The phytogeography, ecology and conservation status of *Lechenaultia* R.Br. (Goodeniaceae)

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Abstract

Morrison, D.A. The phytogeography, ecology and conservation status of *Lechenaultia* R.Br. (Goodeniaceae). Kingia 1(1): 85-133 (1987). Distribution maps for each of the 25 known species of *Lechenaultia* are presented for 0.5° lat. x 0.5° long. grid cells, along with discussions of the habitat, flowering period, morphology, and conservation status. Nineteen of the species are endemic (or nearly endemic) to south-western Western Australia. An isoflor map of this region indicates a high node of species-richness on the northern sandplains, with a band of moderate species-richness running south-eastwards to the southern sandplains. This species-richness band follows the 400 mm annual rainfall isohyet, and corresponds with the kwongan heathlands and the wheatbelt.

Ordination, cluster and discriminant function analyses of the distribution of these 19 *Lechenaultia* species suggests that there are five biogeographic regions:- one area on the far northern sandplains, one on the northern sandplains and northern part of the wheatbelt, one in the jarrah woodlands and karri forests, one on the southern sandplains and southern part of the wheatbelt, and one in the inland mallee area. Discriminant function analyses of the distribution of these 19 *Lechenaultia* species among the phytogeographic regions of Beard and Barlow indicate that they are both accurate reflections of the *Lechenaultia* distributions.

Similarity coefficients of species presence among the phytogeographic regions of Beard indicate that the Irwin, Darling and Avon Botanical Districts are more similar to each other than they are to the Eyre and Roe Botanical Districts; while cladistic analysis of endemic species indicates that the Irwin, Roe and Eyre Districts have a more similar history. This suggests that there has been fairly widespread dispersal of some species in recent times.

Lechenaultia laricina is considered to be an endangered species, with *L. juncea*, *L. longiloba* and *L. pulvinaris* vulnerable, and *L. acutiloba* and *L. superba* rare; *L. chlorantha* and *L. ovata* are too poorly known for the conservation status to be known. Only three of these species are confidently known to be represented in conservation reserves, with two of the others thought to be present.

Introduction

The Goodeniaceae are well-represented in the flora of Western Australia (Marchant 1973), and they are one of the commonly encountered families in the heathlands of the south-west (George et al. 1979, Lamont et al. 1984). Within this family, *Lechenaultia* R.Br. is one of the most interesting genera. It is restricted to Australia and New Guinea, with all of the 25 recognised species occurring in Australia (Morrison 1986). Nineteen of the species are endemic (or nearly endemic) to south-western Western Australia, with one species on North-West Cape, two species in arid western Central Australia, one in arid eastern Central Australia, one restricted to a small area of the Northern Territory, and one species widespread across tropical northern Australia and extending to the southern coast and off-shore islands of New Guinea.

Most of the species are small perennial sub-shrubs or herbs, with only *Lechenaultia acutiloba*, *L. divaricata* and *L. linarioides* becoming shrubs over 1 m high. The plants are widespread but never dominant components of the flora of south-western Western Australia, occurring in woodland, forest, and especially heath (George et al. 1979, Specht 1981, Lamont et al. 1984).

This paper provides previously unpublished notes on the ecology, morphology, and conservation status of all of the species, as well as presenting the distribution data. The phytogeography of the South-West Botanical Province of Western Australia is also analysed in relation to the distribution and phylogeny of *Lechenaultia*.

Methods

The data presented were obtained from the herbarium collections housed at AD, BRI, CANB, CBG, LD, MEL, NT, PERTH and SYD, plus the type collections of CGE and S (codes as in Holmgren et al. 1981), supplemented by field observations of some 70% of the species (all from south-western Western Australia). The taxonomic scheme used was that of Morrison (1986).

The distribution of each species was recorded on a map of Australia subdivided into a 0.5° latitude by 0.5° longitude grid, corresponding to the 1:100,000 topographic survey maps of the Division of National Mapping, Commonwealth Department of Natural Resources.

Within the *Lechenaultia* distribution, only the South-West Botanical Province of Western Australia contains enough species for the analysis of phytogeographic patterns in detail. Consequently, the phytogeographic analyses concentrated on this area.

Two species-richness (isoflor) maps of the South-West Botanical province were derived from the distribution data. The first presented the species distribution based solely on validated herbarium records. However, as this is presumably an incomplete record, due to sparse collecting in some areas and land clearance in others, a second map presented the distributions as they could be conservatively inferred from the recorded distribution. For most species, this second map differed from the first only in one or two grid cells; and this second map was assumed to be superior to the first as a true representation of the species' distributions. It was therefore these inferred distributions that were used in the phytogeographic analyses.

The pattern of variation among the distributions of the 19 *Lechenaultia* species present in the South-West Botanical Province was analysed simultaneously using an ordination technique, detrended correspondence analysis (Hill 1979a), on the presence or absence of the species in each of those 130 grid cells that occur in the South-West Botanical Province. This non-linear technique is reported to be superior to the traditional linear ordinations (Gauch et al. 1977, Hill and Gauch 1980, Gauch et al. 1981), and this appears to be true for the data sets for which I have made comparisons. The pattern of variation among the 130 grid cells was analysed by ordinating the presence or absence of each of the 19 *Lechenaultia* species in each cell.

The clustering pattern of the 130 grid cells was investigated using a clustering strategy, two-way indicator species analysis (Hill 1979b), on the presence or absence of the 19 *Lechenaultia* species in each grid cell. This polythetic divisive technique is reported to be superior to traditional agglomerative techniques (Gauch and Whittaker 1981), and this appears to be also true for the data sets that I have used.

The predictability of the phytogeographic clusters formed by this analysis was tested using discriminant function analysis (Klecka 1975). This technique derives a small number of linear functions that weight the original discriminating variables (in this case, presence or absence of each of the 19 *Lechenaultia* species) so as to maximise the separation of the total scores of a set of reference samples summed over all of the variables. In this case, the reference samples consisted of each of the 0.5° x 0.5° grid cells that make up a particular phytogeographic cluster. Each of the grid cells was then individually re-classified using the discriminant functions derived from the original analysis, to see if the they were correctly classified into the particular phytogeographic region to which they were originally assigned. This technique effectively weights the species by constancy within groups (ie. minimal within-group variance and maximal between-group variance), and this approach to assessing classifications has been suggested by several people (Farris 1966, Johnson 1982).

The relationships between the *Lechenaultia* species distributions and the phytogeographic regions of Beard (1980d) and Barlow (1985) that cover the South-West Botanical Province (see Figures 6a and 6b) were also analysed using discriminant function analysis. For the Barlow (1985) regions, assigning each of the 131 grid cells to a particular region was straightforward, as this system is based on a 1° x 1° grid; while for the Beard (1980d) regions, which are based on vegetation physiognomy, those grid cells near the boundaries of the regions were assigned to the region that occupied the greatest portion of the cell. Once again, each of the grid cells was then individually re-classified using the discriminant functions to see if the they were correctly classified into the particular phytogeographic region to which they were originally assigned. A comparison was also made between the original Barlow (1984) regions and the modified regions of Barlow (1985), to see if there was any significant improvement in the predictivity of the modified regions compared to the original.

The relationships among the five south-western phytogeographic regions of Beard (1980d), as related to *Lechenaultia*, were analysed in two ways. Firstly, the overall superficial similarity was assessed using two similarity indices:- the Jaccard Coefficient and the Simple Matching Coefficient (Hubalek 1982).

Secondly, the historical relationships among the regions were analysed by converting the *Lechenaultia* morphological cladogram of Morrison (1987) into an area cladogram. This was done by simply superimposing the phytogeographic regions of Beard (1980d) onto the cladogram (cf. Nelson and Platnick 1981). Unfortunately, the cladogram as it stands (Figure 7a) is uninformative (or falsely informative; Platnick 1981) as far as the phytogeographic regions are concerned, because too many of the species occur in several of the regions. Therefore, the area cladogram was reduced to only those 11 species that are endemic to one of the phytogeographic regions plus those 3 species that are more characteristic of only one region (Figure 7b). While this potentially results in the loss of information (Platnick 1981), it does allow the cladogram to be resolved to a simple informative five-area cladogram. Those species excluded from the analysis were *L. biloba*, *L. floribunda*, *L. formosa*, *L. macrantha* and *L. tubiflora*, which are all widespread generalist species, while *L. acutiloba* was considered typical of the Eyre region and *L. linarioides* and *L. stenosepala* typical of the Irwin region.

The predominant geographical modes of speciation shown by *Lechenaultia* in Australia were investigated by studying the distributions of pairs or groups of closely related species, as defined by the taxonomic system of Morrison (1986).

Results and Discussion

The distribution maps, and the notes on morphology, ecology, and conservation status are presented in Appendix 1. The species present or presumed to be present in each of the 0.5° x 0.5° grid cells of south-western Western Australia are listed in Appendix 2.

Most of the south-western species occur in shrubland of some sort, although several species also occur in woodland or mallee. Only *L. biloba* is known from forests. The inland species usually occur in open grassland or woodland. All of the species occur in freely-draining sand or lateritic gravelly soils, except for *L. expansa*, which occurs in permanently wet areas. All of the species apparently have woody rootstocks, some of which can spread laterally. This may allow them to regenerate vegetatively after a fire or a dry spell.

The main flowering period for the genus is October and November, as shown in Figure 1. However, many of the species flower sporadically throughout the year, perhaps only after rain or a fire.

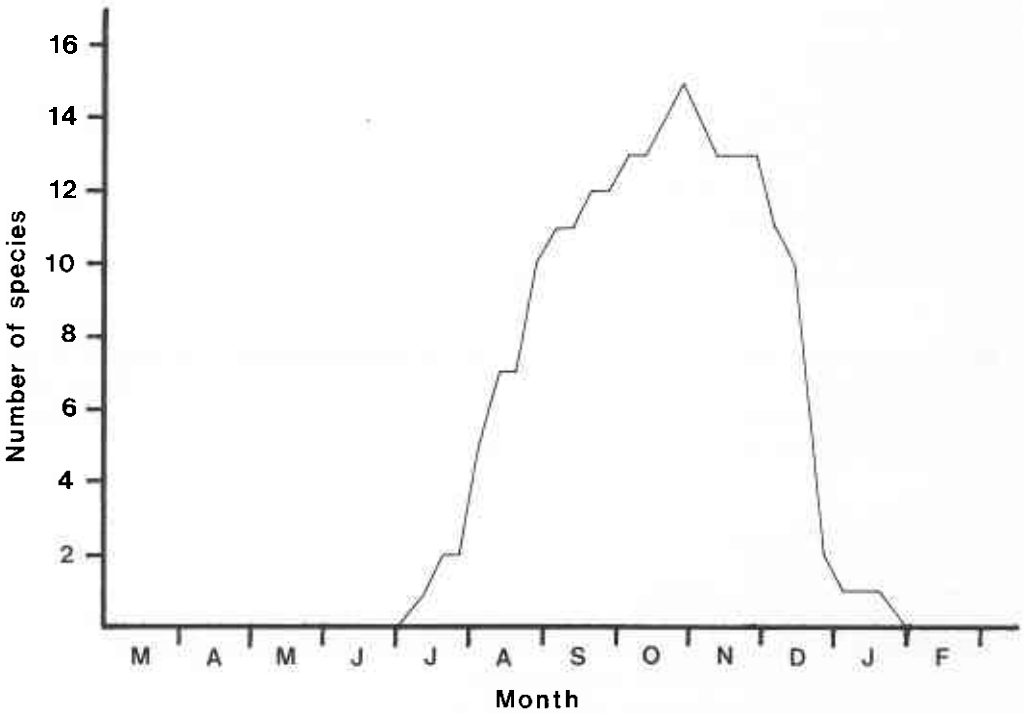


Figure 1. Number of *Lechenaultia* species flowering per week in south- western Western Australia. Data from Appendix 1.

Table 1 summarises the conservation status for those species considered to be at risk. Six of the species (24%) are thought to be under threat, all of them from the South-West Botanical Province of Western Australia. A further two species are too poorly known for their conservation status to be accurately determined. Three of the species are thought not to occur in conservation reserves, while two others have not been recently confirmed as present in them. Rye et al. (1980) and Burgman and Hopper (1982) report only two of these species to be exploited in the wild by the wildflower industry, although 32% of the total number of *Lechenaultia* species are exploited. Nearly all of this exploitation is for the nursery trade.

Table 1. Summary of the conservation data for the *Lechenaultia* species considered to be at risk.

Conservation Category *	Leigh et al. (1981) +	This study +
Extinct (X)	—	—
Endangered (E)	*L. longiloba* (C)	—
	L. pulvinaris	—
	—	*L. laricina*
Vulnerable (V)	*L. juncea*	*L. juncea*
	—	*L. longiloba* (C?)
	—	*L. pulvinaris* (C)
Rare (R)	*L. acutiloba* (C)	*L. acutiloba* (C)
	L. superba (C)	*L. superba* (C)
	L. chlorantha (C)	—
Poorly Known (K)	—	*L. chlorantha* (C?)
	—	*L. ovata*

* See Leigh et al. (1981) for a detailed explanation
\+ C - species known from conservation reserves. ? - not recently confirmed to be present

The two maps of the species-richness isopleths are shown in Figures 2a and 2b. The isoflor map of Figure 2b indicates a high node of species richness on the northern sandplains, with over 44% of the species occurring in a grid cell south-east of Eneabba. This is in accord with the comments of George et al. (1979), who consider *Lechenaultia* to be characteristic species of the floristically rich heathland between the Moore River and Dongara. A band of moderate species-richness then runs south-east through the wheatbelt, and then extends eastward along the southern sandplains past Esperance. The kwongan heathlands predominate on both the northern and southern sandplains of this species-rich area, with eucalypt and banksia woodlands occupying the intermediate wheatbelt. The Jarrah, Marri and Karri forests of the extreme south-west are relatively species-poor, as are the woodlands and shrublands of the inland area.

This band of species richness roughly follows the 400 mm annual rainfall isohyet, with the 800 mm isohyet defining the transition to the species-poor area of the south-western forests and the 300 mm isohyet defining the eastern limit of *Lechenaultia* distribution. This distribution appears to be a recurrent pattern at the generic level in the flora of south-western Australia, with many examples appearing in a wide range of families (eg. Haemodoraceae, Proteaceae, Rutaceae, Mimosaceae, Myrtaceae; see Hopper 1979, Lamont et al. 1984). This has resulted in the recognition of three species-richness zones in south-western Australia:- one in the Eneabba-Mt Lesueur area, one in the Stirling Ranges, and one near the Fitzgerald River (George et al. 1979). It is therefore interesting to note that *Lechenaultia* does not appear to have the expected node in the Stirling Ranges.

One of the apparent reasons for the high species richness in the kwongan heathlands is the high number of localised endemics compared to the wheatbelt and the species-poor areas. There are three extremely localised endemics (*L. chlorantha*, *L. juncea* and *L. longiloba*) in the northern kwongan and another three in the southern kwongan (*L. acutiloba*, *L. heteromera* and *L. superba*), while the wheatbelt only has two localised endemics (*L. laricina* and *L. pulvinaris*) and the other areas none.

A comparison of Figures 2a and 2b highlights several apparently sparsely collected areas in the South-West Botanical Province. The only species with any large remaining disjunctions in its distribution is *L. formosa* (Morrison 1986); the other gaps in the species distributions are therefore presumably the result of under-collection or the destruction of populations due to agricultural clearance. The most obvious under-collected area is the eastern half of the Roe Botanical District. This is an area of mallee that has only recently become easily accessible to botanical collectors, and it

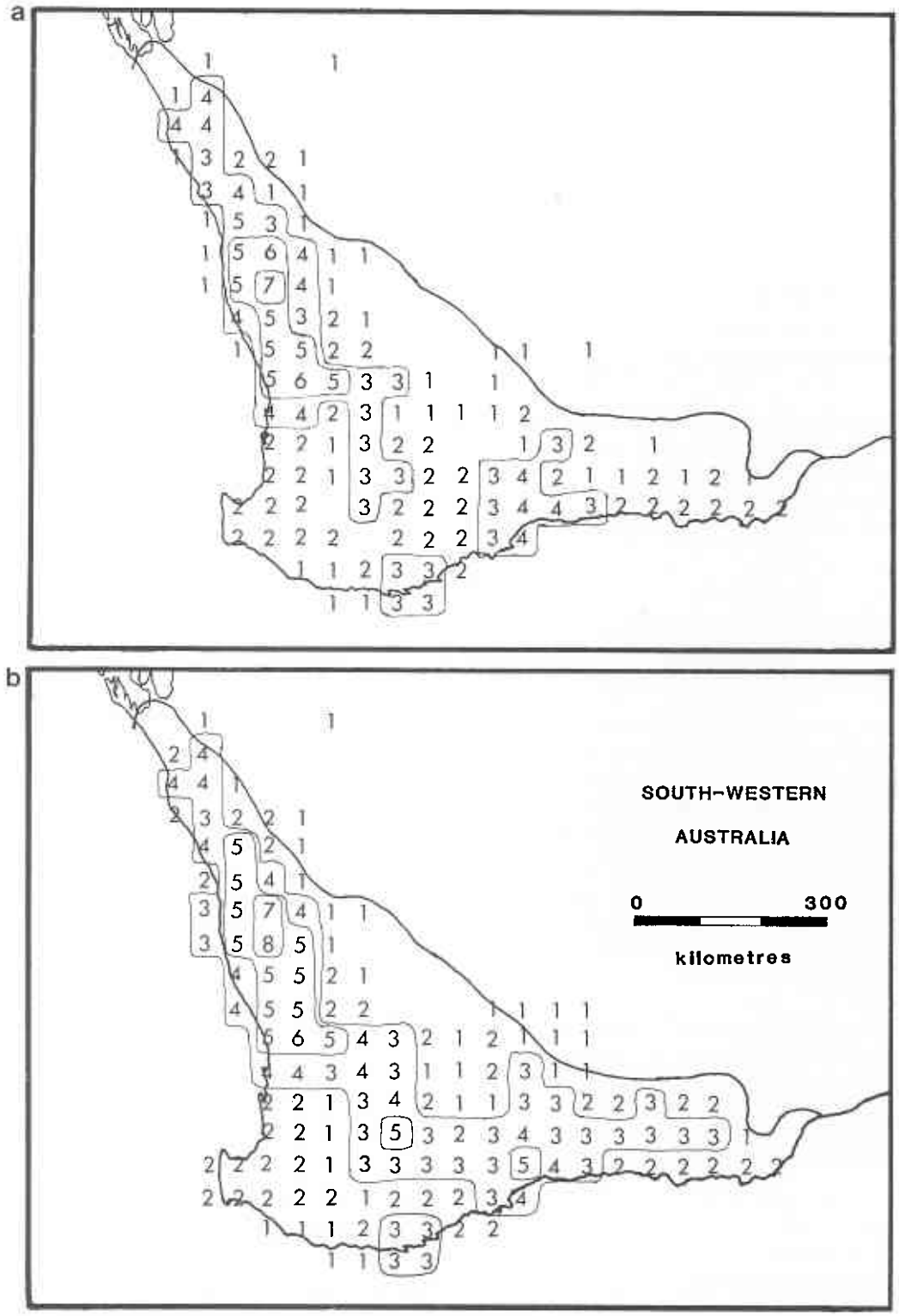


Figure 2. Isoflor maps of *Lechenaultia* species in 0.5° x 0.5° grid cells, based on validated herbarium records (Figure 2a) and on inferred species distributions (Figure 2b). Contour interval is 2 species. Data from Appendix 2.

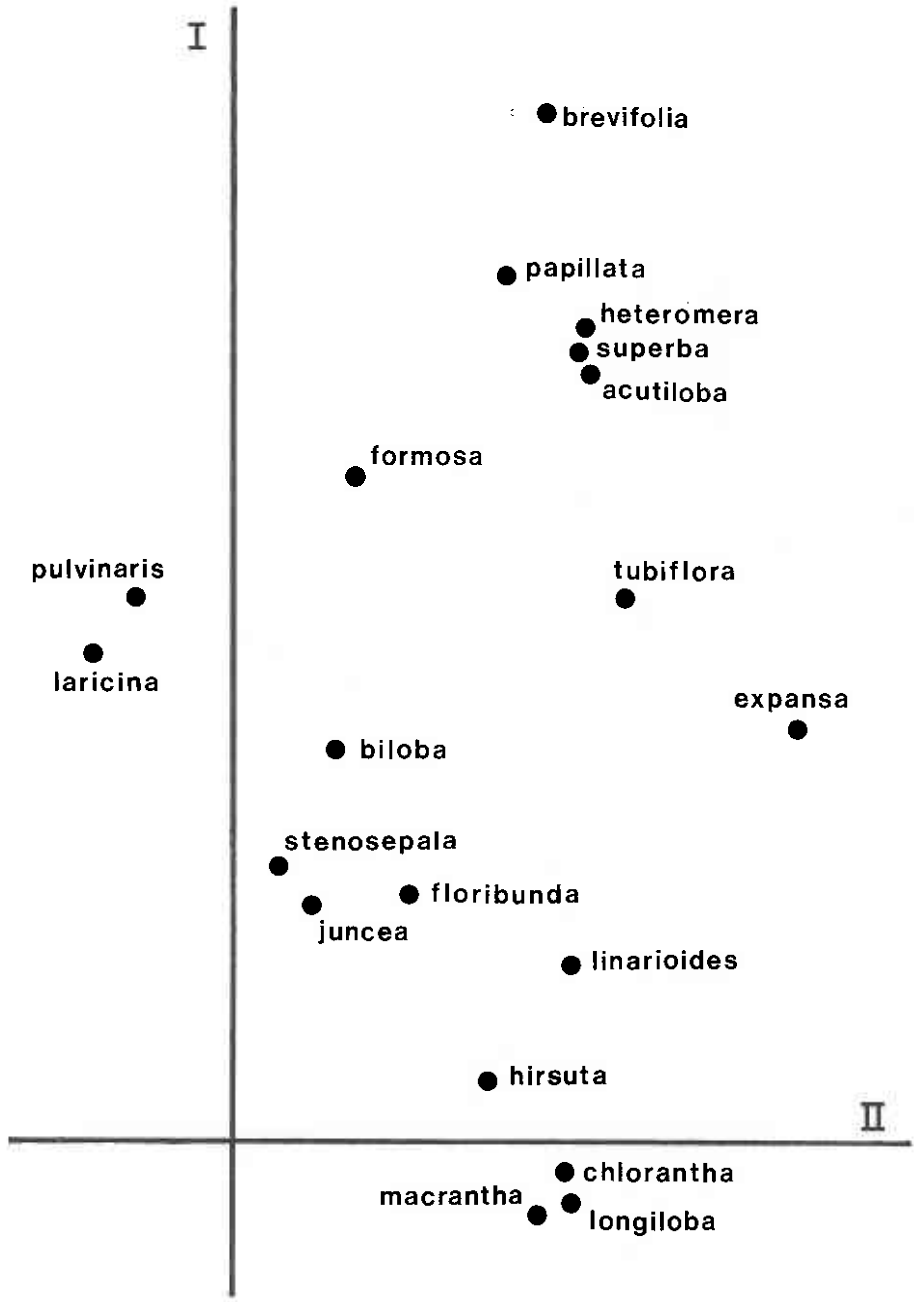


Figure 3. Projection of the *Lechenaultia* species onto axes representing the first two components from the detrended correspondence analysis of the distribution data. The eigenvalues associated with these two components were 0.786 and 0.360 respectively.

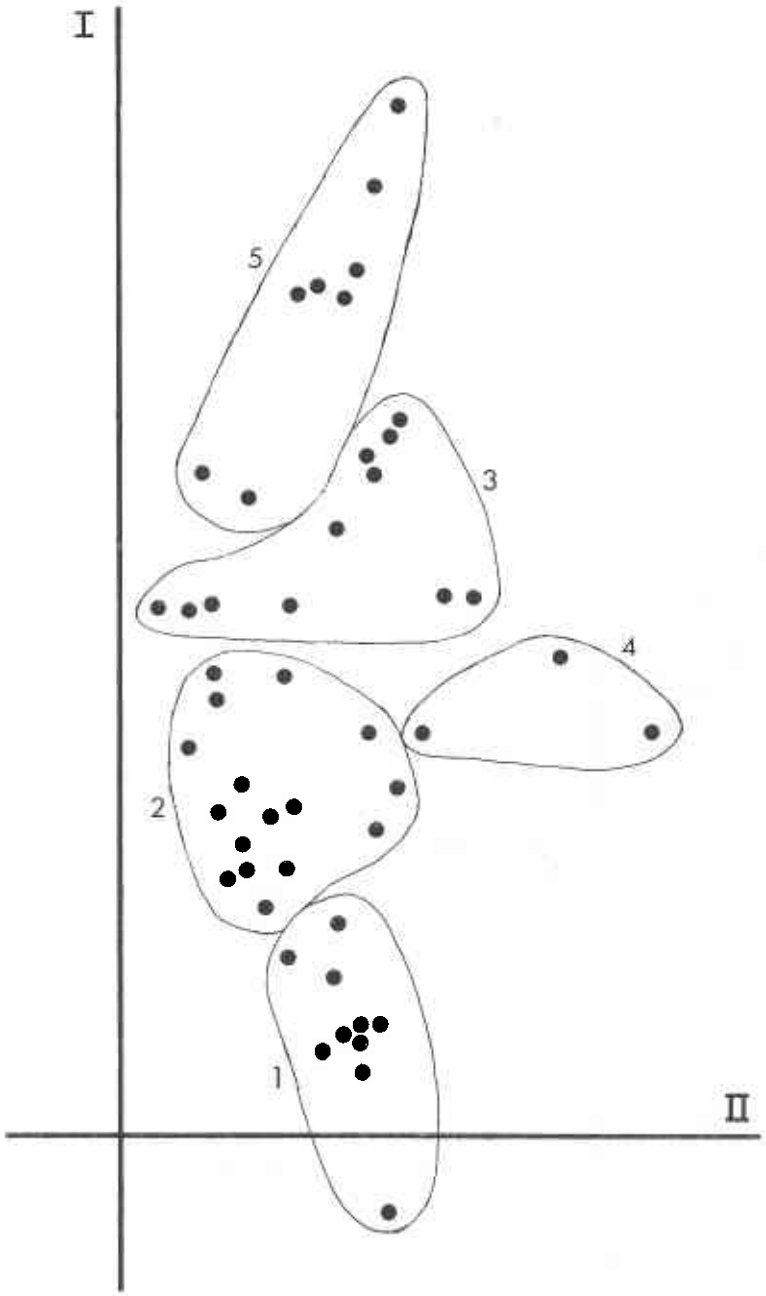


Figure 4. Projection of the 0.5° x 0.5° grid cells onto axes representing the first two components from the detrended correspondence analysis of the distribution data. The eigenvalues associated with these two components were 0.786 and 0.360 respectively. The five phytogeographic groups from the cluster analysis are also shown.

appears to be an area relatively rich in uncollected species. For example, the two newly described *Lechenaultia* species from south-western Australia are from this area (Morrison 1986). The other apparently poorly collected area is the northern tip of the Irwin Botanical District and the Shark Bay area, another area that has received only relatively recent botanical inspection. The area between Collie and Mt Barker in the south-west also shows gaps in many of the species distributions, but this is more likely to be a result of clearing for agriculture.

The ordination of the species distributions (Figure 3) indicates three main groupings of species. Those species that are restricted to the Roe and Eyre Botanical Districts (*L. acutiloba, L. brevifolia, L. heteromera, L. papillata,* and *L. superba*) ordinate together, as do most of those species common in the northern kwongan (*L. biloba, L. chlorantha, L. floribunda, L. hirsuta, L. juncea, L. linarioides, L. longiloba, L. macrantha* and *L. stenosepala*). The two endemics of the Avon District (*L. laricina* and *L. pulvinaris*) form the third group. The sole endemic of the south-western forests (*L. expansa*) and the two widespread species (*L. formosa* and *L. tubiflora*) do not fit into any of the groups.

The first axis of this ordination accurately separates the north-western species from the south-eastern ones, while the second axis appears to reflect the rainfall gradient away from the coast. The distribution of the individual species thus also appears to be strongly influenced by rainfall, as well as the generic distribution.

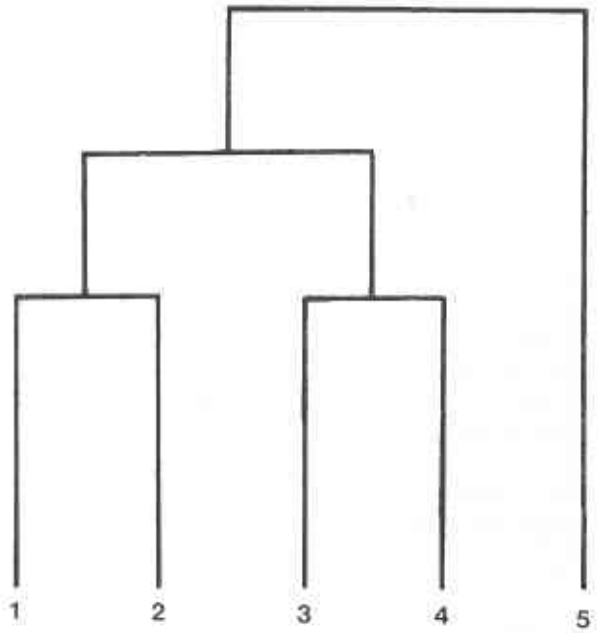
The ordination of the grid cells (Figure 4) does not reveal any obvious clusters, indicating that there are no clear-cut groupings of regions within the South-West Botanical Province as far as *Lechenaultia* is concerned. Once again, the first axis separates those grid cells in the north-west from those in the south-east, while the second axis separates the coastal grid cells from the inland ones.

The clustering analysis reveals five main groupings of the grid cells (Figures 5a and 5b); and the re-classification of the grid cells in the discriminant function analysis of the clusters indicates that only 3.1% of the grid cells were incorrectly classified. This suggests that the cluster pattern has a high level of predictability. However, while the projection of these clusters onto the ordination (Figure 4) shows that they are non- overlapping, they are nonetheless somewhat arbitrary clusters in a continuum of variation.

These grid cell clusters correspond fairly closely to the biogeographic areas traditionally recognised in south-western Western Australia:- Groups 1 and 2 occur in the kwongan of the northern sandplains, with Group 2 extending into the northern part of the wheatbelt, Group 3 occurs in the kwongan of the southern sandplains and extends into the southern part of the wheatbelt, Group 4 occurs in the jarrah and marri woodlands and karri forests of the south-west, and Group 5 occurs in the inland mallee area. However, the cluster analysis fails to unite the wheatbelt as a single unit, and the northern sandplains are clearly divided into two areas. This latter pattern seems to be the result of a large number of localised endemics that are restricted to only one of these two areas. Finally, the analysis also suggests that the southern areas are more similar to each other than they are to the northern areas (Figure 5a).

The results of the re-classification of the grid cells in the discriminant function analyses (Tables 2 and 3) indicate that the phytogeographic regions of both Beard (1980d) and Barlow (1985) are reasonably accurate reflections of the distribution of the *Lechenaultia* species. The discriminant functions correctly re-classified approximately 85% of the grid cells in both cases (87.0% for the Beard regions and 83.2% for the Barlow regions), and those grid cells incorrectly re-classified were usually around the boundaries of the regions (Figures 6a and 6b).

a



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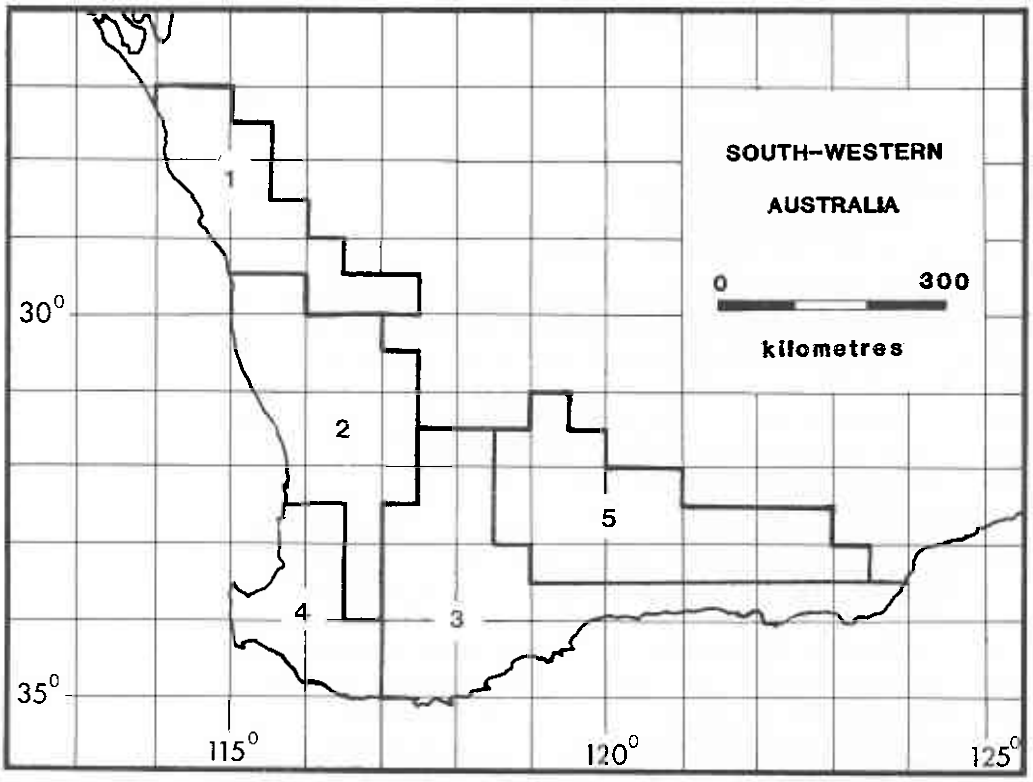

Figure 5. Dendrogram (Figure 5a) and map (Figure 5b) of the five phytogeographic groups resulting from the clustering analyses of the distribution data.

Table 2. Results of the re-classification of the grid cells of the Beard (1980d) phytogeographic regions using discriminant function analysis.

Phytogeographic region predicted from the discriminant function	Phytogeographic region of Beard					Total no. of grid cells
	Irwin	Avon	Darling	Roe	Eyre	
Irwin	18	1	0	0	0	19
Avon	1	24	5	7	0	37
Darling	0	1	32	0	0	33
Roe	0	0	0	22	0	22
Eyre	0	1	1	0	15	17

Table 3. Results of the re-classification of the grid cells of the Barlow (1984) and (1985) phytogeographic regions using discriminant function analysis.

Phytogeographic region predicted from the discriminant function	Phytogeographic region of Barlow			Total no. of grid cells
	Bencubbin	Leeuwin	Esperance	
Barlow (1984)				
Bencubbin	28	7	3	38
Leeuwin	2	32	2	36
Esperance	5	2	50	57
Barlow (1985)				
Bencubbin	38	7	6	51
Leeuwin	3	32	2	37
Esperance	2	2	39	43

For the Beard (1980d) regions, most of the incorrectly re-classified grid cells were in the complex boundary area of the Avon, Darling, Eyre and Roe Botanical Districts to the north of the Stirling Ranges (Figure 6a). In particular, the analysis indicates that most of this area should be correctly classified as part of the Avon Botanical District. However, such a result is not unexpected, as the regions were originally based on vegetation physiognomy rather than floristics (Beard 1980d), and there is thus no *a priori* reason to assume that they should accurately reflect the distribution of any one particular genus.

On the other hand, the incorrectly re-classified grid cells for the analysis of the Barlow (1985) regions are around the boundaries of most of the regions (Figure 6b). In particular, the analysis indicates that most of the boundaries are displaced by 0.5° of latitude or longitude. This is in fact a very suggestive result, as the regions were originally based on a 1° grid, and the analysis thus indicates that the regional boundaries are actually correctly placed at this scale. The Barlow (1985) regions appear to be slightly less predictive than the original Barlow (1984) regions, as the original regions were 84.4% correctly re-classified by the discriminant function analysis (Table 3).

The similarity coefficients among the phytogeographic regions of Beard (1980d) (Table 4) indicate that the Irwin, Avon and Darling Botanical Districts are superficially very similar, as are the Roe and Eyre Botanical Districts. On the other hand, the reduced area cladogram (Figure 7c) indicates that the Irwin Botanical District has a more similar history to that of the Roe and Eyre Botanical Districts. The history thus unites the northern and southern kwongan areas, even though they are now spacially separated.

Such a relationship has been noted for other genera as well, based on the distribution of vicarious species pairs and disjunctions in the distributions of species (see Nelson 1981, Lamont et al. 1984). The current disjunction between the kwongan vegetation areas has been postulated to be the result of disruption of a previously continuous range,

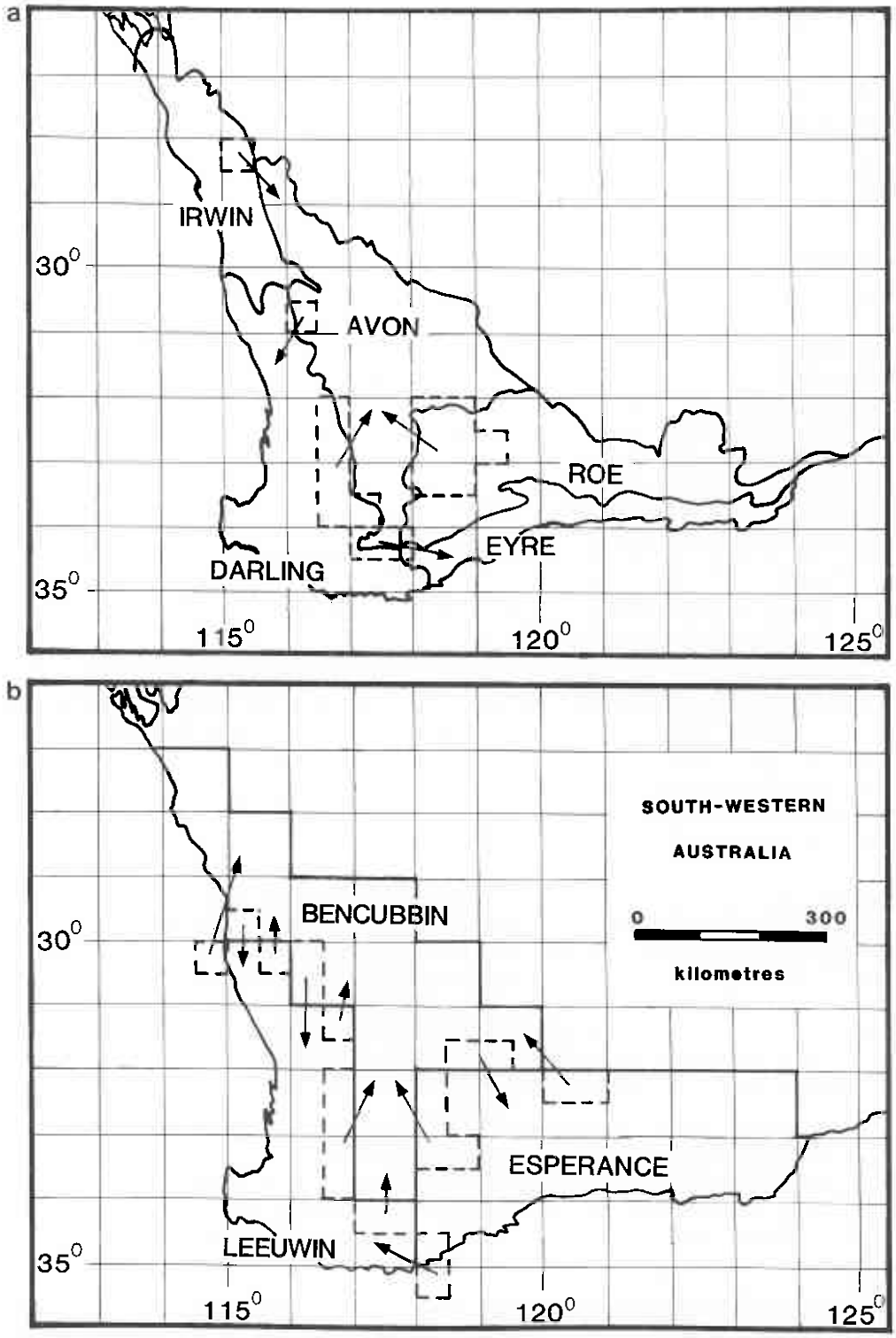

Figure 6. The South-West Botanical Province phytogeographic regions of Beard (1980d) (Figure 6a) and Barlow (1985) (Figure 6b), showing those grid cells incorrectly re-classified by the discriminant functions.

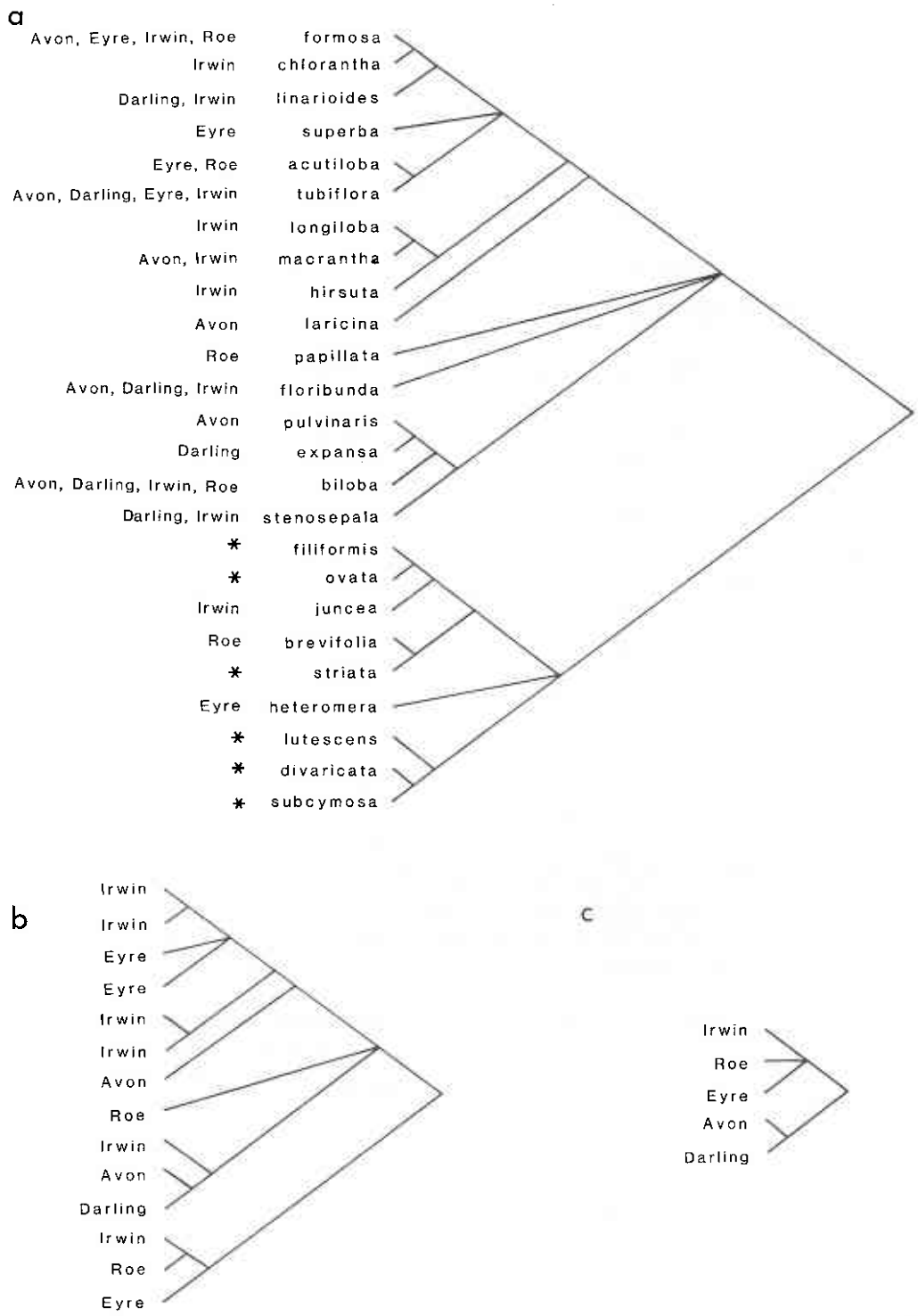

Figure 7. Area cladogram of all of the *Lechenaultia* species (Figure 7a), those *Lechenaultia* species that are endemic to only one Botanical District of the South-West Botanical Province (Figure 7b) and the reduced area cladogram from Figure 7b (Figure 7c), showing the Botanical Districts of the South-West Botanical Province, in which they occur. * Not in South-West Botanical Province.

Table 4. Percentage similarity of the phytogeographic regions of Beard (1980d). The upper half of the similarity matrix contains the Simple Matching Coefficient while the lower half contains the Jaccard Coefficient.

Phytogeographic Region	Phytogeographic region				
	Irwin	Avon	Darling	Roe	Eyre
Irwin	—	57.9	63.2	36.8	36.8
Avon	38.5	—	63.2	57.9	57.9
Darling	50.0	27.3	—	52.6	52.6
Roe	14.3	20.0	20.0	—	68.4
Eyre	14.3	20.0	20.0	25.0	—

this continuous range itself being the result of colonisation of the whole area by laterite-tolerant species after the area was subjected to lateritisation during the Miocene (Marchant 1973, Lamont et al. 1984). The cause of the disjunction is postulated to be the onset of more arid conditions during the Holocene (Nelson 1981, Hopkins et al. 1983, Lamont et al. 1984). The expansion of the drier regimes would have resulted in the extinction of the kwongan species, leaving the upland areas as refugia and subsequent centres of speciation. The current superficial floristic similarity of the northern kwongan with the forests of the south-west and the woodlands of the wheatbelt could thus be the result of very recent dispersal of species into these regions, particularly from the north.

Figure 7a indicates that *L. subcymosa*, which occurs on North West Cape and the Shark Bay islands, is closely related to the arid zone species (particularly *L. divaricata*), and is only more distantly related to the south-western species. Thus, this does not support Burbidge and George's (1978) use of this species as an example of the close taxonomic affinity of the Shark Bay area with that of the South-West Botanical Province rather than with that of the Eremaean Province. This area should indeed, as they suggest, be part of a "transitional zone".

The analysis of the geographical distributions of the groups of closely related species reveals that within the South-West Botanical Province the congeners are frequently allopatric, sometimes sympatric, and rarely parapatric (Table 5). This suggests that, in this area, geographical isolation has probably played a major role in speciation within *Lechenaultia*; and a similar pattern has been found for *Acacia* (Hopper and Maslin 1978). Outside this region, most of the congeners are allopatric, which is in contrast to the finding of Maslin and Hopper (1982) that sympatry and allopatry are about equally common in central Australia.

Table 5. Geographical relationships of the closely related species groups of *Lechenaultia*.

Species group	Geographic distribution		
	Allopatric	Parapatric	Sympatric
Sect. Patentes			
L. biloba and *L. stenosepala*			+
L. expansa and *L. pulvinaris*	+		
L. floribunda and *L. papillata*	+		
Sect. Latouria			
L. heteromera and *L. lutescens*	+		
L. divaricata and *L. subcymosa*	+		
L. brevifolia, L. juncea and *L. striata*	+		
L. filiformis and *L. ovata*			+
Sect. Lechenaultia			
L. hirsuta, L. laricina and *L. superba*	+		
L. longiloba and *L. macrantha*			+
L. acutiloba and *L. tubiflora*		+	
L. chlorantha and *L. formosa*	+		

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Appendix 1. Notes on the distribution, ecology, morphology and conservation status of *Lechenaultia* species

The morphological notes are based on personal observation of the herbarium collections, supplemented by field observations of the species. Distributional and ecological data are from details on the herbarium labels, also supplemented by personal field observations. References which contain more details of some of these aspects (eg. more detailed descriptions of specific habitats) are also cited. Distributional data were derived from the point distributions of the specimens examined, and are mapped for grids of 0.5° lat. x 0.5° long. The distributions are also recorded for the standard botanical regions currently used by each of the state herbaria, and also for the more recent Australian phytogeographic regions of Barlow (1985). The conservation status of each species is expressed using the scheme of Leigh et al. (1981), supplemented where necessary by more detailed observations; and the number of specimens examined is given, to provide some measure of species abundance. The most widely-used common name is also recorded, where known; and a list of checked illustrations is provided, to aid with the identification of the species.

Lechenaultia acutiloba Benth., Fl. Austral. 4:41 (1868)

Distribution (Figure 8)
Western Australia: Roe and Eyre Districts, between Ravensthorpe and Ongerup.

Esperance Region.

Ecology
A small shrub with a woody rootstock that may sucker. It occurs in sand or sandy gravel, usually in damp soil near river banks or occasionally swamps. It is found in open floodplains or heath, where it is never very common. Flowering is from mid September to late December.

Notes
Closely related to *L. tubiflora*, from which it can be readily distinguished by the shrubby habit, larger green flowers, and wingless corolla lobes.

Specimens Examined
18.

Conservation Status
2RC, as it is geographically localised (Marchant and Keighery 1979, Rye 1981) and restricted to a specific habitat. The river banks along which it usually occurs are, in many cases, parts of water conservation reserves; but these reserves are all extremely small, and are thus of only limited use as flora conservation areas. The species may also occur in Fitzgerald River National Park, but this has not been confirmed. It is exploited for the nursery trade (Rye et al. 1980), and is known to be in cultivation (Rye 1981). Newbey (1968) and Fairall (1970) discuss its cultivation requirements.

Common Name
Wingless lechenaultia.

Lechenaultia biloba Lindley, Sketch Veg. Swan R. 27 (1839)

Distribution (Figure 9)
Western Australia: Irwin, Avon, Darling, and Roe Districts.

Bencubbin, Leeuwin, and Esperance Regions.

Ecology
A sub-shrub or small shrub with a woody rootstock (cf. Majer 1981). It has been recorded from white, grey, yellow, orange and light brown sand, or sandy loam (Muir 1976, 1977), often over laterite (Griffin and Hopkins 1985), as well as from gravel. It occurs in a wide range of heaths (Beard 1976d, 1979a, 1980b, 1980c, Muir 1979, Beadle 1981, Hopkins and Hnatiuk 1981, Brown and Hopkins 1983, Griffin et al. 1983, Griffin and Hopkins 1985), scrubs (Beard 1976e, 1980b), mallee (Muir 1976, 1977, Beard 1980b), woodlands (Beard 1979a, 1979b), and (mainly Jarrah and Marri) forests (Williams 1932, Majer 1981), usually occurring in open patches or even disturbed areas (Muir 1977). It is often locally common in the western part of its range, but it usually occurs as scattered plants in the inland areas. Flowering is usually from early August to mid November (cf. Majer 1981, Milewski and Davidge 1981); and it has been recorded to flower in the first season after a March fire (Majer 1981). In the Jarrah forests, the roots show a high level of infection by vesicular-arbuscular mycorrhizae (Lamont 1984).

Variability
Flower and leaf size as well as flower colour vary greatly (see Morrison 1986), but these characters do not appear to be correlated.

Notes
Closely related to *L. expansa* and *L. stenosepala*, from which it can be readily distinguished by the (usually) darker blue flowers with much broader wings and a more hairy floral tube. In inland areas it can look similar to *L. brevifolia*, which has a distinctly scapigerous flowering habit and much reduced wings on the superior lobes of the flowers.

Specimens Examined
343.

Conservation Status
Not at risk, as it is widespread and common throughout South Western Australia. It is exploited for the nursery and seed trades (Rye et al. 1980, Burgman and Hopper 1982).

Common Name
Blue lechenaultia.

Illustrations
Anon. (1965) *Aust. Pl.* 3:141; Morcombe (1968) p.12; Newbey (1968) pp.112-3,125; Baglin and Mullins (1969) p.89; Beard (1970) pl.xxxi; Fairall (1970) p.181; Morcombe and Morcombe (1970) p.80; Baker (1971) p.19; Hodgson and Paine (1971) p.89; Anon. (1973) *Aust. Pl.* 7:115; Blombery (1973) p.190; Holliday (1973) p.16; Grieve and Blackall (1975) pl.v; Green & Wittwer (1976) *Aust. Pl.* 8:329; Gardner (1978) pp.5,130; Mullins and Baglin (1978) pl.75; Erickson et al. (1979) p.46; A.P.S.G. (1980) between pp. 176-7.

Lechenaultia brevifolia D.A. Morrison, Brunonia 9:18 (1987)

Distribution (Figure 10)
Western Australia: Coolgardie and Roe Districts.

Leonora, Bencubbin, and Esperance Regions.

Ecology
A sub-shrub with a woody rootstock that may sucker. It has been found on deep yellow or shallow red sand, usually in low scrub or heath (Beard 1969, as *L.* sp. inedit.). Plants are usually scattered, but are sometimes common in patches. Flowering is from late October to early December.

Variability
There is some variablity in flower and ovary size between populations, but this does not seem to be significant.

Notes
Closely related to *L. heteromera*, from which it can be readily distinguished by the distinctly scapigerous flowering stems and much darker flowers, and to *L. juncea* and *L. striata*, which have much longer leaves and paler flowers.

Specimens Examined
27.

Conservation Status
Not at risk, as it is widespread and relatively common throughout the south-eastern mallee of South Western Australia.

Lechenaultia chlorantha F. Muell., Fragm. 2:20 (1860)

Distribution (Figure 11)
Western Australia: Irwin District, near the mouth of the Murchison River.

Bencubbin Region.

Ecology
A sub-shrub with a woody rootstock that may sucker. Little data exist on the habitat of this species, but it has been recorded from exposed red sandstone breakaways, where it is apparently uncommon. Flowering specimens have been collected in August and September.

Notes
Closely related to *L. formosa* and to *L. linarioides*, from which it can be readily distinguished by the green corolla.

Specimens Examined
7.

Conservation Status
2KC, as it is very geographically localised (Rye 1981) and not locally common, and it is currently known from only one small population. It has also been recorded from Kalbarri National Park (Beard 1976c); but it is not known how extensive these

populations are, and the species has not been recently confirmed to be present. This species is very poorly collected (Marchant and Keighery 1979), and much more needs to be known before the conservation status can be accurately assessed. If a viable representation in a conservation area is demonstrated then it would be more accurately classified as 2RC. It is not known to be in wide cultivation (cf. Rye 1981), but see also A.P.S.G. (1980).

Lechenaultia divaricata F. Muell., Fragm. 3:33 (1862)

Distribution (Figure 12)
Northern Territory: Central Australia North and Central Australia South Regions; Queensland: Gregory North and Gregory South Districts; South Australia: Lake Eyre Basin Region; New South Wales: North Far Western Plains Sub-division.

MacDonnell, Thomson, Simpson, Cooper, and Torrens Regions.

Ecology
A small shrub with a woody rootstock that may sucker (Maconochie 1982). The fruit is woody and often persistent for several years. It has been recorded from deep red sand dunes (where it occurs on the upper slopes and crests; Buckley 1981b), sandplains, alluvial soils, or sometimes in flood-plains (Boyland 1970), swales, or other periodically wet depressions. It occurs in open grassland, low open woodland (Boyland 1970), or open mulga (Cunningham et al. 1981). It usually occurs as scattered bushes, but is sometimes locally common. The plants appear to have high drought tolerance (Buckley 1982). It apparently flowers sporadically throughout the year.

Variability
Throughout its range, there is considerable variability in flower colour and size, but the species nevertheless remains distinctive. However, specimens are often mis-identified (eg. Buckley 1983, who records this species off the Western Australian coast), often in confusion with, for example, *Scaevola depauperata* or *S. spinescens*. Within any one individual plant the number of articles per pseudocapsule (and hence pseudocapsule size) varies greatly, unlike any other species except *L. filiformis*.

Notes
Closely related to *L. subcymosa* and *L. lutescens*, from which it can be readily distinguished by the divaricate almost leafless habit.

Specimens Examined
125.

Conservation Status
Not at risk, as it is apparently common and widespread throughout arid eastern Central Australia. Specht et al. (1974) report it to be rare in South Australia, but this does not appear to be the case. However, Melville (1973) and Specht et al. (1974) list it as a relict species that has retained primitive morphological features, and that is therefore worthy of particular attention.

Common Name
Tangled lechenaultia.

Illustrations
Cunningham et al. (1981) p.636; Jessop (1981) p.360; Jessop & Toelken (1986) p.1407.

Lechenaultia expansa R.Br., Prodr. 1:581 (1810)

Distribution (Figure 14)
Western Australia: Darling District.

Leeuwin Region.

Ecology
A sub-shrub with a woody rootstock. It has been recorded from sand or peaty sand, where it usually occurs in swamp heath, around the edge of paperbark swamps, or in other permanently damp or seasonally waterlogged areas (Speck and Baird 1984). It is sometimes locally common. Flowering is from late October to mid January.

Variability
Flower and pseudocapsule size are very constant, but leaf size can vary considerably between populations.

Notes
Closely related to *L. floribunda* and often confused with it, particularly in the area around Perth where the two distributions overlap. However, *L. expansa* has larger and often minutely pitted leaves, a more densely hairy floral tube, smaller and almost equal corolla wings, a more thickly hairy indusium, and smaller pseudocapsules with fewer and ovoidal articles.

Specimens Examined
96.

Conservation Status
Not at risk, as it is widespread and apparently common throughout the Jarrah and Marri forests of South Western Australia. It is exploited for the nursery trade (Rye et al. 1980).

Lechenaultia filiformis R.Br., Prodr. 1:581 (1810)

Distribution (Figure 13)
Western Australia: Gardner, Fitzgerald, and Hall Districts; Northern Territory: Victoria River, Darwin and Gulf, and Barkly Tableland Regions; Queensland: Burke, Cook, and North Kennedy Districts. Also Papua-New Guinea, along the south-eastern coast.

Kimberley, Arnhem, Barkly, Carpentaria, Tanami, and Cape York.

Ecology
A herb or sub-shrub that probably grows annually from a woody rootstock. It is usually found in sand or sandy loam near water-courses or other low-lying areas, but it sometimes occurs on sandstone plateaux or granitic pebble hillsides. It is usually found in *Triodia* grassland under *Eucalyptus* or *Melaleuca* woodland, where it usually occurs as scattered plants. The plants apparently flower sporadically throughout the year, perhaps only after rain.

Variability
Flower size and colour is very variable, and this apparently correlates with longitude, as plants with the larger flowers predominate in the western part of the distribution and plants with the smallest ones predominate in Queensland and New Guinea (see Morrison 1986).

Notes
This species and *L. ovata* can be readily distinguished from all of the other members of the genus by the fruits, which do not develop articles at the ends, and by the distinctive prolongation of the superior calyx lobe compared to the inferior ones. *L. filiformis* has longer and thinner leaves than *L. ovata*.

Specimens Examined
85.

Conservation Status
Not at risk, as it is widespread and common throughout tropical Northern Australia.

Lechenaultia floribunda Benth., in Endl., Enum. Pl. 70 (1837)

Distribution (Figure 15)
Western Australia: Irwin, Avon, and Darling Districts.

Bencubbin and Leeuwin Regions.

Ecology
A sub-shrub or small shrub with a woody rootstock (Baird 1977, Dodd et al. 1984). It has been recorded from white or grey sand or loamy sand, where it occurs in heath (Beard 1976d, 1979a, Beadle 1981), thicket (Beard 1979a), or *Banksia/Eucalyptus* woodland with a heath understorey (Baird 1977, Milewski and Davidge 1981). It is often locally common. Flowering is from late August to mid December.

Variability
Leaf length, flower size, and flowering habit are all very variable, apparently with a morphocline running from north to south, with many of the northern populations having plants with smaller flowers, larger leaves, and a more densely-branched flowering habit than the southern plants (see Morrison 1986).

Notes
Closely related to *L. expansa*, from which it can be distinguished as above, and to *L. papillata*, which has papillate leaves, sepals, ovaries, and pseudocapsules.

Specimens Examined
108.

Conservation Status
Not at risk, as it is widespread and common throughout the northern sandplains of South Western Australia. It is exploited for the nursery and seed trades (Rye et al. 1980, Burgman and Hopper 1982).

Common Name
Free-flowering lechenaultia.

Lechenaultia formosa R.Br., Prodr. 1:581 (1810)

Distribution (Figure 16)
Western Australia: Irwin, Avon, Roe, Eyre, and Eucla Districts.

Nullarbor, Bencubbin, Leeuwin, and Esperance Regions.

Ecology
A sub-shrub with a woody rootstock that may sucker (Gardner 1944). It has been recorded from sand and sandy soils, often over laterite or granite, as well as from clay and gravelly clay. It occurs in a variety of heaths (Beard 1972, 1973b, 1980c, Beadle 1981), scrubs, mallee (Beard 1973a, 1973b, 1976a, 1979c), and woodlands (Beard 1979c, 1980c), where it is often locally common. Flowering apparently occurs sporadically throughout the year, but it is most prolific from early August to late October.

Variability
Flower and leaf size as well as flower colour and habit vary greatly. Large-flowered prostrate plants occur throughout the geographical range, but the smaller-flowered more erect forms are confined to the coastal strip between Albany and Cape Le Grande (see Morrison 1986).

Notes
Closely related to *L. chlorantha*, from which it can be readily distinguished by the red and orange flowers, and to *L. linarioides*, which is a much larger more tangled plant.

Specimens Examined
302.

Conservation Status
Not at risk, as it is widespread and common throughout South Western Australia. However, Specht et al. (1974) recognise the conservation importance of the disjunct relict populations on the coastal sand sheets of the Great Australian Bight.

It is exploited for the nursery and seed trades (Rye et al. 1980, Burgman and Hopper 1982).

Common Name
Red lechenaultia.

Illustrations
Baglin and Mullins (1969) p.91; Fairall (1970) p.182; Hodgson and Paine (1971) p.89; Blombery (1973) p.190; Holliday (1973) p.17; Grieve and Blackall (1975) pl.v; Gardner (1978) p.5.

Lechenaultia heteromera Benth., Fl. Austral. 4:43 (1868)

Distribution (Figure 17)
Western Australia: Eyre District, between Starvation Boat Harbour and West Mt Barren.

Esperance Region.

Ecology
A sub-shrub with a woody rootstock. It is usually found in deep white sand, where it occurs in heath (Beard 1973a, Beadle 1981, as *L. stenosepala*, Beard 1976a, as *L. stenomera*), open scrub, or *Banksia* woodland. It is usually infrequent. Flowering is from late August to Late November.

Variability
This is a relatively constant species, varying only moderately in flower colour, leaf density, and the degree to which the leaves are reflexed.

Notes
Closely related to *L. brevifolia*, *L. juncea*, and *L. striata*, from which it can be readily distinguished by the non-scapigerous flowering habit and scattered, thicker, recurved leaves. It is also sometimes confused with *L. biloba*, which has subequal wings on all of the petal lobes.

Specimens Examined
45.

Conservation Status
Although it has a restricted distribution it is common throughout its range, and is therefore probably not at risk. It is represented in Fitzgerald River National Park.

Common Names
Claw lechenaultia (Erickson et al. 1979); Hook-leaf lechenaultia (Grieve and Blackall 1975).

Lechenaultia hirsuta F. Muell., Fragm. 6:9 (1867)

Distribution (Figure 18)
Western Australia: Irwin District. Bencubbin and Leeuwin Regions.

Ecology
A herb or sub-shrub with a woody rootstock. It occurs in white or light brown sand or lateritic sand, where it is commonly found in low open heath (Beard 1976c, 1976d, Hopkins and Hnatiuk 1981). It is often frequent, especially when regenerating after fire. Flowering is from early September to mid December.

Variability
This is a very distinctive and relatively constant species, but it does vary somewhat within populations in leaf size and density.

Notes
Closely related to *L. superba* and to *L. laricina*, from which it can be readily distinguished by the extreme hirsuteness.

Specimens Examined
56.

Conservation Status
Not at risk, as it is widespread and common on the northern sandplains of South Western Australia. It is exploited for the nursery trade (Rye et al. 1980, Burgman and Hopper 1982).

Common Name
Hairy lechenaultia.

Illustrations
Morcombe (1968) p.110; Morcombe (1970) p.98; Morcombe and Morcombe (1970) p.81; Baker (1971) p.19; Blombery (1973) p.191; Grieve and Blackall (1975) pl.vi; Gardner (1978) p.5; Erickson et al. (1979) p.98; Crafter (1983) *Aust. Pl.* 12:56.

Lechenaultia juncea E. Pritzel, Bot. Jahrb. Syst. 35:553 (1905)

Distribution (Figure 19)
Western Australia: Irwin District, between Three Springs and Gunyidi. Bencubbin Region.

Ecology
A herb or sub-shrub with a woody rootstock. It occurs in sand or sandy gravel, in heath (Beard 1976d, Beadle 1981, as *L. juncoides*). It is usually infrequent, and usually growing amongst the branches of other plants. It is now only recorded in fields, and along road margins. Flowering is usually from late November (sometimes earlier) to mid December.

Notes
Closely related to *L. brevifolia*, which has much darker-blue flowers and shorter leaves, *L. striata*, which has much thinner more crowded leaves and larger flowers and pseudocapsules, and *L. heteromera*, which does not have the scapigerous flowering habit. This species has also been confused with *L. subcymosa*, from which it can be distinguished by the more upright junciform habit and the much longer sepals.

Specimens Examined
8.

Conservation Status
2V, as it is geographically localised (Rye 1981), and currently known only from a few roadside verges and relatively undisturbed fields in farmland. This species is very poorly collected (Marchant and Keighery 1979), and it is not known from any conservation reserves or known to be in cultivation (cf. Rye 1981). This species would be classified as 2E, except that there are a couple of good populations in protected areas in farmland that will hopefully become conservation reserves in the near future (cf. Beard 1976d).

Common Name
Reedy lechenaultia.

Lechenaultia laricina Lindley, Sketch Veg. Swan R. 27 (1839)

Distribution (Figure 20)
Western Australia: Avon District, between Meckering and Clackline, and between Kukerin and Moulyinning. Bencubbin and Leeuwin Regions.

Ecology
A small shrub with a woody rootstock that may sucker. In the past, this species has been recorded from sand or occasionally gravelly loam, usually in woodland. It is now known only from disturbed areas in farmland. Flowering is from late October to late December.

Variability
This species is relatively constant morphologically, but it does vary somewhat in flower colour, with some populations being less scarlet than others. As well, some variation exists between the two disjunct groups of populations of this species, the southern group being much more prostrate plants, with greyish bark and somewhat smaller flowers.

Notes
Closely related to *L. hirsuta*, from which it can be readily distinguished by the glabrous habit, and to *L. superba*, which has a more upright habit, longer leaves, and yellowish flowers with a broader tube. However, this species is apparently persistently and

frequently confused with other species (see Morrison 1986), usually resulting in the identification of other species (often *L. formosa*) as *L. laricina*. This has, in the past, suggested that *L. laricina* occurs over a much larger area than it really does (cf. the map in Rye et al. 1980) and that it has been collected much more frequently. It was apparently this confusion that caused Marchant and Keighery (1979) and subsequent workers to overlook this species as an endangered taxon.

Specimens Examined
17.

Conservation Status
2E. This species was once apparently common in the area between Meenaar, Meckering, and Northam (Gardner 1978), but in this area it is now known from only two populations in farmland. Both of these populations are currently being protected, but this relies entirely on the goodwill of the people concerned, and one of the populations appears to have contracted recently. The only other reliable collection localities are near Kukerin, where it has not been found recently. It thus seems that this species is under immediate threat, especially as no populations have been reported in conservation areas. Gazettal as protected flora is therefore essential. The species is reported to be exploited for the nursery trade (Rye et al. 1980, Burgman and Hopper 1982), but the collection locality given by Burgman and Hopper (1982) suggests that many of these reports may be mis-identifications (see above). Fortunately, it is apparently in wide cultivation, as this would seem to be critical for the continued survival of the species. Fairall (1970) discusses its cultivation requirements.

Common Name
Scarlet lechenaultia.

Illustrations
Fairall (1970) p.183; Grieve and Blackall (1975) pl.v; Gardner (1978) p.5.

Lechenaultia linarioides DC., Prodr. 7:519 (1839)

Distribution(Figure 21)
Western Australia: Irwin and Darling Districts, and Carnarvon District on the Shark Bay peninsulas. Murchison, Bencubbin, and Leeuwin Regions.

Ecology
A small shrub with a woody rootstock that may sucker. It occurs in deep white or yellow sand, where it is found in open-heath (Beard 1976c, 1976d, 1979a, 1979b, Burbidge and George 1978, Bell et al. 1979, Bridgewater and Zammit 1979, George et al. 1979, Beadle 1981), scrub (Beard 1976c, 1976d, Beard and Burns, 1976), or occasionally woodland (Bell et al. 1979). It is often locally common. Plants apparently flower sporadically throughout the year, but flowering is mainly from early August to early December.

Variability
Stature, leaf and flower size, and flower colour are all very variable. The isolated group of plants near Shark Bay are taller and more densely shrubby with thicker branches than the southern ones, which tend to be more sprawling. Flower size and colour varies considerably between populations, and the flowers themselves also apparently become redder with age.

Notes
Similar to *L. formosa* and *L. chlorantha*, from which it can be readily distinguished by the thicker stems with downcurved branchtips and more scattered leaves, as well as by the larger flowers.

Specimens Examined
135.

Conservation Status
Not at risk, as it is widespread and common throughout the northern sandplains of South Western Australia. It is exploited for the nursery and seed trades (Rye et al. 1980, Burgman and Hopper 1982).

Common Name
Yellow lechenaultia.

Illustrations
Morcombe and Morcombe (1970) p.80 (as *L. linaroides*); Hodgson and Paine (1971) p.91; Blombery (1973) p.191; Grieve and Blackall (1975) pl.v; Gardner (1978) p.131.

Lechenaultia longiloba F. Muell., Fragm. 6:10 (1867)

Distribution (Figure 22)
Western Australia: Irwin District, between Mullewa and Dongara. Bencubbin Region.

Ecology
A sub-shrub with a woody rootstock that may sucker. It has been recorded in deep white or grey earthy sand, in open heath (Beard 1976d). It was apparently once common in *Banksia* heath (especially if regenerating after fire), but it is now more commonly found along disturbed roadsides. Flowering is usually from late July to early October, but it sometimes continues sporadically until early December.

Variability
This is a relatively constant species, but there is some variability between populations in flower colour (varying from red to yellowish) and flower size.

Notes
Closely related to *L. hirsuta*, from which it can be easily distinguished by the glabrous habit, and to *L. macrantha*, which has longer leaves (which are characteristically held to one side of the branch), larger wings, and a shorter broader corolla tube.

Specimens Examined
30.

Conservation Status
2VC, as it is geographically localised (Rye 1981), and is now known from only a few populations along roadsides in farmland (see Leigh et al. 1984 for a more detailed discussion), and from one population in an "A Class" conservation reserve (Beard and Burns 1976). Gazettal as protected flora would seem to be appropriate, and it may be necessary to manage the roadside verges specifically to maintain this species (cf. Scott 1981). Hartley and Leigh (1979) report it to have been subject to heavy commercial exploitation in the wild, but this has not been confirmed (cf. Rye et al. 1980). It is not known to be in wide cultivation (Leigh et al. 1984), and horticultural propagation would seem to be essential to ensure the continued survival of this species.

Common Name
Irwin lechenaultia.

Illustrations
Baglin and Mullins (1969) p.91; Grieve and Blackall (1975) pl.v; Erickson et al. (1979) p.107; Crafter (1983) *Aust. Pl.* 12:57; Leigh et al. (1984) between pp.192-3.

Lechenaultia lutescens D.A. Morrison & R.C. Carolin, *Brunonia* 9:15 (1987)

Distribution (Figure 26)
Northern Territory: Central Australia North, and Central Australia South Regions; Western Australia: Mueller, Giles, Carnegie, and Helms Districts. Gibson, Tanami, MacDonnell, and Victoria Desert Regions.

Ecology
A herb or sub-shrub with a woody rootstock. It has been recorded from deep red sand dunes, sandy loam plains, or around the gravelly edges of lateritic breakaways. It occurs among mallees, desert oak, open *Triodia* grassland, or *Spinifex* open scrub, where it is often locally common. Flowering apparently occurs sporadically throughout the year, perhaps only after recent rain.

Variability
This species varies somewhat between populations in leaf size, and flower size and colour, but this does not seem to be significant.

Notes
Closely related to *L. heteromera*, from which it can be readily distinguished by the yellow flowers and shorter calyx lobes. It has also been confused with *L. striata*, which has a distinctly scapigerous flowering habit and ridged rather than grooved articles.

Specimens Examined
21.

Conservation Status
Not at risk, as it is widespread and common throughout arid western Central Australia.

Lechenaultia macrantha K. Krause, Pflanzenr., IV. 54:100 (1912)

Distribution (Figure 23)
Western Australia: Irwin and Avon Districts; and one isolated collection in Irwin District, near Nerren Nerren station, and one in Austin District, near Boolardy station.

Murchison and Bencubbin Regions.

Ecology
A herb or sub-shrub that grows annually from a woody rootstock (Erickson et al. 1979). It occurs in yellow sand or, more usually, red gravelly soil, in open areas near heathland (Beard 1976e), or along road margins or other disturbed areas. It is usually locally common. Flowering is from mid August to late October.

Variability
Leaf size, and flower colour and size vary considerably between plants. Much of this variability appears to be latitudinal, with the more northern inland plants having the larger organs.

Notes
Closely related to *L. longiloba*, from which it can be readily distinguished by the wreath-like flowering habit, longer leaves and sepals, and larger petals with broader wings.

Specimens Examined
40.

Conservation Status
Not at risk, as it is relatively widespread and common on the inland red gravels of northern South Western Australia. Both Specht et al. (1974) and Hartley and Leigh (1979) consider the species to have suffered marked depletions in distribution, but as it apparently responds well to disturbance this is probably not as big a problem as was first thought. Hartley and Leigh (1979) record the species as occurring in conservation reserves. They also report it to have been subject to heavy commercial exploitation in the wild, but this has not been confirmed (cf. Rye et al. 1980).

Common Name
Wreath lechenaultia.

Illustrations
Morcombe (1968) p.31; Newbey (1968) p.125; Baker (1971) p.19; Blombery (1973) p.191; Grieve and Blackall (1975) pl.v; Gardner (1978) pp.131-2; Erickson et al. (1979) p.118; Crafter (1983) *Aust. Pl.* 12:56.

Lechenaultia ovata D.A. Morrison, Telopea 3: in press

Distribution (Figure 26)
Northern Territory: Darwin and Gulf Region. Arnhem Region.

Ecology
A herb that probably grows annually from a woody rootstock. It has been collected from short sedgeland in a sandy depression on a sandstone plateau. The specimen was flowering in February.

Notes
This species can be readily distinguished from all of the other members of this genus by the ovate leaves.

Specimens Examined
1.

Conservation Status
1K, as it is known only from the type collecion (see Morrison 1987). The population is apparently fairly large, but the locality is just outside Kakadu National Park. Intensive searches need to be made in the area to correctly ascertain the status of this species.

Lechenaultia papillata D.A. Morrison, Brunonia 9:12 (1987)

Distribution (Figure 24)
Western Australia: Roe District. Esperance Region.

Ecology
A sub-shrub or small shrub with a woody rootstock. It has been recorded from yellow or white sand, loamy sand, and gravelly loam. It usually occurs in heath (Beard 1969, Beadle 1981, as *L. expansa*), low open scrub, or eucalypt scrub mallee, where it may be locally common. Flowering is usually from late October to late November.

Variability
Flower size is somewhat variable, but the species nevertheless remains distinctive.

Notes
Closely related to *L. floribunda*, from which it can be readily distinguished by the shorter more crowded leaves, the papillate leaves, sepals, ovaries and pseudocapsules, and the much more hairy floral tube.

Specimens Examined
14.

Conservation Status
Although poorly collected, this species occurs in an area that is sparsely collected in general. Given the large area over which collections have been made, the species is probably not at risk. It is represented in Frank Hann National Park.

Lechenaultia pulvinaris C. Gardner, J. Roy. Soc. W. Austral. 47:63 (1964)

Distribution (Figure 25)
Western Australia: Avon District, between Corrigin and Wagin, and near Beverley. Bencubbin and Leeuwin Regions.

Ecology
A sub-shrub with a woody rootstock. It occurs in deep white sand on plains or gentle slopes, sometimes near low-lying seepage areas. It only grows in open patches in low scrub, becoming absent as the vegetation becomes more dense with age. It is often locally common. Flowering is from mid October to early December.

Notes
Closely related to *L. expansa*, from which it can be easily discerned by the dense pulvinate habit, like that of *L. tubiflora*. It can be readily distinguished from *L. tubiflora* by the hispid foliage and calyx lobes.

Specimens Examined
12.

Conservation Status
3VC, as, although it is not geographically localised (but see Rye et al. 1980), it occurs only in open patches in the vegetation. It is known from only a few apparently disjunct areas (see Leigh et al. 1984), and, although only rediscovered and described in the early 1960s, it was in fact collected late last century. It has been recently reported to occur around the edges of a number of small "A Class" conservation reserves, but it appears to become absent from the vegetation as the vegetation becomes more dense with age. Much more needs to be known about its biology before it can be decided how widespread the species is and whether it is adequately conserved (and therefore more appropriately categorised as 3RC). Hartley and Leigh (1979) report it to have been subject to heavy commercial exploitation in the wild, but the species is now protected as gazetted rare

flora (Patrick and Hopper 1982). However, it should be introduced into cultivation to ensure the long term survival of the species, and Newbey (1968) discusses its cultivation requirements.

Common Name
Cushion lechenaultia.

Illustrations
Anon. (1981) between pp.12-3; Rye and Hopper (1981) p.145; Leigh et al. (1984) between pp.192-3.

Lechenaultia stenosepala E. Pritzel, Bot. Jahrb. Syst. 35:552 (1905)

Distribution (Figure 28)
Western Australia: Irwin and Darling Districts. Bencubbin and Leeuwin Regions.

Ecology
A herb or sub-shrub with a woody rootstock that may sucker. It is found in yellow or white sand or sandy gravel, where it is usually recorded from low open heath (Beard 1976d, Hopkins and Hnatiuk 1981), often in damp depressions or valley floors. It is often locally common, especially as regrowth after fire. Flowering is from early October to mid December.

Variability
Leaf and flower size vary considerably, and this apparently correlates with latitude, the largest leaves and flowers only occurring on plants in the northern part of the distribution, and the smallest leaves and flowers only occurring in the southern part (see Morrison 1986).

Notes
Closely related to *L. floribunda*, from which it can be readily distinguished by the longer sepals, and to *L. biloba*, which has flowers of a much deeper blue and with much larger corolla wings.

Specimens Examined
51.

Conservation Status
Not at risk, as it is widespread and common on the northern sandplains of South Western Australia.

Common Name
Narrow-sepaled lechenaultia.

Lechenaultia striata F. Muell., Fragm. 8:245 (1874)

Distribution (Figure 27)
Northern Territory: Central Australia South Region; South Australia: North-western Region; Western Australia: Giles, Canegie, Helms, and Austin Districts. Gibson, MacDonnell, Leonora, and Victoria Desert Regions.

Ecology
A herb or sub-shrub with a woody rootstock that may sucker (Maconochie 1982). It is found on deep red sand dunes, where it is characteristic of the mid and upper slopes (Buckley 1981a). It occurs in open *Triodia* grassland or *Spinifex* open scrub, where it is often locally common, especially after recent rain. Plants appear to have only a moderate drought tolerance (Buckley 1982). Flowering apparently occurs sporadically throughout the year (perhaps only after recent rain), but it is usually from late August to mid November.

Variability
This species varies considerably between plants in leaf, flower and pseudocapsule size, and somewhat less in flower colour. None of this variation appears to be correlated.

Notes
Closely related to *L. brevifolia*, from which it can be readily distinguished by the longer leaves, and to *L. lutescens*, which does not have the scape-like flowering stems.

Specimens Examined
34.

Conservation Status
Not at risk, as it is widespread and common throughout arid western Central Australia. Specht et al. (1974) report it to be rare in the Northern Territory, but this does not appear to be the case.

Common Name
Striate-stemmed lechenaultia.

Illustrations
Jessop & Toelken (1986) p.1407.

Lechenaultia subcymosa C. Gardner & A.S. George, J. Roy. Soc. W. Austral. 46: 134 (1963)

Distribution (Figure 29)
Western Australia: Carnarvon District, on North West Cape and on the Shark Bay islands. Murchison Region.

Ecology
A herb or sub-shrub with a woody rootstock. It has been recorded from sand or loam over limestone (Burbidge and George 1978) or in red sand dunes, where it occurs with scattered low shrubs. It is often found in very dense stands regenerating after fire. Flowering apparently occurs sporadically throughout the year (perhaps only after a recent fire), but it is usually from late July to early October.

Notes
Closely related to *L. divaricata*, from which it can be readily discerned by the larger leaves, smaller flowers, and non-moniliform pseudocapsule.

Specimens Examined
15.

Conservation Status
Although poorly collected, this species occurs in an area that is sparsely collected in general. As it is apparently common where it does occur, the species is probably not at risk.

Common Name
Wide-branching lechenaultia.

Lechenaultia superba F. Muell., Fragm. 6:10 (1867)

Distribution (Figure 30)
Western Australia: Eyre District, at the eastern end of the Barrens. Esperance region.

Ecology
A small shrub with a woody rootstock. It only occurs in quartzite soils on rocky hillsides or in open gullies, where it is found in open patches in thick scrub. Plants are sometimes locally common. Flowering is usually from September to October, but flowering plants have been recorded at other times.

Notes
Closely related to *L. hirsuta*, from which it can be readily distinguished by the glabrous habit, and to *L. laricina*, which has a low spreading habit.

Specimens Examined
19.

Conservation Status
2RC, as it is geographically localised (Rye 1981) and restricted to a specific habitat. Almost the entire known distribution is within Fitzgerald River National Park, but the number of known plants is very small (Rye 1981). It is known to be in cultivation (Rye 1981, Rye and Hopper 1981), and Fairall (1970) discusses its cultivation requirements. It is also protected as gazetted rare flora (Patrick and Hopper 1982).

Common Name
Barrens lechenaultia.

Illustrations
Erickson et al. (1979) p.92; Anon. (1981) between pp.12-3; Rye and Hopper (1981) p.147.

Lechenaultia tubiflora R.Br., Prodr. 1:581 (1810)

Distribution (Figure 31)
Western Australia: Irwin, Avon, Darling, and Eyre Districts. Bencubbin, Leeuwin, and Esperance Regions.

Ecology
A sub-shrub with a woody rootstock that may sucker (Gardner 1944). It has been recorded from deep yellow or white sand, where it usually occurs in open patches in mixed heath (Beard 1973a, 1979c, 1980a, Beadle 1981), or *Eucalyptus* or *Banksia* woodland. It is often locally common, especially on bare ground. Flowering appears to occur sporadically throughout spring and summer, but it is mainly from late September to early December.

Variability
Apart from flower colour and leaf size, which can vary considerably within a single population, this species is apparently differentiated into coastal and inland forms (see Morrison 1986).

Notes
Closely related to *L. acutiloba*, from which it can be readily distinguished by the smaller flowers and winged corolla lobes. The prostrate habit is similar to that of *L. pulvinaris*, which has hispid leaves and calyx lobes.

Specimens Examined
153.

Conservation Status
Not at risk, as it is widespread and common throughout South Western Australia.

Common Name
Heath lechenaultia.

Illustrations
Beard (1970) pl.xxxi; Morcombe (1970) p.110; Walton (1970) *Aust. Pl.* 5:248; Wrigley (1970) *Aust.Pl.* 5:241; Blombery (1973) p.191; Holliday (1973) p.16; Grieve and Blackall (1975) pl.iv; Erickson et al. (1979) p.84; Wrigley and Fagg (1979) pp.128-9; Elliot and Jones (1982) p.185.

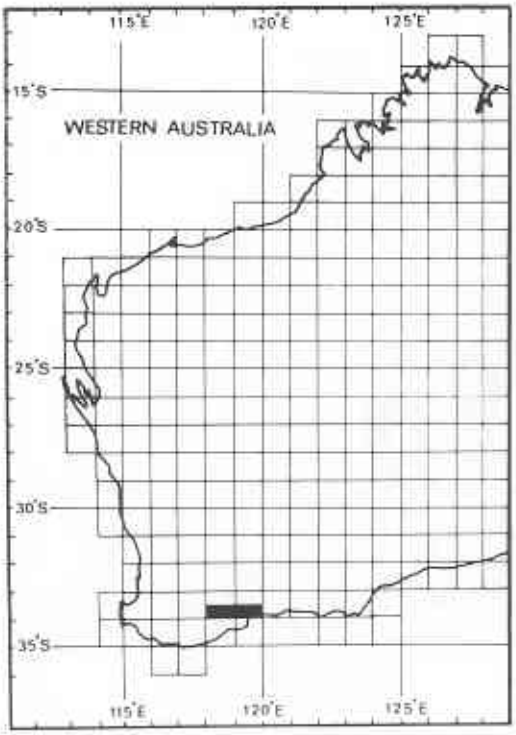

Figure 8. Distribution of L. acutiloba

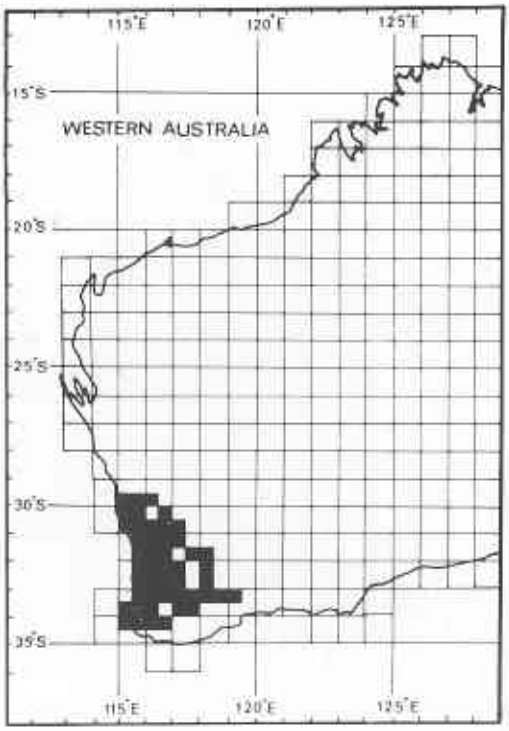

Figure 9. Distribution of L. biloba

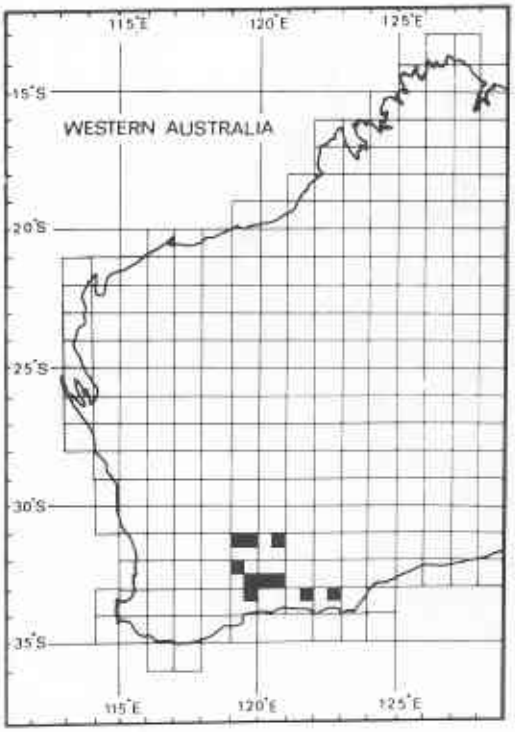

Figure 10. Distribution of L. brevifolia

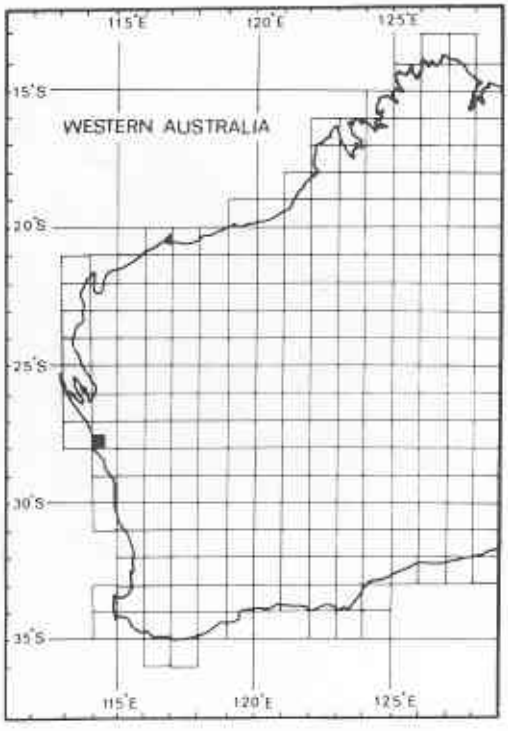

Figure 11. Distribution of L. chlorantha

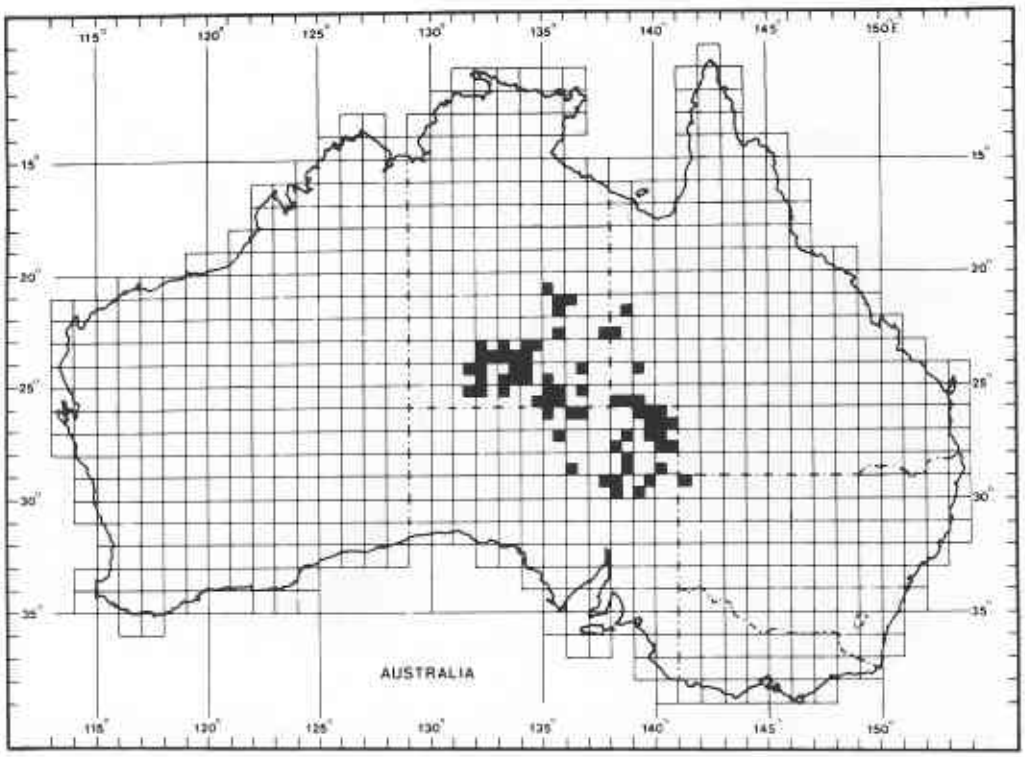

Figure 12. Distribution of L. divaricata

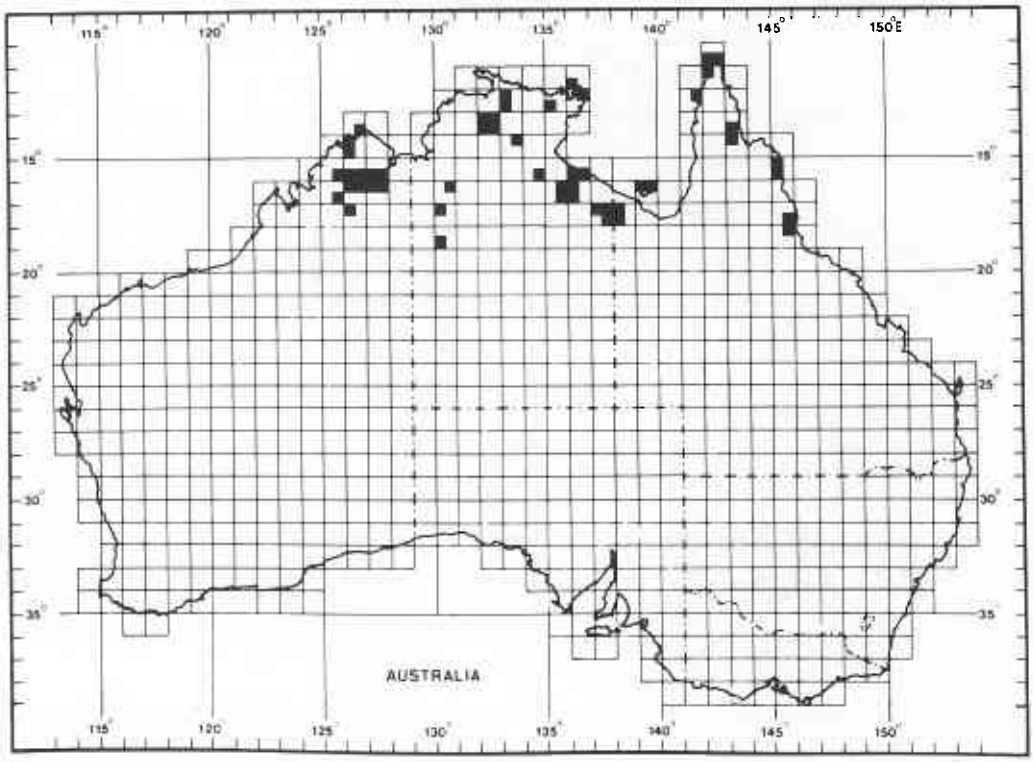

Figure 13. Distribution of L. filiformis

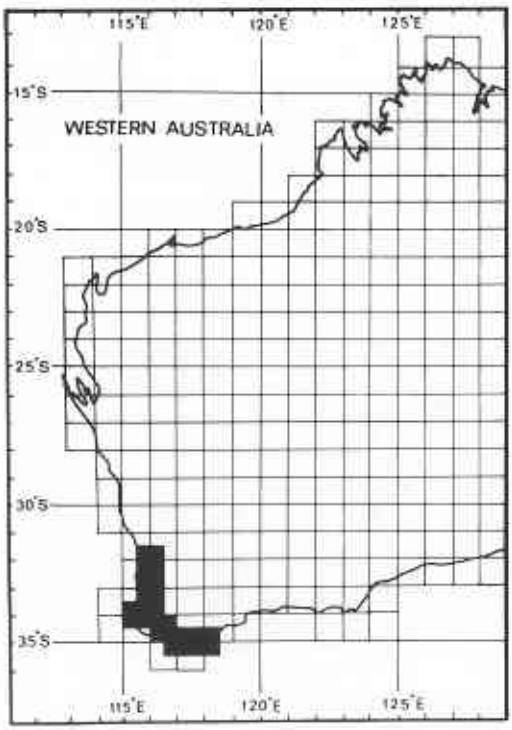

Figure 14. Distribution of L. expansa

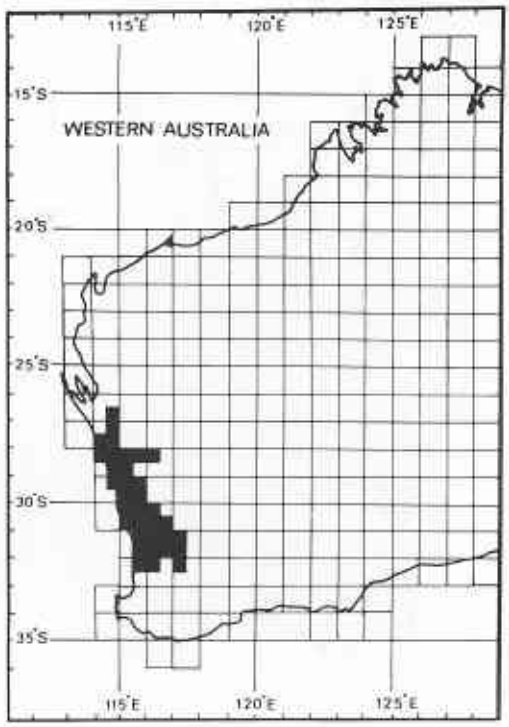

Figure 15. Distribution of L. floribunda

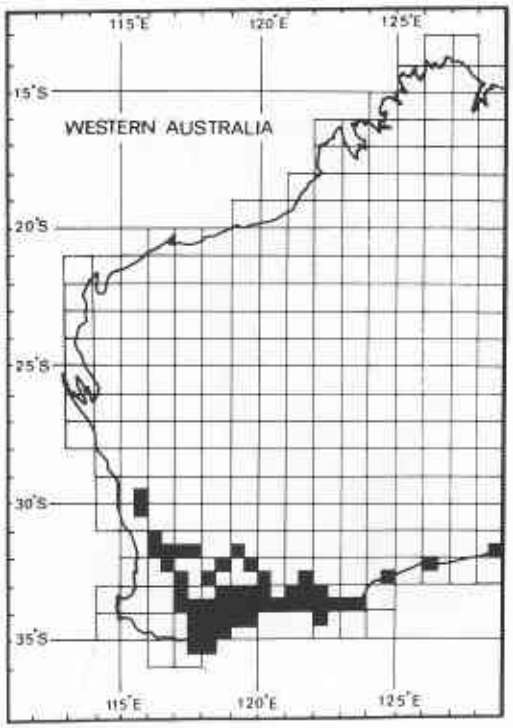

Figure 16. Distribution of L. formosa

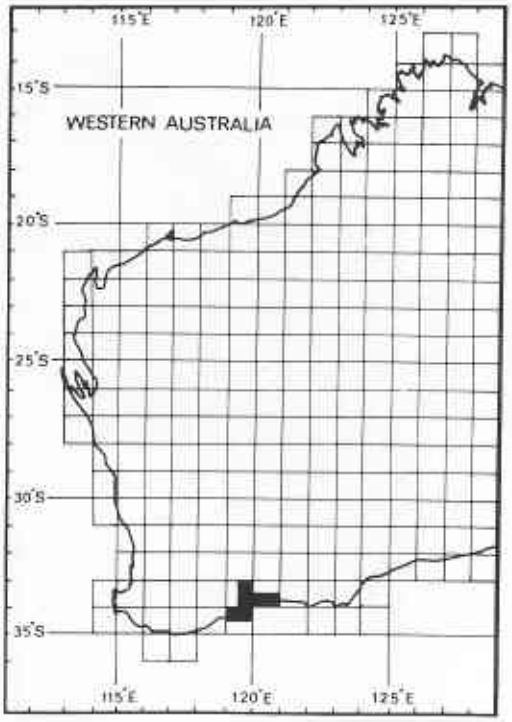

Figure 17. Distribution of L. heteromera

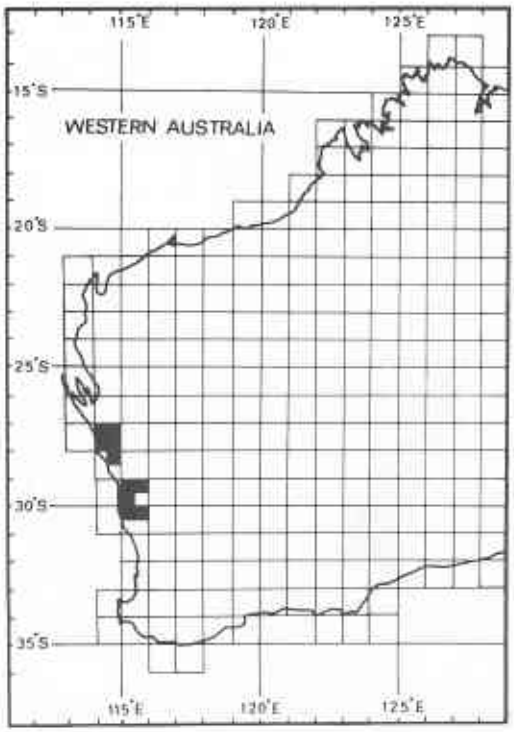

Figure 18. Distribution of L. hirsuta

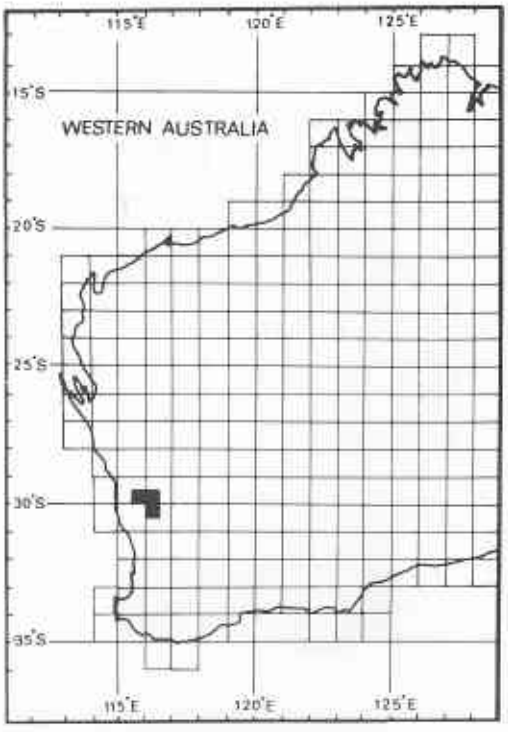

Figure 19. Distribution of L. juncea

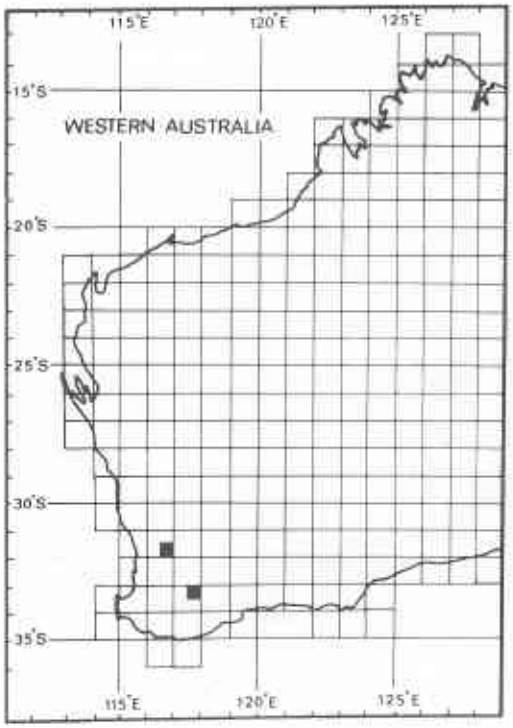

Figure 20. Distribution of L. laricina

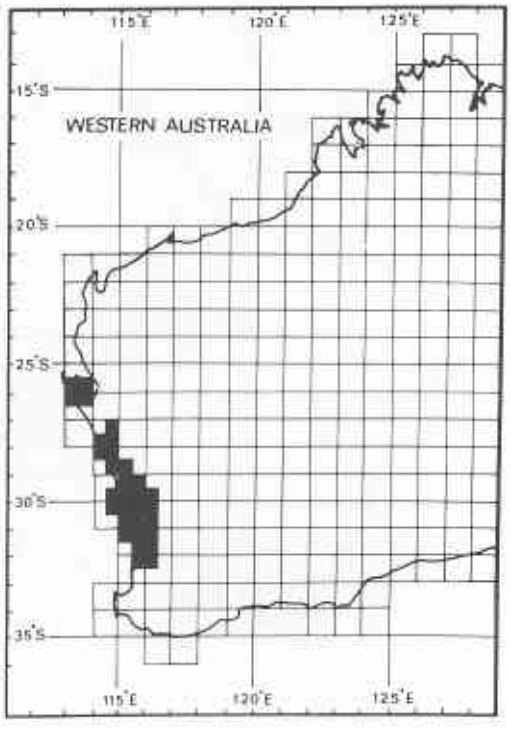

Figure 21. Distribution of L. linarioides

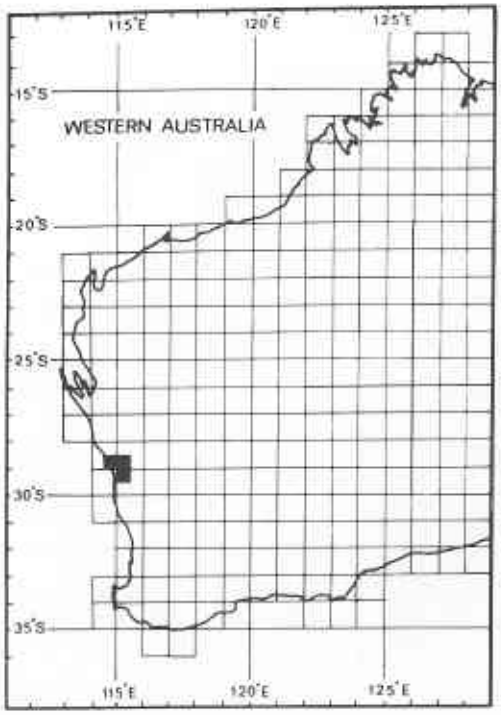

Figure 22. Distribution of L. longiloba

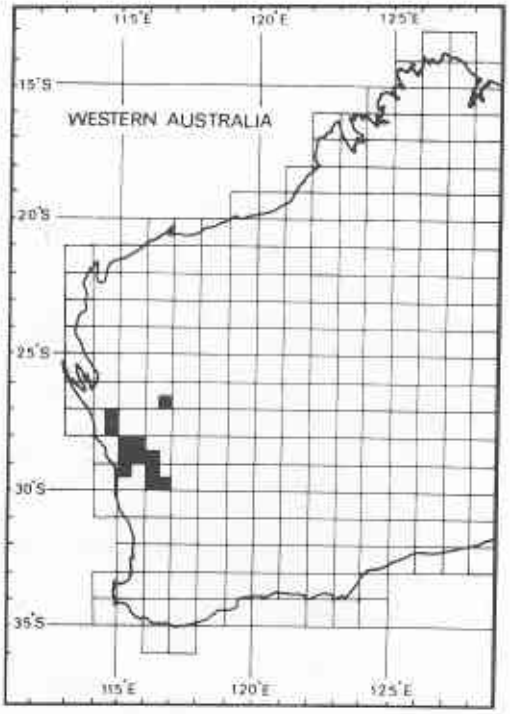

Figure 23. Distribution of L. macrantha

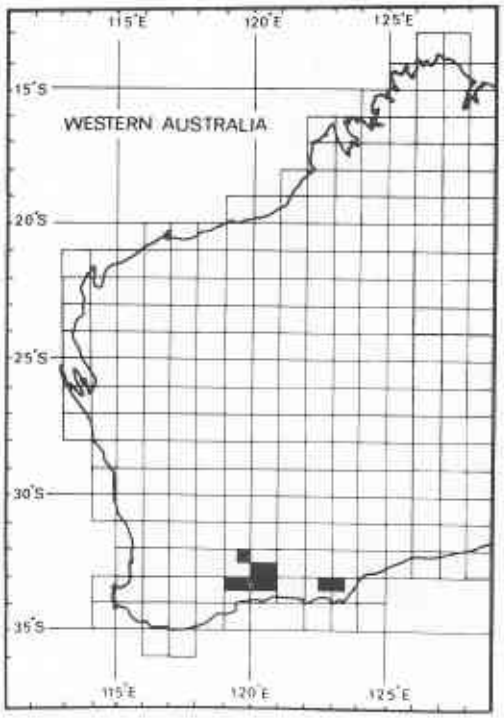

Figure 24. Distribution of L. papillata

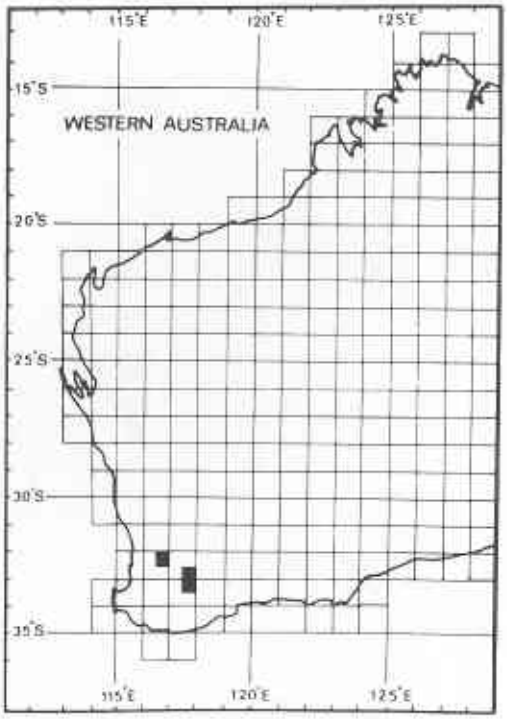

Figure 25. Distribution of L. pulvinaris

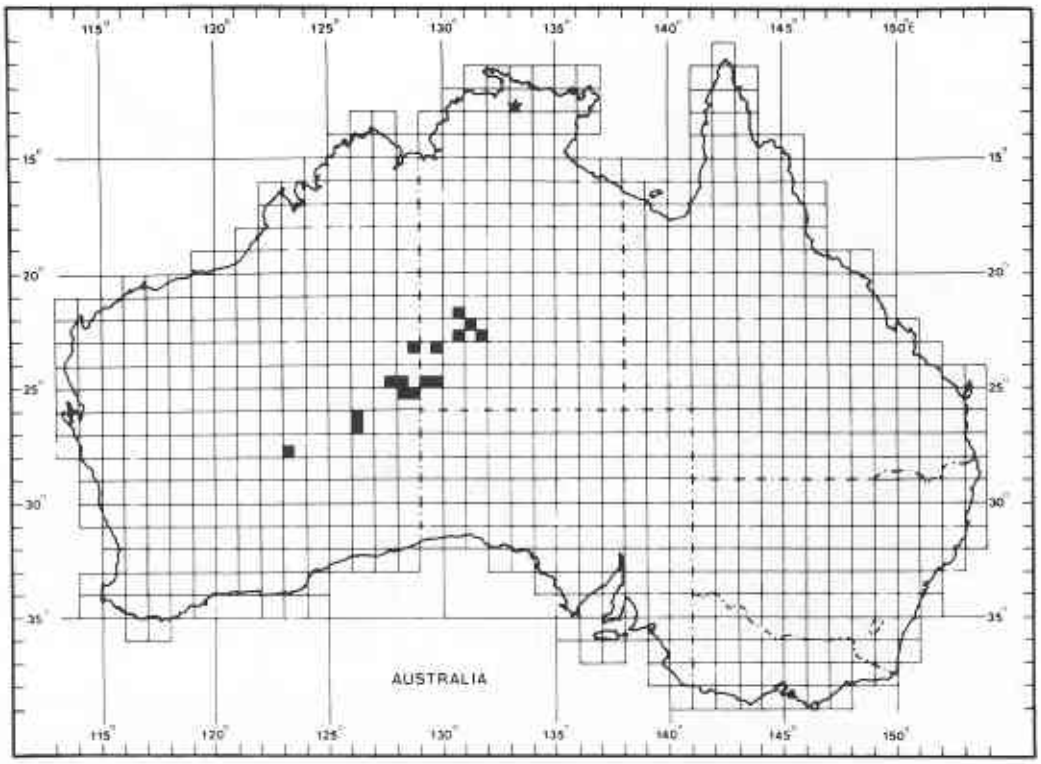

Figure 26. Distribution of L. lutescens and ★ L. ovata

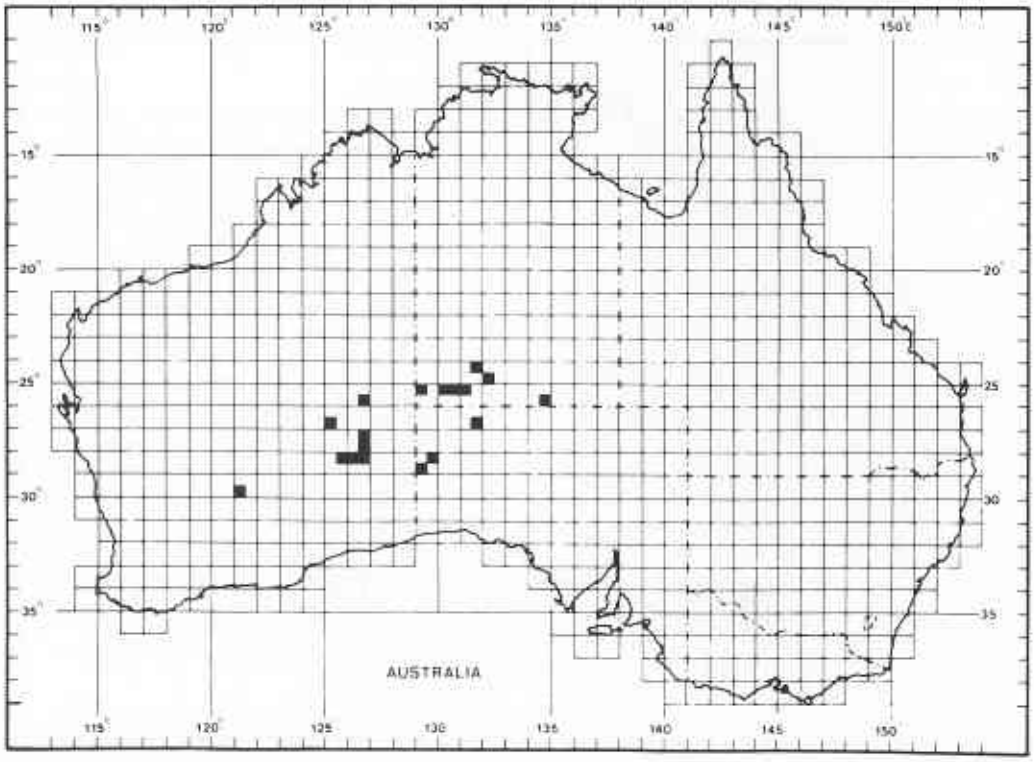

Figure 27. Distribution of L. striata

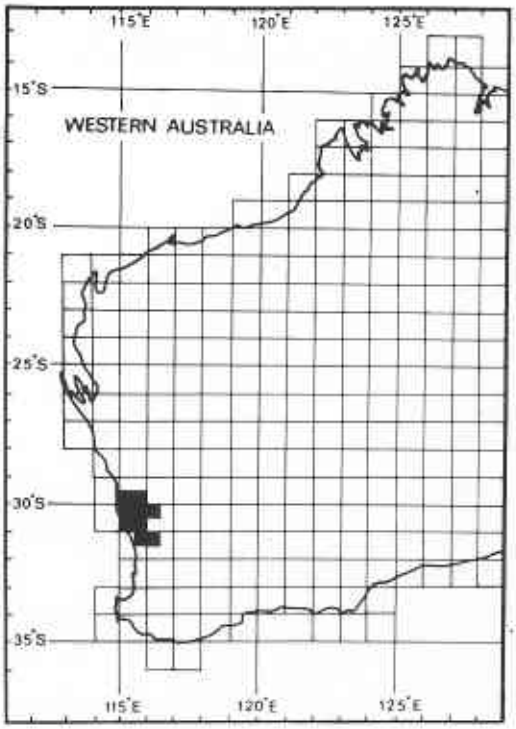

Figure 28. Distribution of L. stenosepala

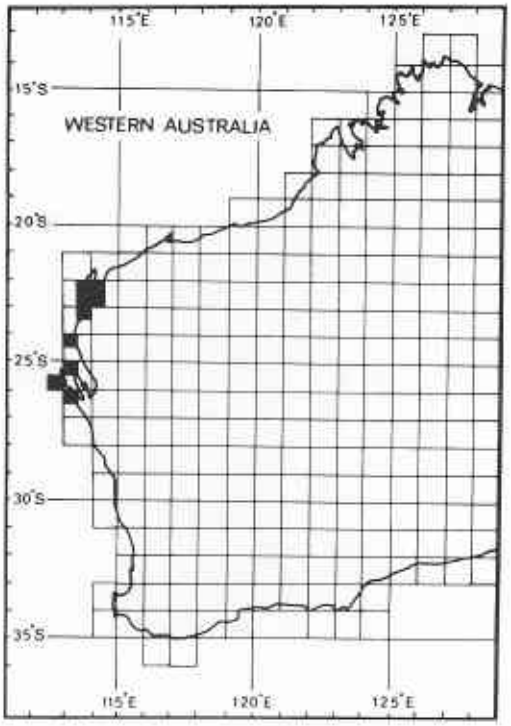

Figure 29. Distribution of L. subcymosa

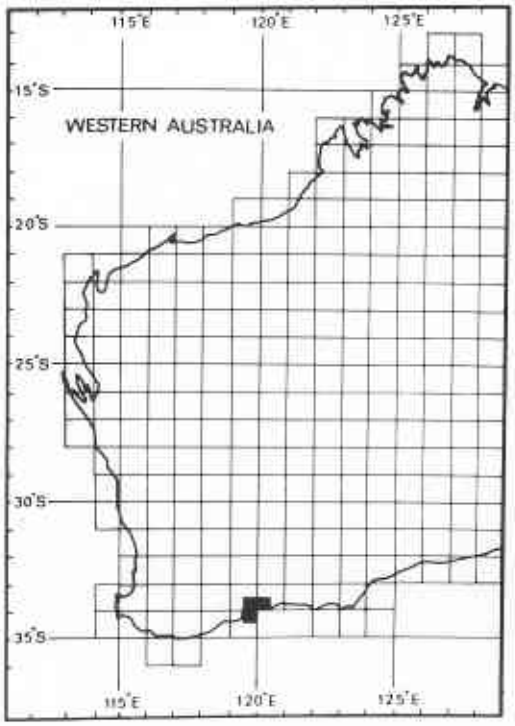

Figure 30. Distribution of L. superba

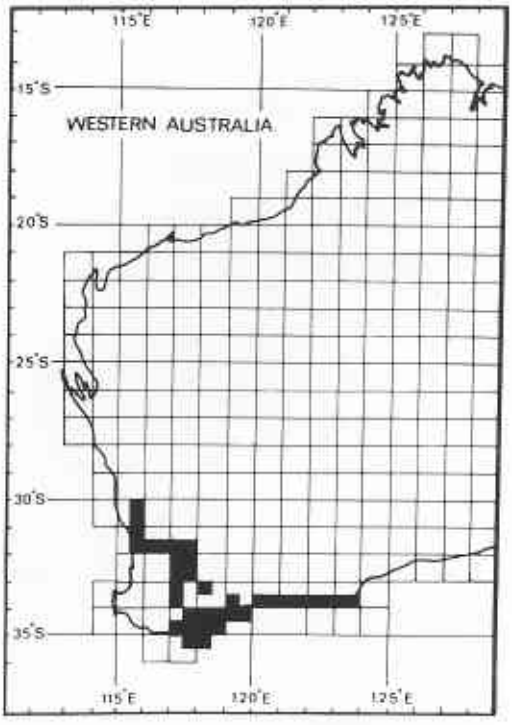

Figure 31. Distribution of L. tubiflora

Appendix 2. *Lechenaultia* species recorded (or considered likely) to occur in 0.5° lat. x 0.5° long. grid cells of South Western Australia and adjacent areas. Occurrences not represented by a herbarium specimen are in brackets. The grid cell numbers and names are those of the Division of National Mapping's coding system for the 1:100,000 topographic maps.

1446 QUOIN				
(*L. linarioides*)	*L. subcymosa*			
1547 DORRE				
L. subcymosa				
1546 DENHAM				
L. linarioides	(*L. subcymosa*)			
1545 EDEL				
L. linarioides	*L. subcymosa*			
1646 SHARK BAY				
L. linarioides				
1645 PERON				
L. linarioides				
1743 COOLCURDA				
L. hirsuta	(*L.linarioides*)			
1742 KALBARRI				
L. chlorantha	*L. floribunda*	*L. hirsuta*	*L. linarioides*	
1741 HUTT				
L. floribunda	*L. linarioides*			
1844 WANNOO				
L. floribunda				
1843 NERREN NERREN				
L. floribunda	*L. hirsuta*	*L. linarioides*	*L. macrantha*	
1842 AJANA				
L. floribunda	*L. hirsuta*	*L. linarioides*	*L. macrantha*	
1841 NORTHAMPTON				
L. floribunda	*L. hirsuta*	*L. linarioides*		
1840 GERALDTON				
L. floribunda	(*L. hirsuta*)	*L. linarioides*	*L. longiloba*	
1839 DONGARA				
L. floribunda	(*L. linarioides*)			
1838 BEAGLE ISLANDS				
(*L. biloba*)	(*L. floribunda*)	*L. linarioides*		
1837 GREEN HEAD				
(*L. biloba*)	(*L. floribunda*)	*L. linarioides*		
1830 CLAIRAULT				
(*L. biloba*)	(*L. expansa*)			
1829 TOOKER				
(*L. biloba*)	(*L. expansa*)			
1942 COOLCALALAYA				
(*L. macrantha*)				
1941 MUNGO				
L. floribunda	*L. macrantha*			
1940 INDARRA				
L. floribunda	(*L. hirsuta*)	*L. linarioides*	*L. longiloba*	*L. macrantha*
1939 MINGENEW				
L. floribunda	*L. hirsuta*	*L. linarioides*	*L. longiloba*	*L. macrantha*
1938 ARROWSMITH				
L. biloba	*L. floribunda*	*L. hirsuta*	*L. linarioides*	*L. stenosepala*
1937 HILL RIVER				
L. biloba	*L. floribunda*	*L. hirsuta*	*L. linarioides*	*L. stenosepala*

1936 WEDGE ISLAND
L. biloba *L. floribunda* *L. linarioides* *L. stenosepala*

1935 LEDGE POINT
(*L. biloba*) (*L. floribunda*) *L. linarioides* (*L. stenosepala*)

1930 BUSSELTON
L. biloba *L. expansa*

1929 LEEUWIN
L. biloba *L. expansa*

2041 TALLERING
L. floribunda *L. macrantha*

2040 MULLEWA
(*L. floribunda*) *L. macrantha*

2039 YANDANOOKA
L. floribunda *L. hirsuta* *L. linarioides* (*L. macrantha*)

2038 CARNAMAH
L. biloba *L. floribunda* *L. formosa* (*L. hirsuta*) *L. juncea*
L. linarioides *L. stenosepala*

2037 BADGINGARRA
L. biloba *L. floribunda* *L. formosa* *L. hirsuta* (*L. juncea*)
L. linarioides *L. stenosepala* *L. tubiflora*

2036 DANDARAGAN
L. biloba *L. floribunda* *L. linarioides* *L. stenosepala* *L. tubiflora*

2035 GINGIN
L. biloba *L. floribunda* *L. linarioides* *L. stenosepala* *L. tubiflora*

2034 PERTH
L. biloba *L. expansa* *L. floribunda* *L. linarioides* *L. tubiflora*

2033 FREMANTLE
L. biloba *L. expansa* *L. floribunda* *L. linarioides*

2032 PINJARRA
L. biloba *L. expansa*

2031 BUNBURY
L. biloba *L. expansa*

2030 DONNYBROOK
L. biloba *L. expansa*

2029 DONNELLY
L. biloba *L. expansa*

2028 MEERUP
(*L. expansa*)

2141 WURARGA
L. floribunda

2140 MELLENBYE
L. macrantha

2139 PERENJORI
L. macrantha

2138 CARON
L. biloba *L. juncea* *L. linarioides* *L. macrantha*

2137 WATHEROO
(*L. biloba*) *L. floribunda* *L. juncea* *L. linarioides* *L. stenosepala*

2136 MOORA
L. biloba *L. floribunda* (*L. formosa*) *L. linarioides* (*L. stenosepala*)

2135 CHITTERING
L. biloba *L. floribunda* *L. formosa* *L. linarioides* *L. stenosepala*

2134 WOOROLOO
L. biloba *L. expansa* *L. floribunda* *L. formosa* *L. linarioides*
L. tubiflora

2133 JARRAHDALE
L. biloba *L. expansa* *L. floribunda* *L. linarioides*

2132 DWELLINGUP
L. biloba *L. expansa*

2131 COLLIE
L. biloba *L. expansa*

2130 BRIDGETOWN
L. biloba *L. expansa*

2129 MANJIMUP
L. biloba *L. expansa*

2128 NORTHCLIFFE
L. expansa

2244 BOOLARDY
L. macrantha

2238 MONGERS
L. macrantha

2237 DALWALLINU
L. biloba

2236 WONGAN
L. biloba *L. floribunda*

2235 GOOMALLING
L. biloba *L. floribunda*

2234 NORTHAM
L. biloba *L. floribunda* *L. formosa* *L. laricina* *L. tubiflora*

2233 BEVERLEY
L. biloba (*L. floribunda*) *L. formosa* *L. pulvinaris*

2232 CROSSMAN
L. biloba

2231 DARKAN
L. biloba

2230 DINNINUP
L. biloba

2229 TONEBRIDGE
L. biloba *L. expansa*

2228 DEEP RIVER
L. expansa

2227 RAME HEAD
L. expansa

2338 MOUNT GIBSON
L. macrantha

2336 KOORDA
L. biloba

2335 DOWERIN
L. biloba *L. floribunda*

2334 CUNDERDIN
(*L. biloba*) *L. floribunda* *L. formosa* *L. tubiflora*

2333 BROOKTON
L. biloba *L. floribunda* (*L. formosa*) *L. tubiflora*

2332 NARROGIN
L. biloba *L. formosa* *L. tubiflora*

2331 WAGIN
L. biloba *L. formosa* *L. tubiflora*

2330 KOJONUP
L. biloba *L. formosa* *L.tubiflora*

2329 FRANKLAND
(*L. tubiflora*)

2328 DENMARK
L. expansa *L. tubiflora*

2327 PARRY INLET
L. expansa

2434 KELLERBERRIN
L. biloba *L. formosa* *L. tubiflora*

2433 CORRIGIN
(*L. biloba*) (*L. formosa*) *L. tubiflora*

2432 YEALERING
(*L. biloba*) (*L. formosa*) *L. pulvinaris* *L. tubiflora*

2431 DUMBLEYUNG
L. biloba (*L. formosa*) *L. laricina* *L. pulvinaris* (*L. tubiflora*)

2430 KATANNING
L. biloba *L. formosa* (*L. tubiflora*)

2429 TAMBELLUP
L. formosa *L. tubiflora*

2428 MOUNT BARKER
L. expansa *L. formosa* *L. tubiflora*

2427 ALBANY
L. expansa *L. formosa* *L. tubiflora*

2534 BRUCE ROCK
L. biloba (*L. formosa*)

2533 NAREMBEEN
L. biloba

2532 KULIN
L. biloba *L. formosa*

2531 KUKERIN
L. biloba (*L. formosa*) *L. tubiflora*

2530 NYABING
L. acutiloba *L. formosa* (*L. tubiflora*)

2529 BORDEN
L. formosa *L. tubiflora*

2528 MANYPEAKS
L. expansa *L. formosa* *L. tubiflora*

2527 BREAKSEA
L. expansa *L. formosa* *L. tubiflora*

2634 MUNTADGIN
(*L. formosa*)

2633 HYDEN
L. formosa

2632 PEDERAH
(*L. formosa*)

2631 BURNGUP
L. biloba *L. formosa*

2630 JERRAMUNGUP
L. acutiloba *L. formosa* (*L. tubiflora*)

2629 PALLINUP
L. formosa *L. tubiflora*

2628 CHEYNE
L. formosa *L. tubiflora*

2735 SOUTHERN CROSS
L. brevifolia

2734 HOLLETON
(*L. brevifolia*) *L. formosa*

2733 O'CONNOR
L. brevifolia (*L. formosa*)

2732 HURLSTONE
(*L. formosa*)

2731 NEWDEGATE
L. biloba *L. formosa* *L. papillata*

2730 JACUP
L. acutiloba *L. formosa* *L. tubiflora*

2729 BREMER
L. formosa *L. heteromera* *L. tubiflora*

2728 CAPE KNOB
(*L. formosa*) (*L. tubiflora*)

2835 YELLOWDINE
L. brevifolia

2834 CHERITONS FIND
(*L. brevifolia*)

2833 HOLLAND
(*L. brevifolia*) *L. formosa* *L. papillata*

2832 IRONCAP
L. brevifolia (*L. formosa*) (*L. papillata*)

2831 KING
L. brevifolia *L. formosa* *L. heteromera* *L. papillata*

2830 COCANARUP
L. acutiloba *L. formosa* *L. heteromera* *L. superba* (*L. tubiflora*)

2829 HOOD POINT
L. formosa *L. heteromera* *L. superba* *L. tubiflora*

2935 BOORABBIN
(*L. brevifolia*)

2934 LAKE PERCY
(*L. brevifolia*)

2933 ROUNDTOP
(*L. brevifolia*)

2932 HOPE
L. brevifolia *L. formosa* *L. papillata*

2931 MOOLYALL
(*L. brevifolia*) *L. formosa* *L. papillata*

2930 RAVENSTHORPE
L. formosa *L. heteromera* *L. superba* *L. tubiflora*

3035 WOOLGANGIE
L. brevifolia

3034 DIAMOND ROCK
(*L. brevifolia*)

3033 JOHNSTON
(*L. brevifolia*)

3032 TAY
L. brevifolia *L. papillata*

3031 NORTHOVER
(*L. brevifolia*) (*L. formosa*) *L. papillata*

3030 OLDFIELD
L. formosa *L. heteromera* *L. tubiflora*

3132 PEAK CHARLES
(*L. brevifolia*) (*L. papillata*)

3131 LORT
(*L. brevifolia*) *L. formosa* (*L. papillata*)

3130 STOKES INLET
L. formosa *L. tubiflora*

3232 DUNDAS
(*L. brevifolia*) *L. formosa* (*L. papillata*)

3231 SCADDAN
L. brevifolia *L. formosa* (*L. papillata*)

3230 ESPERANCE
L. formosa *L. tubiflora*

3332 COWALINYA
(*L. brevifolia*) (*L. papillata*)

3331 BURDETT
(*L. brevifolia*) *L. formosa* (*L. papillata*)

3330 MERIVALE
L. formosa *L. tubiflora*

3432 MOUNT ANDREW
(*L. brevifolia*) (*L. papillata*)

3431 BEAUMONT
L. brevifolia *L. papillata*

3430 HOWICK
L. formosa *L. tubiflora*

3531 BURAMINYA
L. papillata

3530 SANDY BIGHT
L. formosa *L. tubiflora*

3630 MALCOLM
L. formosa *L. tubiflora*

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