boswell, P.* 24 (8-PERTH). *Bowen, H.* 198 (3-K), 271 (3-K), 311 (10-K). *Bridgewater, P.* s.n., Oct. 1979 (PERTH). *Brockway, G.E.* s.n., Oct. 1947 (12-CANB, PERTH). *Brooker, M.G.* 3647 (3-PERTH). *Brooks, S.T.C.* (as Miss *"Brooke"*, *"Brookes"*) s.n., 1883 (3-MEL), s.n., 1884 (3-MEL), s.n., 1885 (10-MEL), s.n., 1893 (1-MEL). *Brown, C.D.* s.n., 1890 (7-MEL). *Brown, R.* 4998 (10-BM, K), 5103 (3-BM), 5110 (2-BM, CANB, K, MEL). *Brown, Mrs T.* s.n., Oct. 1907 (10-NSW). *Browne, J.H.* 125 (10-PERTH), 126 (10-PERTH). *Brumby, Mrs* s.n., 1937 (3-AD). *Brummit, R.* s.n., Aug. 1892 (10-AD). *Buckley, R.* 7135 (4-PERTH), 7136 (4-PERTH), 7137 (4-PERTH), 7147 (4-PERTH). *Bufton, J.* s.n., 1892 (2-MEL), s.n., 1893 (2-MEL). *Burbidge, N.T.* 263 (8-K), 1433 (3-PERTH), 2738 (10-CANB, PERTH), 4088 (10-CANB), 4610 (3-CANB), 4713 (3-PERTH), 4755 (12-BRI, CANB), 4756 (12-CANB, PERTH), s.n., Aug. 1938 (7-PERTH). *Burgman, M.A.* 2704 (7-PERTH). *Butler, R.* s.n., July 1965 (4-PERTH). *Bynoe, B.* s.n., s.dat. (2-K). *Callen, R.* s.n., 1969 (10-AD). *Carr, G.W.* 2396 (3-NT), 4498 (3-AD, NT), 1925 (4-NT). *Carr, S.G.M.* 512 (12-PERTH), 1925 (4-NT), 4498 (3-NT). *Carrick, J.* 1802 (3-AD), 3710 (10-AD). *Carrol, E.J.* s.n., Sept. 1965 (3-CBG, NSW). *Caulfield, H.W.* 146a (3-AD, BM, BRI, CANB, K, MEL, NSW, NT, PERTH). *Chadwick, —* 2317 (3-CBG, NSW). *Chapman, C.* s.n., Oct. 1967 (11-PERTH), s.n., s.dat. (10-PERTH). *Chapman, D.* s.n., Oct. 1967 (11-BM, BRI, K, NSW, NT, PERTH). *Cheal, P.D.C.* s.n., Dec. 1980 (10-MEL). *Chinnock, R.J.* 87 (10-AD), 772 (10-AD), 773 (10-AD), 336 (3-AD), 666 (3-AD), 941 (7-AD), 1495 (3-AD), 1505 (10-AD), 1506 (10-AD), 2617 (3-AD), 2930 (3-AD), 4006 (12-AD), 4007 (12-AD), 4132 (9-AD), 4157 (9-AD). *Chippendale, G.* 10611 (3-AD, BRI, CANB, K, MEL, NSW, PERTH), 10612 (3-AD, CANB, MEL, NSW, NT), 6375 (3-AD), 10612 (3-AD, CANB, MEL, NSW). *Chorney* 1066 (3-AD, PERTH). *Churchill, D.* 202 (12-UWA). *Clarke, E. de C.* s.n., 1916 (3-BM, PERTH). *Clarke, W.* s.n., s.dat. (2-MEL). *Cleland, J.B.* s.n., Nov. 1913 (1-AD), s.n., Jan. 1924 (2-AD), s.n., Nov. 1924 (2-AD), s.n., Jan. 1926 (2-AD), s.n., 5 Nov. 1926 (10-AD 96601963), s.n., 5 Nov. 1926 (10-AD 96805867), s.n., 7 Nov. 1926 (10-AD), s.n., 1 Nov. 1928 (10-AD), s.n., 27 Nov. 1928 (10-AD), s.n., June 1933 (3-NT), s.n., Aug. 1939 (3-AD), s.n., Nov. 1941 (3-AD), s.n., July 1943 (3-AD), s.n., Nov. 1950 (10-AD), s.n., Dec. 1953 (3-AD), s.n., Dec. 1953 (10-AD), s.n., Nov. 1955 (3-AD), s.n., Nov. 1956 (3-AD), s.n., Nov. 1959 (2-AD), s.n., July 1960 (3-PERTH), s.n., Feb. 1964 (3-AD), s.n., Feb. 1968 (10-AD), s.n., Nov. 1968 (3-AD), s.n., s.dat. (3-NT). *Clement, E.* s.n., s.dat. (4-K). *Coleby-Williams, J.* 117 (11-PERTH), 118 (11-PERTH). *Comber, H.F.* 2024 (2-K). *Cooper, H.M.* s.n., March 1941 (3-AD). *Copley, B.* 817 (3-AD), 1020 (10-AD), 1136 (2-AD), 1235 (10-AD), 1563 (3-AD), 1571 (3-AD), 1603 (3-AD), 2398 (10-AD), 2719 (10-AD), 3678 (3-AD), 3843 (3-AD), 4541 (10-AD). *Cornwall, G.C.* 129 (3-AD). *Corrick, M.G.* 5072 (3-MEL), 6239 (1-AD, MEL), 6376 (1-MEL), 6380 (1-MEL), 6656 (10-MEL). *Coveny, R.* 8258 (10-NSW, PERTH). 8411 (12-PERTH). *Cranfield, R.J.* 638 (8-PERTH), 1723 (7-PERTH), 1856 (7-PERTH), 2521 (4-PERTH), 2584 (4-PERTH), 2595 (4-PERTH), 4009 (10-PERTH). *Craven, L.A.* 5033 (12-BRI, MEL, NT, PERTH). *Crawford,* — 39 (10-MEL), 48 (10-MEL). *Crisp, B.C.* 576 (3-CANB). *Crisp, M.D.* 676 (3-AD, CANB), 1231 (10-MEL), 3295 (10-CBG, MEL), 3417 (3-CBG, MEL), 5469 (11-CANB), 5630 (10-CBG, NT). *Crocker, R.L.* s.n., July 1939 (3-AD), s.n., Aug. 1939 (3-AD), s.n., Aug. 1939 (10-AD), s.n., 1939 (10-AD), s.n., s.dat. (10-AD). *Cronin, M.* s.n., 1890 (3-MEL), s.n., 1893 (1-MEL). *Cummings, D.J.* 232 (10-CBG, NT). *Cunningham, G.M.* 3026 (3-NSW), 4776 (10-NSW). *Curtis, W.M.* s.n., Jan. 1944 (2-HO), s.n., Jan. 1946 (2-HO), s.n., Dec. 1946 (2-HO), s.n., April 1953 (2-HO), s.n., Feb. 1966 (2-HO). *Czornij* (as *"Chorney"*), K. 1066 (3-AD, BH, K, PERTH). *Dalachi,* — s.n., s.dat. (2-MEL, NSW, PERTH). *Dallachy, J.* 237 (3-MEL), 238 (3-MEL), s.n., s.dat. (10-K). *D'Alton, St E.* 16 (3-MEL), 26 (3-NSW), s.n., Oct. 1899 (3-MEL). *Davies, C.F.* 283 (1-PERTH). *De Marci, C.* s.n., Sept. 1964 (4-PERTH). *Dennis, T.* 152 (2-AD). *de Rebeira, P.* 415 (6-AD, PERTH), 422 (6-AD, PERTH), 433 (12-PERTH). *Demarz, H.* 4445 (3-KP, PERTH), 4610 (10-KP, PERTH), 4712 (7-AD, KP, PERTH), 4587 (3-KP, PERTH), 4690 (3-KP, PERTH), 4829 (4-PERTH), 4831 (7-KP, PERTH), 4894 (8-KP, PERTH), 5292 (10-KP), 5367 (3-KP, PERTH), 6015 (2-KP), 6310 (10-KP, PERTH), 7140 (7-KP, PERTH), 8241 (7-KP), 8995 (7-KP, PERTH), 9258 (2-PERTH), 9540 (4-PERTH). *Deseglise, L.* s.n., 1866 (3-BM). *Diels, L.* 5204 (8-PERTH). *Dixon, S.* s.n., Oct. 1893 (12-AD). *Donner, N.N.* 1785 (3-AD), 2457 (10-AD), 2458 (10-AD). *Drummond, J.* 6 (3-K), 24 (9-BM, K), 55 (3-BM, MEL, PERTH, K), 104 (9-K), 106 (10-BM, K, PERTH), 137 (3-K), 208 (10-BM, K, MEL, PERTH), 252 (10-BM, K, MEL), 246 (3-K), 275 (1-K), 302 (2-BM, K, MEL), s.n., 1848 (10-K), s.n., Jan. 1854 (2-MEL), s.n., s.dat. (1-MEL), s.n., s.dat. (2-K, MEL 98729, 98730 98754), s.n., s.dat. (4-MEL 98692), s.n., s.dat. (10-K), s.n., s.dat. (10-MEL 98771, 98772, 98781, 98785). *Dunlop, C.* 1810 (3-AD), 2452 (10-K, NSW), 2541 (3-AD, MEL, NT). *Eckert, J.P.* s.n., 1892 (10-MEL). *Eichler, Hj.* 12536 (3-AD), 12958 (3-AD), 13001 (10-AD), 14186 (10-AD), 15732 (10-AD), 16859 (2-AD), 17629 (3-AD), 18745 (3-AD), 19417 (10-AD), 19433 (10-AD), 19434 (10-AD), 19445 (3-AD), 19550 (3-AD), 19550 (3-AD), 20317 (9-AD, PERTH), 20321 (10-AD, PERTH), 20322 (10-AD). *Elkington, J.* 330 (12-PERTH). *Erroy, E.G.* 3228 (7-NT), 3314 (12-NT). *Everist, S.L.* 9164 (7-BRI). *Fagg, M.* 376 (3-AD). *Fairall, A.R.* 1825 (12-KP). *Fell, L.* 678 (10-KP). *Fillagan, I.* 3 (2-MEL). *Fitzgerald, W.V.* s.n., 1893 (2-HO), s.n., Oct. 1898 (8-NSW, PERTH), s.n., Jan. 1903 (10-PERTH), s.n., Aug. 1903 (10-NSW, PERTH), s.n., Sept. 1903 (7-PERTH), s.n., Nov. 1907 (10-NSW). *Flounders, B.* 8 (3-AD). *Forde, N.* 479 (3-AD, K, MEL), 1330 (10-CANB), 1355 (12-CANB). *Forrest, A.* s.n., 1879 (3 & 4-MEL). *Forrest, J.* s.n., 7 June 1874 (3-MEL), s.n., 28 June 1874 (3-MEL), s.n., 30 June 1874 (3-MEL). s.n., 1882 (3-MEL). *Fraser, C.* 27 (2-BM), 126 (2-BM), 178 (2-K). *French, C.* s.n., April 1923 (3-MEL). *Galbraith, J.* 10 (10-AD). *Gardner, C.A.* 1993 (1-PERTH), 2094 (10-PERTH), 2128 (12-BM, PERTH), 2403 (7-PERTH), 2441 (7-BM, K, PERTH), 2444 (10-PERTH), 2545 (7-PERTH), 3264 (3-BM, PERTH), 3264A (3-K,PERTH), 6075 (3-PERTH), 6089 (7-PERTH), 7532 (10-PERTH), 7800 (3-PERTH), 7814 (12-PERTH), 8618 (10-PERTH), 13352 (7-PERTH), s.n., Aug. 1927 (12-PERTH), s.n., Aug. 1931 (7-PERTH), s.n., Sept. 1935 (1-PERTH). *Gasteen, J.* 85 (5-BRI). *Gauba, E.* s.n., Oct. 1942 (3-NSW, CANB). *George, A.S.* 915 (12-PERTH), 923 (12-PERTH), 952 (7-PERTH), 1482 (7-PERTH), 2290 (10-CANB), 2291 (10-CANB), 2948 (3-PERTH), 4214 (8-PERTH), 5692 (1-AD, BH, K, PERTH), 8111 (3-AD, BH, PERTH), 9131 (10-AD, PERTH), 9132 (3-MEL*, NSW, PERTH), 9137 (6-PERTH, AD), 9765 (3-BH, K, PERTH), 10207 (7-PERTH), 10214 (4-BH, K, MEL*, NSW, NT, PERTH), 11380 (NT, PERTH), 14783 (4-PERTH), 14812 (6-BH, NT, PERTH), 14813 (6-PERTH), s.n., Dec. 1964 (10-PERTH), s.n., June 1970 (9-PERTH), s.n., Sept. 1972 (4-PERTH). *George, D.N.* s.n., July 1931 (3-AD). *Giles, W.E.P.* s.n., 1872-4 (3-MEL), s.n., 1875 (10-MEL), s.n., 1876 (6-MEL), s.n., 1876 (3-MEL 98695), s.n., 1876 (3-MEL 98731). *Gill, W.* s.n., Feb. 1903 (2-NSW). *Glennon, P.* 109 (4-PERTH). *Goodall, D.W.* 2910 (10-PERTH), 3313 (7-PERTH, UWA). *Goss, G.F.* s.n., April 1955 (3-AD). *Gratte, S.* s.n., Aug. 1970 (3-AD), *Green, A.* s.n., Nov. 1924 (1-PERTH). *Gregory, J.H.* s.n., 1901 (1-BM). *Gregory,* Prof. s.n., May 1909 (12-MEL). *Grieve, B.J.* s.n., Oct. 1960 (10-UWA). *Griffin, E.A.* 3084 (4-PERTH). *Griffith, H.H.D.* s.n., Dec. 1907 (2-AD), s.n., Oct. 1927 (10-AD). *Gullan, P.K.* 384 (2-MEL). *Gunn, R.* 746 (2-K). *Hall, A.J.* s.n., Feb. 1928 (2-PERTH). *Hannaford, S.A.* 9 (10-NSW). *Heal, M.* s.n., 1889 (1-MEL). *Helms, R.* s.n., Sept. 1891 (1-MEL), s.n., Nov. 1891 (9-AD, K, MEL), s.n., Nov. 1891 (12-AD, K, MEL, NSW, PERTH), s.n., 1899 (12-K, PERTH). *Henderson, W.* 2556 (10-NSW), s.n., Oct. 1946 (10-NSW). *Henry, N.M.* 378 (4-MEL), 383 (3-AD, NT), 953 (4-AD). *Henshall, T.* s.n., Sept. 1966 (10-NSW). *Herbert, D.A.* s.n., July 1918 (12-PERTH). *Heyligers, P.C.* 79140 (10-CANB), 80136 (10-AD, CANB). *Hill, F.L.* 119 (4-BM), 124 (4-BM, K), 416 (4-CANB, K), 619 (4-K). *Hill, R.* 54 (3-AD), 229 (3-AD), 1006 (10-AD), 1173 (3-AD). *Holst, N.O.* s.n., April 1896 (12-MEL). *Horbury,* — s.n., Oct. 1937 (3-PERTH). *Humphries, A.W.* P48 (11-PERTH). *Ince, W.H.* s.n., June 1903 (12-K). *Ising, E.H.* s.n., Dec. 1922 (2-AD), s.n., Jan. 1925 (2-AD), s.n., Aug. 1925 (8-AD), s.n., Sept. 1936 (1-AD), s.n., Jan. 1937 (10-AD), s.n., Nov. 1938 (10-AD 96935429 & 97416003), s.n., Sept. 1938 (3-AD), s.n., Oct. 1950 (3-AD), s.n., Sept. 1951 (3-AD), s.n., Aug. 1952 (3-AD), s.n., Aug. 1955 (3-AD), s.n., Sept. 1955 (3-AD), s.n., Oct. 1955 (3-AD), s.n., Dec. 1958 (10-AD), s.n., Sept. 1960 (1-AD). *Jackson, E.N.S.* 741 (3-AD, PERTH), 1136 (AD), 1835 (10-MEL), 2559 (10-AD). *Jacob, G.L.* s.n., May 1968 (3-NSW). *Jacobs, S.W.L.* 1114 (10-NSW). *Johns, C.W.* s.n., 1941 (10-AD). *Johnson, U.* 30 (10-NSW). *Keighery, G.J.* 1956 (10-KP, PERTH), 2966 (8-KP), 3883 (2-KP), 5543 (10-PERTH). *Kenneally, K.F.* 7351 (7-PERTH). *Kenny, R.* s.n., Feb. 1946 (2-UWA). *Kingsmill, W.* 485 (12-BRI, NSW). *Kniep, N.* s.n., 1937 (12-PERTH). *Koch, M.* 1167 (10-K, NSW). *Kraehenbuehl, D.N.* 495 (10-AD), 918 (10-AD). *Kuchel, R.H.* 271 (3-AD), 515 (10-AD), 659 (3-AD), 681 (10-AD) 716 (3-AD), 2147 (8-

AD), 3328 (10-AD). *Lander, N.S.* 1101 (10-BH, BM, BRI, MEL*, NSW, NT, PERTH), 1113 (3-BH, CANB, K, MEL*, NT, PERTH), 1116 (12-BH, K, PERTH), 1120 (12-MEL*, PERTH), 1122 (11-K, MEL*, NSW, PERTH), 1123 (11-BH, CANB, PERTH), 1125 (7-BH, BRI, K, MEL*, NT, PERTH), 1128 (12-NSW, PERTH), 1129 (7-CANB, MEL*, NSW, NT, PERTH), 1139 (7-NSW, PERTH), 1140 (7-PERTH), 1142 (7-MEL*, NSW, PERTH), 1143 (4-BM, BRI, K, NSW, NT, PERTH), 1145 (7-BH, BM, CANB, K, MEL*, NSW), 1149 (4-MEL*, NT, PERTH), 1150 (4-PERTH, NT), 1151 (7-PERTH), 1154 (7-BM, PERTH), 1155 (4-K, PERTH), 1156 (7-BH, BM, BRI, CANB, K, NSW, PERTH), 1158 (4-PERTH), 1159 (4-PERTH), 1160 (3-AD, K, NSW, PERTH), 1161 (10-BH, BRI, K, MEL*, NSW, NT, PERTH), 1162 (10-K, PERTH), 1164 (10-K, NSW, PERTH), 1165 (10-BRI, K, NSW, NT, PERTH), 1166 (2-CANB, K, MEL*, NSW, PERTH). 1167 (3-PERTH), 1168 (3-AD, BH, BRI, NSW, NT, PERTH); 1214 (10-BRI, K, NSW, PERTH), 1227 (10-BRI, K, NSW, PERTH), 1228 (10-BRI, K, NSW, PERTH). *Latz, P.K.* 1971 (3-CANB), 2129 (10-AD, PERTH), 4797 (10-AD, BH, MEL, PERTH), 5591 (3-AD, MEL), 5946 (10-AD, NT, PERTH), 6567a (4-MEL, NT), 6567b (3-MEL, NT). *Laveny, H.S.* 52 (5-BRI). *Lawson, —* s.n., s.dat. (3-CANB). *Lay, B.* 548 (3-AD), 657 (3-AD). *Lea, T.S.* s.n., 1885-6 (3-AD, BM). *Leake, R.B.* s.n., Sept. 1897 (1-PERTH). *Leigh, J.H.* W 20 (10-NSW). *Leigh, J.W.L.* 2047 (3-NSW). *Lindgren, E.* s.n., Sept. 1963 (10-PERTH). *Long, F.H.* 137 (2-HO), s.n., Jan 1930 (2-HO). *Lothian, T.R.N.* 698 (10-AD), 1101 (3-AD), 1122 (3-AD), 1255 (2-AD). 1407 (10-AD), 1937 (3-AD), 2634 (10-AD), 3929 (3-AD), 4346 (10-AD), 4900 (3-AD), 5508 (10-AD, PERTH). *Lowry, J.* 43 (2-PERTH). *Lullfitz, F.* 1496 (12-KP, PERTH). 1588 (12-KP), s.n., Jan. 1963 (2-PERTH). *McDougall, V.F.* 22(1-PERTH). *McGillivray, D.J.* 3374 (12-NSW, PERTH). *Mackinnon, D.D.* 12 (7-PERTH). *Maclaine, E.* s.n., 1894 (2-MEL). *Maconochie, J.R.* 1891 (4-AD, CANB, CBG, MEL, NT), 1893 (3-AD, MEL, NT). *Maddox, M.D.* s.n., Sept. 1924 (2-MEL). *Malcom, C.V.* s.n., Oct. 1960 (3-PERTH), s.n., Oct. 1960 (10-PERTH). *Maroske, J.O.* s.n., 1959 (3-MEL). *Maxwell, G.* s.n., s.dat. (1-K, MEL), s.n., s.dat. (1-MEL), s.n., s.dat. (pro pte 11, pro pte 12-MEL). *Melville, R.* 219 (10-K, MEL), 988 (10-K, MEL), 4011 (12-AD, BRI, K, MEL, NSW, PERTH), 4019 (12-K, PERTH). *Merrall, E.* s.n., 1889 (8-MEL), s.n., 1890 (8-MEL), s.n., 1890 (1-MEL), s.n., 1892 (1-MEL), s.n., 1889 (1-MEL). *Milewski, A.V.* s.n., Oct. 1981 (3-PERTH), s.n., Oct. 1981 (9-PERTH), s.n., June 1982 (8-PERTH). *Milligan, J.* s.n., Feb. 1844 (2-HO). *Milthorpe, P.L.* 576 (3-AD), 2440 (10-NSW). *Minchin, J.* s.n., Oct. 1887 (3-MEL). *Mitchell, A.A.,* 45 (10-NT, PERTH), 517 (4-PERTH), 845 (3-PERTH), 968 (11-MEL*, PERTH), 969 (7-PERTH). *Mitchell, A.S.,* 517 (4-PERTH), 995 (3-NT, PERTH), 1010 (4-NT, PERTH), 1023 (6-NT, PERTH), 1059 (10-NT, PERTH), 1247 (3-NT), 1259 (3-NT). *Moore, C.W.E.* 5087 (3-CANB), 6367 (3-CANB), 6760 (10-CANB, NSW), 6761 (10-CANB, NSW). *Moore, S.* s.n., 1895 (8-BM, K). *Morris, K.A.* s.n., Oct. 1936 (3-BRI). *Morrison, A.* 11 (12-k), 15 (4-K), s.n., Feb. 1903 (2-BM, CANB, MEL), s.n., June 1903 (2-BM), s.n., Nov. 1906 (3-BM, BRI, PERTH), s.n., s.dat. (12-PERTH, KEW). *Mueller, F.* s.n., Dec. 1850 (2-MEL 98721, 98722, 98723, 98757), s.n., Nov. 1852 (2-MEL), s.n., Jan. 1854 (3-MEL), s.n., Oct. 1857 (10-98790, 98812 & 584132), s.n., Oct. 1857 (10-MEL 584133), s.n., Oct. 1867 (10-MEL), s.n., Oct. 1877 (4-MEL), s.n., 1880 (3-MEL), s.n., s.dat. (2-MEL 98725, 98755), s.n., s.dat. (2-MEL 98732), s.n., s.dat. (2-MEL 98747), s.n., s.dat. (2-K, MEL 98763), s.n., s.dat. (3-MEL 98683), s.n., s.dat. (3-BM, MEL 98684, 98686 & 98687 pro pte, NSW), s.n., s.dat. (3-MEL 98688), s.n., s.dat. (3-MEL 98689), s.n., s.dat. (3-MEL 98710), s.n., s.dat. (3-MEL 98712), s.n., s.dat. (3-NSW), s.n., s.dat. (10-MEL 98775), s.n., s.dat. (10-MEL 98785), s.n., s.dat. (10-K), s.n., s.dat. (10-MEL 98787), s.n., s.dat. (10-MEL 98789, 98789), s.n., s.dat. (10-MEL 98791, K), s.n., s.dat. (10-MEL 98812), s.n., s.dat. (10-MEL 584131), s.n., s.dat. (10-NSW). *Muir, E.T.* ACB 42987 (3-MEL), ACB 42994 (10-MEL), s.n., 1948 (3-MEL). *Murray, B.J.* s.n., Nov. 1927 (3-AD). *Newbey, K.* 407 (1-PERTH), 1463 (1-PERTH), 3084 (10-PERTH), 4247 (1-PERTH), 6879 (1-PERTH), 7239 (8-PERTH), 7521 (10-PERTH), 7537 (8-PERTH), 7575a (9-PERTH), 7658 (3-PERTH), 8095 (10-PERTH), 8304 (8-BH, NSW, PERTH), 8523 (8-PERTH), 8853 (8-PERTH), 9011 (8-PERTH), 9136 (10-PERTH), 9456 (3-PERTH). *Nicholls, A.O.* 808 (10-K, MEL), 818 (3-AD, CANB, K, MEL, PERTH, NT). *Noble, J.C.* 184 (3-AD), 622 (2-AD). *Norton, J.* s.n., Nov. 1936 (2-AD). *O'Farrell, R.* 16 (3-PERTH). *Oldfield, A.* s.n., s.dat. (4-K, MEL). *Ollerenshaw, P.* 148 (3-AD), 249 (3-CANB). *Olsen, M.* 717 (3-BRI). *Orchard, A.E.* 114 (10-AD), 1445 (9-AD, BH, PERTH). *Osborn, T.G.B.* s.n., Oct. 1918 (AD). *Paijmans, K.* 3166 (3-CANB), 3319 (10-CANB). *Parham, J.W.* s.n., Feb. 1976 (2-HO). *Parker, S.* 242 (3-AD), 280 (4-AD, K, MEL, NT). *Parr-Smith, G.* 1359 (10-PERTH). *Payne, A.* 163 (4-PERTH). *Peake-Jones, K.* s.n., Aug. 1952 (3-AD). *Pearman, G.* s.n., s.dat. (12-UWA). *Pearson, J.D.M.* 2024 (3-MEL). *Perry, R.A.* s.n., Oct. 1944 (10-CANB). *Phillips, M.E.* 49 (10-CBG), 237 (10-CBG), CBG 20817 (8-CANB), CBG 21616 (10-AD, CBG). *Pickard, J.* 2458 (3-NSW). *Polak, J.* (as *"Pollack"*) s.n., 1882 (3-MEL). *Preiss, L.* 1231 (10-MEL), 2381 (2-MEL), 2387 (2-MEL). *Probert, I.* 356 (10-AD), 362 (10-AD), 418 (10-AD), 420 (10-AD), 422 (10-AD), 431 (10-AD). *Purdie, R.W.* 759 D (10-BRI). *Quartermaine, E.* s.n., Dec. 1934 (2-PERTH). *Reader, F.M.* 2 (3-MEL), 8 (2-MEL), s.n., March 1895 (3-BM), s.n., Oct. 1895 (10-MEL), s.n., Dec. 1895 (2-MEL), s.n., Nov. 1898 (3-MEL). *Reader, J.* 5 (10-MEL), 8 (10-MEL), s.n., March 1895 (3-MEL). *Rees, J.D.* s.n., s.dat. (10-AD). *Richards, T.* 4 (3-MEL), s.n., 1875 (10-MEL 98810), s.n., 1875 (10-MEL 98811), s.n., 1877 (3-MEL 98709 & 98676), s.n., 1800 (3-MEL), s.n., 1880 (3-MEL), s.n., s.dat. (3-MEL). *Ridley, J.B.* s.n., April-Sept. 1863 (7-BM, K). *Ritman, H.* s.n., Feb. 1960 (2-MEL). *Robertson, J.G.* s.n., s.dat. (2-K). *Robinson, A.* s.n., Oct. 1976 (10-AD). *Rodway, E.* 2358 (2-K, NSW). *Rodway, L.* s.n., 1883 (2-HO), s.n., Jan. 1897 (2-HO), s.n., April 1930 (2-HO, K), s.n., s.dat. (2-HO 12978), s.n., s.dat. (2-NSW). *Rogers, Mrs. R.* s.n., Oct. 1915 (10-NSW). *Royce, R.D.* 5357 (10-PERTH), 5829 (10-PERTH), 6630 (7-PERTH), 6655 (3-PERTH), 9137 (2-PERTH). *Saffrey, R.A.* 657 (7-PERTH), 803 (12-PERTH), 816 (11-PERTH). *Saunders, Mrs* s.n., Oct. 1971 (1-KP). *Schomburgk, R.D.* 82 (10-AD, K, PERTH), s.n., March 1872 (2-K), s.n., s.dat. (1-AD, BRI), s.n., s.dat. (2-AD), s.n., s.dat. (10-AD). *Serventy, D.L.* s.n., Feb. 1982 (2-PERTH). *Sharrad, M.C.R.* 1224 (10-AD). *Short, P.S.* 1185 (3-AD, CBG, MEL). *Sims, E.B.* s.n., Aug. 1969 (10-AD). *Smith, G.G.* s.n., Aug. 1958 (10-UWA). *Smith, P.* 53 (4-PERTH). *Smith, R.V.* 517 (12-MEL). *Smith, T.J.* 439 (10-AD), 580 (10-AD), 1096 (2-AD), 1109 (2-AD), 1225 (10-AD), 1485 (10-AD), 1727 (10-AD), 1796 (10-AD), 1860 (2-AD), 1864 (2-AD), 1871 (2-AD), 1900 (10-AD). *Somerville, J.* s.n., Dec. 1960 (2-HO). *Southcott, R.V.* s.n., Dec. 1960 (3-AD). *Specht, R.L.* 24 (10-AD), 2227 (2-AD), s.n., Nov. 1959 (10-AD). *Speck, N.H.* 644 (3-CANB, PERTH), 683 (3-PERTH), 730 (3-CANB, PERTH), 744 (12-BRI, CANB, NSW, PERTH), 1346 (10-AD, BRI, K, MEL, NSW), 1435 (3-AD, CANB, MEL). *Spooner, A.G.* 1677 (10-AD), 2430 (3-AD), 3224 (2-AD), 6149 (10-AD). *Stevenson, P.* s.n., Nov. 1978 (2-PERTH). *Stoward, F.* s.n., Nov. 1914 (3-BM, NSW 146993 & 146994). *Story, Dr.* s.n., s.dat.

(2-MEL). *Streich, V.* s.n., 1895 (12-MEL). *Strid, A.* 20150 (12-PERTH). *Stuart, J.M.* s.n., 1859 (3-K). *Sutton, C.S.* 1174 (10-K), 1175 (3-K), s.n., Oct. 1905 (2-MEL). *Swinbourne, R.* 94 (3-AD), 180 (3-AD). *Symon, D.E.* 2338 (3-AD, PERTH), 3205 (10-NSW), 3251 (10-CANB, K), 3268 (3-CANB, K), 4300 (1-AD, CANB), 4308 (3-CANB), 5460 (12-AD, PERTH), 8149 (3-K), 9945 (12-AD, PERTH). *Tate, R.* s.n., 1880 (3-AD), s.n., 1883 (2-AD), s.n., 1883 (3-AD), s.n., 1889 (3-AD). *Telford,* I.R. 5859 (12-CANB). *Tepper, J.G.O.* 82 (1-MEL), 444 (1-MEL), 756 (2-MEL), 880 (2-MEL), 916 (3-MEL), 932 (2-MEL), 1209 (2-MEL), s.n., Oct. 1879 (1-AD), s.n., Jan. 1880 (1-MEL), s.n., s.dat. (1-MEL). *Tietkins, W.H.* s.n., 1880 (3-MEL). *Tilden, J.E.* 797 (2-BM, K). *Tindale, M.D.* 130321 (3-NSW). *Tindale, N.B.* s.n., 8 Aug. 1935 (3-AD), s.n., 22 Aug. 1935 (3-AD). *Toelken, H.R.* 6093 (12-AD, BH, BM, CANB, PERTH), 6094 (3-AD, BH, PERTH), 6129 (10-AD). *Trezise, P.* 359 (3-AD), 370 (3-AD). *Turner, H.* s.n., Sept. 1960 (3-AD). *Turner, J.* s.n., April 1977 (2-MEL). *Tyson, I.* 18 (10-MEL), s.n., 1892 (7-MEL). *Vickery, J.W.* s.n., Oct. 1949 (10-NSW). *Wace, N.M.* 9 (10-AD), 45 (10-AD), 136 (10-AD), 146 (3-AD), 172 (10-AD), 193 (3-AD), 212 (10-AD), 219 (3-AD, MEL), 228 (10-AD), 255 (3-AD), 262 (10-AD), 270 (10-AD), 285 (3-AD). *Wade, R.* s.n., Sept. 1971 (10-MEL). *Wakefield, N.A.* 2243 (2-MEL). *Walter, C.* s.n., Oct. 1899 (3-NSW), s.n., Oct. 1899 (10-NSW), s.n., Oct. 1900 (10-BRI, K), s.n., Feb. 1902 (2-NSW). *Warburton, P.E.* s.n., s.dat. (2-MEL); s.n., s.dat. (3-MEL). *Warnes, K.B.* 31 (3-AD), 34 (3-AD). *Weber, J.Z.* 774 (3-AD, MEL), 1321 (3-AD), 1380 (3-AD), 2081 (3-AD), 3568 (10-AD, BRI), 4229 (10-AD), 4251 (10-AD), 4339 (10-AD), 5031 (12-PERTH), 5786 (3-AD, BH, PERTH). *Webster, G.* L. 18666 (8-NSW). *Webster, L.G.* s.n., 1889 (8-NSW). *Weindorfer, G.* 222a (2-MEL), 222b (3-MEL). *Weston, A.* s.n., 1892 (7-MEL). *Wheatcroft, C.* 3678 (3-AD). *Whibley, D.J.E.* 562 (10-AD), 1234 (3-AD), 3425 (3-D), 5673 (10-AD). *Whinray, J.* 17 (2-MEL). *White, S.A.* s.n., Sept. 1910 (3-AD), s.n., Sept. 1912 (3-AD, K), s.n., Sept. 1912 (10-AD, K), s.n., Aug. 1913 (3-AD), s.n., April 1916 (2-AD), s.n., Oct. 1916 (3-AD), s.n., May 1917 (2-AD), s.n., 1936 (2-AD). *Wilcox, D.G.* 37 (3-PERTH), s.n., April 1954 (11-PERTH), s.n., Sept. 1966 (10-PERTH). *Willcocks, M.C.* 46 (10-AD). *Williams, C.* s.n., s.dat. (10-AD). *Wilhelmi, C.* s.n., Jan. 1852 (10-MEL), s.n., 1854 (10-K), s.n., s.dat. (2-MEL 98719), s.n., s.dat. (2-MEL 98738), s.n., s.dat. (10-MEL). *Williams, L.D.* 4102 (2-AD), 6388 (3-AD), 7179 (10-AD), 7234 (10-AD), 7488 (10-AD), 8688 (10-AD). *Williamson, H.B.* 1021 (2-NSW). *Willis, J.H.* s.n., Aug. 1947 (10-K, MEL 98782), s.n., Aug. 1947 (10-MEL 98780), s.n., Aug. 1955 (3-MEL). *Wilson, H.M.* 22 (2-PERTH). *Wilson, P.G.* 602 (3-AD, K), 1154 (2-AD), 1588 (3-AD), 1604 (10-AD), 1621 (10-AD), 1762 (3-AD), 2623 (10-AD), 2664 (2-AD), 2793 (10-AD), 5798 (10-PERTH), 6075 (10-K, NSW, PERTH), 6403 (10-BH, BRI, NSW, NT, PERTH), 6912 (3-BH, NSW, PERTH), 7136 (10-BRI, K, NSW, NT, PERTH), 7340 (7-PERTH), 7393 (10-PERTH), 7506 (12-PERTH), 7654 (10-K, PERTH), 7655 (10-PERTH), 8234 (4-PERTH), 8249 (10-BH, NSW, PERTH), 8604 (11-PERTH), 8635 (10-K, PERTH), 8636 (10-K, MEL*, NSW, PERTH), 8866 (12-BH, BM, BRI, CANB, K, NSW, NT), 8867 (12-BH, BRI, CANB, CBG, K, MEL*, NT, PERTH), 8945 (7-PERTH), 8964 (7-BH, NSW, PERTH), 9950 (3-BH, BRI, MEL*, PERTH), 10163 (9-PERTH), 11582 (12-PERTH), 11583 (12-PERTH), s.n., Sept. 1966 (9-PERTH), s.n., July 1967 (10-PERTH). *Wittwer, E.* 349 (1-KP, PERTH), 977 (10-KP, PERTH), 1120 (3-PERTH), 1395 (10-PERTH), 1397 (3-KP, PERTH), 1429 (10-KP, PERTH), 1447 (3-PERTH), 1734 (12-PERTH), 1768 (12-KP), 1845 (10-PERTH), 1891 (2-KP). *Wood-Jones, F.* s.n., Nov. 1920 (10-AD, NSW). *Wrigley, J.W.* 5802 (2-CBG). *Zimmer, W.J.* s.n., Oct. 1932 (1-MEL).

Index to Names and Synonyms in *Lawrencia*

Names of new taxa, new combinations, and names with new status appear in bold type, other accepted names and epithets appear in roman, and synonyms in italic. For an accepted name, reference is made only to the page where the main entry begins; for a rejected name, only the page where it is listed as a synonym of an accepted name is indicated.

Nuytsia 5(2): 273-303 (1984)

New taxa of tropical Australian grasses (Poaceae)

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Abstract

Lazarides, M. New taxa of tropical Australian grasses (Poaceae). Nuytsia 5(2): 273-303(1984). The morphology of 15 new taxa of grasses, chiefly from wet tropical parts of Western Australia and the Northern Territory, is described and illustrated. They include *Symplectrodia*, a genus of 2 species, allied to *Plectrachne* Henr. and *Triodia* R. Br., 5 species in *Micraira* F. Muell. and 4 in *Plectrachne* Henr. *Chloris scariosa* F. Muell. and *Panicum deschampsioides* Domin are segregated as new genera, viz. *Oxychloris* and *Arthragrostis* respectively. *Heteropholis* C. E. Hubb., represented by an endemic species, is recorded for Australia for the first time. The circumscriptions of *Plectrachne* Henr. and of *P. bynoei* C. E. Hubb., which is based on a relatively uncommon, ecotypic variant, are emended to include significant new morphological data.

Contents

Introduction

The object of this paper is to validate the names of new taxa required chiefly for 3 projects, viz. an intensive survey of the world's grass genera being undertaken in Kew, the Flora of Australia project, and for regional treatments of the flora of the Kimberleys of Western Australia and other regions.

Symplectrodia (Eragrostideae) Lazarides, gen. nov.

Gramina perennia; culmi nodis 3-4 pilosis; laminae arcte conduplicatae incrassatae teretes pungentes; ligula ciliata. Panicula racemosa laxa. Spicula flosculis 3-6; flosculus basalis hermaphroditus; ceteri neutri, sine paleis, saepe reducti. Glumae subaequales cartilagineae obscure paucinervatae, dorsaliter rotundatae vel complanatae. Lemma basale cartilagineum integrum aristulatum obscure paucinervatum, nervis lateralibus submarginalibus. Callus curvatus vel obliquus, pungens, barbatus autem glaber prope apicem. Palea adnata rhachillae, cartilaginea binervata in parte infera, libera membranacea bicarinata in parte supera. Caryopsis vix compressa, rostrata, ad basim acuminata, in superficie hili sulcata. Rhachilla articulata, internodium basale adnatum dorso paleae flosculi fertilis; internodia supera ad basim juncta et partim inclusa lemmatibus cassis, maturitate elongata. Lemmata cassa cartilaginea trilobata inaequaliter triaristata (laterales media breviores), sursum aristis redacta. Aristae complanatae, scaberulae.

Typus: S. lanosa Lazarides

Non-resinous *perennials;* culms erect, terete, with 3-4 hairy nodes; leaf sheaths shorter than culm internodes; blades thickened, tightly conduplicate, terete, pungent; ligule ciliate. *Inflorescence* a loose racemose *panicle* of solitary spikelets pedicelled and approximate to distant on simple (rarely divided), 1-nate branches; divisions pubescent-scabrous; axis ribbed or striate; branches and pedicels triquetrous or compressed, the latter thickened below spikelet. *Spikelet* 3-6-flowered; the basal floret hermaphrodite; the remainder neuter, without paleas, often reduced. *Glumes* persistent, subequal, cartilaginous, lanceolate-elliptic, acuminate, entire, muticous or aristulate, usually glabrous, rounded or flattened on the back, weakly few-nerved. *Basal lemma* cartilaginous, lanceolate, acuminate, entire, aristulate, weakly 3-nerved (laterals close to margins). *Callus* curved or oblique, pungent, glabrous near tip otherwise densely bearded, with a linear-elliptic scar. *Palea* adnate to rhachilla and cartilaginous in the lower part, free and membranous above, acute, entire, muticous; keels prominent in upper free part, scaberulous, represented in the lower hardened part by 2 nerves; flaps prominent, membranous with hyaline margins, incurved. *Lodicules* at first thickened, becoming hyaline or membranous, often firm near base and hyaline above, many-nerved, oblong or cuneate, truncate, glabrous, irregular or entire on the apical margin. *Anthers* laterally exserted near apex of floret, reddish, large. *Styles* free. *Caryopsis* slightly compressed dorsally, oblong to oblanceolate, abruptly narrowed into a truncate apical beak, acuminate at base, with a longitudinal depression on the hilar face; embryo c. 1/3 as long as the grain itself; hilum sub-basal, linear to narrowly oblong; pericarp tardily free. *Rhachilla* stout, compressed, glabrous, jointed with horizontal circular articulations; basal internode adnate to back of palea of the fertile floret for most of its length; the upper internodes joined at base to, and partly enclosed within, the empty lemmas, elongating with maturity. Empty lemmas cartilaginous, glabrous or almost so, scaberulous, 3-lobed, 3-nerved, unequally 3-awned (median longer than laterals), reduced upwards to the awns, at first clustered close above the fertile floret and mostly enveloped by the glumes, becoming distant and prominently exserted with the elongation of the rhachilla. *Awns* flattened, scaberulous, becoming longer upwards.

Species 2, in the Northern Territory of Australia

Key to *Symplectrodia* and allied genera

1. Lemmas minutely 3-toothed or 3-lobed (rarely entire), the lobes small or sometimes half as long as the lemma itself, awnless or rarely 1-aristulate; glumes usually much shorter than spikelet, awnless or rarely aristulate; callus absent or minute and obtuse .... *Triodia*
1. Lemmas deeply 3-lobed or sometimes entire, 1-3 awned; glumes often as long as the spikelet or longer, awnless or awned; callus minute to small, acute.
   2. Rhachilla elongating with maturity, the basal internode adnate to palea of the fertile floret; hermaphrodite florets one; glumes awnless or aristulate; basal lemma entire .... *Symplectrodia*
   2. Rhachilla not changing with maturity, free; hermaphrodite florets usually at least 2; glumes awned or awnless; basal lemma 2-3 lobed .... *Plectrachne*

On morphological features, the relationships of *Symplectrodia* are clearly with *Plectrachne* Henr. and *Triodia* R. Br., the complexity of its spikelet structure possibly indicating it to be a specialized derivative of *Plectrachne.* During development, the spikelet undergoes major changes, which dramatically alter its appearance. In the immature state, all the florets are condensed almost wholly within the glumes. With maturity the spikelet, or more specifically the rhachilla, elongates to at least 3 times its length. Consequently, the infertile florets become widely separated from each other and from the hermaphrodite floret and glumes. Ultimately, the infertile florets disarticulate individually and the fertile floret falls with its callus, while the glumes remain attached to the pedicel. The complexity in structure seems difficult to justify in terms of seed dispersal or any other function, considering that all the florets affected by these changes are sterile, and better dispersal might be achieved by the aristulate fertile floret remaining attached to the cluster of 3-awned sterile florets.

The two species in the genus are extremely homogenous in morphology, the only variable feature being density of indumentum on the foliage. However, plants of the species differ outstandingly in habit and dimensions.

Key to the species of *Symplectrodia*

1. Plants robust, rhizomatous, 1.8-3 m high; basal sheaths reddish-brown, often covered in woolly hairs; blades 60-90 cm long; panicles 44-54 cm long; basal lemma mostly hairy, with an awn <3 mm long .... *S. lanosa*

1. Plants slender, not rhizomatous, 0.75-1.05 m high; basal sheaths not coloured, if hairy then not woolly; blades 7-15 cm long; panicles 7-17 cm long; basal lemma mostly glabrous, with an awn 5-8 mm long .... *S. gracilis*

Symplectrodia lanosa Lazarides, sp. nov. (Figure 7)

Gramen perenne rhizomatosum robustissimum<3 m altum; vaginae foliorum basalium maxime coloratae rubiginosae, saepe pilis densis lanatis omnino vestitae; laminae 60-90 cm longae; panicula 44-54 cm longa; lemma basale pilis densis pro parte maxima vestitum.

Typus: Northern Territory: Darwin & Gulf District: *Dunlop* 4874, 2.vi.78, Mt Gilruth area, 12° 58'S, 133° 10'E (holo: NT; iso: BRI, CANB, DNA, K, NSW).

Robust tussocky rhizomatous *perennial* forming extensive clumps; tussocks 61-135 cm high; flowering culms 1.8-3 m high. *Culms* branched near base or simple; nodes pubescent or bearded, the hairs extending to the sheaths. *Leaf sheaths* highly coloured reddish-brown in the lower part, sometimes entirely covered in dense woolly hairs which extend along the blades, often ciliate on margins, often 1.5-2 cm wide, much wider than blade at their junction. *Blades* 60-90 cm long, usually glabrous, scabrous on upper surface, smooth on the lower one, often glaucous. *Ligule* 0.8-1 mm long. *Panicle* 44-54 x 5 cm, sometimes rather dense; primary branches<15 cm long, spikelet-bearing to base, rarely the lower ones sparsely divided; pedicels<1 cm long. *Glumes* 10-13 mm long, often aristulate, smooth in the lower part or scaberulous, faintly 3-5-nerved (laterals often close together), the lower usually 1-2 mm shorter than upper. *Basal lemma* 12-13 mm long (including callus and awn), ciliate on margins and hirsute about the midnerve in the lower 1/2-2/3, glabrous and scaberulous above and along the lateral nerves; callus c. 2 mm long; awn <3 mm long. *Palea* c. 9.5 mm long, glabrous, smooth. *Lodicules* 1.2-1.5 mm long. *Anthers* c. 4.8 mm long, reddish. *Caryopsis* c. 4 x 0.8 mm, embryo c. 1 mm and hilum c. 0.5 mm long. *Rhachilla*: basal internode c. 5 mm long, adnate to palea for c. 4 mm. *First empty lemma* 5-6 mm long (excluding lobes); lobes narrowly acuminate, sometimes sparsely ciliate on the margins, mid-lobe awn-like; awns 6-7 mm (median) and 3-4 mm (laterals) long. *Upper empty lemmas* similar to first or reduced to the awns.

Surprisingly, the extremely dense cover of woolly hairs on the basal foliage, which is a striking feature of some plants, is completely absent in others of the species. However, the unusually robust, rhizomatous, clump-forming habit, high colouring, great dimensions of leaves and panicles, and hirsute lemma of the fertile florets are consistent distinguishing characters.

The species occurs on the western margins of the Arnhem Land Plateau in rugged, sandstone habitats such as steep rocky slopes and massive outcrops.

Paratypes

Northern Territory: Darwin & Gulf District: *Dunlop* 5478, 23.iv.80, Mt. Brockman, 12°48′S, 132°55′E (BRI, CANB, DNA, NSW). *Dunlop* 6597, 23.ii.84, 12°55′S, 133°02′E (BRI, CANB, DNA, MEL, NSW). *Lazarides* 7757, 17.ii.73, c. 26 miles E of Oenpelli Mission, 133°26′E, 12°20′S (CANB, DNA, K). *Telford* 8029, 23.iv.80, 6.5 km SSW of Mt Brockman, 12°48′S, 132°56′E (CANB, CBG). *Lazarides* 7655, 18.vii.72, East Alligator River, 12°47′S, 133°21′E (BRI, DNA, K, L, NSW, US). *Lazarides* 9134, 2.vi.80, 19.5 km SE of Jabiru East, 12°49′S, 132°59′E (CANB). *Craven* 6614 & *Craven* 6616, 30.iii.81, c. 25 km NE of Jabiru, 12°29′S, 132°57′E (CANB). *Latz* 7677, 10.vi.78, Radon Creek, Brockman Range, 12 km S of Jabiru (BRI, CANB, DNA, K, NSW, NT, PERTH).

Symplectrodia gracilis Lazarides, sp. nov.

Symplectrodiae lanosae affinis, sed habitu gracili non-rhizomatoso, panicula et laminis multo brevioribus, lemmate flosculi fertilis pro parte maxima glabro longius aristato, lodiculis et antheris parvioribus differt.

Typus : Northern Territory: Darwin & Gulf District: *Lazarides* 7919, 28.ii.73, c. 7.5 miles SE of Mt Gilruth, 133°09′E, 13°07′S (holo: CANB; iso: BRI, DNA, K, L, US).

Slender tussock-forming *perennial* ; tussocks c. 30 cm high, neatly compact; flowering culms 0.75-1.05 m high. *Culms* branched near base, with c. 3 pubescent nodes. *Leaves* varying from hirsute to almost glabrous. *Leaf sheaths* ciliate on at least the outer margin. *Blades* 7-15 cm long, often ciliate on margins upwards from the ligule, scabrous on the upper surface; ligule 0.5-1 mm long. *Panicle* 7-17 x 1-3 cm (excluding awns); branches <3.5 cm long; pedicels <1.2 cm long. *Glumes* scaberulous or partly smooth; lower 10-12 mm long (including awn of c. 2 mm), faintly 1-3-nerved; upper 12.5-15 mm long (including awn of 1-3 mm), faintly 3-5-nerved, rarely with a few scattered hairs. *Basal lemma* 10-12 mm long (including callus), ciliate to almost glabrous on margins, glabrous on surface or sometimes sparsely hairy along midnerve near the base, awned; awn 5-8 mm long, scaberulous; callus 1.8-2.5 mm long. *Palea* c. 8 mm long, narrowly lanceolate-oblong, ciliolate or scaberulous at apex. Lodicules 0.8-1 mm long. Anthers c. 3.5 mm long. *Caryopsis* 4-4.5 x 1 mm, pallid; embryo 1.3-1.5 mm long. *Rhachilla:* basal internode 5-5.5 mm long, free in the upper 1 mm; second internode c. 0.5 mm long (in immature spikelets), elongating to c. 15 mm with maturity; third internode c. 17 mm long at maturity. *Empty lemmas* usually 4-5, the first 4-6 mm long (body), sparsely ciliate on margins of lobes near sinus, median awn 8-9 mm long, laterals 5-6 mm long; the second lemma 3-5 mm long, sparsely ciliate on margins, median awn 12-13 mm long, laterals 9-10 mm long; third lemma similar to second but smaller, the remainder reduced to awns.

Plants of the species can be greyish from a dense cover of hairs on leaves, (cf. Lazarides 7943), or vary from sparsely hairy to glabrous, as in the other specimens cited. The species is distinguished from *Symplectrodia lanosa* by its slender habit, smaller dimensions, and mostly glabrous longer awned lemma of the fertile floret.

The species is known only from a small area on the sandstone plateau of Arnhem Land.

Paratypes

Northern Territory: Darwin & Gulf District: *Lazarides* 7943, 28.ii.73, c. 2.5 miles SW of Mt Gilruth, 133°02′E, 13°03′S (CANB, DNA, K, US). *Dunlop* 4410, 22.ii.77, Mt Gilruth, Deaf Adder Gorge, 13°04′S, 133°05′E (CANB, DNA, NT) *Lazarides* 8003, 4.iii.73, c. 11 miles SW of Mt Gilruth, 132°56′E, 13°04′S (BRI, CANB, DNA, NSW, PERTH).

Plectrachne Henr. (Eragrostideae)

Originally monotypic, *Plectrachne* was enlarged considerably by Hubbard (1939, 1941) and with the present additions, the genus comprises 16 Australian endemic taxa. As might be expected, variations in morphology have become evident with the increased content. In particular, the new species in this paper differ in the structure of lobes and awns on glumes and lemmas, from all other species in the genus except *P. bynoei* C. E. Hubb. New features of generic significance are incorporated in the following summary of diagnostic characters of the genus.

Plectrachne Henr., Viertelj. Naturf. Gesell. Zurich. 74: 132 (1929). *Type species: P. schinzii* Henr.

Tussock-forming, resinous or non-resinous *perennials;* culms few-noded, usually glabrous, branched from the lower nodes or simple; leaf sheaths shorter than culm internodes, abruptly narrowed at junction with blade; blades soon tightly conduplicate, terete, thickened, pungent; ligule ciliate. *Panicle* racemose and usually elongated or contracted. *Spikelets* few-flowered, lower 1-4 florets hermaphrodite, the remainder neuter and usually reduced to awns. *Glumes* persistent, equal to somewhat unequal, lanceolate, entire or emarginate, awnless or 1-3-awned, usually glabrous, subequal or longer (rarely much shorter) than spikelet (excluding awns). *Lemmas* 2-3-lobed, 1-3-awned, variously hairy; awns (when 3) subequal or laterals shorter than median; callus small, bearded or with glabrous tip. *Paleas* 2-keeled, truncate or obtuse, entire or notched, muticous, glabrous or hairy between keels. *Ovary* glabrous; stigmas plumose. *Lodicules* cuneate, truncate, glabrous. *Rhachilla* glabrous, disarticulating between the fertile florets and above glumes, continuous between the sterile florets. *Caryopsis* scarcely compressed, broader upwards, obtuse; embryo prominent.

Key to new and allied species in *Plectrachne*

1. Glumes 3-awned, pilose .... *P. aristiglumis*
1. Glumes awnless or sometimes 1-awned, usually glabrous.
  2. Lemmas 1-awned.
    3. Spikelet c. 8 mm long (excluding awns), with 6-7 florets exserted above glumes; palea hairy between keels in lower 1/3-1/2 .... *P. contorta*
    3. Spikelet c. 5 mm long (excluding awns), with usually 4 florets enclosed within glumes; palea glabrous between keels .... *P. uniaristata*
  2. Lemmas 3-awned or rarely (in *P. bynoei)* the lowest one 1-awned and the remainder 3-awned.
    4. Palea coriaceous in lower 1/2-4/5, hyaline above.
      5. Glumes 6-6.5 mm long; lemmas not demarcated between lobes and body; spikelet with one hermaphrodite floret .... *P. mollis*
      5. Glumes 8-20 mm long; lemma with a transverse joint at base of lobes, which finally disarticulate from the body; spikelet with 2-4 hermaphrodite florets .... *P. pungens, P. schinzii*
    4. Palea entirely coriaceous or membranous.
      6. Spikelet 4-8.5 mm long (excluding awns); lemmas membranous; lateral awns on lemma of basal floret absent or distinctly shorter than the median; spikelets approximate on numerous racemose branches .... *P. bynoei*
      6. Spikelet usually 10-25 mm long (excluding awns); lemmas coriaceous or firmly membranous; lateral awns subequal to median; spikelets irregularly arranged in contracted panicles .... *Remaining species*

Plectrachne aristiglumis Lazarides, sp. nov. (Figures 3a, b, 4a)

Gramen perenne non-resinaceum; culmi sparsim pilosi vel glabri; vaginae foliorum hirsutae vel in parte infera pilosae; laminae prope ligulam pilosae; spicula flosculis 7-8; flosculi arcte imbricati, supra corpus glumarum exserti, sursum aristis reducti, glumae bilobatae, lobis et sinu inaequaliter triaristatae, pilosae vel glabrae; lemmata bilobata, lobis et sinu inaequaliter triaristata, in parte 1/3 infera pilis argenteis in seriebus longitudinalibus barbata, pilosa vel secus margines superos ciliata; palea corpore lemmatis leviter longior, ad basim barbata.

Typus: Northern Territory: Darwin & Gulf District: *Dunlop* 3371 (DNA 6558), 25.ii.73, Magela Creek, 12°40′S, 133°03′E (holo: CANB; iso: BRI, DNA, K, NT, PERTH).

Tufted or tussock-forming, non-resinous *perennial* c. 60 cm high. *Culms* 3-4-noded, densely scaberulous, sparsely pilose or glabrous. *Leaf sheaths* hirsute to pilose in the lower part. *Blades* <25 cm long, slender, often flexuose, scabrid-hispid on the upper surface, scaberulous on lower, pilose near ligule; ligule c. 0.8 mm long. *Panicle* 11.5-13 x 3-4 cm (including awns), loose, sparse; primary branches <3 cm long, sparsely divided; pedicels <1.5 mm (laterals) and <14 mm (terminals) long; divisions acutely triquetrous, scabrous-hispid. *Spikelets* 11-13 x 2-3.3 mm (excluding awns), 7-8-flowered, laterally compressed; florets closely imbricate, reduced upwards to the awns, exserted above the body of glumes; awns straight or recurved or twisted. *Glumes* 7-8 mm long (excluding awns), membranous to cartilaginous, scaberulous, faintly 3-nerved, 2-lobed, (especially the upper) pilose or glabrous on surface, ciliate-pilose on the upper margins and sparsely so on the lobe margins, unequally 3-awned from lobes and sinus; awns on lower glume 6-7 mm (median) and 2-3 mm (laterals) long, on upper glume 8-9 mm (median) and 3-4 mm (laterals) long. *Lemmas* c. 6 mm long (excluding awns), cartilaginous, scaberulous, 2-lobed, unequally 3-awned from lobes and sinus, bearded in the lower 1/3 with silvery-white hairs in longitudinal series, pilose-ciliate on the upper margins (including lobe margins); awns c. 12 mm (median) and c. 7 mm (laterals) long; callus c. 0.3 mm long, with glabrous blunt tip. *Paleas* c. 5 mm long, slightly longer than body of lemma, membranous, oblong, subacute, bearded at base; keels acute, scaberulous; flaps broad, with hyaline edges. Awns on upper lemmas similar to the lower ones or slightly longer. *Caryopsis* not seen.

The species is known from only one locality on the escarpment of the Arnhem Land plateau of the Northern Territory.

Characteristic features, some of which are unique within the genus, include the 2-lobed unequally 3-awned glumes and lemmas, hairy leaf sheaths, glumes and lemmas, many-flowered spikelet with exserted florets, and mostly glabrous palea.

Paratype
Northern Territory: Darwin & Gulf District: *Dunlop* 3372 (details as for holotype).

Plectrachne contorta Lazarides, sp. nov. (Figures 3c, d, 4b, c)

Gramen perenne non-resinaceum; folia saepe pilis simplicibus et tuberculis portatis pilosa; spicula flosculis 6-7; flosculi exserti supra glumas; glumae pilosae vel praecipue in marginibus superis ciliatae vel glabrae, uniaristatae; gluma infera integra; gluma supera bilobata sinu aristata; lemmata profunde bilobata, sinu uniaristata, secus margines superos ciliata, in parte 1/3 infera hirsuta; arista valde curva vel contorta; palea longitudine corpore lemmatis, inter carinas in parte 1/3-1/2 infera, carinis ciliatis vel scaberulis.

Typus: Northern Territory: Darwin & Gulf District: *Lazarides* 7924, 28.ii.73, c. 7.5 miles SE of Mt Gilruth, 13° 07′ S, 133° 09′ E (holo: CANB; iso: BRI, DNA, K, L, PERTH, US).

Non-resinous *perennial* 0.70-1.05 m high; vegetative tussocks c. 15 cm high; flowering culms 0.90-1.05 m high. *Culms* 2-3-noded, terete, scaberulous or becoming smooth. *Leaf sheaths* glabrous or hairy with simple and tubercle-based hairs, ciliate on margins, bearded or pilose at mouth. Blades <15 cm long, rigid, straight, pilose especially near ligule or glabrous, scabrous or papillose; ligule 0.8-1 mm long. *Panicle* 14-21 x c. 3 cm, loose; axis and divisions acutely triquetrous, densely scabrous-hispid to pilose; primary branches < 6 cm long. *Spikelets* c. 8 mm long (excluding awns), 6-7-flowered, florets exserted above glumes. *Glumes* firmly membranous, acuminate, faintly 3-nerved, obtusely keeled, scaberulous, awned from keel, glabrous or pilose-ciliate especially on the upper margins; lower 5-8 mm long, entire, with a straight stiff scaberulous awn 2-5 mm long; upper 5-6 mm long, with 2 acuminate apical lobes and a similar awn 3.5-4.5 mm long from sinus. *Lemmas* c. 5.2 mm long (including callus and lobes), firmly membranous, deeply 2-lobed and awned from sinus, densely scaberulous, obscurely nerved, ciliate on the upper margins, hirsute in the lower third; awn 8-12 mm long, strongly curved or contorted, scaberulous; lobes acuminate; callus minute, with glabrous obtuse tip. *Palea* as long as body of lemma or somewhat shorter, thinly membranous, narrowly lanceolate, entire, hirsute between keels in lower 1/3-1/2; keels ciliate upwards or scaberulous from near base. *Lodicules* c. 0.8 mm long, firm. *Caryopsis* not seen. *Rhachilla* stout; internodes c. 1 mm long, with acutely oblique articulation.

The species is known from two relatively close localities on the Arnhem Land plateau of the Northern Territory, where plants were common on sandstone shelves and outcrops.

Distinctive features of the species include the 1-awned, 2-lobed lemma and glumes, exserted florets, relatively short palea, and contorted awns of the lemma. From *Plectrachne uniaristata*, the only other species in the genus with exclusively 1-awned lemmas, *P. contorta* differs markedly in spikelet morphology.

Paratype
Northern Territory: Darwin & Gulf District: *Dunlop* 4340, 21.ii.77, Deaf Adder Gorge, 13° 02′ S, 132° 57′ E (BRI, CANB, DNA, NT).

Plectrachne mollis Lazarides, sp. nov. (Figure 2a, b)

Gramen perenne gracile non-resinaceum; culmi ad nodos infernos ramosi; panicula contracta; spicula parva, flosculo hermaphrodito et sursum flosculis neuteris setis reductis plerumque tres; lemma obscure nervatum, trilobatum, triaristatum, continuum inter lobos et corpus; lobi plani, triangulares; lobus medianus trinervis; lobi laterales binerves; aristae leviter inaequales; palea coriacea autem in parte 1/5 supera membranaceae vel hyalina, inter carinas sparsim pubescens; carinae excurrentes minutis mucronibus.

Typus: Western Australia: Northern Province: *Kenneally* 8656, 7.xii.82, 19 km N of Mitchell Plateau mining camp on track to Port Warrender, 14° 42′ S, 125° 47′ E (holo: CANB; iso: PERTH).

Slender non-resinous *perennial* 60-75(-90) cm high, forming compact leafy tussocks. *Culms* 2-3 noded, branched at the lower nodes, terete, glabrous, smooth, purple-black when young. *Leaves* filiform, glabrous; sheaths loose, pilose at mouth; blades thickened, terete, soon conduplicate, finely pungent, densely scabrous on upper surface, sparsely scabrid on edges; ligule c. 0.2 mm long; collar sometimes ciliolate. *Panicle* 9-14 x 1-1.5 cm, contracted, rather dense; primary branches <2.8 cm long, few, naked in the lower part; pedicels 0.8 mm (laterals) and 2.8-4 mm (terminals) long. *Spikelet* with one hermaphrodite floret and usually 3 neuter florets above, the latter reduced to slender stiff scabrous bristles 3-7 mm long and clustered at apex of rhachilla; rhachilla internode 1-1.5 mm long, slender, compressed, glabrous, smooth. *Glumes* membranous, lanceolate, acuminate, entire, muticous, glabrous, scaberulous upwards, 3-nerved, longer than spikelet (excluding awns), lower 6-7.5 mm and upper 4.6-6.5 mm long. *Lemma* coriaceous to indurated, 3-lobed, 3-awned; body (including callus) 1.8-2 mm long, entirely or partly pubescent, indistinctly nerved, sometimes (usually in mature spikelets) with a transverse thickened ridge at base of lobes on the inner surface, but no articulation; lobes flat, c. 0.5 mm wide at base, attenuate with awns, triangular, mid-lobe 3-nerved and the lateral lobes 2-nerved; awns 6-9 (median) and 5-6.5 (laterals) mm long (including lobes); callus c. 0.3 mm long; lodicules 0.4-0.5 mm long. *Palea* 2.2-2.5 mm long, slightly longer than body of lemma, narrowly oblong and truncate, notched or entire, coriaceous in the lower 4/5 and abruptly membranous to hyaline above, sparsely pubescent between keels; keels smooth and obtuse in the lower coriaceous part of palea, acute and scaberulous above, excurrent as minute mucros; flaps narrow, with hyaline edges. *Anthers* 2.3-2.8 mm long, purple. *Caryopsis* not seen.

The species is known from the Mitchell Plateau in the north Kimberleys of Western Australia, usually associated with damp habitats and laterite.

Plectrachne mollis has the two-textured palea of *P. pungens* (R. Br.) C. E. Hubb. and *P. schinzii* Henr., but is otherwise quite dissimilar, having a slender, compact habit, smaller spikelet with only one hermaphrodite floret, and no articulation between lobes and body of its lemma. A noteworthy feature of similarity in the 3 species is the presence of a transverse calloused ridge on the inner surface of the lemma at the base of the lobes. The feature, which appears to develop with maturity of the spikelet, is recorded for *P. pungens* by Hubbard (1939), who referred plants possessing the character to var. *callosum*.

By nature of their slender habit, especially the filiform scarcely pungent leaves, plants of *P. mollis* are soft in aspect in comparison with the tough, xerophytic facies of many "spinifex" species.

Paratypes
Western Australia: Northern Province: *Kenneally* 7954, 25.i.82, weather station, 29 km N of mining camp, Mitchell Plateau, 14° 34′10″S, 125° 48′10″E (CANB, PERTH). *Beard* 8380, 23.ii.79, Mitchell River Falls, Mitchell Plateau, 14° 49′S, 125° 40′E (CANB, PERTH). *Fryxell & Craven* 4042, 10.v.83, Mitchell Plateau, 29 km N of mining camp, 14° 35′S, 125° 47′E (CANB). *Fryxell & Craven* 4047, 11.v.83, Mitchell Plateau, 20 km SE of mining camp, 14° 56′S, 125° 58′E (CANB).

The following specimens are sterile, but almost certainly belong to *P. mollis*:-
Western Australia: Northern Province: *Kenneally* 4785, 13.vi.76, Airport swamp, Mitchell Plateau, 125° 48′E, 14° 47′S (CANB, PERTH). *Kenneally* s.n., 15.v.78, ibid (CANB, PERTH).

Plectrachne uniaristata Lazarides, sp. nov. (Figure 2c, d)

Gramen perenne non-resinaceum; spicula quadriflora; glumae bilobatae, uniaristatae; flosculi similares, sursum gradatim parviores, glumis inclusi; lemmata bilobata, uniaristata, indimidio infero margines et costam ciliata; arista acute curva vel recurva; palea quam corpore lemmatis leviter longior, glabra, carinis anguste alatis.

Typus : Northern Territory: Darwin & Gulf District: *Lazarides* 7764, 17.ii.73, c. 28 miles SE of Oenpelli Mission, 133° 25′E, 12° 29′S (holo: CANB; iso: BRI, DNA, K, L, PERTH, US).

Erect non-resinous *perennial*; vegetative tussocks 30-45 cm high; flowering culms 0.90-1.20 cm high. *Culms* c. 4-noded, terete, branched near base, minutely scaberulous. *Leaves* densely scaberulous, glabrous. *Sheaths* with rounded auricles minutely ciliolate on the edges. Blades <40 cm long, filiform, finely pungent, scabrous on the upper surface; ligule c. 1 mm long. *Panicle* <30 x <5 cm, loose; axis and divisions strongly ribbed and scabrous; primary branches <11 cm long, naked in the lower 5-8 mm; pedicels 3 mm (laterals) and 15 mm (terminals) long. *Spikelets* c. 5 mm long (excluding awns), narrow, 4-flowered, florets (excluding awns) enclosed by glumes. *Glumes* 5-6 mm long (including awn), membranous to cartilaginous, obscurely 3-5-nerved, with 2 apical muticous acuminate lobes c. 0.5 mm long and aristulate from sinus; lower densely scaberulous, the awn 0.6-0.8 mm long; upper scaberulous upwards, awn c. 1.5 mm long. *Lowest lemma* 5-5.5 mm long (including callus and lobes), ciliate in the lower ½ on margins and midnerve, minutely scaberulous towards apex, with 2 apical acuminate muticous lobes c. 1 mm long and awned from sinus; awn c. 13 mm long, flattened in the lower part, scaberulous, sharply curved or recurved; callus c. 0.3 mm long, with glabrous subobtuse tip and oblique articulation. *Palea* slightly longer than body of lemma, membranous, linear-oblong, glabrous, with entire scaberulous apex; keels scaberulous, narrowly winged in the lower part. *Anthers* c. 1.8 mm long. *Caryopsis* not seen. *Rhachilla* compressed, smooth, slender, internodes c. 1 mm long. *Upper florets* similar to the lowest, gradually smaller upwards.

Only the type collection known of the species.

Unlike any other species in the genus except *Plectrachne contorta*, all the lemmas in the spikelet are 1-awned. On comparison with *P. contorta*, there are marked differences in the morphology and indumentum of the spikelets, and in the habit of their plants.

Plectrachne bynoei C. E. Hubb., Kew Bull. Misc. Inf. no.3, 30 (1941); Gardner, Fl. W. Aust. 1 (1): 83 (1952); Lazarides, J. Roy. Soc. W. Aust. 44 (3): 81 (1961). *Type* : Western Australia: Northern Province: North-west coast, *Bynoe* s.n. (holo: K, fragment in PERTH).

Viscid aromatic *perennial*; vegetative tussocks 30-45 cm high, 15-90 cm wide, forming clumps 1.5-1.8(-2.5) m wide; flowering culms 0.90-1.65 m high. *Culms* terete or slightly compressed, c. 4-noded, smooth or minutely scaberulous, branched near base. *Leaves* resinous especially on sheaths and lower part of blades. *Sheaths* ciliate on the outer margin with straight or crimped woolly hairs, bearded at mouth with stiff silvery hairs <7 mm long. *Blades* <45 cm long, scabrous-mealy on the upper surface, sparsely scabrid-prickly along edges, hairy near ligule or glabrous, flexuose, usually flattened and glaucous when young, soon tightly conduplicate and shiny-green; ligule c. 1 mm long; collar glabrous or partly ciliate. *Panicle* usually 30-51 x 4-5 cm, loose to rather dense, the spikelets biseriate, secund and contiguous to approximate on numerous simple solitary branches (racemes) <11 cm long; axis and divisions densely scabrous, purplish when young; axis ribbed, grooved, more or less pubescent in axils; branches and pedicels acutely triquetrous; pedicels 0.9-2 mm long. *Spikelets* 4-8 mm long (excluding awns), loosely 4-6-flowered, usually the lower 2 florets hermaphrodite and the remainder neuter and reduced. *Glumes* membranous, acuminate, entire or notched, cuspidulate to aristulate (<1.4 mm long), scaberulous or smooth; lower 4.4-9.5 mm long, 1-nerved; upper 3.3-7 mm long, 3-nerved with the laterals often faint. *Rhachilla* compressed, scaberulous on edges or smooth, c. 0.2 mm long between lower and upper glumes, c. 0.3 mm long between upper glume and callus; internodes between the fertile florets 0.8-1.5 mm long, slender, with cupular oblique articulation. *Lowest lemma* 1.6-2.3 mm long (body and callus), membranous, 3-lobed, 1-awned or unequally 3-awned, faintly 3-5-nerved (laterals submarginal), sparsely and irregularly hairy in the lower ½-¾, scaberulous above; median lobe and awn 4.5-7 mm long; lateral lobes awnless and 1.2-1.5 mm long, or awned and 2.5-3.8 mm long; awns flattened, scabrous along edges, purplish when young. *Callus* 0.1-0.2 mm long, oblique, bearded with glabrous obtuse tip. *Palea* 2.4-3 mm long, membranous, narrowly oblong, truncate or obtuse, notched, sparsely hairy between keels in c. the lower ½, scaberulous on keels upwards, flaps with hyaline margins. *Lodicules* 0.2-0.3 mm long, membranous. *Anthers* 1-1.7 mm long, often purplish. *Caryopsis* c. 1.5 mm long, oblanceolate, obtuse, acuminate at base, slightly compressed dorsally, somewhat flattened on the hilar face, brown; embryo c. 0.6 mm long, basal, obovate. *Second lemma* always 3-awned, otherwise similar to the lowest one, the median lobe and awn 5-6 mm long, the lateral lobes and awns 3.8-4.8 mm long. *Upper lemmas* reduced usually to the awns. (Figure 4d-h).

The above description, derived from the material cited, emends the original one based entirely on the holotype, which I consider to be an ecotypic variant. In its original sense, *Plectrachne bynoei* is characterized by the absence of lateral awns on the basal lemma (unlike the 3-awned condition of the remaining lemmas in the spikelet) and by the large glumes of the spikelet relative to the florets. This combination of features represents the exceptional state in the morphological variation in evidence. In the material studied, plants with considerably smaller spikelets and with the lemmas all 3-awned clearly predominate over those resembling the holotype or intermediate in the range of variation.

The species is the dominant grass over extensive areas of rugged mountain ranges of outcropping sandstone and quartz in the Kimberleys, Western Australia, and adjacent parts of the Northern Territory. In the field the large, spreading clumps with their numerous, tall flowering culms and curling highly resinous, shining green leaves present a striking feature in habit.

Specimens examined. WESTERN AUSTRALIA: Northern Province: *Beauglehole* 51894, 2.vi.76, King Edward River, Mitchell Plateau road, c. 200 km W of Wyndham (CANB). *Burbidge* 5137, 14.iv.56, Martin's Gap, E of Ord River (CANB). *Dunlop* 5240, 22.ii.80, Mitchell River, 14° 50′S, 125° 42′E (BRI, CANB, DNA, NSW, NT, PERTH). *Dunlop* 5558, 23.ii.80, Mitchell Falls, Mitchell River, 14° 50′S, 125° 42′E (BRI, CANB, DNA, PERTH). *Hopkins* BA0051 & BA0086, and *Kenneally* 8284, 11.vi.82, Sunday Island, Buccaneer Archipelago, 16° 25′S, 123° 11′E (PERTH). *Hopkins* BA0113, Long Island, Buccaneer Archipelago, 16° 34′S, 123° 22′E (PERTH). *Hopkins* BA0406, 23.vi.82, Irvine Island, Buccaneer Archipelago, 16° 05′S, 123° 32′E (PERTH). *Kenneally* 6753, 20.v.78, SE of Amax campsite on Theda Station road, 14° 56′S, 125° 57′E (CANB, PERTH). *Kenneally* 6805, 22.v.78, Mitchell Plateau, 14° 49′S, 125° 46′E (CANB, PERTH). *Kenneally* 7021, 5.ii.79, Mitchell Plateau, 14° 47′S, 125° 48′E (CANB, PERTH). *Kenneally* 7655, 24.vi.82, Deep Water Point, Dampier Peninsula, 16° 40′S, 123° 05′E (CANB, PERTH). *Kenneally* 7790 & 7791, 19.i.82, approx. 30 km NW of Mitchell River Mine, 14° 35′S, 125° 43′30″E (CANB, PERTH). *Kenneally* 7899, 22.i.82, Mitchell River Falls, 14° 49′20″S, 125° 41′40″E (CANB, PERTH). *Kenneally* 8012 & 8012B, 28.i.82, Kelly's Knob, 1 km N of Kununurra, 15° 46′S, 128° 30′E (PERTH). *Kenneally* 8323, 14.vi.82, Lachlan Island, Buccaneer Archipelago, 16° 38′S, 123° 29′E (PERTH). *Kenneally* 8412, 20.vi.82, Hidden Island, Buccaneer Archipelago, 16° 15′S, 123° 29′E (PERTH). *Kenneally* 8426, 21.vi.82, & 8449, 22.vi.82, Gibbings Island, Buccaneer Archipelago, 16° 09′S, 123° 31′E (PERTH). *Langfield* 206, 14.ii.56, Deception Ranges (CANB, PERTH). *Lazarides* 2945, 10.vii.52, Thompson's Springs, 42 mi SE of Kimberley Research Station (BRI, CANB, K, PERTH). *Lazarides* 6595A, 6.x.59, 6 mi S of Oobagooma Station (CANB). *Lazarides* 6716, 3.iii.63, Carr Boyd Range, 40 mi SE of Kununurra (BRI, CANB, K, L, MEL, NSW, PERTH, US). *Lazarides* 6722, ibid (CANB, K, NSW, PERTH). *Lazarides* 6725, ibid (AD, B, CANB, K, MEL, P). *Lazarides* 8516, 12.iii.78, Carr Boyd Range, 20 km ENE of Dunham River homestead (CANB). *Pen* 11, 27.vi.82, Sir Frederick Island, Buccaneer Archipelago, 16° 07′S, 123° 24′E (PERTH). *Petheram* 570, 18.iii.80, 1 km S of Dunham River bridge, Kununurra, 16° 09′S, 128° 22′E (CANB, NT, PERTH). *Roberts* s.n., 1.ii.61, Ord River (PERTH).

NORTHERN TERRITORY: Victoria River District: *Dunlop* 5715, 23.iii.81, Keep River National Park, 15° 46′S, 129° 06′E (BRI, CANB, DNA, NT, PERTH). *Dunlop* 5794, 27.ii.81, Wandjina Rock, Keep River National Park, 15° 49′S, 129° 06′E (DNA, MEL, NSW). *King* 92, 23.iv.82, Keep River National Park, 15° 49′S, 129° 03′E (CANB). *King* 151, ibid, 15° 47′S, 129° 05′E (CANB). *King* 152, 25.iv.82, ibid, 15° 49′S, 129° 04′E (CANB). *Lazarides* 2982, 21.vii.52, 65 mi ENE of Carlton homestead (CANB, NT, PERTH). *Lazarides* 2991, 22.vii.52, 56 mi E of Carlton homestead (BRI, CANB, K, NSW, NT, PERTH, US). *Lazarides* 2996, 22.vii.52, 80 mi SE of Carlton homestead (AD, BRI, CANB, K, MEL, NSW, NT, PERTH, US). *Perry* 2619, 27.vii.49, near Alligator Springs, 70 mi E of Carlton Station (BRI, CANB, K, MEL, NSW, PERTH).

Oxychloris (Chloridoideae, Chlorideae) Lazarides, gen. nov.

Distinguitur spicula 4-6-floribus, flore basali hermaphrodito et ceteris neutris, callo elongato pungenti, et flosculorum sterilium lemmatibus late alatis 5-7-nervibus.

Typus: *Oxychloris scariosa* (F. Muell.) Lazarides *(Chloris scariosa* F. Muell.)

Annual or *short-lived perennial*; culms compressed or terete, ribbed, usually simple and 5-7-noded; *leaves* often tubercled; blades narrow, flat or convolute, with tubercle-based prickle-like hairs along the thickened margins; ligule a small ciliolate membrane. *Inflorescence* of 3-6 digitate shortly peduncled, appressed or divergent spikes; rhachides triquetrous, scabrous-pilose or (the peduncles) with simple and tubercle-based hairs. *Spikelet* 4-6-flowered, falling as a whole; basal floret hermaphrodite; the remainder neuter, without paleas, clustered on a very short rhachilla, separated from the fertile floret by a thickened elongated internode. *Glumes* unequal, membranous, 1-nerved, keeled, glabrous, the upper 2-lobed, the lower entire. *Fertile floret* smaller than the sterile ones; *lemma* cartilaginous to indurated, with broad scarious or membranous margins, 2-toothed, strongly convex on the back, 3-nerved, with tufts of hairs near apex on the lateral nerves and in the lower part near midnerve, the midnerve ribbed and prolonged into a scabrous awn arising from the back of the apex, and the lateral nerves submarginal. *Palea* as long as its lemma, membranous, acute, notched, muticous, ciliolate on apex and keels otherwise glabrous; keels slightly shorter than the palea itself, narrowly winged upwards. *Callus* elongated, continuous with the rhachilla, pungent, straight or curved, compressed, densely pubescent except for a glabrous tip and a narrow median line on the front and back. *Anthers* 3; *stigmas* plumose, purple, exserted near apex of floret. *Caryopsis* obovate, trigonous, concave on the hilar face, convex on the back; hilum basal, linear or elliptic; embryo ½-¾ as long as the grain itself. *Sterile florets: lemmas* expanded and wing-like, membranous or scarious, 5(-7)-nerved, glabrous, 2-toothed, awned from the back of the apex, gradually smaller upwards.

Species 1, in Australia between 14th and 30th parallels; adventive in Switzerland.

Oxychloris scariosa (F. Muell.) Lazarides, comb. nov. Based on *Chloris scariosa* F. Muell., Fragm. Phyt. Aust. 6: 85 (1867); Benth., Fl. Aust. 7: 614 (1878); Bailey, Queensland Fl. 6: 1896 (1902); Domin, Biblioth. Bot. 20 (85): 370 (1915); Ewart & Davies, Fl. Northern Territory 45 (1917); Black, Fl. S. Aust., 2nd edit., pt. 1, 132 (1943); Gardner, Fl. Western Aust. 1 (1): 220 (1952); Lazarides, Grasses of Central Aust. 87 (1970); Lazarides, Aust. J. Bot., Suppl. Ser., no. 5, 22 (1972); Anderson, Brigham Young Univ. Sc. Bull., Biol. Ser., 19 (2): 40 (1974); Black (revis. Jessop), Fl. S. Aust. pt. 1, 3rd edit., 204 (1978); Lazarides in Jessop, Fl. Central Aust. 465 (1981); Cunningham et al., Plants of Western N.S. Wales 75 (1981); Wheeler et al., Grasses of N.S. Wales 141 (1982). *Type*: Western Australia: Eremean Province; Sturt's Creek, *Gregory* s.n. (holo: MEL; iso: K).
Chloris ?scariosa P. Beauv., Ess. Agrost. 79, 158 (1812), nomen nudum.
"Sect. vel. subgen. (nov.), *Hackelochloris*" Thellung, Vjschr. naturf. Ges. Zurich 64: 707 (1919).

Annual or *short-lived perennial* 15-47 cm high. *Culms* (3-)5-7-noded, glabrous. *Leaves* strongly nerved, often glaucous; sheaths much shorter than culm internodes; blades $<$16 cm x $<$3.5 mm, finely acuminate, scabrous or pilose (especially on upper surface) with simple and tubercle-based hairs or tubercled only; ligule c. 0.5 mm long. *Spikes* 1.8-4.5(-6) mm long. *Glumes* scaberulous on nerve or smooth, often purple; lower 3-5 mm long, narrowly elliptic, obtuse; upper 5-8 mm long, oblanceolate or oblanceolate-elliptic, truncate. *Fertile floret: callus* 2.5-3 mm long; *lemma* 3.3-5 mm long, obovate, bearded near apex with white hairs $<$1.5 mm long, often purple or brown; awn 5.5-8 mm long; *palea elliptic* or obovate, sometimes sparsely scabrous between keels; *caryopsis* 1.3-2 x c. 1 mm, brown; *anthers* 0.8-1 mm long. *Sterile florets*: *lemmas* usually 3-4 mm long, orbicular-elliptic to broadly elliptic, often yellowish-green when young and brown when mature; *awn* (3-4)4-7 mm long. *Rhachilla-internode* between fertile and sterile florets 1-1.5 mm long, flattened or grooved along one side, with a basal tuft of hairs otherwise glabrous. (Figure 1a, b).

Distributed in all mainland States except Victoria; predominant in arid and lower rainfall areas of the Northern Territory and Queensland, often in saline soils.

The characteristic features of *Chloris scariosa* are well known and its segregation to generic rank has been considered previously by Clayton (1967), Lazarides (1972) and Anderson (1974). After continued research on generic boundaries within the tribe, I am elevating the taxon on the basis of its elongated, pungent callus, a unique feature within the subfamily Chloridoideae, and its 4-6-flowered, winged spikelet, which more closely resembles the spikelet of *Tetrapogon* Desf. than that of *Chloris* Sw. A species of arid regions and hard soils, these features are seen as evolutionary adaptations to aid germination and dispersal.

Specimens examined. QUEENSLAND: Cook District: *Brass* 1710, ii.27, Gilbert River (CANB, K). *Brass* 1790, 8.ii.31, Forest Home Station (CANB, K). *Domin* s.n., II.1910, Metal Mtns, Chillagoe (PR, ex K). *Lazarides* 4173, 26.ii.54, 4 mi N of Lynd Station (CANB). North Kennedy District: *Lazarides* 7145, 4.iv.65, Lansdown Pasture Research Station, 35 mi S of Townsville (CANB, K). Burke District: *Hubbard* & *Winders* 7610, 14.ii.31, Chudleigh Park Station, 110 mi N of Hughenden (BRI, CANB, K). *Lazarides* 4248, 3.iv.54, Norman River, near Normanton (AD, BRI, CANB, K, MEL, NSW, NT, PERTH, US). *Purdie* 2180, 24.ix.81, c. 10 km NE of Hughenden, 20° 48′S, 144° 17′E (CANB). *Winders* 7436, 9.ii.31, Mt Isa (BRI, CANB, K). South Kennedy District: *Adams* 1076, 14.vii.64, 6 mi E of Pasha Station (BRI, CANB, K). Pt Curtis District: *Bowman* s.n., Gracemere (BR, K). Warrego District: *Allen* 87, 6.iii.42, "South Glen" E of Cunnamulla (CANB). *Blake* 5464, 23.iv.34, Earlstoun Station, between Quilpie and Windorah (BRI, CANB). *Key* & *Chinnik* 7230, 2.v.57, 20 mi NNE of Charleville (CANB). *Purdie* & *Boyland* 167, 25.iii.76, 51 km N or Charleville, 26° 01′S, 146° 27′E (BRI, CANB). *Rutledge* s.n., 2.v.49, Quilpie (BRI, CANB). Gregory North District: *Everist* 3264, 23.xi.47, Ardmore, c. 25 mi W of Dajarra (BRI, CANB). Maranoa District: *S.W.Q.S.* 1337, 10.iii.53, "Deiran" W of Bollon (CANB). District unknown: *Davies* s.n., v.39, Kalimoo, Carmoo (CANB).

NORTHERN TERRITORY: Darwin & Gulf District: *Perry* 1218, 3.vi.48, 60 mi N of Wollogorang Station (BRI, CANB, K, NT). *Perry* 1822, 30.vii.48, on coast 35 mi E of Borroloola (BRI, CANB, K, NT). Barkly Tableland: NT *(Chippendale)* 1068, 10.iii.55, 26 mi S of Elliott (CANB, NT). *Perry* 195, 4.vii.47, 0.5 mi E of Muckety Homestead (CANB, K). *Perry* 551, 24.iv.48, 8 mi N of Tennant Creek township (BRI, CANB, K, NT). Victoria River District: NT *(Chippendale)* 5698, 3.iv.59, 66.9 mi NE of Tanami(CANB, NT, PERTH).

CENTRAL AUSTRALIA: *Burbidge* & *Gray* 4194, 19.ix.55, E of Undoolya Gap (CANB). *Burbidge* & *Gray* 4216, 20.ix.55, on Stuart Highway approx. 30 mi N of Alice Springs (CANB). *Carr* 1684 (& *Beauglehole* 45463), 12.vi.74, c. 138 km W of Alice Springs (CANB). *Cleland* 349, 9.viii.31, Burt's Well (K). *Cleland* s.n., 12.viii.32, Mt Liebig (K). *Cleland* s.n., 23.viii.36, Pine Hill Station (K). *Gardner* s.n., i.53, Burt Plain (PERTH). *Gardner* 11636, 13.iii.53, Hamilton Downs (PERTH). *Lazarides* 5280, 13.v.55, 14 mi NNW of Alice Springs (CANB). *Maconochie* 64 (NT 12166), 7.iv.67, on Yuendemu road 23 mi W of Stuart Highway (CANB, NT). *Martin* 14 (NT 11937), ii.66, Mt Denison Station (CANB, NT). *Nelson* 655, 21.iii.63, McGrath Flat, 29 mi N of Alice Spring (CANB, NT). *Nelson* 809, 9.vii.63, ibid (CANB, NT). *Nelson* 904, 15.i.64, ibid (CANB, NT). *Nelson* 1624, 6.ii.68, Burt Plain, 34 mi N of Alice Springs (CANB, NT, PERTH). *Nelson* 1839, 27.i.69, Stuart Highway, 32 mi N of Alice Springs (CANB, NT). *Nelson* 1873, 28.iii.69, McGrath Flat, 29 mi N of Alice Springs (CANB, NT). NT *(Chippendale)* 439, 9.xi.54, 1 mile E of Undoolya Gap (CANB, NT). NT *(Chippendale)* 2941, 18.ix.56, 1.5 mi W of no. 18 bore, Sandover S.R. (CANB, NT). NT *(Chippendale)* 4121, 26.iii.58, 13 mi WNW of Ambalindum (CANB, NT, PERTH). NT *(Chippendale)* 9017, 24.v.62, 31 mi N of Alice Springs (CANB, NT). *Perry* 3368, 10.iii.53, 5 mi S of Yambah Station (BRI, CANB, K, NSW, NT, US). *Pullen* 10.526, 29.iii.77, c. 13 km SSW of Alice Springs, 23° 49'S, 133° 51'E (BRI, CANB, K, PERTH, WIR). *Schomburgk* s.n., Central Australia (W). *Swinbourne* 596 (NT 9795), 16.xi.62, 31 mi N of Alice Springs (CANB, NT). *Winkworth* 225, 29.iv.54, 22 mi W of Bond Springs (CANB). *Winkworth* 808, 8.xi.54, 6 mi NW of Alcoota (CANB).

SOUTH AUSTRALIA: North East: *Gosse* 173, without precise locality (K).

WESTERN AUSTRALIA: Eremean Province: *H.S. King* s.n., 1885, between Gascoyne and Fortescue Rivers (K, PERTH). *O'Flaherty* s.n., Balgo Hills (PERTH). Northern Province: *Gardner* 10176, 10.v.51, Moola Bulla (PERTH).

Arthragrostis (Paniceae, Panicinae) Lazarides, gen. nov.

Distinguitur praesentia articuli constricti in axillis omnium ramorum et pedicellorum paniculae, flosculo fertili stipitato cum articulo ad basim stipitis, rhachillae internodio producto inter glumam inferam et superam, gluma infera late ovata involventi basim spiculae, gluma supera lemmate infero inaequali ambobus plerumque cuspidatis.

Typus: *A. deschampsioides* (Domin) Lazarides (*Panicum deschampsioides* Domin).

Annual; culms simple or sparsely branched, few-noded; blades linear, flat; ligule a ciliate membrane. *Inflorescence* a contracted loose panicle, the spikelets solitary and long-pedicelled on primary and secondary branches; the spikelets at their base, and the pedicels and branches in their axils, all with a deeply constricted articulation, disarticulating at maturity and leaving only the naked axis; primary panicle branches 1-nate or the lowest group semi-whorled, divided, rather distant on axis; pedicels with a cupuliform apex. *Spikelet* 2-flowered, lower neuter, upper hermaphrodite. *Glumes* unequal, membranous, strongly many-nerved, separated at their points of attachment on rhachilla; lower c. ½ as long as spikelet, enclosing base of spikelet, muticous to aristulate; upper slightly or distinctly shorter than spikelet, long-acuminate, cuspidate to awned. *Lower lemma* determining the shape and size of the spikelet, membranous, strongly many-nerved, long-acuminate, cuspidate to awned, without floret or palea. *Fertile (upper) floret* almost ½ as long as spikelet, indurated or crustaceous, elliptic, muticous, smooth, glossy, borne on a slender stipe, disarticulating with or without its stipe. *Upper lemma* oblong or elliptic, obtuse to subacute, truncate at base, obtusely convex on the back, faintly 5-7-nerved, with incurved margins. *Palea* similar to lemma in length and shape, flattened, faintly 2-nerved (but not 2-keeled), with incurved margins which widen abruptly near the base. *Anthers* 3, c. 1 mm long, exserted terminally. *Stigmas* plumose, purple; styles free. *Lodicules* c. 0.2 mm long, firm, cuneate, with notched apex. *Caryopsis* dorsally compressed, biconvex in profile; embryo c. ½ as long as the grain itself and almost as wide; hilum in basal 1/3 of grain, circular.

Species 1, Australia.

Arthragrostis deschampsioides (Domin) Lazarides, comb. nov. Based on *Panicum deschampsioides* Domin, Biblioth. Bot. 20(85): 320 (1915). *Type*: Queensland: North Kennedy District: *Domin* 1208, II.1910, Castle Hill, Townsville (holo: PR).

Slender flaccid *annual* 17-50 cm high. *Culms* terete or compressed, striate to ribbed or grooved, c. 4-noded, glabrous, smooth. *Leaves* thin, hispid to hirsute with tubercle-based or simple hairs, usually also a few longer stiff hairs 3-4.5 mm long on margins of blade near ligule, with numerous ribbed or prominent nerves. *Sheaths* shorter than culm internodes, loose, especially the upper ones sometimes partly glabrous and smooth. *Blades* < 9 cm x < 2.8 mm, firmly pointed, with thickened white scabrous margins; ligule 0.5-0.8 mm long; collar not demarcated. *Panicle* < 25 x 2-5 cm; axis upwards and all divisions triquetrous or compressed, densely scabrous, filiform; primary branches < 12 cm long; pedicels 8-25 mm long. *Spikelets* 4-5 x 1-1.5 mm. *Lower glume* 2-4 mm long (including awn), ovate, obtuse to subacute, 7-nerved, scabrous especially on nerves and margins and on the inner surface towards apex, attached 0.3-0.4 mm below the upper glume. *Upper glume* 3-6.3 mm long (including awn), with 9-11 ribbed nerves, lanceolate, scabrous on back and in the upper part on the inner surface. *Lower lemma* 3.8-7.5 mm long (including awn), narrowly lanceolate, 9-nerved, glabrous and smooth on back, scaberulous on margins, sparsely hairy in the upper part on the inner surface. *Fertile floret* 1.5-1.7 mm long, striolate, stipe c. 0.3 mm long. *Caryopsis* 1.2-1.4 x 0.7 mm, elliptic to slightly obovate, obtuse, pallid, smooth. (Figure 1e-g).

Apparently restricted in distribution, the species is represented by collections from the North Kennedy and Cook Districts of Queensland.

Panicum deschampsioides is segregated as a new genus on the basis of a number of distinctive morphological features. Its diagnostic character, the absolute disarticulation of the panicle into component divisions, appears to be unique within the Tribe. However, partial disarticulation in the inflorescence does occur in monotypic, Australian endemic genera (*Paractaenum* P. Beauv., *Plagiosetum* Benth., *Pseudochaetochloa* Hitchc., *Uranthoecium* Stapf), and elsewhere in the Paniceae (*Stenotaphrum* Trin., *Pennisetum* L. C. Rich.).

In *Paractaenum, Pseudochaetochloa, Pennisetum* and *Plagiosetum,* each raceme disarticulates from the common axis of a racemose or spiciform panicle. In each case the raceme, containing one to many spikelets subtended by one to several bristles or bristle-like branchlets, falls as a whole. In *Uranthoecium,* the axis is jointed and breaks up into individual segments containing a short spike of few spikelets. Similarly in *Stenotaphrum,* the thickened axis with imbedded spikelets breaks at joints into segments of individual spikelets or short racemes. Sometimes the inflorescence is shed as a whole. With the exception of this feature, these genera bear little morphological resemblance to *Arthragrostis* and no close relationship.

Supporting generic characters of *Arthragrostis* include the stipitate fertile floret, the distinct rhachilla-internode between lower and upper glumes, the broad enveloping lower glume, and the unequal usually cuspidate upper glume and lower lemma. As well as the articulation at the base of the spikelet, which is a tribal feature, the fertile floret disarticulates above and below its stipe.

The generic significance of a number of these features is discussed by Lazarides & Webster (1984) in segregating a new genus from *Panicum* L. and *Ichnanthus* P. Beauv. Also, to a greater or lesser degree the features characterize genera allied to *Panicum,* such as *Brachiaria* (Trin.) Griseb., *Paspalidium* Stapf, *Ottochloa* Dandy, *Oplismenus* P. Beauv., *Ichnanthus* P. Beauv., and *Echinochloa* P. Beauv., rather than *Panicum* itself.

Surprisingly, Domin (l.c.) makes no reference to the articulated panicle. Also, the upper lemma is described as nerveless or 1-nerved, but five to seven can be observed with high magnification particularly on the inner surface. In conflict with Domin, I have not observed a palea in the lower floret, either in the holotype or in the slightly larger plant on the second sheet in Prague, (viz. Domin 1209), on which Domin comments in the protologue.

Specimens examined. QUEENSLAND: North Kennedy District: *Blake* 8159, 22.iii.35, Castle Hill, Townsville (topotype, BRI, K). *Blake* 11704, 11.vi.36, Charters Towers (BRI, CANB, L). *Blake* 14905, 4.iv.43, near Charters Towers (BRI). *Domin* 1209, details as for holotype (PR 524423). *Lazarides* 4659, 9.vii.54, 20 miles W of Greenvale Station (CANB). Cook District: *Blake* 13491, 28.iii.38, E of Dimbulah, 17° 0-′, 145° 0-′ (BRI). *Goodall* 66, 20.iv.61, Mount Spider, 17° 0-′, 145° 2-′ (BRI). *Goodall* s.n., 30.iv.61, headwaters of Murphy's Creek, 17° —′, 145° —′ (BRI). *Lazarides* 4212, 27.ii.54, 43 miles SSW of Mt Garnet township (AD, BRI, CANB, K, MEL, NSW, NT, PERTH, US). *Simon & Clarkson* 3598, 10.iii.80, 4 km from Almaden on Petford road, 17° 22′, 144° 42′ (BRI, CANB).

Heteropholis (Andropogoneae, Rottboelliinae, Rottboelliastrae) C. E. Hubb. in Hook., Ic. Plant. 6(2) 5th Ser. or 36 Tab. 3548 (1956); Pilger in Engl. & Prantl, Naturl. Pflanzenfam., 2nd. Ed., 14d : 206 (1956); Bor, Grasses of Burma, Ceylon, India and Pakistan 162 (1960); Jacques-Felix, Graminees D'Afrique Tropicale 282 (1962); Clayton, Kew Bull. 35(4): 813 (1981); Clayton & Renvoize in Polhill, Fl. Trop. East Africa, Gramineae (Part 3): 849 (1982); Koning et al., Gard. Bull. Singapore 36(1): 137 (1983). *Type species*: *H. sulcata* (Stapf) C. E. Hubb. (*Peltophorus sulcatus* Stapf).

Perennials or (in Australia) *annual*; culms slender or very stout, branched, few-many-noded; blades linear to lanceolate, flat; ligule membranous. *Inflorescence* of solitary, spiciform, spatheate racemes terminal on culms and branches. *Racemes* slightly compressed, finally exserted from spathe; rhachis jointed, breaking up into thickened segments containing the imbedded sessile spikelet and the fused pedicel of the adjacent pedicelled spikelet, each segment with a cupuliform apex and a basal peg for attachment to the adjacent segments. *Spikelets* secund, awnless, in pairs and dissimilar, one of the pair sessile, the other pedicelled or absent. *Florets* 2, lower staminate or neuter, upper (in the sessile spikelet) hermaphrodite and (in the pedicelled spikelet) staminate or neuter or absent. *Sessile spikelet* dorsally compressed; callus very short, truncate, glabrous, with a thickened rim. *Glumes* dissimilar, as long as spikelet, glabrous, 2-keeled, keels usually winged or thickened near apex. *Lower glume* thickened, coriaceous to indurated, variously sculptured or pitted, slightly convex, obtuse, 7-11-nerved, with inflexed rigid margins. *Upper glume* cymbiform, keeled or rounded on back, chartaceous or crustaceous except for narrow hyaline margins, subacute to obtuse, 3-7-nerved. *Lower lemma* almost as long as glumes, elliptic-oblong, obtuse, thinly membranous to hyaline, 2-nerved near margins; palea as long as lemma or shorter or absent. *Upper lemma* similar to lower in length, shape and texture, 2-3-nerved; palea as long as lemma or shorter, hyaline, 2-nerved or nerveless. *Lodicules* 2, broadly cuneate-oblong, truncate, glabrous. *Stamens* 3; anthers linear-oblong. *Ovary* glabrous; styles free, filiform; stigmas plumose, purple, laterally exserted. *Caryopsis* dorsally compressed, oblong, obtuse; embryo c. 2/3 as long as the grain itself; hilum basal, rotund. *Pedicelled spikelet* as long as the sessile or longer, disarticulating from its pedicel, oblong, glabrous. *Glumes* equal or unequal, coriaceous or herbaceous, smooth. *Lower glume* oblong, strongly asymmetrical with one margin narrow and acutely inflexed; other margin broad slightly concave, keeled, the keel narrowly winged and 5-9-nerved. *Upper glume* cymbiform, with a 3-5-nerved winged keel, or more or less reduced. *Lemmas* and *paleas* similar to those of the sessile spikelet, or absent.

Heteropholis, which is a new record for Australia, also contains *H. sulcata* (Stapf) C. E. Hubb. from East Africa, *H. nigrescens* (Thw.) C. E. Hubb. from Sri Lanka, *H. benoistii* A. Camus from Madagascar, and *H. cochinchinensis* (Lour.) Clayton vars. *cochinchinensis* and *chenii* (Hsu) Sosef & Koning, which are distributed from India and southern China through Southeast Asia to Malesia.

As the key shows, *Heteropholis* appears to be closely allied to *Hackelochloa* Kuntze and *Manisuris* L., but differs from the former by the morphology of both sessile and pedicelled spikelets, and from the latter genus by the mode of disarticulation of the pedicelled spikelet and by the morphology of the lower glume of the sessile spikelet. However, in *Heteropholis* the pedicelled spikelet is sometimes reduced or absent and, as indicated by Clayton (l.c.) and Koning et al. (l.c.), generic boundaries within the group are not clearly defined.

Key to *Heteropholis* and allied genera

1\. Spikelets solitary (by suppression) and sessile or subsessile; pedicelled spikelet (if present) rudimentary or reduced to the pedicel; pedicel fused to internodes of rhachis .... *Thaumastochloa, Ophiuros, Eremochloa*

1\. Spikelets in pairs with one of the pair sessile and the other pedicelled or sometimes (in *Heteropholis)* absent.

  2\. Pedicel of the pedicelled spikelet free of internodes of rhachis ...... *Coelorachis, Elionurus*

  2\. Pedicel fused to internodes of rhachis.

    3\. Spikelets of each pair similar in form and sex; rhachis tough or tardily disarticulating .... *Hemarthria*

    3\. Spikelets (all or mostly all) dissimilar in form and sex; rhachis readily disarticulating at the joints.

      4\. Spikelets pseudo-opposite on a cylindrical rhachis; pairs of spikelets in upper part of raceme similar; lower glume of sessile spikelet smooth or roughened by papillae, but not sculptured .... *Rottboellia*

      4\. Spikelets secund on a compressed or flattened rhachis; all pairs of spikelets dissimilar (sometimes the terminal pair similar in *Hackelochloa);* lower glume of sessile spikelet variously sculptured.

        5\. Pedicelled spikelet adnate by its base to, and falling with, internode of rhachis; lower glume of sessile spikelet usually with awns or prominent wings; embryo as long as the grain itself .... *Manisuris*

        5\. Pedicelled spikelet (when present) disarticulating at its base and falling free of internode of rhachis; lower glume of sessile spikelet awnless, wingless or with small wings; embryo c. 2/3 as long as the grain itself.

          6\. Sessile spikelet globose or subglobose; the lower glume tessellately sculptured, wingless; lower glume of pedicelled spikelet symmetric .... *Hackelochloa*

          6\. Sessile spikelet compressed; the lower glume coarsely rugose or tessellate, with narrow apical wings; lower glume of pedicelled spikelet (when present) asymmetric in form and nervation .... *Heteropholis*

Heteropholis annua Lazarides, sp. nov. (Figures 1c-d, 7f)

Distinguitur habitu robusto annuo, facie glabra laevi, laminis cordatis amplexicaulibus latissimis tenuibus atroviridibus cum aculeis secus margines, spiculae sessilis gluma supera adnata infera rugosa.

Typus: Western Australia: Northern Province: *Kenneally* 8219, 3.v.1982, Gauging Station, Camp Creek, approx. 12 km SW of mining camp, Mitchell Plateau, 14° 53′10″S, 125° 45′05″E (holo: CANB; iso: BRI, DNA, K, L, PERTH, US).

Robust leafy *annual* <2 m. high, mostly glabrous and smooth on culms and leaves. *Culms* 5-10 mm diam., branched, cylindrical or the lower internodes compressed, many-noded, strongly striate and with a broad longitudinal groove along one side; internodes pithy; nodes glabrous; prop roots from lower nodes common. *Leaves* thinly herbaceous, dark-green, with many (c. 16) ribbed primary nerves and numerous secondary (thinner but prominent) nerves. *Sheaths* <2.5 cm wide (at widest part), loose on the culms, longer than the lower internodes and shorter than the upper ones, with subhyaline glabrous smooth margins. *Blades* <60 x <4.5 cm, lanceolate, flat, acuminate, cordate and amplexicaul, with stout prickles approximate to distant along the thickened margins; the prickles 0.5-0.8 mm long, antrorse, usually translucent, with a thickened base; midnerve ribbed on the lower surface towards the apex and forming a prominent acute wing-like ridge. *Ligule* 1-2 mm long, irregularly dentate, V-shaped; collar glabrous. *Racemes* 1-4 from the upper nodes, 5-7.3 cm long; peduncle widened upwards, strongly striate, glabrous, smooth; rhachis internodes thickened, indurated, strongly nerved. *Sessile spikelet: Lower glume* 4.5-5.5 mm long, as long as rhachis-internode and covering concavity containing the spikelet, indurated, obovate, truncate or broadly obtuse, obtuse at base, coarsely rugose especially near margins, somewhat glossy and faintly striolate, 11-nerved on the inner surface, with a deep transverse groove near base, the inflexed margins acute. *Upper glume* adnate to concavity in rhachis-internode except near the base, rounded on the back, broadly oblong or slightly wider upwards, obtuse with a minute subacute thickened mucro, thinly 3-nerved with the lateral nerves submarginal, crustaceous with hyaline flat inturned margins <0.5 mm wide, glabrous on the outer surface except for sparse pubescence on the basal free part, glabrous smooth and shiny on the inner surface. *Lower lemma* broadly elliptic or oblong, obtuse, hyaline, glabrous, smooth, the nerves thin. *Palea* absent. *Upper lemma* slightly shorter and narrower than lower lemma, broadly oblong, obtuse to subacute, glabrous, smooth, thinly or obscurely sub 2-3-nerved. *Palea* slightly shorter than its lemma and much narrower, flat, oblong, obtuse, glabrous, smooth, obscurely nerved in the lower part or nerveless. *Lodicules* c. 0.8 x 1 mm, cuneate, membranous or thinly cartilaginous to thickened, minutely crenate to more or less entire on apical edge. *Anthers* c. 2 mm long. *Caryopsis* c. 3.5 x 2 mm, elliptic-oblong, obtuse at apex and base, plano-convex in profile, thicker upwards, smooth; embryo as wide as the grain itself; hilum 0.8-1 mm long and almost as wide. *Pedicelled spikelet* longer than the sessile. *Lower glume* 7.5-8 mm long (<10 mm in terminal spikelet), lanceolate-oblong, obtuse, thickened and truncate at base, coriaceous to indurated, glabrous, asymmetrically 5- sub 7-nerved (nerves broad and flat), with a thickened keel along one margin. *Upper glume* c. 7 mm long and slightly shorter than lower, membranous to coriaceous with hyaline margins, sparsely ciliate on margins with short stiff hairs otherwise glabrous, asymmetrically nerved, with a prominent winged few-nerved acute keel. *Lower lemma* c. 5 mm long, lanceolate-oblong, obtuse, emarginate, membranous to hyaline, sparsely ciliate on apex and upwards on margins with short stiff hairs otherwise glabrous, smooth, with 2 submarginal nerves or obscurely 2- sub 3-nerved. *Palea* absent. *Floret* neuter. *Upper lemma* as long as the lower, similar in shape and texture, glabrous, 3-nerved. *Palea* c. 3.5 mm long, flat, lanceolate-oblong, acute, membranous to hyaline, nerveless, smooth. *Floret* staminate; anthers c. 3 mm long; filaments filiform, papillose.

At present, the species is known from only the two cited collections, which were growing on alluvial seasonally wet soils among massive sandstone outcrops.

Within *Heteropholis* the Australian species is distinctive by virtue of its stout, annual habit and the adnate upper glume of the sessile spikelet. On comparison with the other three species, it resembles the African *H. sulcata* which, however, is a rhizomatous, narrower-leaved often hirsute perennial with a different surface on the lower glume of the sessile spikelet.

Paratype

Western Australia: Northern Province; *Kenneally* 7128, 9.ii.79, 9 km SW of Amax Campsite, Mitchell Plateau, 14° 55′S, 125° 44′E (PERTH).

Micraira F. Muell. (Micrairoideae).

In a previous publication (Lazarides 1979), *Micraira* was expanded from its monotypic state to a genus of 8 species, and its circumscription was modified to include resulting new morphological data. The new species presented here conform to the revised circumscription.

With the exception of the original *M. subulifolia* F. Muell., which is confined to Queensland, all the species are distributed in a relatively small area of the Northern Territory and Western Australia. Characteristically, plants of the species grow in localized colonies in highly specific habitats. The genus is notable for prominent features such as spiral phyllotaxy, mat-forming habit, and an unusual, 2-keeled and many-nerved or nerveless palea which is usually divided into 2 equal parts. Also, the culms, comprising numerous nodes and extremely short internodes, are completely covered by the leaf sheaths. The inflorescence is sometimes reduced from a simple panicle to a capitate spike. A noteworthy physiological feature, the ability of plants to revive after dehydration (i.e. they are resurrection plants), is described by Gaff & Latz (1978).

On the previous addition of new species, which are homogeneous in many respects, *Micraira subulifolia* became taxonomically isolated in terms of morphology, distribution and ecology. However, one species in this paper, *M. multinervia*, has some features which connect *M. subulifolia* with the group in the western part of the continent.

The following key to all the species in the genus indicates the relationships between the new and existing taxa.

Key to the species of *Micraira*

1. Inflorescence a compact spike, the spikelets sessile or subsessile on axis.
   2. Spike shorter than and obscured by the upper leaves .... *M. inserta*
   2. Spike prominently exserted above the upper leaves.
      3. Glumes terminating in a flattened spine c. 0.5 mm long; leaf sheath abruptly narrowed at junction with blade .... *M. compacta*
      3. Glumes muticous; sheath of similar width to blade at their junction.
         4. Peduncle glabrous, glandular; florets c. ½ as long as glumes; glumes oblong, obtuse, glabrous, 1-3-nerved .... *M. spiciforma*
         4. Peduncle pilose to hirsute, eglandular; florets c. 1/3 as long as glumes; glumes ovate, subacute, pilose, 1-nerved .... *M. subspicata*
1. Inflorescence a contracted panicle, the spikelets pedicelled on few branches.
   5. Leaf blades terminating in a pungent spine 0.5-1.5 mm long.
      6. Lemmas 5-7-nerved; paleas 2-keeled and 4-nerved; leaf blades cartilaginous and hairy at base, minutely scaberulous or smooth on margins .... *M. multinervia*
      6. Lemmas 1-3-nerved; paleas 2-keeled and nerveless; blades even in texture, glabrous, prickly on margins.
         7. Glumes broadly oblong, truncate, dentate, 1-3-nerved; lemmas oblong, obtuse to truncate, entire or dentate on the apical margins, 1-nerved; panicle shortly exserted, eglandular; leaf sheaths 11-13 nerved.. *M. pungens*
         7. Glumes ovate-oblong, subacute to obtuse or sometimes truncate, entire or denticulate, 1-nerved; lemmas ovate, obtuse, entire, 1-3-nerved; panicle prominently exserted, glandular on divisions; leaf sheaths 7-9-nerved .... *M. pungens*

5. Leaf blades muticous or firmly acute, lacking a distinct spine.
    8. Lemmas with 6-9 ribbed nerves; palea 5-7-nerved, 2-keeled, undivided; florets usually longer than glumes; grain shortly beaked; leaf sheaths smooth on margins; culms below the sheaths usually ribbed and pallid .... *M. subulifolia*
    8. Lemmas with 1-4 ribbed or faint nerves; palea usually 2-nerved, 2-keeled, divided to base between keels into 2 equal parts; florets usually shorter than glumes; grain minutely or not beaked; sheaths usually scaberulous on margins; culms below the sheaths usually smooth and brown.
        9. Glumes (midnerve) prolonged into a terete spine 0.2-0.5 mm long .... *M. spinifera*
        9. Glumes muticous or mucronulate, lacking a distinct spine.
            10. Plant viscid from glandular tubercles on leaf margins, panicle divisions and glumes; leaf sheaths hairy on surface .... *M. viscidula*
            10. Plant not viscid, eglandular; leaf sheaths hairy about the mouth or glabrous.
                11. Lemmas strongly 3-nerved; grain smooth; leaf blades 3-nerved .... *M. dunlopii*
                11. Lemmas 0-4-nerved, often faint when more than one; grain striate or wrinkled; leaf blades 1-nerved or 5-7-nerved.
                    12. Leaf blades c. 0.3 mm wide, 1-nerved, flattened in the lower part and convolute-involute upwards; panicle 2-3 x 2-4 cm, usually eglandular; ligular hairs usually 0.5-1.3 mm long; lemmas 1-nerved .... *M. tenuis*
                    12. Leaf blades 0.5-1.5 mm wide, 5-7-nerved, flat or with incurved margins; panicle 10-15 x 7-15 mm, glandular; ligular hairs 0.3-0.5 mm long; lemmas 1-4 nerved .... *M. adamsii*

Micraira dunlopii Lazarides, sp. nov.

Micrairae tenui Lazarides affinis sed habitu et lemmate aliter formato trinervato, laminis trinervatis, caryopside laevi nitida, flosculis glumis brevioribus, panicula glandulosa plerumque parviore differt.

Typus: Western Australia: Northern Province: *Telford* 6174, 27.vii.77, Wonjarring Gorge, Carson Escarpment, c. 36 km E of new Theda homestead, 14° 49′S, 126° 49′E (holo: CANB; iso: CBG, PERTH).

Mat-forming *perennial* c. 30 cm long or more and <5 cm high. *Culms* c. 0.8 mm wide (with sheaths), c. 0.5 mm wide (without sheaths), smooth, dark-brown; internodes c. 1 mm long. *Leaves* herbaceous to coriaceous, bright-green, mostly glabrous. *Leaf sheaths* 3-4 x 1 mm, as wide as blade at their junction or slightly wider, thickened and 3-5-nerved along the centre, subhyaline to scarious and nerveless on margins, which widen downwards and enclose the internode at its base, sparsely bearded at the mouth with stiff tubercle-based hairs 1-1.5 mm long and sometimes ciliate on the upper margins; nerves flattened on the upper surface and ribbed on the lower. *Blades* 6.5-9.5 x c. 0.3 mm, flattened in the lower part and conduplicate upwards, acute to subobtuse, slender but stiff, scaberulous on margins and surfaces or partly smooth on the lower surface, 3-nerved with the nerves flattened and prominent on the upper surface, and obscure or partly prominent on the lower. *Ligule* sparsely pubescent and 0.1-0.2 mm long or puberulous-tuberculate or glabrous; collar sometimes partly ciliate with the hairs of the mouth. *Panicle* 1-1.3 cm long and wide, loose, well-exserted, glabrous, with pit-like or crateriform or pustulate glands on peduncle (sometimes on upper part only), axis, branches and pedicels; peduncle terete, glabrous; axis grooved or ribbed; branches $<4.5(-9)$ mm long; pedicels mostly 0-2 mm long; pulvini prominent. *Glumes* c. 1 mm long, equal, thinly membranous with subhyaline margins, ovate or broadly oblong, obtuse to truncate, minutely emarginate or entire, mucronulate, with one thickened nerve, scaberulous on apical edge and upper margins otherwise glabrous and smooth. *Florets* 1/2-2/3 as long as glumes. *Lemmas* 0.3-0.5 mm long, membranous, oblong, obtuse or truncate, minutely 3-toothed or entire, muticous or mucronulate, with 3 ribbed closely spaced nerves (all prominent or the laterals faint). *Paleas* c. as long as lemmas, membranous, glabrous, smooth, divided into 2 narrowly oblong, obtuse to truncate parts, nerveless between keels; keels ribbed, slightly excurrent and mucronulate or not. *Anthers* c. 0.8 mm long, greenish-yellow, terminally exserted. *Caryopsis* 0.2-0.5 mm long, subequal to floret, turgid or slightly compressed dorsally, elliptic to obovate, smooth, shiny, obtuse to subacute at apex and base, minutely rostrate, pale or golden brown; embryo basal, c. ¼ as long as the grain itself.

The species is known only from a small area in the Kimberleys, Western Australia, where plants grow in crevices, moist and shady sites on steep slopes in rocky gorges.

Micraira dunlopii closely resembles *M. tenuis* Lazarides, but differs in habit, by its 3-nerved differently shaped lemmas, shorter florets relative to the glumes, shiny smooth grain, 3-nerved blades, and glandular usually smaller panicle.

The species is named after Mr C. R. Dunlop, Conservation Commission of the Northern Territory, Darwin (DNA), whose knowledge, collections and co-operation have been invaluable to research on the flora of northern Australia.

Paratypes
Western Australia: Northern Province: *George* 14072, 9.viii.75, Morgan Falls, Drysdale River National Park, 15° 02′S, 126° 40′E (CANB, PERTH). *George* 13642, 10.viii.75, Orchid Creek, Carson Escarpment, Drysdale River National Park, 14° 49′S, 126° 49′E (CANB, PERTH). *Lazarides* 8710, 25.iii.78, near Wonjarring Gorge, Carson Escarpment, 10 km E of Theda homestead (CANB). *Kenneally* 4567, 20.viii.75, Euro Gorge, Drysdale River National Park, 15° 03′S, 126° 44′E (CANB, PERTH).

Micraira inserta Lazarides, sp. nov. (Figure 6a-c)

Distinguitur inflorescentia spiciformi eglandulata glabra foliis superis breviore, glumis truncatis late oblongis muticis paucinervibus flosculis multo longioribus, lemmatibus uninervibus, palea divisa, paginis laminarum incrassatarum dissimilibus.

Typus: Northern Territory: Darwin & Gulf District: *Dunlop* 4427, 22.ii.77, Mt Gilruth, 13° 04′S, 133° 05′E (holo: CANB; iso: BRI, DNA, K, NT).

Mat-forming *perennial. Culms* 0.8-1 mm wide (with sheaths), 0.5-0.8 mm wide (without sheaths), blackish-brown and smooth (below sheaths); internodes 0.5-0.8 mm long. *Leaves* rigid, tightly imbricate, mostly glabrous. *Leaf sheaths* 2-3 mm long, as wide as blade at their junction or slightly wider, thickened in the middle part or herbaceous, few-nerved and membranous to hyaline on the margins which widen downwards and enclose the internode at its base, scaberulous along the edges. *Blades* 5-6 mm long, 0.3-0.5 mm wide, subobtuse, sparsely pilose upwards, with thickened white scaberulous edges; upper surface flat, 3-nerved, even in texture, minutely papillose in longitudinal series, green when young; lower surface mostly indurated, white and nerve-like, smooth and obtusely convex in the lower part, more or less keeled and scaberulous in the upper part, the thickened centre separated from the edges by a linear often green depression. *Ligule* ciliate with hairs 0.3-0.5 mm long. *Inflorescence* a spike of sessile or subsessile spikelets. *Spike* 3-4 x 1 mm, overtopped by the upper leaves, eglandular, subtended by a subhyaline, lanceolate, acuminate, glabrous, 1-nerved floral sheath c. 3 mm long; peduncle c. 1 mm long, glabrous; axis triquetrous, scaberulous on the edges, glabrous; pedicels 0-0.5 mm long, stout, compressed, scaberulous on the edges. *Glumes* c. 1 mm long, equal, distinctly longer than lemmas and paleas, thinly membranous, broadly ovate-oblong, truncate, entire, glabrous, scaberulous on the apical edge and upper margins, 1-nerved or the upper sub 3-nerved, midnerve thickened and keeled. *Lemmas* c. 0.5 mm long, membranous, truncate, dentate, glabrous, smooth, with 1 thickened keeled nerve. *Paleas* slightly longer than lemmas, glabrous, smooth, split to base into 2 equal parts, each part notched by the keel; keels prominent. *Anthers* c. 0.8 mm long, well-exserted above lemmas and paleas, yellow or purple. *Caryopsis* not seen.

Only the type collection is known of the species.

The spiciform inflorescence, a feature shared with *Micraira compacta, M. spiciforma* and *M. subspicata* is, in contrast to those species, much shorter than the upper leaves and often scarcely visible among the foliage. Also, there are differences between the four species in the morphology and nervation of glumes and lemmas, structure of blades and ligule, and indumentum of the keels.

Micraira multinervia Lazarides, sp nov. (Figure 6e, f)

Distinguitur lemmate palea foliisque multinervibus, spina laminarum apicali, marginibus laminarum et vaginarum scaberulis vel laevibus, basi laminarum cartilaginea pilosa, divisibus paniculae glandulosis, flosculis et glumis subaequalibus, palea divisa, glumis late ovatis truncatis vel obtusis, integris vel minute emarginatis, saepe latioribus quam longioribus (complanatis).

Typus: Northern Territory: Darwin & Gulf District: *Dunlop* 5634, 29.i.81, top of Jim Jim Falls, 13° 17′S, 132° 51′E (holo: CANB; iso: DNA).

Vigorous mat-forming *perennial* forming compact clumps 10-15 cm high. *Culms* c. 1.5 mm wide (with sheaths), c. 1 mm wide (without sheaths), smooth and brown below sheaths; internodes 1-2 mm long; prophylla densely ciliate on keels and apex. *Leaves* ciliate on margins near ligule otherwise glabrous or almost so. *Sheaths* 4-5 mm long, narrowed to blade at their junction, scarious with membranous margins, minutely and densely scaberulous along the edges, shiny on the upper surface, many-nerved (nerves 8-9, more or less flattened, prominent on the upper surface); margins nerveless, widened downwards and enclosing the internode at its base. *Blades* pungent with an apical spine 0.8-1 mm long, 9-12.5 mm long (including spine), c. 1.3 mm wide (near base), coriaceous to hardened, rigid, triangular, long-acuminate, involute near apex otherwise flat, 7-9-nerved (nerves thickened, ribbed, scaberulous along their edges), similar on both surfaces though the lower appearing smooth, with thickened, minutely and sparsely scaberulous to smooth margins; the basal part of the blades different to the upper, somewhat cartilaginous, sparsely hairy, ciliate on the edges. *Ligule* c. 0.2 mm long, densely ciliate with white silky hairs. *Panicle* c. 1 x 0.3-1 cm, finally loose, prominently exserted, glabrous, smooth, with crateriform or depressed glands on peduncle (close below panicle), axis and divisions; peduncle and axis striate to ribbed, grooved; branches and pedicels triquetrous or compressed; branches <5 mm and pedicels 0.1-0.8 mm long. *Glumes* 0.5-1 mm long, equal, membranous to scarious, broadly ovate, obtuse to truncate, often wider than long (flattened), entire or minutely notched, mucronulate from the midnerve or muticous, glabrous, smooth, with one thickened nerve or rarely the lower glume 2-nerved. *Florets* as long as glumes or slightly longer. *Lemmas* 0.5-1 mm long, membranous, ovate-oblong, obtuse to truncate, minutely notched or emarginate, glabrous, with 5-7 thickened ribbed nerves. *Paleas* as long as lemmas, similar in texture and indumentum, with 2 thickened ribbed keels and 4 similar or thinner nerves (2 intercarinal and one between each keel and margin), the palea splitting into 2 equal parts when fruit present. *Anthers*

c. 0.8 mm long, purple, well-exserted above florets. *Caryopsis* 0.5-0.6 x 0.3-0.5 mm, elliptic or oblong-elliptic, subacute or obtuse at apex and base, minutely beaked, pale brown, striolate, flattened near the hilum otherwise turgid, embryo obliquely basal.

Though resembling *Micraira pungens* and *M. dentata, M. multinervia* is the only species of the 12 in the Northern Territory and Western Australia with a many-nerved lemma and palea. In this feature and in the scaberulous to smooth (not prickly) margins of the blades, it resembles *M. subulifolia*, which is considered to be a disjunct species as mentioned previously. However, *M. multinervia* differs from *M. subulifolia* by the apical spine on its blades, the divided palea and the subequal florets and glumes.

Micraira multinervia is relatively widespread in the Northern Territory on the sandstone plateau of Arnhem Land and adjacent areas, growing in crevices and moist sites on rocky slopes and pavements.

Paratypes
Northern Territory: Darwin & Gulf District: *Martensz & Schodde* AE 592, 25.i.73, 2-3 miles N of El Sharana (c. 1 mile due E of old mine) (CANB). *Lazarides* 9067, 29.v.80, tributary of Deaf Adder Creek, 17.5 km NE of Jim Jim Falls, 13° 08'S, 132° 56'E (holo: CANB).

Though sterile, the following collections are believed to belong to *Micraira multinervia*:- Northern Territory: Darwin & Gulf District; *Gaff* s.n., viii.73, Site 40, Nourlangie Rock area (CANB 249548). *Lazarides* 7609B, 12.vii.72, Query 101, Arnhem Land, 13° 07'S, 133° 09'E (CANB). *Telford* 7970, 22.iv.80, Deaf Adder Creek gorge, 13° 07'S, 132° 56'E (CANB, CBG). *Rankin* 1970, 19.iv.70, Koongarra area, 12° 51'S, 132° 51'E (AD, CANB, DNA). *Rice* 2544, 26.v.78, Koongarra, 12° 51'S, 132° 50'E (CANB).

Micraira spiciforma Lazarides, sp. nov. (Figure 5e-h)

Distinguitur inflorescentia spiciformi exserta, pedunculo glabro glanduloso, glumis exspinosis, glumis et lemmatibus 1-3-nervibus, palea divisa enervi bicarinata carinis laevibus, flosculis glumis duplo brevioribus, foliis pilosis vel hirsutis pilis simplicibus et tuberculis portatis, laminis et vaginis ad juncturam latitudinum similarium, ligula glabra incrassata.

Typus: Western Australia: Northern Province: *Dunlop* 5298, 24.ii.80, Mitchell Plateau, Lat. 14° 50', Long. 125° 42' (holo: CANB; iso: BRI, CANB, DNA, K, MEL, NSW, NT, PERTH).

Mat-forming *perennial* usually 2-5 cm high; prop roots common. *Culms* c. 1 mm wide (with sheaths), c. 0.5 mm wide (without sheaths), brown and smooth below sheaths; internodes c. 0.5 mm long. *Leaves* herbaceous, pilose to hirsute with stiff, simple and tubercle-based hairs on blades (both surfaces) and sometimes on sheath near ligule. *Leaf sheaths* 2-3 mm long, usually glabrous, with 3 ribbed often green nerves, colourless and subhyaline on the margins which widen downwards and enclose the internode, sparsely scaberulous on the edges upwards, attenuate (of similar width) with blade at their junction. *Blades* 4-5 x 0.4-0.5 mm, flat, closely 3-5-nerved between the thickened margins (midnerve thicker than laterals), acute, stiffly hairy and tubercled on both surfaces, tubercled-scabrous-hairy on the edges. *Ligule* a tubercular-thickened ridge, glabrous or sparsely puberulous; collar somewhat thickened (like ligule), glabrous. *Inflorescence* a compact spike of 5-7 subsessile spikelets, 3-4 x c. 1 mm, finally well-exserted; peduncle filiform, glabrous, with a few crateriform, pit-like or depressed glands in the upper part; axis and pedicels triquetrous, smooth, glabrous, eglandular, pedicels c. 0.3 mm long. *Glumes* c. 1 mm long, equal, membranous, oblong, obtuse, entire or minutely emarginate, muticous, minutely scaberulous on apical edges and upper margins, otherwise glabrous and smooth, 1-3-nerved with the laterals often obscure in the lower or both glumes. *Florets* c. 0.5 mm long and c. ½ as long as the glumes or somewhat less. *Lemmas* subhyaline, narrowly lanceolate, obtuse, minutely emarginate, thinly and closely 1-3-nerved, glabrous, smooth. *Paleas* similar to lemmas in texture and indumentum, 2-keeled (otherwise nerveless), divided into 2 equal narrowly oblong, entire or minutely notched parts; keels smooth. *Anthers* 0.5-0.6 mm long, yellow, well-exserted terminally. *Caryopsis* c. 0.5 mm long and more or less equal to floret, elliptic, obtuse, acute at base, turgid though flattened about the hilum, smooth, glossy, pale brown, minutely rostrate; embryo basal; hilum central.

Micraira spiciforma is known only from the type collection, but is clearly distinct from allied species with a spike, viz. *M. inserta, M. compacta* and *M. subspicata.* It is distinguished by the following characters in combination — spineless glumes, glabrous glandular peduncle, pilose to hirsute leaves, more or less glabrous thickened ligule, attenuate sheaths and blades, 1-3-nerved glumes and lemmas, short florets relative to the glumes, and nerveless paleas with smooth keels.

Micraira viscidula Lazarides, sp. nov. (Figures 5a-d, 6d)

Distinguitur praesentia tuberculorum glandulorum alborum vel translucentium in glumis, marginibus foliorum, pedunculo axe ramis pedicellisque paniculae, vaginis foliorum et glumis pilosis, lemmatibus obtuse tridentatis, foliis glumis lemmatibusque trinervibus, flosculis glumis duplo brevioribus vel minoribus.

Typus: Northern Territory: Darwin & Gulf District: *Dunlop* 4975, 11.vii.78, c. 8 km SW of Oenpelli, Lat. 12° 23′, Long. 133° 01′ (holo: CANB; iso: AD, BRI, DNA, K, MEL, NSW, NT, PERTH).

Mat-forming viscid *perennial* several metres long; prop roots common. *Culms* c. 0.8 mm wide (with sheaths), c. 0.5 mm wide (without sheaths), glabrous, not ribbed, brown, entirely covered by the overlapping leaf sheaths; internodes c. 1 mm long. *Leaves* thinly herbaceous, 5-nerved, with short simple hairs especially on sheaths. *Leaf sheaths* loose, slightly wider than the blades at their junction, with hyaline margins. *Blades* c. 10 x 0.5 mm, longer than sheaths, flat, abruptly acute or subobtuse, hairy on both surfaces, with a prominent row of colourless glandular tubercles along margins; ligule of sparse minute hairs; collar glabrous. *Panicle* c. 1.5 cm long and wide, open, glabrous on the divisions, with glandular often white tubercles or striations on peduncle, axis, branches and pedicels; primary branches <5 mm long; pedicels <3 mm long. *Glumes* 1.3-1.5 mm long, equal or the upper slightly wider than lower, at least twice as long as florets, lanceolate, acuminate, muticous, membranous with thinner margins, sparsely hairy, with glandular tubercles mostly in the upper part and 3 ribbed nerves. *Lemmas* c. 0.5 mm long, membranous with thinner margins, glabrous, smooth, obtusely 3-toothed, with 3 ribbed nerves. *Paleas* c. as long as lemmas and similar in texture and indumentum, strongly keeled, nerveless between keels, divided into 2 equal parts, each part notched by the slightly shorter keel. *Anthers* c. 0.5 mm long. *Caryopsis* c. 0.5 x 0.3 mm, subequal to lemma and palea, elliptic, subacute at apex and base, scarcely compressed, striolate, embryo basal and very small.

The glandular, white or translucent tubercles on leaf margins, panicle divisions and glumes are a unique feature in the genus. Also, leaf sheaths are glabrous in most other species. Other significant characters include the 3-nerved sheaths, blades, glumes and lemmas, the nerveless paleas, and the short florets relative to glumes.

Though all the specimens examined match the holotype in most respects, Dunlop 4906 differs in its shorter, blunter glumes and their shorter length relative to the florets.

The species is known at present only from the Oenpelli-Mt Gilruth area of the Northern Territory and plants seem to favour sheltered or partially shady habitats.

Specimens examined. NORTHERN TERRITORY: Darwin & Gulf District: *Gaff* s.n., 4. vii.73, Arnhem Land, 26 miles N of junction of Oenpelli and Nourlangie Rock roads (CANB). *Latz* 7842, 13.vi.78, 44 km SE of Oenpelli, 12° 34′, 133° 23′ (BRI, CANB, NSW, NT). *Dunlop* 4906, 7.vi.78, Mt Gilruth area, 13° 03′, 133° 01′ (BRI, CANB, DNA, NT).

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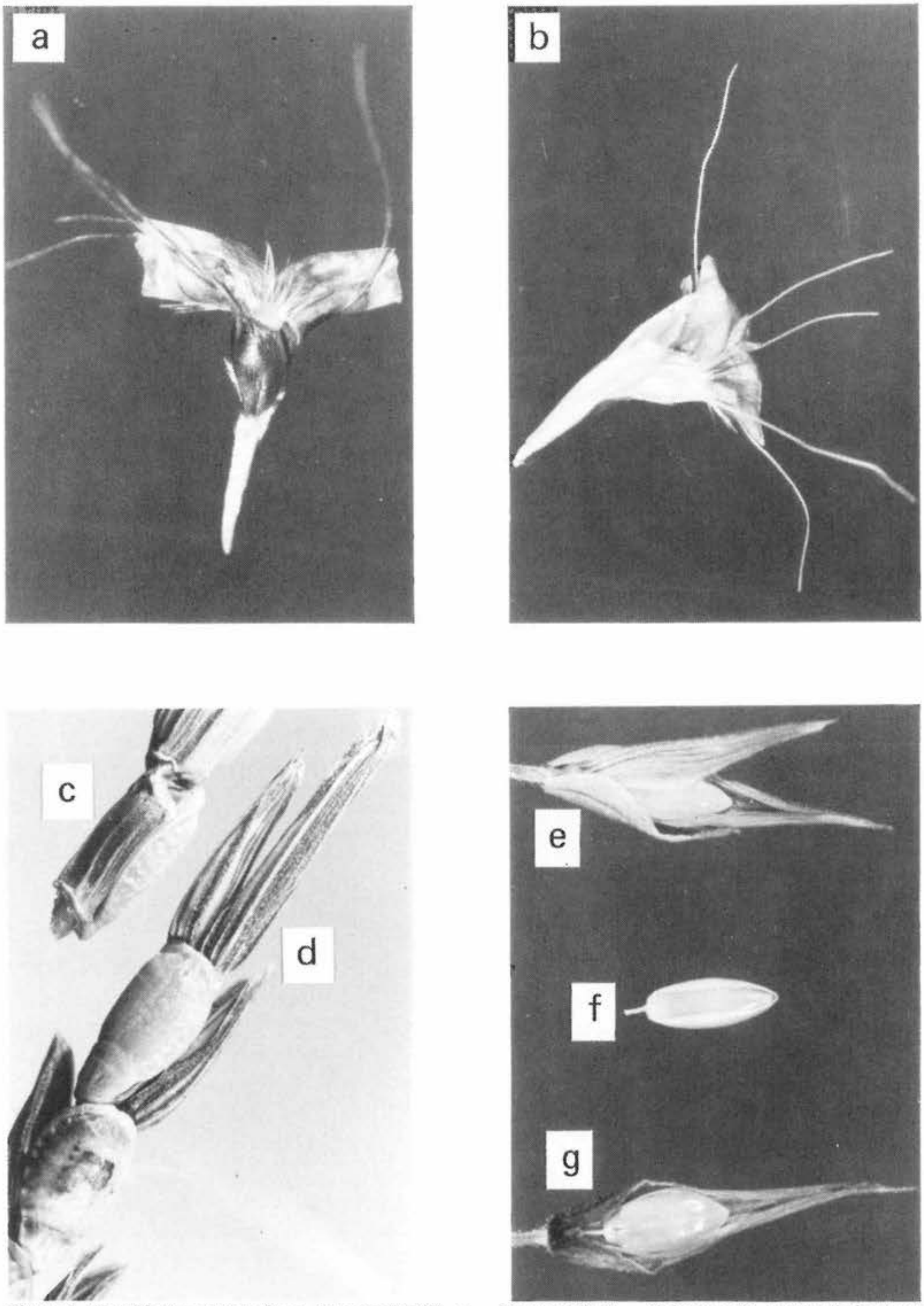

Figure 1. *Oxychloris scariosa* (from *Maconochie* 64). a — Florets x10. b — Spikelet x10. *Heteropholis annua* (from holotype). c-d — Parts of raceme x8, showing sessile and pedicelled spikelets, terminal pair of spikelets and rachis internode. *Arthragrostis deschampsioides* (from *Lazarides* 4212). e — Spikelet x13. f — Fertile floret x13. g — Spikelet with upper glume removed x13.

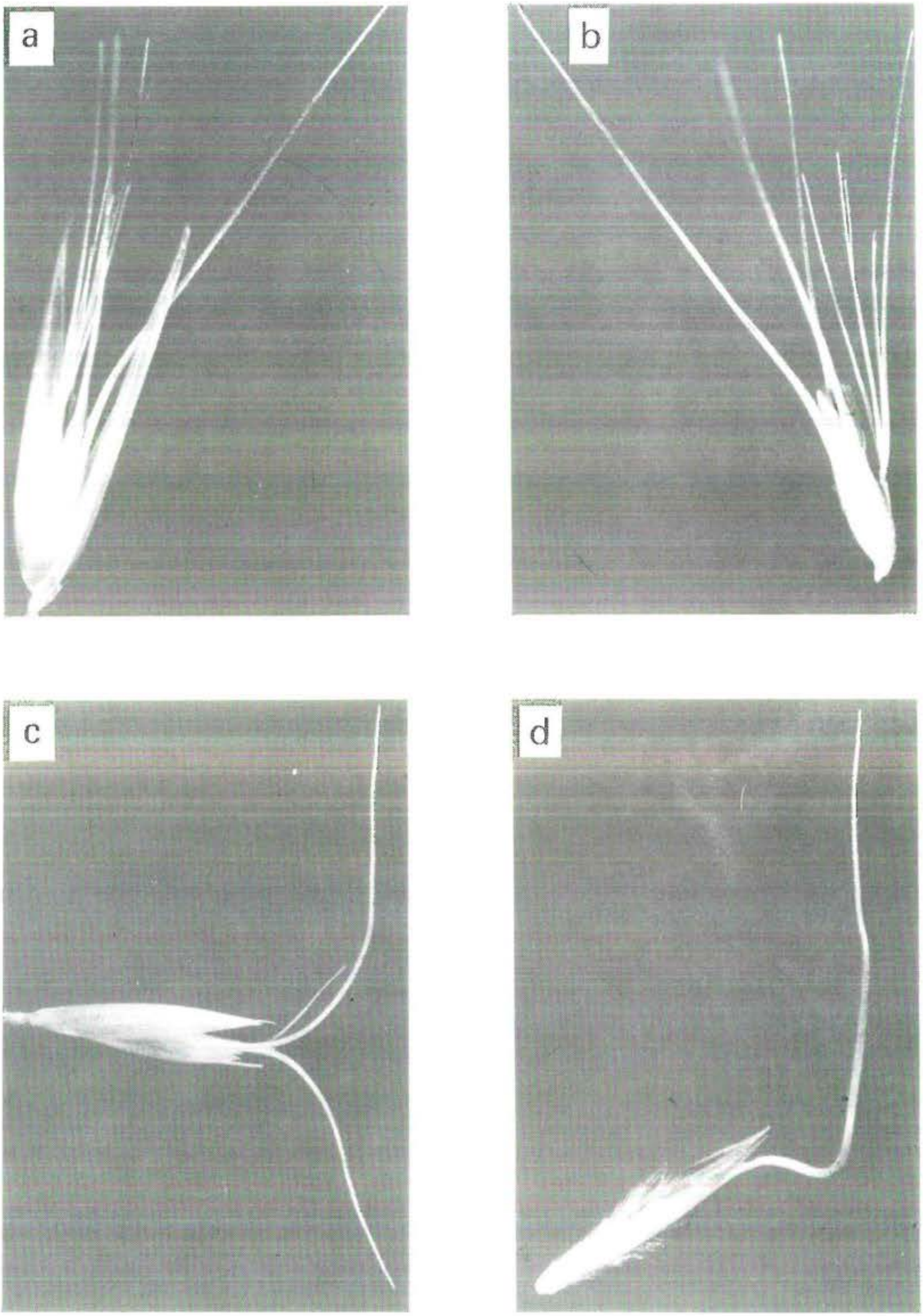

Figure 2. *Plectrachne mollis* (from holotype). a — Spikelet x10. b — Fertile and sterile florets x12. *Plectrachne uniaristata* (from holotype). c — Spikelet x9. d — Floret x10.

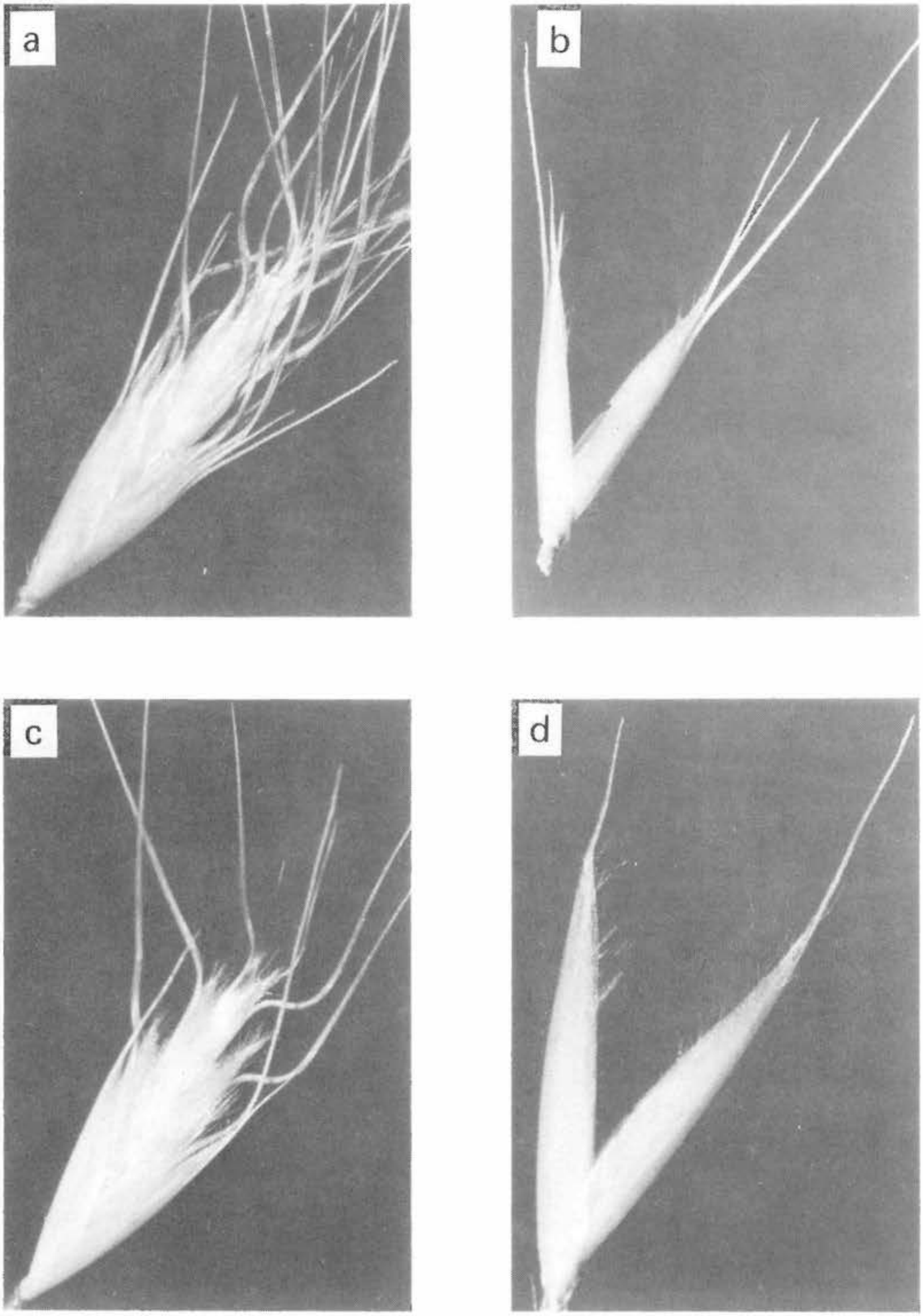

Figure 3. *Plectrachne aristiglumis* (from holotype). a — Spikelet x6. b — Glumes x6. *Plectrachne contorta* (from holotype). c — Spikelet x10. d — Glumes x10.

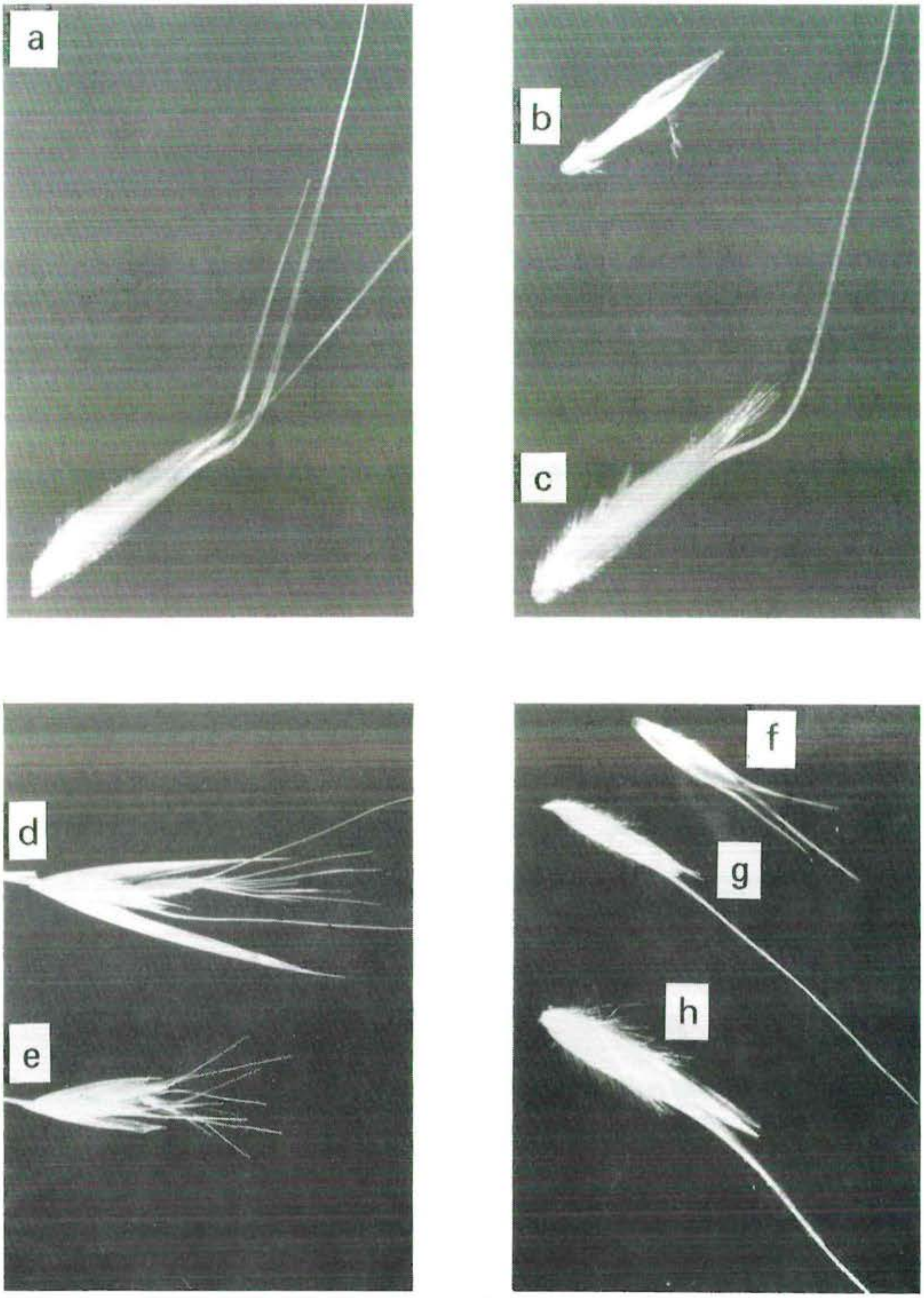

Figure 4. *Plectrachne aristiglumis* (from holotype). a — Floret x7. *Plectrachne contorta* (from holotype). b — Palea x10. c — Floret x10. *Plectrachne bynoei*. d — Spikelet x6 (from holotype). e — Spikelet x6 (from *Lazarides* 6712). f — Basal (fertile) floret x15 (from *Lazarides* 6712). g — Basal (fertile) floret x15 (from holotype). h — Basal (fertile) floret x15 (from *Beauglehole* 51894).

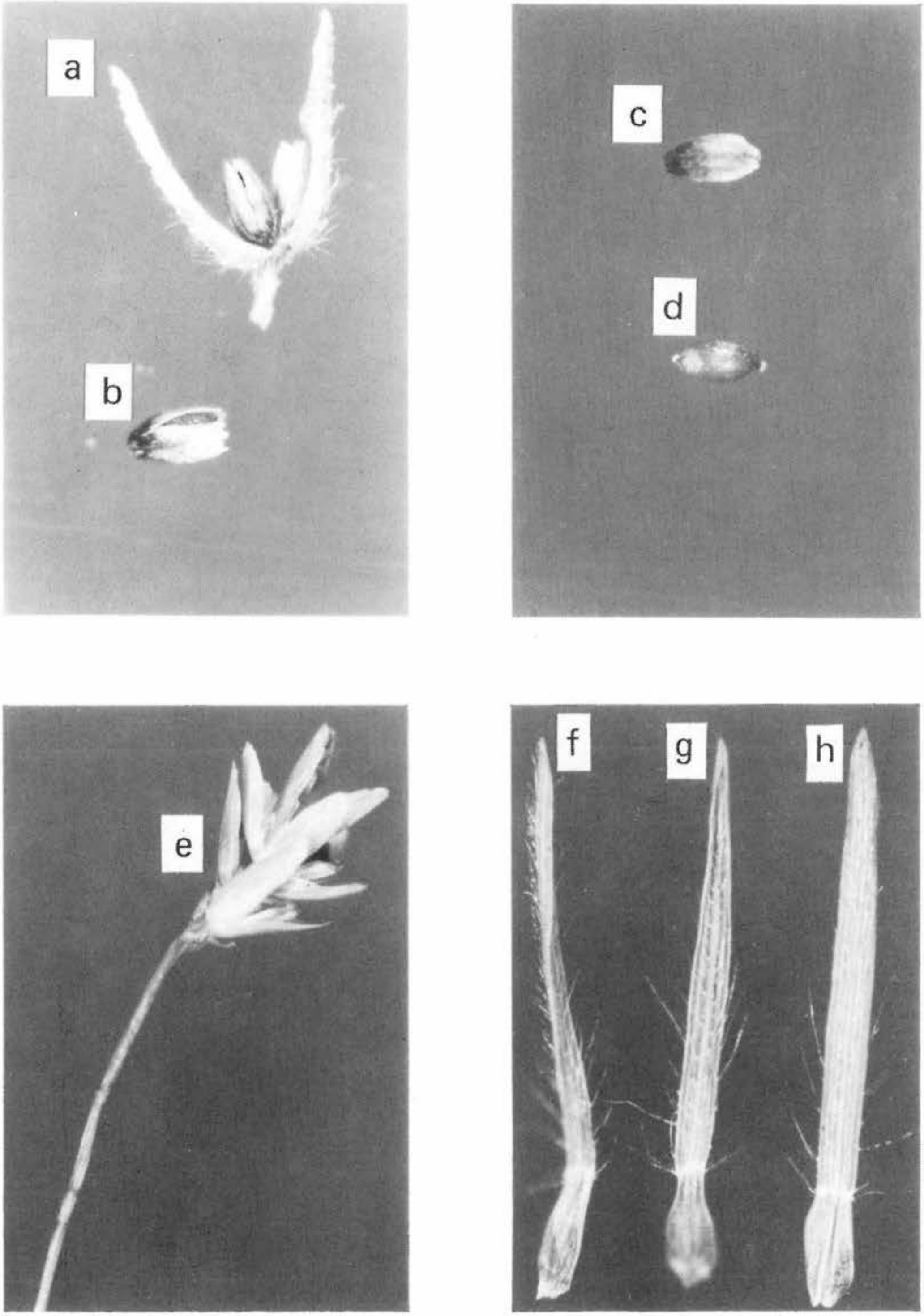

Figure 5. *Micraira viscidula* (from holotype). a — Spikelet x30. b — Floret x30. c — Floret (lemma) x30. d — Caryopsis x30. *Micraira spiciforma* (from holotype). e — Spike and peduncle x25. f-h — Leaves x16.

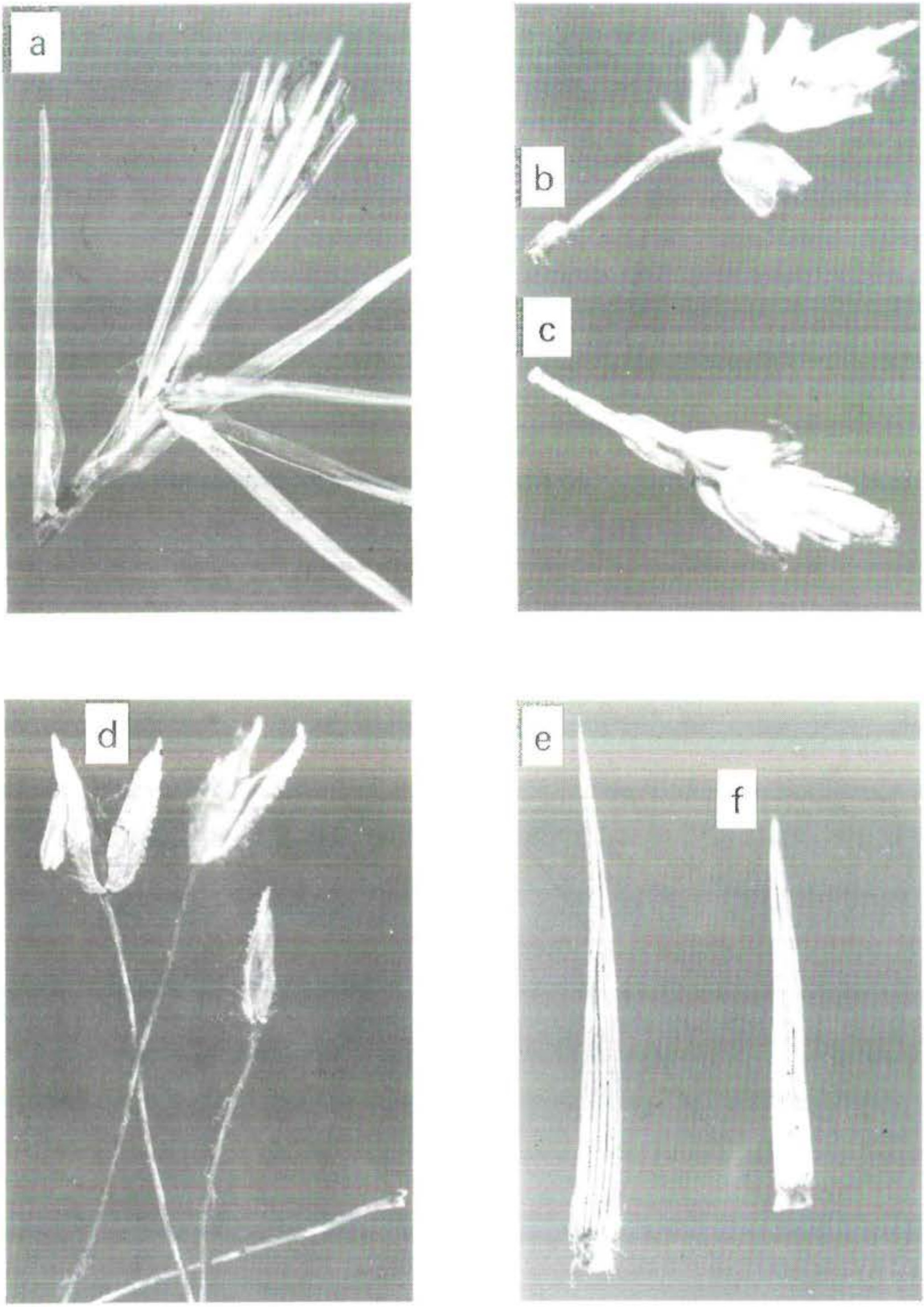

Figure 6. *Micraira inserta* (from holotype). a — Inflorescence and upper leaves x10. b-c — Spikes with leaves removed x15. *Micraira viscidula* (from holotype). d — Glumes and pedicels x20. *Micraira multinervia* (from holotype). e-f — Blades x8.

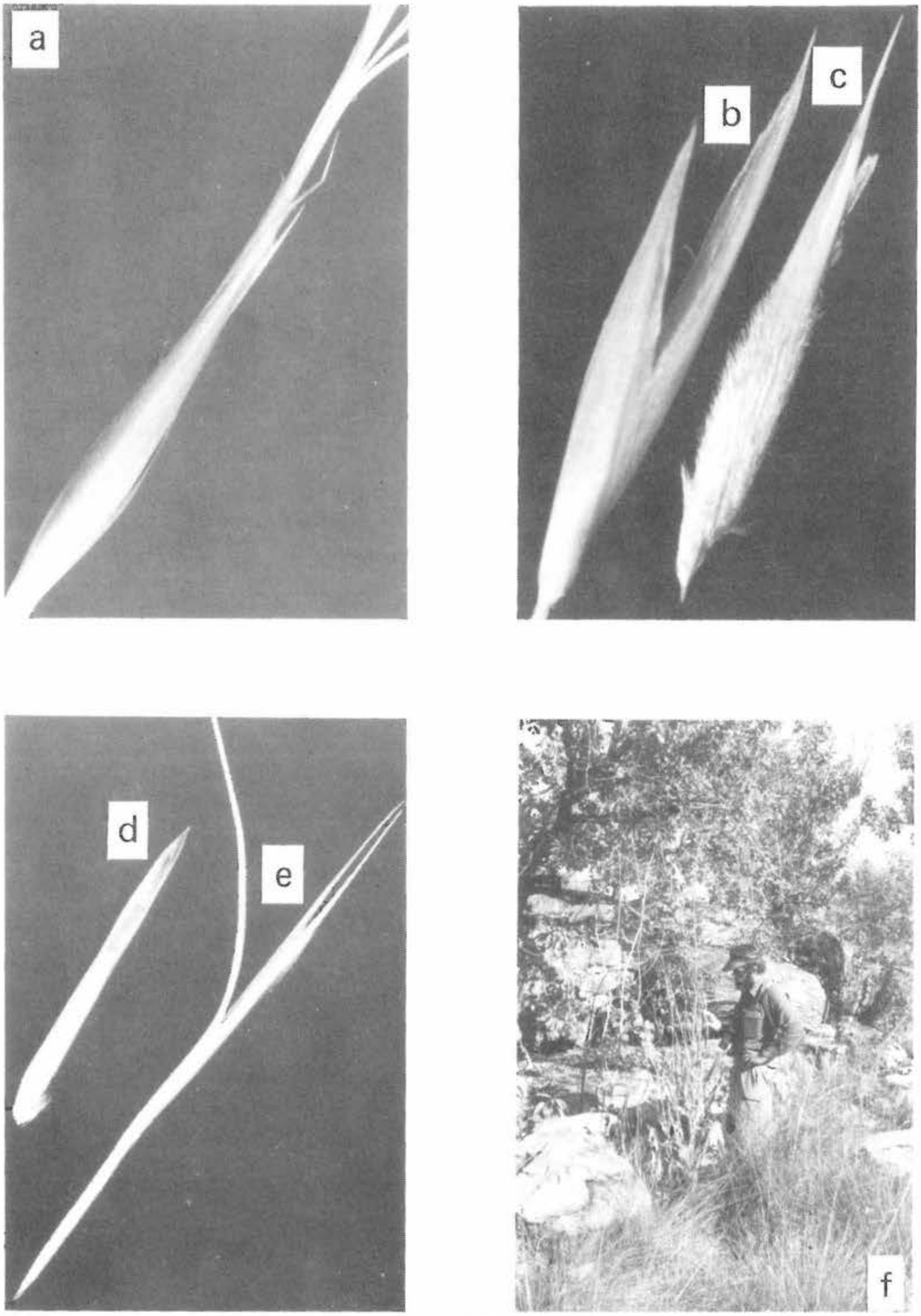

Figure 7. *Symplectrodia lanosa* (from holotype). a — Spikelet (excluding awns) x10. b — Glumes x10. c — Floret x10. d — Palea of fertile floret and rhachilla internode x7. e — First sterile floret and rhachilla internode x7. *Heteropholis annua*. f — field photo by K. F. Kenneally.

Calothamnus accedens T. J. Hawkeswood (Myrtaceae), a rare and endangered new species from Western Australia

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Abstract

Hawkeswood, T. J. *Calothamnus accedens* T. J. Hawkeswood (Myrtaceae), a rare and endangered new species from Western Australia. Nuytsia 5(2): 305-310 (1984). *Calothamnus accedens* is described as new from the Piawaning district of the Western Australian wheatbelt. Since it is presently known from only 14 plants growing on a road verge adjacent to cleared land, its survival is threatened unless efforts are made to conserve the species. *Calothamnus accedens* is closely related to another rare species in the Piawaning area, *Calothamnus brevifolius* T. J. Hawkeswood, and also has close affinities to *C. hirsutus* T. J. Hawkeswood.

Introduction

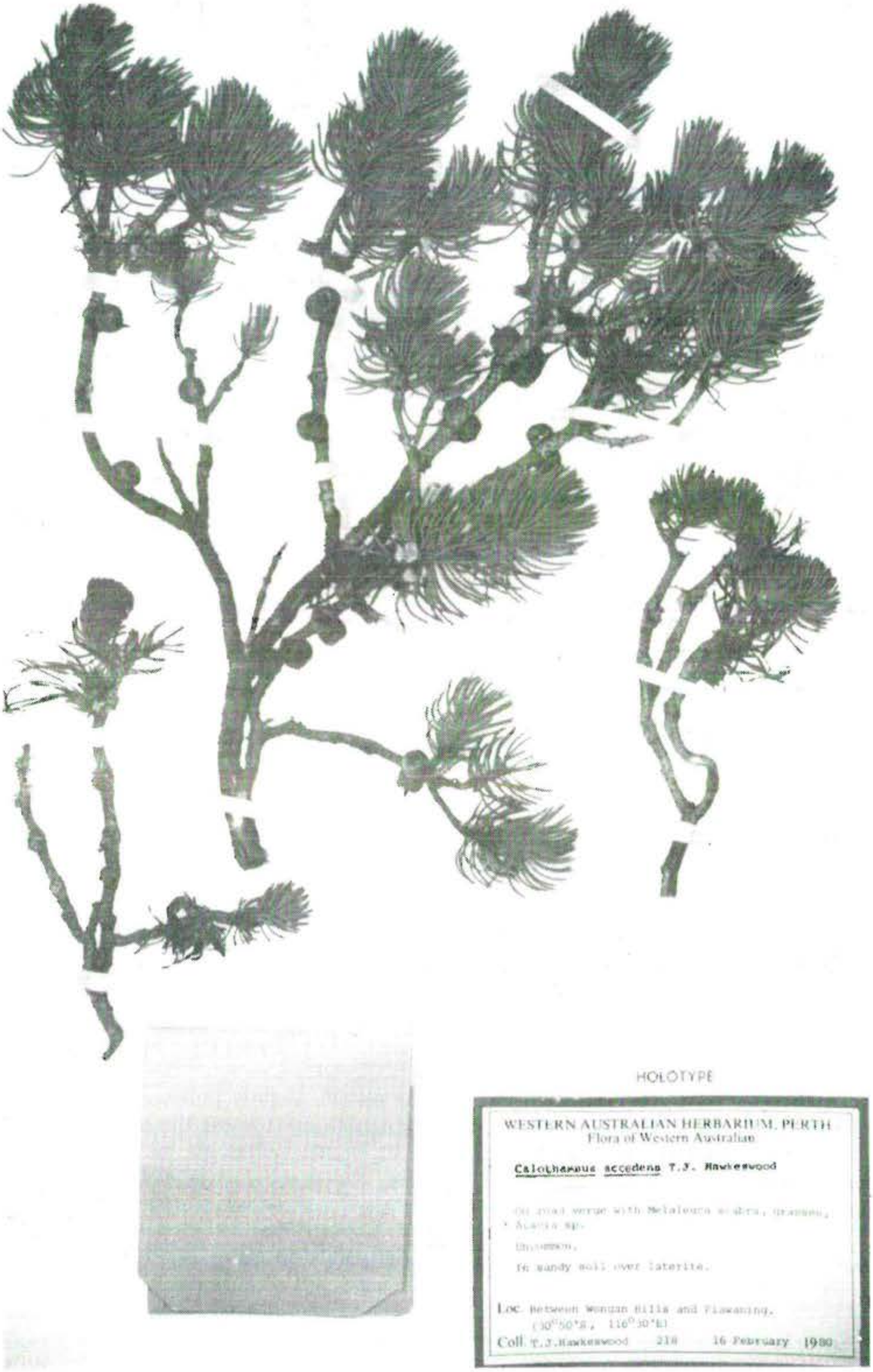
During a field trip on 16 February 1980, in search of a rare species of *Calothamnus* in the Piawaning area (i.e. *C. brevifolius* T. J. Hawkeswood, Hawkeswood 1984) the author discovered another taxon which at first appeared to be the species sought. Closer examination showed that this differed from *C. brevifolius* in a few characters, the most prominent being growth habit and the density of hairs on the leaves. The fruit in general was larger than that of *C. brevifolius*. On the basis of these differences, a new species is described below. The description conforms to the terminology and format of Hawkeswood (1984).

Calothamnus accedens T. J. Hawkeswood, sp. nov. (Figures 1,2,3)

Frutex usque ad 1.8 m altus. Folia linearia, teretia, (7)10-15(20) mm longa, 0.8-1 mm lata, breviter mucronata, pilosa. Flores (2)4-10 in fasciculis parvis. Calycis tubus 3-4(5) mm longus, hirsutus; calycis lobi 3.5-4 mm longi, 2.2-2.6 mm lati. Petala 6.5-7(8) mm longa. Unguis staminalis 20-25(28) mm longus, filamentis (15)16-19(21). Fructus sessilis, depresso-globularis, 5-6 mm longus, 6.2-8(9) mm latus. Semina 1.5-2 mm longa, atrobrunnea.

Typus: Between Wongan Hills and Piawaning, (c. 30° 50′S, 116° 30′E); in sandy soil over laterite; on road verge with *Melaleuca scabra, Acacia* sp. and grasses; uncommon; 16 February 1980, *T. J. Hawkeswood* 218 (holo: PERTH; iso: BRI, MEL, PERTH).

Erect, slender, usually single-stemmed, much-branched, slightly pubescent *shrubs* to 1.8 m high. Mature plants with thin, corky *bark* often splitting towards the base of the plant and on larger branches. *Young shoots* glabrous or shortly pubescent, becoming glabrous with age. *Older branches* with prominent leaf and bud scars. *Leaves* densely crowded at ends of branches, sessile, linear, terete, semi-erect to erect, rigid, (7)10-15(20) mm long, 0.8-1 mm wide, shortly mucronate, slightly pungent, clothed with long, spreading, whitish hairs; older leaves becoming glabrous with age; oil glands on leaves randomly distributed, conspicuous, especially on more or less glabrous leaves. *Flowers* (2)4-10 in short clusters, each cluster usually more or less unilateral but occasionally almost encircling the rhachis, usually on portions of stems from which the leaves have fallen. *Calyx tube* almost campanulate, 3-4(5) mm long, greenish-brown, densely pilose at base, the hairs becoming shorter and less dense at apex of calyx tube; *calyx lobes* more or less equal, 3.5-4 mm long, 2.2-2.6



HOLOTYPE

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australian

Calothamnus accedens T.J. Hawkeswood

On road verge with Melaleuca scabra, grasses, Acacia sp.

Uncommon.

In sandy soil over laterite.

Loc. Between Wongan Hills and Piawaning.
(30°50'S, 116°30'E)

Coll. T.J.Hawkeswood 218 16 February 1980

Figure 1. *Calothamnus accedens* T. J. Hawkeswood — Holotype (*Hawkeswood* 218).

mm wide, erect, narrowly deltoid, acute, concave, shortly pubescent outside and within; margins thinner than centre of lobes, slightly scarious, partially ciliate. *Petals* narrowly elliptic, more or less acute, concave, glabrous, 6.5-7(8) mm long, including a short claw 1-1.5 mm long, pale orange-brown to orange-brown; central vein prominent; oil glands prominent in centre and towards the apex, the largest glands in the centre. *Staminal claws* more or less equal, 20-25(28) mm long, 1-1.5 mm wide, glabrous, dark pinkish red to dark crimson; filaments per claw (15)16-19(21), all marginal; anthers linear to linear-oblong, 1-1.5 mm long, yellow to yellow-brown. *Style* 25-35 mm long, slender, uniform to slightly tapering, glabrous, not persistent in fruit; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, depressed globular to almost cylindrical, more or less truncate, shortly 5-lobed at first but lobes wearing away with age, or young fruit with one or more lobes deflexed across the orifice but lobes usually wearing away during the first year, 5-6 mm long, 6.2-8(9) mm wide, smooth, young fruit densely pubescent but becoming glabrous with age; orifice 2.5-3 mm diameter. *Fertile seeds* few to many per capsule, 1.5-2 mm long, linear-cuneate, usually truncate at one end, angular, angles usually bluntly rounded; testa glabrous, dark brown to chocolate brown. *Ovulodes* numerous, 1.5-2.5 mm long, linear to linear-cuneate, shiny, glabrous, usually truncate at one end, angular with sharp angles, yellow buff to light yellow-brown.

Derivation of name. Accedens, Latin, meaning approximating or resembling. This name is provided since this species is so closely related to *C. brevifolius* and *C. hirsutus*.

Habitat. Fourteen plants were found growing on a road verge 1-2 m across in remnants of a heath community on pale sandy soil over laterite.

Distribution. Only known from one locality between Piawaning and Wongan Hills (c. 30° 50′S, 116° 30′E) in the central wheatbelt area of Western Australia.

Table 1. Comparison of *Calothamnus hirsutus* T. J. Hawkeswood, *C. brevifolius* T. J. Hawkeswood and *C. accedens* T. J. Hawkeswood.

C. hirsutus	*C. brevifolius*	*C. accedens*
Shrub to 1 m high	Shrub to 0.5 m high	Shrub to 1.8 m high
Leaves (15)20-25(30) mm long, 0.5-0.8 mm wide	Leaves (7)8-12(15) mm long, 0.5-0.8 mm wide	Leaves (7)10-15(20) mm long, 0.8-1 mm wide
Flowers mostly 4-8 in short, dense clusters, usually encircling the stem, sometimes unilateral, amongst leaves on older stems	Flowers mostly 1-5 in short, dense clusters, usually encircling the stems, amongst leaves, usually on younger branches	Flowers (2)4-10 in short, dense clusters, usually unilateral but sometimes encircling the stem, usually on portions of stems without leaves
Filaments per staminal claw 20-25	Filaments per staminal claw 15-20	Filaments per staminal claw (15)16-19(21)
Anthers 0.7-1(1.2) mm long	Anthers 0.5-0.7(1) mm long	Anthers 1-1.5 mm long
Fruit 5-6 mm long, 5-6(7) mm wide	Fruit 4-5(6) mm long, 5-6 mm wide	Fruit 5-6 mm long, 6.2-8(9) mm wide
Fertile seeds 0.7-1 mm long, testa dark grey	Fertile seeds 0.7-1 mm long, testa dull dark brown	Fertile seeds 1.5-2 mm long, testa dark brown to chocolate brown

Comments. Calothamnus accedens is very closely related to *C. brevifolius* T. J. Hawkeswood with which it overlaps in range in the Piawaning-Wongan Hills area. These two species share the following features: short, erect to semi-erect, terete, pilose leaves with oil glands clearly observable on the older, less pilose leaves; flowers in short, dense clusters; depressed globular to almost cylindrical fruits on which the styles do not persist as they do in some other *Calothamnus* species. *Calothamnus accedens* is also very closely related to *C. hirsutus* in gross morphology and these three species may be regarded as a species-group. The main differences and some similarities between the taxa are outlined in Table 1. There is marked variation between the taxa in plant height but this variation may be partly due to climatic or soil factors and not strictly genetic. Therefore plant height may not be a good taxonomic character. The leaves of all three species are similar morphologically, with those of *C. hirsutus* being distinctively longer than those of the other two (Table 1). There is little difference between the leaves of *C. brevifolius* and *C. accedens*, although those of the latter species are usually slightly thicker (Table 1) and often more pilose.

There is some intraspecific variation in the number of flowers per cluster, but *Calothamnus hirsutus* and *C. accedens* usually have a higher number of flowers of larger size than *C. brevifolius* (Table 1). The flowers of *C. accedens* are usually on portions of stems from which the leaves have fallen, while those of the other two species are usually amongst leaves (Table 1). While this may not be a major taxonomic feature, the position of flowers on stems is a readily observable and useful character in the field.

The hairs on the calyx tube of *Calothamnus accedens* resemble those of *C. hirsutus* in being very slender and spreading with the longer ones being over 1 mm long, while those of *C. brevifolius* are slightly thicker, less spreading and less than 1 mm in length.

The number of filaments per staminal claw has proved to be an important character in *Calothamnus* taxonomy (Hawkeswood 1980 and in prep.). However, the three species are not clearly separated on the basis of this feature (Table 1) indicating their very close relationship. Anther length is also an important taxonomic character, but again, *C. accedens* is not clearly separated from its two relatives on the length of anthers since some anthers of *C. hirsutus* and *C. brevifolius* are c. 1 mm or more in length, which overlaps the range in anther size for *C. accedens* (Table 1).

The fruit of all three species are also generally similar, being depressed globular to almost cylindrical in shape, although the size varies. In some cases, one calyx lobe (or rarely two or three) is deflexed over the orifice and remains on the young fruit during the first year (Figure 3) in all three species, but usually the lobe(s) break or erode away with age so that the capsule becomes truncate or almost so.

Calothamnus exhibits little variation in gross seed morphology, but the size and testa colour of the fertile seeds have proved to be of taxonomic significance (Hawkeswood in prep.). These two characters combined appear to be the most important in separating *C. accedens* from the other two taxa presently under consideration (Table 1).

Despite field work in the Piawaning area I failed to find further populations of *Calothamnus accedens*. Only 14 plants were counted growing at or near the entrance of a property between Piawaning and Wongan Hills. Cleared paddocks were present on both sides of the road and only remnants of a heath community grew on the narrow road verge. There appears little chance of the *Calothamnus* surviving in the event of further disturbance to these road verges. It is imperative that this population of *C. accedens* be conserved as this species must be considered rare and endangered on the basis of present knowledge of its distribution. A more detailed search for other populations should also be undertaken by interested botanists in Western Australia.

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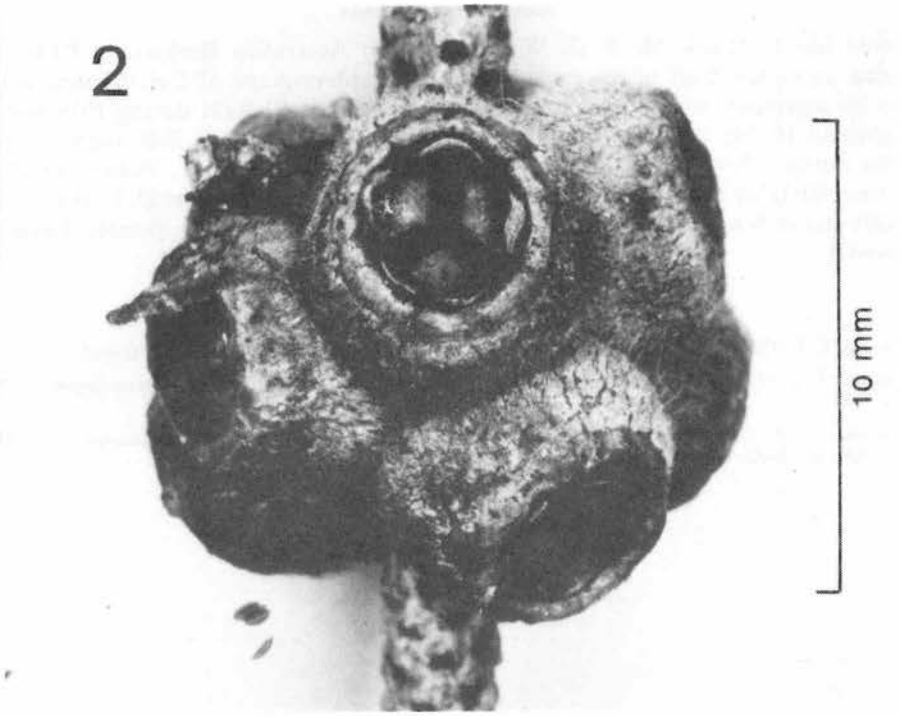

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Figure 2. Close-up of a cluster of young fruits of *C. accedens* (from isotype at PERTH).

Figure 3. Close-up of a young fruit of *C. accedens* showing one persistent calyx lobe deflexed over the orifice (from holotype).

Acknowledgements

I would like to thank Mr P. G. Wilson (Western Australian Herbarium, PERTH) for examining an earlier draft of this paper, for the type photograph of *Calothamnus accedens* and for his assistance while I was undertaking research at PERTH during 1979 and 1980. I am grateful to Mr S. Wilson for accompanying me on various field trips in Western Australia during 1979 and 1980. Thanks are also expressed to Mr L. Pedley (Queensland Herbarium, BRI) for use of microscope facilities. I thank my mother, Mrs D. E. Hawkeswood, for much assistance during this research which was written with private funds while unemployed.

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Eucalyptus ornata (Myrtaceae), a new Silver Mallet from near Kondinin, Western Australia

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Abstract

Crisp, M. D. *Eucalyptus ornata* (Myrtaceae), a new Silver Mallet from near Kondinin, Western Australia. Nuytsia 5(2); 311-315 (1984). A new eucalypt apparently restricted to the region around Kondinin, Western Australia, is described. It is closely related to *Eucalyptus falcata* Turcz., from which it may be distinguished by the prominent ribs on the buds and fruits, and by the shape of the fruits.

Introduction

In January 1979, while searching near Kondinin in the Western Australian wheat-belt for the rare and endangered species, *Daviesia purpurascens* Crisp, a party including myself from the Australian National Botanic Gardens discovered a grove of small silver-barked eucalypt trees with very ornate fruits. Further examination showed these plants to be closely related to *Eucalyptus falcata* but to differ in their conspicuously ornate fruits. At the time of their discovery, these trees bore no mature buds, so I delayed further study of them until such material could be obtained. It was not until September, 1983 that Mrs J. Taylor and Mr P. Ollerenshaw of the Australian National Botanic Gardens were able to obtain mature buds.

The material held under *Eucalyptus falcata* in relevant herbaria (CBG, FRI, NSW, and PERTH) was examined to determine its pattern of variation and its relationship to *E. ornata.* Some additional specimens of *E. ornata* were found among this material, plus an intermediate between *E. ornata* and *E. falcata* in the National Herbarium of New South Wales. The intermediate is discussed in the section on affinity later in this paper. Photographs of the types of *E. falcata, E. gonianthα* and their synonyms were examined at the Herbarium of the CSIRO Divison of Forest Research.

Eucalyptus ornata Crisp, sp. nov. (Figure 1)

Arbor ad 10 m alta, cortice laevi cinereo. Cotyledones bisectae. Plantulae foliis paribus oppositis 10-12 tum alternantibus petiolatis primo lineari-obovatis postea ellipticis. Folia adulta alternantia petiolata angusto-ovata longe acuta falcata. Flores (7)11 in umbellastris axillaribus. Pedunculi et pedicelli longi graciles teretiusculi. Alabastra ovoideo-rostrata costis 7-9 prominentibus. Hypanthium alabastri et fructus costis in prominentias gongylodes ad labrum incrassatis. Stamina pro parte maxima inflexa. Ovula 4-seriata. Semen compresso-ovoideum leviter reticulatum nigrescens.

Typus: 9 km NE of Kondinin, trig point, 32° 27′ S, 118° 21′ E, 25 Sep. 1983, *J. Taylor* 2244 & *P. Ollerenshaw* (holo : CBG 8310890; iso : CBG, K, MEL, NSW, PERTH).

Tree to 10 m tall, with a straight trunk, steeply ascending branches and a high, open crown (Figure 1b); *bark* smooth, grey and white (Figure 1c). *Cotyledons* bisected (Figure 1d). *Seedling leaves* opposite for 10-12 nodes, petiolate, at first linear-obovate, becoming elliptic, obtuse, 12-32 x 2-10 mm (Figure 1d). *Juvenile leaves* alternate, petiolate, ovate

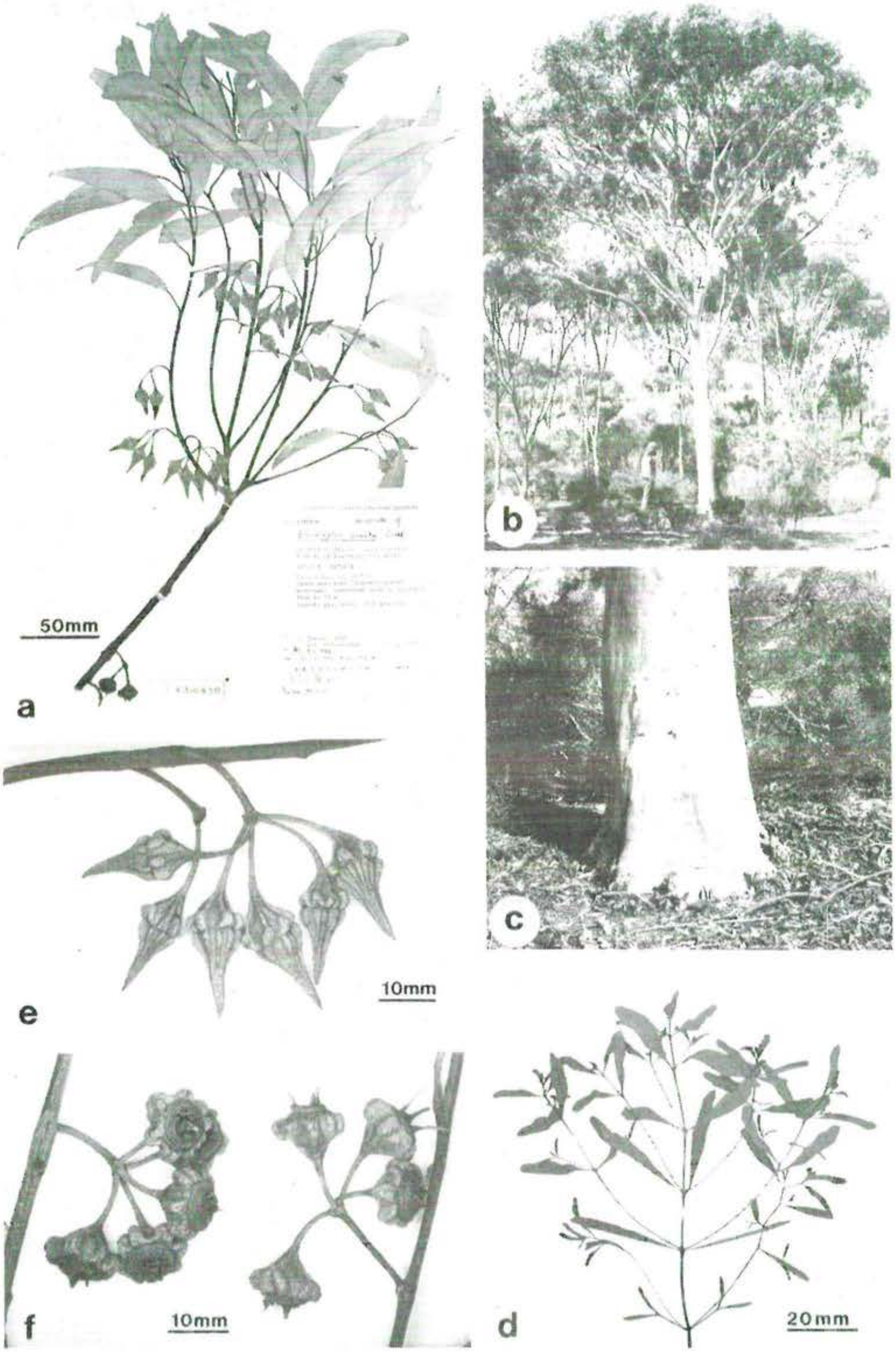

Figure 1. *Eucalyptus ornata* a—Holotype, *Taylor* 2244 (CBG). b—Habit. c—Bark. d—Seedling, from *Crisp* 5522 (CBG 8007431). e—Buds, from isotype (CBG). f—Fruits, from *Crisp* 5522 (CBG).

or elliptic, acute, 35-60 x 15-20 mm, dull, grey-green. *Adult leaves* alternate, spreading to descending, narrow-ovate, mostly curved, long acute, tapered to base, 50-150 x 10-22 mm, glossy, green; petiole 10-20 mm long (Figure 1a). *Unit inflorescence* axillary, solitary, (7) 11-flowered; peduncle decurved, compressed, slender, 12-20 mm long. *Buds* pendulous, ovoid, rostrate, 14-23 x 7-10 mm; hypanthium and operculum prominently 7-9-ribbed; hypanthium with ribs thickened into large knuckle-like protuberances at rim, tapered to pedicel; pedicel slightly angular, slender, 6-15 x 0.5-1 mm (Figure 1e). *Stamens* mostly inflexed in bud; anthers versatile, very broad ovate to square in outline, deeply notched at base. *Ovary* with 3 or 4 locules; ovules in 4 longitudinal rows on the lower part of each placenta. *Fruit* 6-11 x 9-13 mm excluding valves; hypanthium turbinate, tapered to pedicel, ornamented as in bud; operculum scar depressed; staminophore convex; disc collar-like, to 1 mm high; valves 3 or 4, exserted, acicular, 6-10 mm long (Figure 1f). *Seed* ellipsoid, compressed, dorsally rounded, ventrally concave or angular, marginally rounded or acute, c. 2.5 x c. 1.5 x c. 1.25 mm, shallowly reticulate, lustrous, grey-black; hilum ventral.

Additional specimens examined. WESTERN AUSTRALIA: Roe District: 15 miles (24 km) S of Hyden, *J.S. Beard* 3935 (PERTH); trig point 9 km NE of Kondinin, *M.D. Crisp* 5522 (CBG, FRI, NSW, PERTH); ibid., *M.D. Crisp* 6163, *J. Taylor* & *R. Jackson* (AD, CBG, FRI, NSW, PERTH); Kalgarin to Lake Grace, Sep. 1932, *C.A. Gardner* s.n. (PERTH); trig 9 km NE of Kondinin, *K. Hill* 649-50, *L. Johnson, D. Blaxell, I. Brooker* & *S. Hopper* (NSW); ibid., *J. Taylor* 2243 & *P. Ollerenshaw* (AD, CBG, FRI, MO).

Cultivated: New South Wales, Canowindra, garden of W. Bassett, seed ex *C. Gardner*, W. McReaddie, 21 Oct. 1961 (NSW). Australian Capital Territory, Australian National Botanic Gardens, seedlings from Nursery, seed ex *M.D. Crisp* 5522 (CBG 8007431-2).

Distribution (Figure 2). Western Australia: Roe District, east of Kondinin and south of Hyden. *Eucalyptus ornata* occurs at the inland margin of the distribution of *E. falcata*, which is also mapped in Figure 2.

Habitat. At the type locality, *Eucalyptus ornata* is codominant with *E. gardneri* Maiden (Crisp 5520, CBG 7902272) in woodland with a shrubby understorey dominated by *Allocasuarina acutivalvis* (F. Muell.) L. Johnson. The substrate is a yellow-brown sandy loam with ironstone gravel, derived from laterite. Specimens from other localities carry no additional habitat information.

Conservation status. Apparently endangered, coded 2A (criteria from Leigh et al., 1981). The species is known from only three localities over a range of 75 km. The single grove at the type locality extends a short distance along the verges of a road in otherwise cleared land. The status of the other two occurrences is unknown but both are within a region that is mostly cleared for agriculture.

Affinity. This species has an obvious and immediate relationship to *Eucalyptus falcata*, which has been placed in the informal series *Cneorifoliae* by Pryor & Johnson (1971). *Eucalyptus falcata* is a widespread species whose considerable variation is documented by Gardner (1979) and Chippendale (1973). In areas not far from the coast it is a small mallee but at some inland localities it grows into a smooth-barked tree up to 10 m tall, resembling *E. ornata*. These habit forms of *E. falcata* may include an undescribed taxon (Johnson and Blaxell, personal communication). Despite this variation, *Eucalyptus falcata*. is distinguished from *E. ornata* by qualitative characters of fruit shape and bud and fruit ornamentation.

The principal character distinguishing *E. falcata* from *E. ornata* is the nature of the ribbing on the buds and fruits. The hypanthium of *E. falcata* is frequently ribbed both in bud and in fruit but the ribs are usually obscure and are never thickened into prominent knuckle-like projections at the rim, as seen in *E. ornata* (Figure 1e & f). Ribs are rare on the operculum of *E. falcata* and when they do occur, they are narrow, sharp and very slightly raised (e.g. Crisp 6476, CBG). On the type of *E. falcata* (Drummond coll. III no. 70, photos

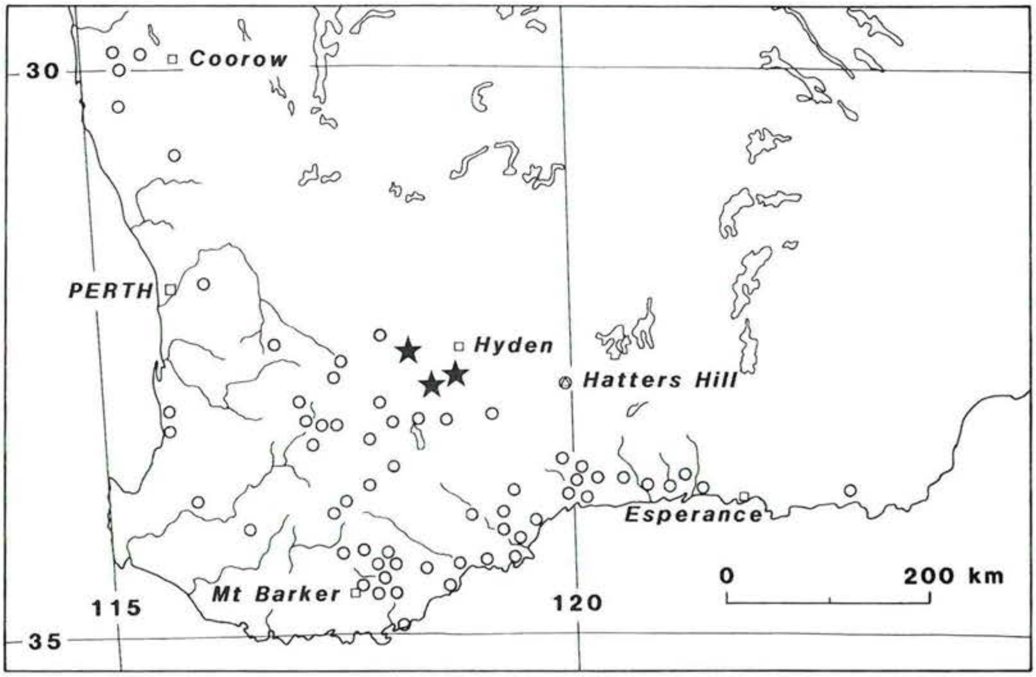

Figure 2. Distribution of *Eucalyptus ornata* (★) and *E. falcata* (o). Map of *E. falcata* incorporates distributional data from the Eucalist data bank at the CSIRO Division of Forest Research.

seen at FRI), the hypanthium is distinctly ribbed but lacks knuckle-like projections at the rim and the operculum lacks ribs altogether.

The shape of the fruit also distinguishes *E. falcata* from *E. ornata*. In *E. falcata* the fruiting hypanthium is hemispherical or depressed-globular, with a truncate base, whereas in *E. ornata* it is turbinate and tapering at the base (Figure 1f).

Leaves of *E. falcata,* both at seedling and adult stages, are indistinguishable from those of *E. ornata.* Bud size varies greatly in *E. falcata* but seems to be generally smaller than in *E. ornata,* at least in breadth. The largest I have seen are 18 x 7.5 mm (Crisp 4960, CBG). Chippendale (1973) gives a range of 14-16 x c. 6 mm for the species (figures derived by adding dimensions given separately for operculum and hypanthium). The operculum is sometimes short and obtuse, sometimes long and acute as in *E. ornata* (e.g. Maiden 1912, t.68).

Apart from the variation in habit mentioned above, *Eucalyptus falcata* also shows considerable variability in buds and fruits. Maiden (1912) established the var. *ecostata* for a form in which the buds and fruits lacked ribs, by contrast with the type of *E. falcata* (see above). However, this variant appears to be trivial, occurring at the same localities as the ribbed form and merging continuously with it. *Eucalyptus dorrienii* Domin, also a synonym of *E. falcata,* differs only in having a slightly shorter, broader operculum (photos of type seen at FRI).

A specimen at NSW from 25 km NW of Kondinin (Blaxell DFB/W75/18a) appears to be intermediate between *Eucalyptus ornata* and *E. falcata.* The buds are of similar proportions to those of *E. ornata* but the operculum is virtually smooth as in *E. falcata,* with only a hint of ribbing. The hypanthium of the bud is ribbed and tends to form projections at the rim, as in *E. ornata* but less markedly so. In fruit, the ribs become obscure as in *E. falcata.* The fruiting hypanthium is turbinate and tapers at the base like that of *E. ornata.*

Another specimen in NSW from the same locality (Blaxell DFB/W75/18) represents typical *E. falcata* and shows no characters of *E. ornata.* Further investigation of this locality may yield typical trees of *E. ornata,* in which case the presence of the intermediate would indicate hybridisation between *E. falcata* and *E. ornata.*

Eucalyptus goniantha Turcz. is placed next to *E. falcata* in the classification of Pryor & Johnson (1971), and has much in common with *E. ornata.* However, it is readily distinguished from *E. ornata* by coriaceous, more broadly ovate leaves, very robust, flattened peduncles, short, thick pedicels and larger, coarser buds and fruits (photo of type, Drummond coll. III no. 71, seen at FRI). The hypanthium of *E. goniantha* is often coarsely ribbed but lacks the thickened, knuckle-like projections of *E. ornata.* Some forms of *E. goniantha,* notably the subsp. *semiglobosa* Brooker (holotype, Brooker 3613, seen at FRI) have longer, more slender peduncles and pedicels but otherwise differ from *E. ornata* in the characters given above. Other species in the informal *Eucalyptus* series *Cneorifoliae* are more distantly related to *E. ornata.*

Acknowledgements

I thank the heads of the herbaria FRI, NSW and PERTH for assisting me with access to their collections. I am grateful to Mr Doug Boland for providing me with information from the Eucalist data bank, to Dr Lawrie Johnson and Mr Don Blaxell who forwent their plans to make the first publication of *E. ornata* when they learned of my intention to do so, to Mr Ian Brooker for making useful comments upon the manuscript and for bringing to my attention two specimens of *E. ornata,* to Mr Ted Aplin for providing me with information and a specimen from the Western Australian Herbarium at short notice, to Mr Ken Hill and Dr Peter Weston for helping me locate specimens in the National Herbarium of New South Wales and to Mr Ron Hotchkiss for providing excellent photographic prints.

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Xanthorrhoea acanthostachya (Xanthorrhoeaceae), a new species of the Perth Region, Western Australia

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Abstract

Bedford D. J. *Xanthorrhoea acanthostachya* (Xanthorrhoeaceae), a new species of the Perth Region, Western Australia. Nuytsia 5(2): 317-321 (1984). *Xanthorrhoea acanthostachya* is described and illustrated. It is distinguished from other *Xanthorrhoea* species in Western Australia by the combination of very elongated, prominent clusterbracts and subulate floral bracts and from *X. australis,* its nearest relative, by its scape length to spike length ratio and leaf colour. Very few examples of the species are known.

Xanthorrhoea acanthostachya Bedford, sp. nov. (Figures 1-3)

X. australi similis, sed scapo plus minusve spicam aequanti et foliis viridibus vel minus glaucis differt. A speciebus Australiae Occidentalis bracteis fasciculorum conspicuis elongatissimus ad maturitatem et bracteis floralibus subulatis distinquenda.

Typus: Chatfield Rd, South Western Highway, Western Australia, 24 Nov. 1982, *D. J. Bedford* 4 and *T. D. Macfarlane* (holo: NSW; iso:PERTH).

Trunk short to 1.5 m tall, crowns 1 to 2. *Leaves* (terminal) in more or less hemispherical crowns, 60-70 cm long, quadrate-rhombic in transverse section, 2-2.25 mm wide and 1.5-2 mm thick, green to slightly glaucous. *Leaf-base* swollen and rigid at the junction with the leaf. Scape 40-50 cm long, 7-16 mm diam. *Spike* usually more or less equal in length to scape, (20)40-50(90) cm long and 20-40 mm diam., prickly in appearance. *Cluster-bracts* very elongated, subulate in shape, dilated at the base, usually very prominent (occasionally slightly prominent), glabrous, rarely subglabrous. *Packing-bracts* (floral bracts) subulate in shape, often twisted or folded, subglabrous to glabrous (except for occasional large bracts, which have a line of hairs along the centre of the back and hairs at the margins below the tip). *Sepals* short, acute, with short beak at the tip, glabrous except for a tuft of hairs in the beak. *Petals* more or less erect at anthesis, sometimes beaked, with an adaxial proboscis, soft and membranous, glabrous except for short hairs in and around the tip, and hairs covering the proboscis. *Fruit* acute at the tip with a persistent long style-base-point, dark brown at maturity. *Seeds* dorsi-ventrally flattened, narrow ovate to ovate (Systematics Association (1962) figures 37-38), triangular in median transverse section, semi-matt black, 11-12 mm long by 4.5-5.5 mm wide, when fully mature. (Terminology as per Lee (1966a and b) and Systematics Association (1962)).

Other specimens examined. WESTERN AUSTRALIA: Harvey Dam Reserve, 13 Nov. 1981, *T.D. Macfarlane* 659 (PERTH); Keysbrook, Nov. 1900, *W.V. Fitzgerald* NSW 154569 (NSW); 5 miles E of Mogumber, 25 Aug. 1970, *K.M. Allan* s.n. (spirit collection only) (PERTH).

Distribution. At present *X. acanthostachya* is known only from four sites in the Perth Region of W.A. as defined by Marchant and Perry (1981).

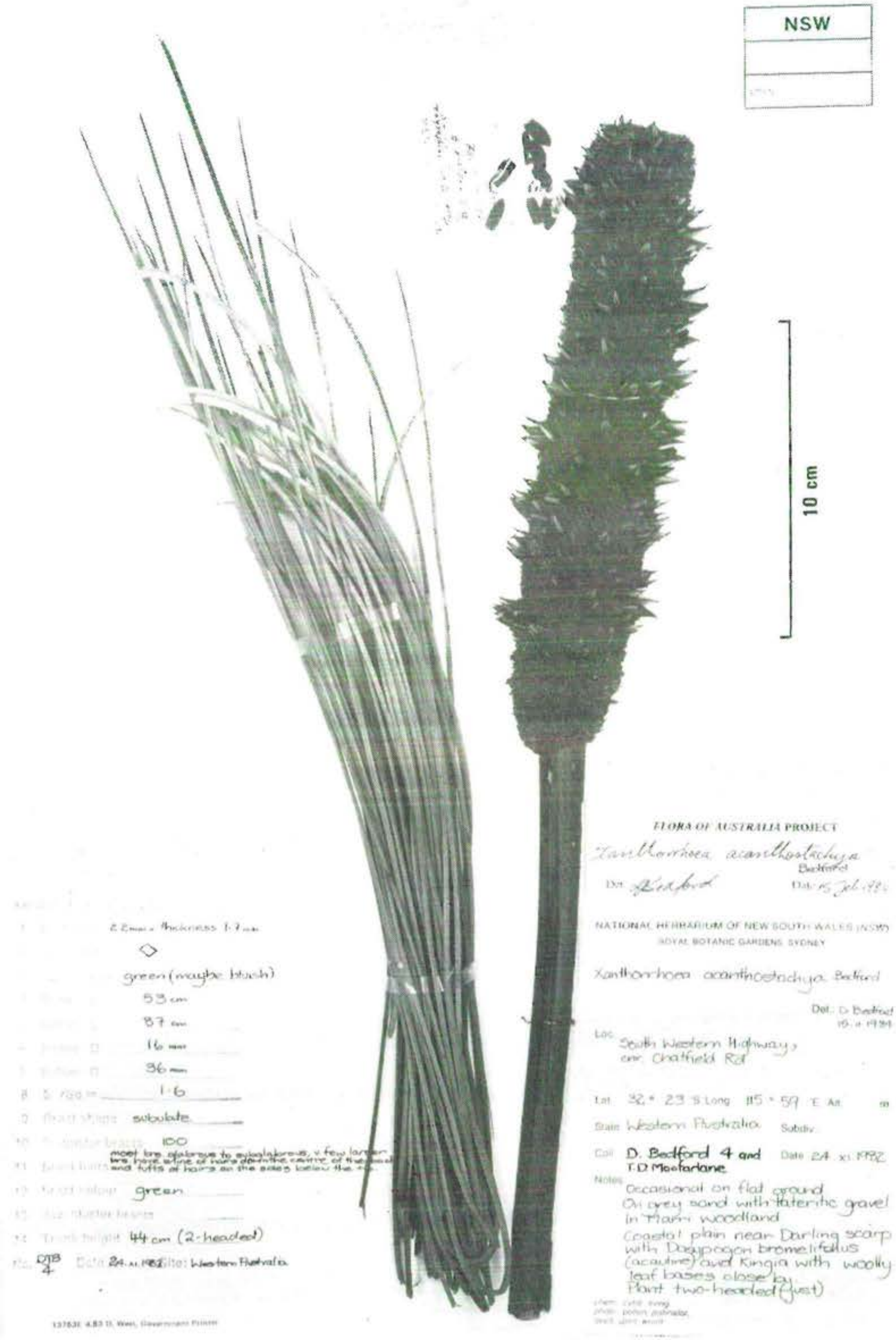

Figure 1. *Xanthorrhoea acanthostachya*, holotype specimen in herb. NSW.

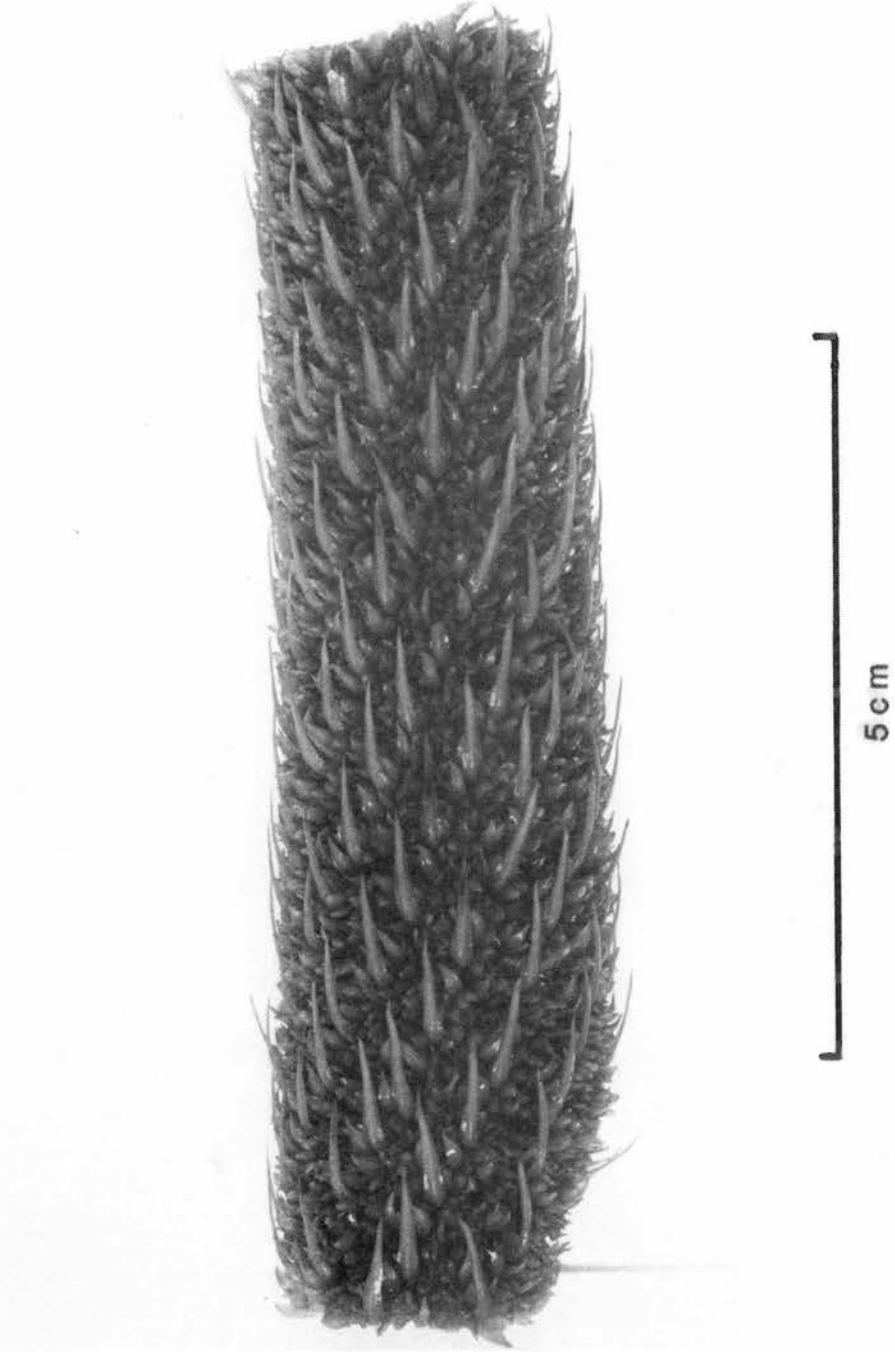

Figure 2. *Xanthorrhoea acanthostachya*, close-up view of immature spike, showing very prominent cluster-bracts. *K. M. Allan* s.n., 5 miles E of Mogumber, W. Austral., 25 Aug. 1970.

Ecology. The species occurs on the coastal plain in grey sand overlain by lateritic gravel, often with *Dasypogon bromeliifolius* and *Kingia australis*, and on steep slopes in stony lateritic soil in Jarrah (*Eucalyptus marginata*) woodland.

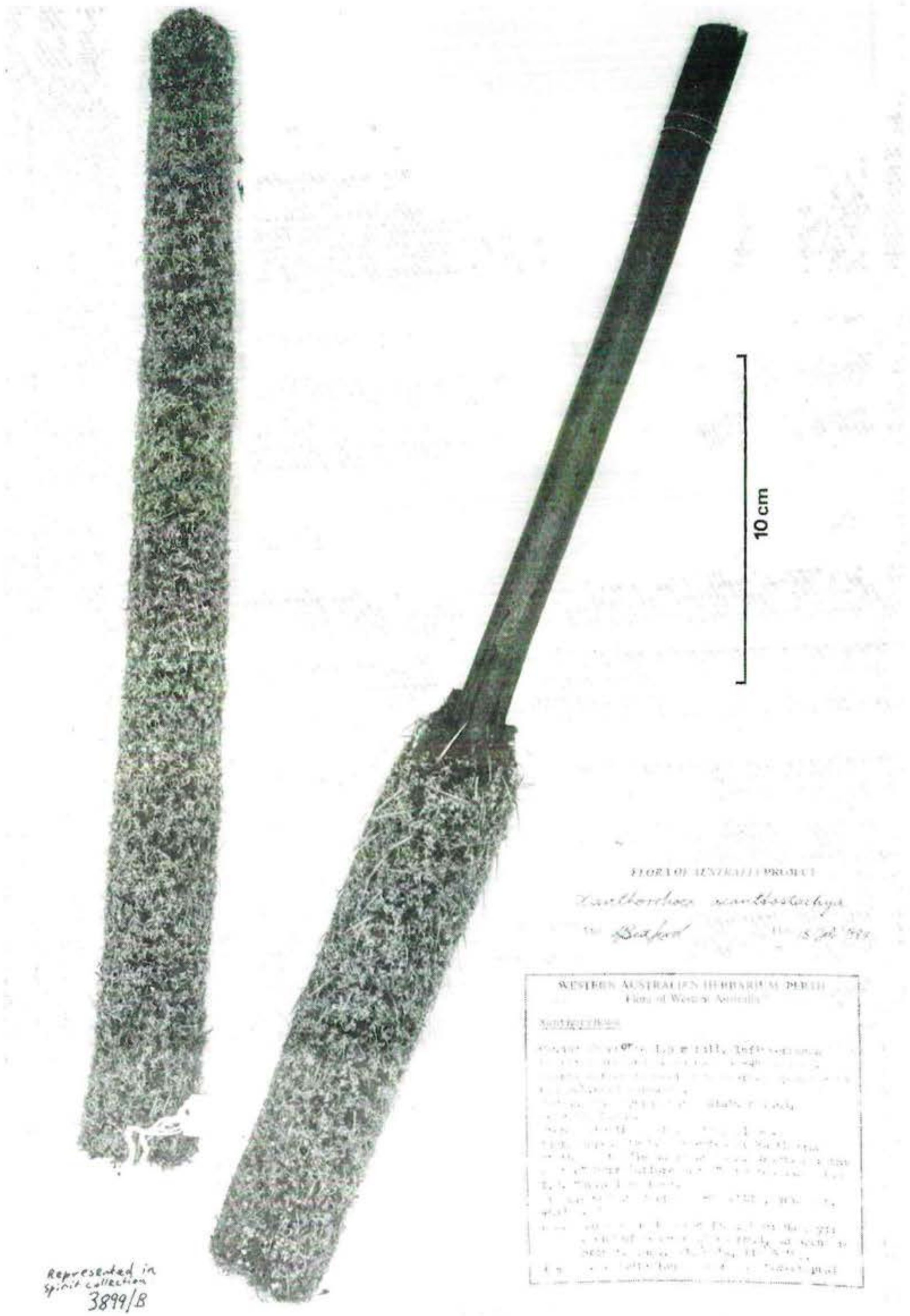

Figure 3. *Xanthorrhoea acanthostachya*, mature flowering spike showing exceptionally long prominent cluster-bracts. *T. D. Macfarlane* 659, sheet 1.

Flowering period. Young flowering spikes have been collected in August and flowering and recently fruiting spikes have been collected in November.

Affinities. There are no obvious allies of *Xanthorrhoea acanthostachya* in Western Australia, although its leaves are at least superficially similar to those of *X. preissii. X. australis* of eastern Australia has similarly shaped bracts and leaf cross-sectional shape, and is therefore probably the most closely allied species. *X. semiplana* of South Australia has similarly shaped floral bracts to *X. acanthostachya* but is a much more massive plant with large broad transverse-rhombic median transverse section leaves.

Xanthorrhoea acanthostachya differs from *X. australis* in (a) scape length to spike length ratio; *X. acanthostachya* has scape length more or less equal to spike length, *X. australis* always has a much shorter scape than spike (less than ½ the length), (b) leaf colour; *X. acanthostachya* has green to slightly glaucous leaves, *X. australis* has very glaucous leaves, (c) sepals; *X. acanthostachya* has short, acute sepals, with a short beak at the tip, without a proboscis in the beak, *X. australis* has subulate shaped sepals with a long narrow beak at the tip, often with a proboscis in the beak, (d) petals; *X. acanthostachya* petals sometimes have a beak, *X. australis* petals never have a beak.

Etymology. The specific epithet is from the Greek *akantha*, meaning a thorn or prickle, and *stakhys*, an ear of grain or a spike, in reference to the distinctly thorny or prickly appearance of the spike due to the prominent cluster-bracts.

Acknowledgements

I wish to thank Dr Terry Macfarlane for help with my field studies on *Xanthorrhoea* in Western Australia, Mrs Karen Wilson for advice with the Latin diagnosis and Ms Anna-louise Quirico for technical assistance. The research and field work were undertaken with the aid of a grant from the Australian Biological Resources Study.

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Acacia conniana, a new name for a Western Australian *Acacia* section *Juliflorae* species (Leguminosae: Mimosoideae)

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Abstract

Maslin, B. R. *Acacia conniana*, a new name for a Western Australian *Acacia* section *Juliflorae* species (Leguminosae: Mimosoideae). Nuytsia 5(2): 323-325 (1984). The name *Acacia conniana* Maslin replaces the illegitimate homonym *A. cognata* Maiden et Blakely (1928). *Acacia acuminata* var. *latifolia* Benth. is relegated to synonymy under *A. conniana*. The distinguishing features between *A. conniana* and its closest relative, *A. lasiocalyx*, are discussed.

Introduction

The following new name is required for inclusion in a forthcoming paper by E. E. Conn and myself on cyanogenic Australian *Acacia* species. The taxon was originally described by Bentham (1864) as a variety of *A. acuminata* and later as a distinct species by Maiden and Blakely (1928). Maiden and Blakely's name, *A. cognata*, is illegitimate, being a later homonym of *A. cognata* Domin (1926) and therefore must be replaced. Blakely was aware of the need to replace the name *A. cognata* because in an undated, unpublished manuscript (copy found among papers belonging to the late C. A. Gardner) he proposed a new name for it.

Acacia conniana Maslin, nom. nov.

Base name: *Acacia cognata* Maiden et Blakely

Acacia cognata Maiden et Blakely, J. Roy. Soc. W. Austral. 13:28 pl.20 figs. 1-5 (1928), non Domin (1926). *Type*: Israelite Bay, W.A., Sept. 1915, *J. P. Brookes* s.n. (iso: K, MEL, PERTH — fragment).

Acacia acuminata var. *latifolia* Benth., Fl. Austral. 2:404 (1864). *Lectotype* (here selected): Middle Island, W.A., *Maxwell* s.n. (K — right hand specimen on sheet annotated "Negative No. Kew 454"; iso: K; possible iso: MEL — see discussion below).

Distribution and habitat. South-east Western Australia in the Eyre Botanical District (1:250,000 maps I51-6, 7, 10 and 11). Restricted to coastal and near-coastal areas from Cape Le Grand (25 km southeast of Esperance) east-northeast to near Israelite Bay (about 190 km east of Esperance); recorded from both Mondrain Island and Middle Island in the Recherche Archipelago, east of Esperance. The most inland record is R. A. Saffrey 1249 from near Mt Sparkle which is about 40 km from the coast. The species is normally found associated with granite rocks.

Typification. Although I have not seen the holotype of *Acacia cognata* Maiden et Blakely I have examined isotypes at herb. K and MEL as well as a fragment of isotype at PERTH. The Kew specimen is ex herb. NSW and is labelled "Acacia cognata Maiden et Blakely. Israelite Bay, J. P. Brookes, 9/1915" in what I believe is Maiden's handwriting. The original description of the species is quite comprehensive and is accompanied by a fine illustration. I therefore have no doubts about the application of this name and accordingly have based *A. conniana* on it.

Table 1. Principal distinguishing features between *Acacia conniana* and its closest relative, *A. lasiocalyx.*

Attribute	*A. conniana*	*A. lasiocalyx*
Habit*	Dense, bushy shrubs or trees 2-5(6) m high, branchlets and phyllodes seemingly erect	Spreading or erect tall shrubs or trees commonly 3-7 m high ((sometimes to 12 m), canopy rather loose and open (often bushy on young plants), branchlet extremities or phyllodes often rather pendulous
Bark (mature plants)*	Grey or dark red-brown, with longitudinal fissures (of a fawn colour) at base of main trunks; upper branches and branchlets not pruinose	Fibrous and grey at base of main trunks; smooth, pruinose and brown, reddish, pinkish or orange on upper branches; branchlet extremities often not pruinose
Phyllodes —length (mm)	(50)80-160	120-260(320)
—width (mm)	(3-4)5-12	2-6(9)
—l/w	10-25(40)	(20)30-80(150)
—aspect	Ascending to erect; seemingly neither lax nor pendulous	Often pendulous or sub-pendulous, lax and rather strap-like
Flowering peduncle length (mm)	4-10	7-18
Flowering spike length (mm)	10-25	(15)20-40(50)
Areole	Closed or with a narrow opening at hilar end, narrowly oblong, 3.5 mm long	Open "u"-shaped, 0.5-1 mm long
Distribution	Restricted to southern regions in coastal-near coastal areas (extending 40 km inland) from Cape Le Grand to Israelite Bay (1:250,000 maps: I51-6,7,10,11)	Widespread in wheatbelt region of the south-west from Coorow southeast to Bremer Bay and Mt Burdett (1:250,000 maps: H50-6,10, 11,14,15,16; I50-2,3,4,7, 8,12; H51-9,13; I51-1,2, 5,6)

* I have examined only a single population of *A. conniana.* Additional field studies are required to assess the range of variation in habit, bark and phyllode aspect for this species. The parameters listed above for these attributes are derived principally from herbarium labels.

The type of *A. acuminata* var. *latifolia* at herb. K consists of two sheets both of which are stamped "Herbarium Hookerianum" and labelled by Bentham as *A. acuminata* var. *latifolia.* Each sheet supports two specimens which although showing some variation in phyllode width, are all referable to the same taxon. The specimen selected as lectotype is indicated above. I have compared this lectotype with the isotype of *A. cognata* at herb. K and there is no doubt that the two are the same taxon. At herb. MEL there are two specimens of *A. conniana* from Middle Island which are labelled "TYPE". No collector is given on these specimens so their type status cannot be accurately ascertained, however, they may be isotypes. Someone (seemingly Bentham) has annotated one of these sheets as "Acacia drepanophylla F.M." but this name was never published for this taxon.

Affinities. Acacia conniana is most closely allied to *A. lasiocalyx* C. R. P. Andrews and the principal differences between the two species are given in Table 1. The most obvious features distinguishing *A. conniana* from *A. lasiocalyx* are its non-pruinose branches, its larger seed areoles, its generally shorter, broader, erect phyllodes and its more southerly distribution. Current indications are that *A. conniana* and *A. lasiocalyx* are allopatric. The latter species is widespread in the wheatbelt area of south-west Western Australia (Maslin and Pedley 1982) and like *A. conniana* is often associated with granite rocks. The closest records of *A. lasiocalyx* to *A. conniana* are from the Wittenoom Hills-Mt Ney area, about 50 km northeast of Esperance. I have examined the area south of Wittenoom Hills to Merivale Road (where B. R. Maslin 5544, *A. conniana*, was collected) and have not been able to find either species. This area, however, is intensively cultivated. Further field work in the region east of Mt Ney is necessary to ascertain the extent, if any, of overlap in range between these two species.

Etymology. The species is named in honour of Professor Eric Conn, University of California, Davis, in recognition of his biochemical work on cyanogenesis in plants, including *Acacia*. During the past two years the present author and Eric Conn have been examining cyanogenesis in Australian species of *Acacia* and the results of this research are soon to be published elsewhere.

Index to specimens of *Acacia conniana* studied

Unless otherwise stated the specimens listed here are lodged at the Western Australian Herbarium (PERTH).

Aplin, T.E.H. 2612 and 4245; *Brookes J.P.* s.n. Sept. 1915 — type of *A. cognata* (K, MEL, PERTH — fragment); *Brown, A.* 178; *Daniell, T.C.* s.n. Dec. 1964 (K); *Donner, N.N.* 2650; *Edinger, D.J.* 187: *Eichler, Hj. 20068; Goodwin, J.* 251; *Hart, C.* s.n. Feb. 1984; *Haegi, L.* 1227 and 1233; *Hnatiuk, R.J.* 761177; *Hopper, S.D.* s.n. 9 Sept. 1982; *Jackson, E.N.S.* 1241 and 1314; *Maslin, B.R.* 5544 (CANB, PERTH); *Maxwell, G.* s.n. type of *A. acuminata* var. *latifolia* (K. ?MEL); *Muir, B.G.* 501, 502 and s.n. 15 Nov. 1983; *Newbey, K.* 8058; *Orchard, A.E.* 1105; *Royce, R.D.* 6206; *Saffrey, R.A.* 1249 (BRI, MEL, MO, PERTH) and 1369 (CANB, K, PERTH); *Weston, A.S.* 7201, 8917, 8921 and 10775; *Wilson, P.G.* 3079 and 8125 (AD, NSW, PERTH).

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