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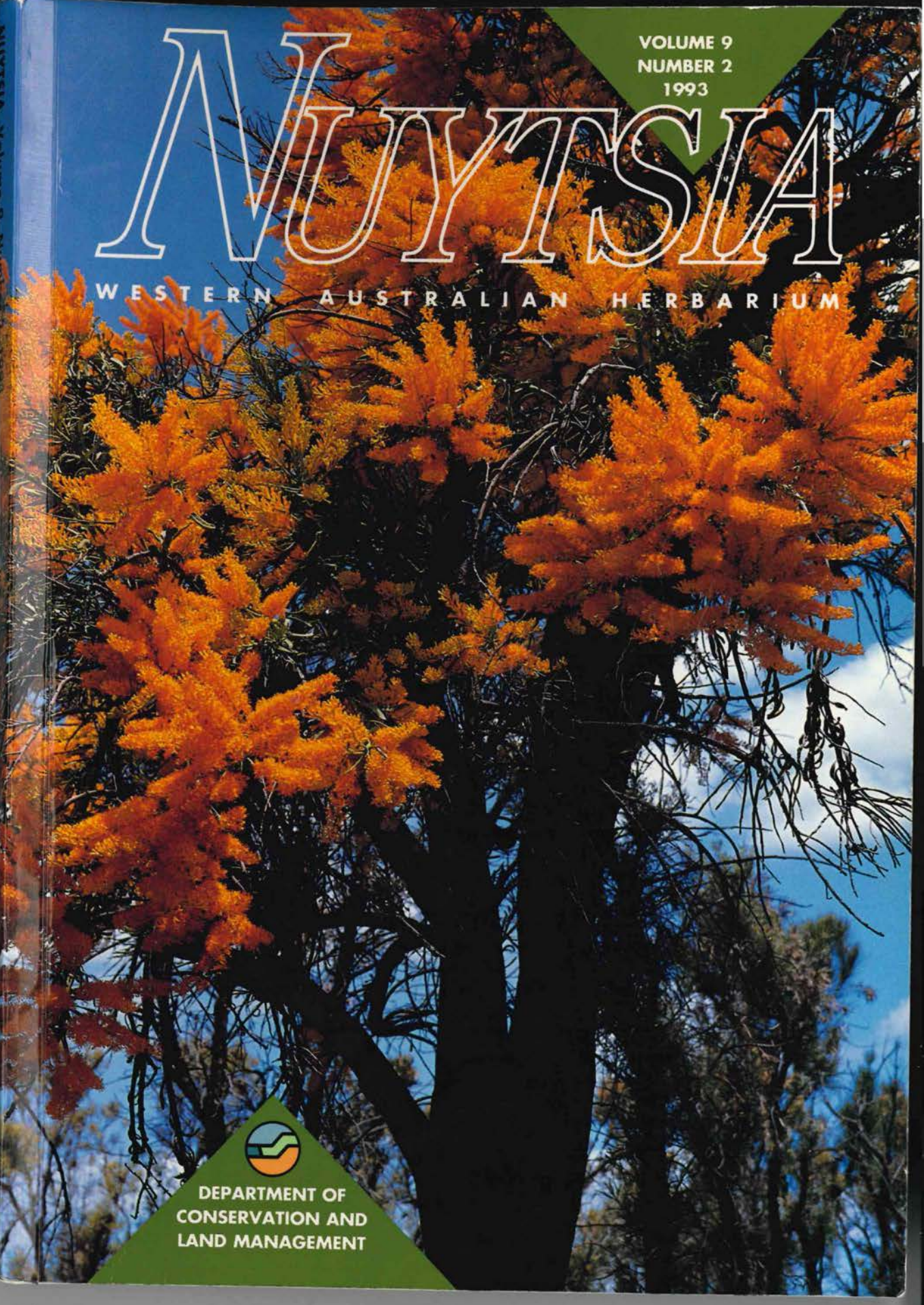

DEPARTMENT OF
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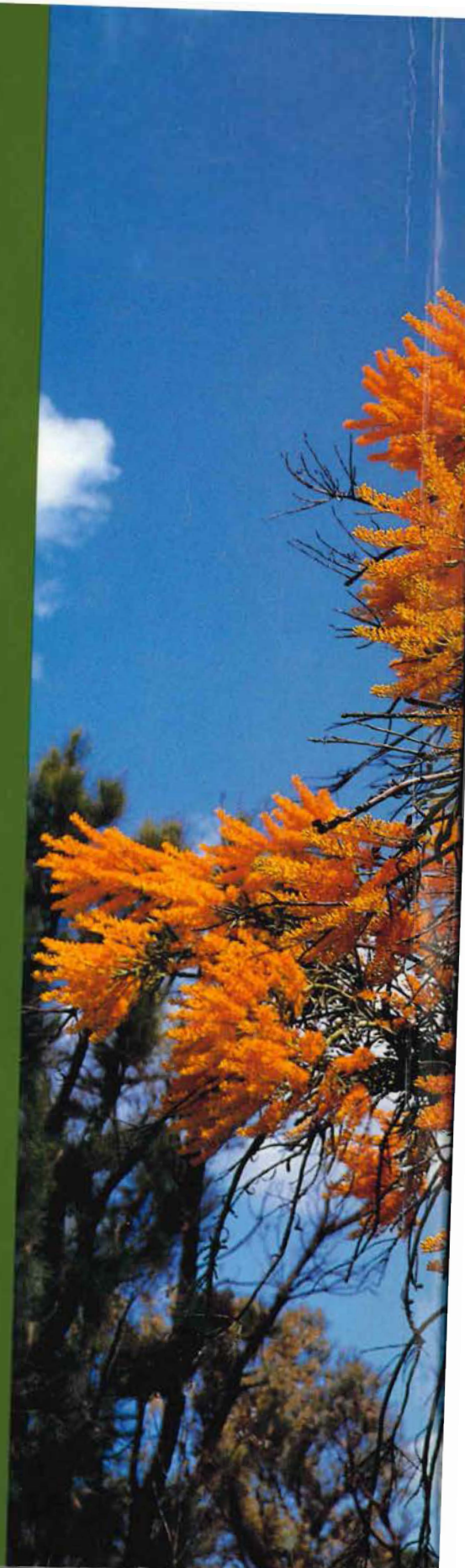

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Western Australian Herbarium,
Department of Conservation and Land Management,
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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) - the Western Australian Christmas Tree is one of the few aborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the "Gulde Zeepard" on one of the first explorations along the south coast of Australia.

Cover design by Sue Marais

Photograph A.S. George

A revision of the genus *Eremaea* (Myrtaceae)

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Abstract

Hnatiuk, Roger J. A revision of the genus *Eremaea* (Myrtaceae). Nuytsia 9 (2): 137-222 (1993). *Eremaea* is a genus of shrubs and small trees endemic in south-western Australia. It has an unusual distribution in that 15 of its 16 species occur on or very close to the coastal plain (Irwin and Darling Botanical Districts) and one species extends throughout much of the non-forested areas of the South West Botanical Province. The genus is a significant component of the shrub layer of several vegetation types. Eight new species, 5 subspecies, and 8 varieties are described (*E. asterocarpa* subsp. *asterocarpa*, *E. asterocarpa* subsp. *histoclada*, *E. asterocarpa* subsp. *brachyclada*, *E. atala*, *E. hadra*, *E. beaufortioides* var. *beaufortioides*, *E. beaufortioides* var. *lachnosanthe*, *E. beaufortioides* var. *microphylla*, *E. blackwelliana*, *E. ebracteata* var. *ebracteata*, *E. ebracteata* var. *brachyphylla*, *E.* x *codonocarpa*, *E. dendroidea*, *E. ectadioclada*, *E. pauciflora* var. *pauciflora*, *E. pauciflora* var. *calyptra*, *E. pauciflora* var. *lonchophylla*, *E.* x *phoenicea*, *E. violacea* subsp. *violacea* and *E. violacea* subsp. *raphiophylla*). Keys to and descriptions of taxa, and illustrations of most taxa are presented. An index to taxa is given on page 222.

Introduction

Eremaea is a genus of shrubs and small trees in the family Myrtaceae. It occurs only in the south-western corner of Australia. Although it is a significant component of several vegetation types, it has not received any particular attention in taxonomic, ecological, or other botanical studies. At the time of commencement of the present study in 1977, the only published works were a treatment by Bentham (1867) and a series of miscellaneous taxonomic papers (Kuntze 1903, Domin 1923, Gardner & George 1963, Gardner 1964).

In the course of carrying out detailed ecological studies of the vegetation of the kwongan between Coomalloo Creek and Eneabba, north of Perth, the taxonomic richness of this genus was discovered. The study was initially believed to be a simple, small one, but it has revealed a taxonomic, and geographic diversity and complexity not previously known in this genus.

The first named species of *Eremaea*, *E. pauciflora* (Endl.) Druce (as *Metrosideros pauciflora* Endl.), was described in 1837. Over the next 127 years, 11 species (including 3 synonyms) were described, as botanical exploration of the south-west proceeded. The present study recognises 16 species, 5 subspecies and 8 varieties of *Eremaea*.

Eremaea was classified (Briggs & Johnson 1979) as a member of the Leptospermoideae sub-family, Leptospermum alliance and Calothamnus sub-alliance. The capsular fruits, basifixed anthers, slightly fused staminal filaments and small leaves are significant characters in this placement.

Conservation status is detailed in "Conservation Codes for Western Australian Flora" on page 305 of this issue of Nuytsia.

Methods

The general distribution of *Eremaea* was determined from specimens in the Western Australian Herbarium. A field collecting program was designed to allow monthly collections in the area from Perth to a little north of Eneabba. A single trip was made in December to collect from the north of the then known range of the genus to obtain material of *E. ebracteata* which was known to flower at that time. A single spring collecting trip was designed to cover much of the range of *E. pauciflora*.

Following the extensive collecting, specimens were sorted into broad morphological groupings based on characters of the fruits, leaves, and flowers. A selection of specimens was made from each group to represent morphologically complete specimens from throughout the geographic range of each taxon. This resulted in 87 specimens being selected.

Each of the 87 specimens was scored for the 59 characters listed in Table 1. These data were then analysed for patterns of association using the programs in the TAXON package available from CSIRO Division of Computing Research.

These analyses were phenetic and based on a range of morphologic characters. They were carried out specifically to search for patterns in the morphology of *Eremaea* as a means of understanding the complex variation found in the field.

The analyses used were MINSPAN, a minimum spanning tree which links similar pairs of specimens to show relationships in a non hierarchical manner (Figure 1), and MULCLAS to show a hierarchical classification (Figure 2). The similarity index used was the Euclidean metric.

Subsidiary field collections were made to obtain material (fresh flowers, young leaves and seeds) for use in isozyme analyses. The methods and results of this have been reported in Coates & Hnatiuk, 1990. The analyses of the isozyme data were cladistic in contrast to the phenetic analyses of the morphologic data.

Some seed from the first collections were sown at the Western Australian Herbarium and plants placed in that Garden. Unfortunately, most of the plants were lost to an invasion of grasshoppers. However, sufficient plants survived to provide some indication of morphological stability between generations.

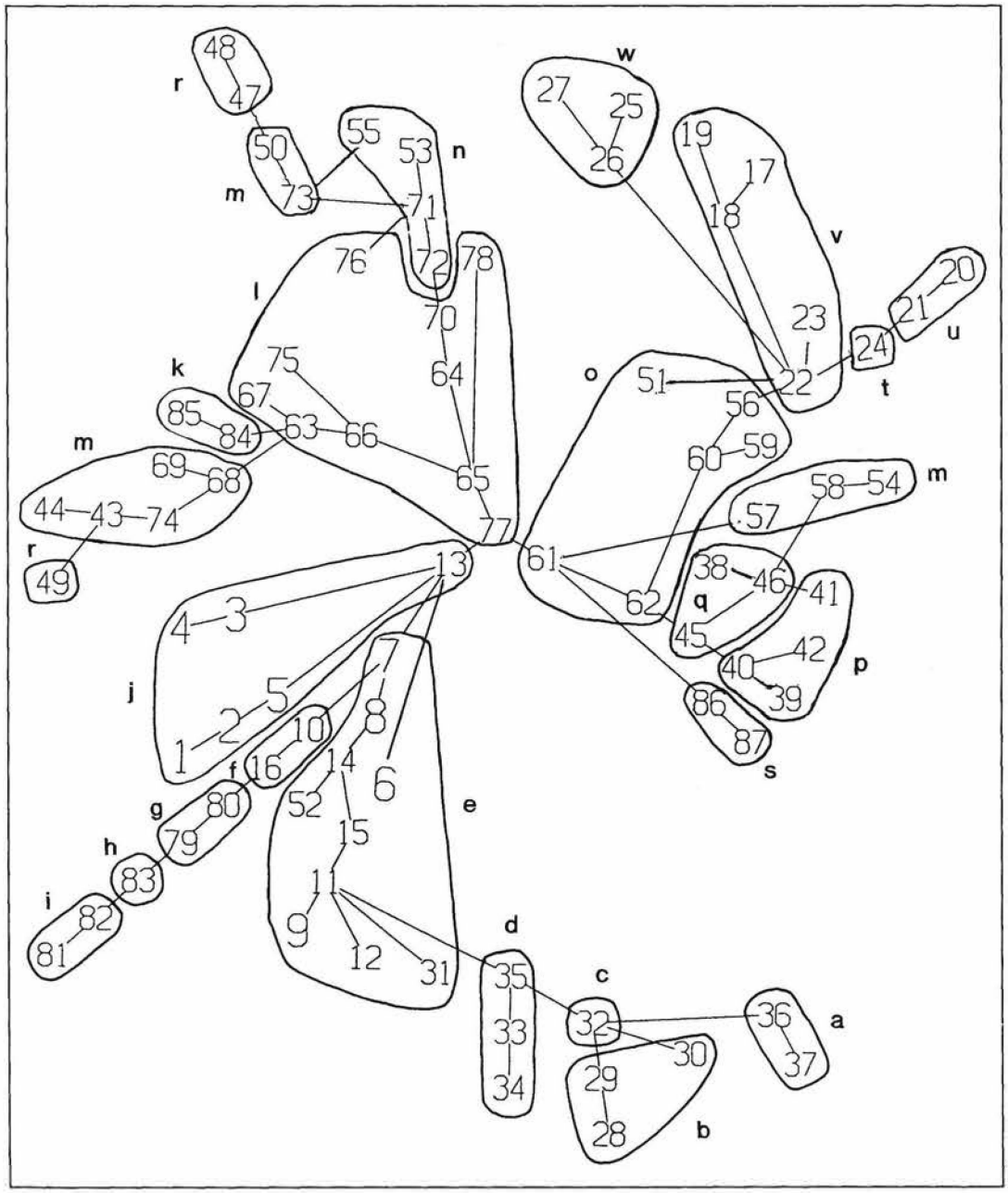

Figure 1. MINSPAN representation of similarities between the 87 *Eremaea* specimens of this study (see methods). Each specimen is linked to the one which is most similar to it. The shape of the illustration is arbitrary. Lower-case letters identify taxa: **a**: *E. brevifolia*, **b**: *E. asterocarpa* subsp. *asterocarpa*, **c**: *E. asterocarpa* subsp. *brachyclada*, **d**: *E. asterocarpa* subsp. *histoclada*, **e**: *E. ectadioclada*, **f**: *E. acutifolia*, **g**: *E. purpurea*, **h**: *E. ebracteata* var. *brachyphylla*, **i**: *E. ebracteata* var. *ebracteata*, **j**: *E.* x *codonocarpa*, **k**: *E. dendroidea*, **l**: *E. pauciflora* var. *pauciflora*, **m**: *E. pauciflora* var. *lonchophylla*, **n**: *E. pauciflora* var. *calyptra*, **o**: *E.* x *phoenicea*, **p**: *E. beaufortioides* var. *beaufortioides*, **q**: *E. beaufortioides* var. *microphylla*, **r**: *E. beaufortioides* var. *lachnosanthe*, **s**: *E. fimbriata*, **t**: *E. violacea* subsp. *violacea*, **u**: *E. atala*, **v**: *E. violacea* subsp. *raphiophylla*, **w**: *E. hadra*.

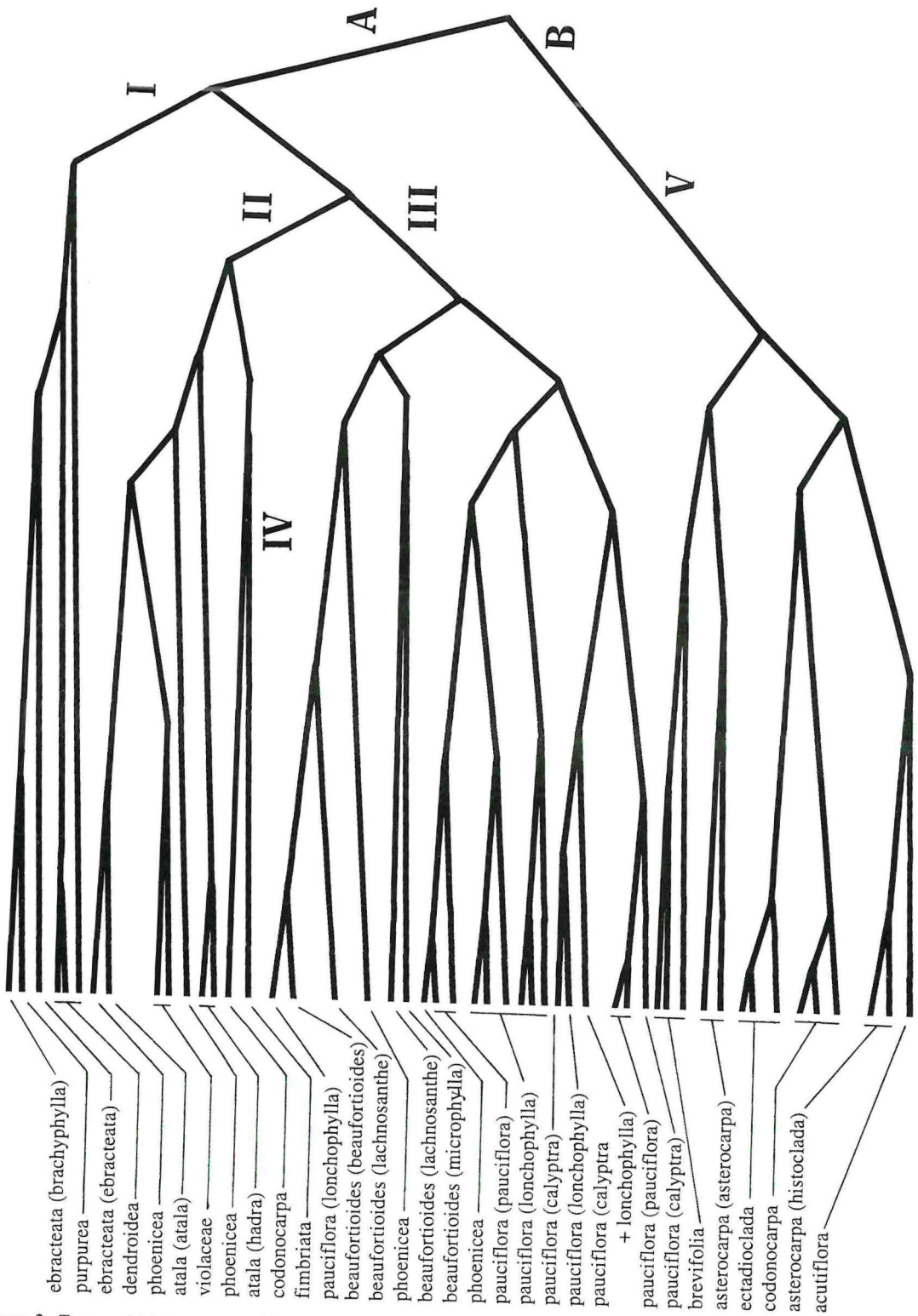

Figure 2. Truncated MULCLAS classification of 87 *Eremaea* specimens using numerical data only. "A" = subg. *Eremaea;* "B" = subg. *Okriocarpa.* "I" = sect. *Ebracteata*"; "II" = sect. *Violacea;* "III" = sect. *Eremaea*; "IV" = sect. *Fimbriata*; "V" = sect. *Okriocarpa.* The sixth branch from the top is unlabelled and represents an unusual *E. pauciflora.* The specimens of the presumed hybrids, *E.* x *codonocarpa* and *E.* x *phoenicea* can be seen to be scattered amongst putative parental taxa.

Table 1. Characters used in the morphological analysis of *Eremaea*

Numeric data

1. plant height (m)
2. leaf length (mm)
3. leaf width (mm)
4. petiole length (mm)
5. leaf-hair length (mm)
6. no. of primary veins visible on abaxial leaf surface
7. bract (perule) length (mm) [longest bract]
8. bract (perule) width (mm) [longest bract]
9. bract (perule) no. at base of flower
10. no. flowers per conflorescence
11. calyx lobe length (mm)
12. calyx lobe width (mm)
13. petal length (mm)
14. petal width (mm)
15. staminal claw length (mm)
16. staminal claw width (mm)
17. filament (free) length (mm)
18. filament no. per bundle
19. stigma width (mm)
20. style length (mm)
21. ovule (incl. ovulodes) no. per loculus
22. hypanthium length in open flower
23. hypanthium length in fruit (mm)
24. hypanthium width in fruit (mm)
25. location of valves relative to fruit rim
26. seed length (mm)

Qualitative data

27. leaf shape
28. leaf-hair type
29. bract (perule) shape (of largest bract)
30. bract (perule): location of indumentum
31. bract (perule) texture [not used]
32. hypanthium: texture at flowering
33. hypanthium: shape at flowering
34. calyx lobe: shape
35. anther dehiscence [not used]
36. branching pattern
37. leaf indumentum density
38. hypanthium: abundance of glands at flowering
39. petal disposition when open [not used]
40. petal colour
41. petal indumentum
42. petal texture

43. petal: abundance of glands
44. calyx lobe: persistence after flowering
45. calyx lobe: texture
46. calyx lobe: abundance of glands [not used]
47. stamen: abundance of glands [not used]
48. filament: presence - absence of swelling
49. anther: type of gland
50. stigma shape
51. style: abundance of indumentum
52. valves at flowering: abundance of indumentum
53. placenta: position [not used]
54. distribution of ovules/ovulodes on placenta
55. hypanthium: texture in fruit
56. hypanthium: shape in fruit
57. calyx lobes: texture in fruit
58. valves: position when open
59. seed surface texture

Numeric data for leaves were based on measurements of 10 randomly selected leaves. Flower measurements were from one flower only (to avoid extensive destruction of herbarium specimens). Fruit measurements were taken from 1-5 fruits as available on a herbarium sheet. Seed measurements were taken from 1-3 seeds as available.

Results

The field collecting revealed a much wider range of morphological diversity in the genus than had been previously known. The observations made of populations in the field showed that individual populations had noticeably less variation than was found between populations. With intimate familiarity of the field situation, it was possible to fairly accurately estimate from where new specimens were collected. In contrast, some populations studied in the isozyme analyses (Coates & Hnatiuk 1990) indicated that there was as much variation within some populations as between some taxa.

Pattern analyses were done to bring together all of the selected morphometric data to see if there was any biologically meaningful pattern to the data. The data were analysed in three ways: all data, numeric data only, and qualitative data only. The results of analyses using the numeric data only grouped most specimens which intuitively belonged together, whereas analyses using only the qualitative data variously grouped or separated many specimens which intuitively either did or did not belong together. For example, of the two specimens which clearly represented the same taxon, *E. fimbriata*, one was placed with an *E. pauciflora* var. *lachnosanthe* specimen and the other with *E. beaufortioides*. These two pairs were separated on either side of the second highest branch of the MULCLAS tree indicating very little "similarity". The all-data set provided intermediate results. Given the clear utility of the numeric-data-only set, this was used in preference to the qualitative-data or all-data sets for the rest of this paper.

The analyses indicated that the genus could be interpreted as having several significant infra-generic groupings (Figure 2). They also highlighted the relationships between the known and the new

taxa as well as focussing attention onto the geographic component of the variation. These aspects had not previously been highlighted as significant within *Eremaea* except for the contrast in distribution of *E. pauciflora* compared to the rest of the species.

The results helped to clarify the complexity surrounding several of the newly discovered rose-, red-, or pink-flowering taxa. These "taxa" (*E.* x *codonocarpa*, and *E.* x *phoenicea*) are now interpreted as being of possible hybrid origin because of the mixed relationships which specimens had with several other taxa as well as their noticeably heterogeneous morphological condition across their area of distribution. The hybrid status of *E.* x *codonocarpa* was confirmed in the isozyme study of Coates & Hnatiuk (1990). The field situation requires further study. Individuals in the field cannot yet be determined as being members of a stabilised hybrid, or members of very recent crosses or back-crosses. All possible combinations could be expected.

E. pauciflora is shown to be a very large species-complex as well as the most widely distributed taxon. Three species have been recognised within the group: *E. beaufortioides, E. blackwelliana,* and *E. pauciflora*. The first and last of these have been further subdivided into a number of varieties. The relationships between *E. beaufortioides* and *E. pauciflora* are complex and probably involve a long history of interbreeding, and repeated episodes of isolation and re-uniting. The MINSPAN analysis (Figure 1) shows something of the complexity of relationships within and between these taxa.

Keys to and descriptions of all taxa are presented later in this paper.

Ecology

Eremaea is a small to medium sized shrub that grows in the understorey of open *Banksia* or Eucalypt low woodlands or as one of many species of shrubs which form the kwongan on shallow or deep, yellow or gray sand over lateritic gravels and clays.

Eremaea survives fire either through regeneration from lignotubers or by re-seeding. Populations of some species have a high frequency of lignotubers while others never form them. There is no clear habitat distinction between lignotuberous and non-lignotuberous species. In taxa with both conditions, individual populations tend to be dominated by one or other condition, but this does not clarify the relative roles of genetic *versus* habitat induced lignotuber formation. Further detailed study is needed.

Little detail is known about the root systems of most species. The basic form of the root system appears to be a system of deep tap and sinker roots complemented by a fibrous root system. This is only one of the types of root systems found in these communities (Dodd *et al.* 1984). The root systems of *E. beaufortioides* and *E. violacea* subsp. *raphiophylla* have been observed to extend up to at least 6 m below the surface in open-cut mines near Eneabba (Hnatiuk & Hopkins 1980, & pers. obs.). *E. ebracteata*, *E. brachyphylla* and *E. purpurea* can be assumed to have deep roots to supply water to their growing and flowering activity during the long hot and dry summer season. The flowering and vegetative growth during the mid to late spring and early summer of most of the rest of the species is most likely supported by water supplied by deep roots as surface soil is usually drying out by this time and showers of rain are often too small or non-existent to supply sufficient water.

Pollination has not been studied in detail, but casual observations indicate that a variety of insects as well as birds visit the flowers and could effect pollination. The flowers are brightly coloured as well as scented thus accounting for their attractiveness to these animals. The flowers of Subgenus *Okriocarpa* all have a distinctive musty smell, which contrasts to the sweet or spicy smell of those of Section *Eremaea*. Such a distinction would contribute to reproductive isolation as it could be expected to attract different pollinators.

Phenology

Growth in *Eremaea* is strongly seasonal. The winter period is a time of little or no growth for most species, as is the common condition of most species in the south-west of Australia. With the exception of *E. fimbriata*, the coming of warmer weather in spring (September), marks the beginning of growth. In *E. fimbriata* growth begins in mid-winter, July and August.

There are three flowering patterns amongst the species. In two species, *E. ebracteata* and *E. purpurea*, growth, on mature plants, commences with the production of leaves. Flowers are then produced on this season's stems for as long as moisture and temperature are suitable. In three species (*E. atala, E. dendroidea,* and *E. purpurea*) and some populations of two other species (*E.* x *phoenicea* and *E. violacea* subsp. *raphiophylla*), first growth is the production of flowers which is then followed by new stems and leaves with a continued production of flowers on the new wood. There is variation between these taxa in the relative intensity of the flush of flowering at the start and later in the season. All the other species appear to flower only in the first flush of growth, followed by vegetative growth. This latter pattern of growth results in flowering plants presenting conspicuously massed displays on the upper canopy of each plant. On plants that do not flower, and non-flowering stems of plants with flowers, new shoot production can occur at the same time as flowering on other stems and plants.

Once flowering is complete, fruits mature over approximately the next 12 months. In all species, fruits, with their contained seeds, are held on the stems until the stems die. Then, upon drying, the valves open, releasing the seed in all but *E. fimbriata*. In this species, the orifice of the fruit is very frequently too small for the winged seeds to escape. On death of a stem of *E. fimbriata*, the valves frequently do not open. Seed is effectively released in this species either when the fruit is burned or the outer surface decays. Some populations of *E. pauciflora* also have fruits with very small orifices. In these cases the winged seeds appear to also be small and capable of release when the fruits dry.

There is a broad, though not precise sequence of flowering amongst species. The first to flower is almost always *E. fimbriata*, starting in July or August. *E. ebracteata* and *E. purpurea* are usually the last found in flower. *E. beaufortioides* is a late spring (November, December) flowering species, usually only starting to flower as other species which flower on old wood are nearly finished. All other species tend to flower in September to November.

Many exceptions to this pattern of flowering occur. No precise reasons have been found, but local variations in the occurrence of rainfall and the timing of the warming in any particular place seem to be the most likely reasons for the variations. Detailed observations of temperature and rainfall pattern near Eneabba closely linked rainfall pattern and abundance to growth, flowering and fruiting (my own unpublished observations). In some years, the pattern is clear whereas in other years, it is far from obvious with the exception of the early and late flowering species noted above which still flower at the extremes of the sequence.

The plants are evergreen with leaves typically lasting for 12-18 months: the previous year's leaves falling after the present season's have matured.

Conservation

No taxon of *Eremaea* is currently on the Western Australian list of gazetted rare flora. Field surveys for *E. purpurea* were done by D. Halford for the then Department of Fisheries and Wildlife. He found several more populations than had been previously known and the species was removed from the critical list.

The many new taxa which are recognised by the completion of the present study focus attention on the need for further field survey to determine whether any of them need special consideration as rare taxa. Taxa which should be investigated as a matter of urgency include: *E.acutifolia, E. asterocarpa* subsp. *brachyclada, E. blackwelliana, E. brevifolia, E. dendroidea, E. ebracteata* var. *brachyphylla, E. hadra, E.* x *phoenicea*, and *E. violacea* subsp. *violacea.*

A location which appears to be especially rich in genetic variation in *Eremaea* is on either side of the Brand Highway, 18 km south of Eneabba. This site should be protected and managed so as to protect the high diversity of *Eremaea* found there. The geographic extent of this area needs to be determined. The lateritic tops, and the slopes and extending to the plains to the west of the complex of hills from Mt Benia, to Mt Lesueur, to Mt Peron are also especially rich in diversity of *Eremaea.*

Morphology

Growth form varies from low, spreading shrubs less than 0.5 m high (e.g. *E. ectadioclada, E. violacea*) to small trees 4-5 m high (e.g. *E. dendroidea*). Branching patterns vary from low, spreading, arching branches to upward-spreading to erect forms. Basal diameter of stems varies from 2-4 cm to 10 cm or more. Mature stems are covered with a hard, thin, fissured bark.

A secondary pattern in branching is also conspicuous and varies between species. In the most commonly occurring type, ultimate branches are more or less erect or upward spreading. These give rise in the next growth cycle to other branches which are essentially similar in length and disposition to their parent branches. This growth pattern produces a plant with the familiar domed or broom canopy. The second type is found in some of the low growing species (e.g. *E. violacea* subsp. *raphiophylla*). It differs in that the long branches produced in one year themselves give rise to a number of lateral branches that remain relatively short in comparison with their parent branch. These short laterals frequently flower in their second year creating elongated displays of flowers in contrast to the domed displays of the other taxa. These elongated massed flowers are "superconflorescences" in the terminology of Briggs & Johnson (1979). *E.* x *codonocarpa* displays a mixed branching pattern. It is a putative hybrid between taxa with the two branching types.

Leaves have a disperse arrangement and are relatively crowded along branches. They are rigid in nearly all taxa, but in *E. atala* they are noticeably flexible giving the leafy branches a "soft" feel when touched.

Leaves vary in shape from flattened ovate to obovate to acerose. They vary from about 3 to 20 mm in length. Margins are simple although some are scabrid (e.g. *E. hadra*).

The most frequent condition is a two-layered indumentum on both surfaces of immature leaves. References to leaf indumentum in the species descriptions refers to the condition of very immature leaves. Taxa vary in the rate of disappearance and the amount of indumentum which remains at maturity. The lower layer usually falls earliest and most completely. The density and degree of erectness of hairs vary between populations and can be an enticingly conspicuous characteristic. It has not proven to be a useful taxonomic character even though some early names refer to this character (e.g. *E. pilosa*).

Leaf tips are pungent to rounded. Oil glands are present in all taxa. There is a small amount of variation in size and disposition of glands, but it has not been taxonomically useful. The most conspicuous variation in arrangement is that in narrow leaves, the glands appear to be in one line on either side of the mid-vein. Where leaf shape is somewhat variable, where broader leaves occur on a plant with otherwise narrow leaves, the broad leaves frequently do not have proportionately more glands, but this is not always so.

The extension-growth of leaves and stems declines rapidly at the end of the growing season resulting in short crowded leaves at the apex. These late-produced leaves also become progressively bract-like with the production of brown, slightly expanded laminae topped by progressively shorter, narrow green tips. In the end, a dormant or resting bud is produced covered with a variable number of bracts ("perules" of Briggs and Johnson 1979). With the commencement of growth in the spring, a reverse sequence is often seen with the first leaves having expanded brown laminae at the base which in progressively newer leaves becomes smaller until "normal" leaves occur. The stems in the region of the dormant bud are often somewhat expanded. This expanded region seems to disappear in branches more than about three years old.

Flowers

The inflorescence of *Eremaea* is a "monad" in the sense of Briggs & Johnson (1979). Specifically, it appears to be a "metaxymonad" i.e. it consists of a conflorescence reduced to a single flower. The basic structure is most easily seen in *E. ebracteata* and *E. purpurea* where the three "bracts" ("metaphylls" of Briggs & Johnson 1979) below each flower are readily visible in young flowers. These metaphylls are small, short, broad and caducous. In other species the metaphylls are difficult to see, but are present. They are reduced to almost filiform structures which are difficult to see because they are covered by the much larger and more numerous "perules".

The conflorescence of *Eremaea* occurs in many species as single flowers at the ends of branches. These are not "terminal" or "anthotelic" structures, rather they are all axillary. In most species the primary axis grows on after flowering. In *E. violacea* subsp. *raphiophylla*, the main axis frequently does not grow on. In these cases the branch is "anauxotelic" in Briggs and Johnson terminology.

In some species, the monads occur in close association with one another to form clusters of up to 7 flowers called "superconflorescences". In *E. violacea* subsp. *raphiophylla*, these first order superconflorescences may be grouped into higher order groups so that whole branches form an aggregation of superconflorescences.

The overwintering bracts (perules) form a conspicuous feature of the flowers of those *Eremaea* taxa which produce flowers as the first growth in the season. They are variable in number and range from about 1 to 40 These bracts include the phyllomes produced at the end of the last growing season, plus new bracts produced or at least developed fully once dormancy is broken. The length of these late-produced bracts varies from relatively short in the outermost (older) to relatively long and broad and finally to very narrow and short. The metaxyphylls, if present, are found distal to (i.e. inside or above) the innermost phyllomes. In many species there are a variable number of minute elongate scales at the very base of the flower. The significance of these is not known. These latter are only seen in dissections of flowers and in neither their number nor shape were found to have any taxonomic value within the genus.

The perules are typically indumented on the exposed abaxial surfaces and occasionally, and very variably, on the distal adaxial surface as well. The outer indumentum of the bracts is of some limited taxonomic value, but in most taxa it is too variable between populations to be of great use. The shape and arrangement of the bracts is also a conspicuous feature of the inflorescence of some taxa, but again it is too variable in relation to other characters to be generally of taxonomic value.

The *hypanthium* is glabrous or variously indumented. This character is useful taxonomically. The shape of the hypanthium at the time of flowering is abruptly constricted at the base, occasionally nearly cylindrical in the mid-region though more commonly it expands more or less rapidly from near the base to the distal rim. This character is not useful taxonomically. The surface of the hypanthium may be smooth, and then often shiny and sometimes sticky too, or it may be dull because of the roughness caused by the swellings at the base of hairs. This character is closely related to the indumentum type and is not used taxonomically because it is difficult to quantify or describe unambiguously. Glands may be more or less conspicuous, but this is not taxonomically useful.

Five *calyx* lobes arise from the rim of the hypanthium. In only one taxon, *E. asterocarpa* subsp. *histoclada*, does the number and regularity of lobes vary. In this subspecies, the lobe number is often 5 but can vary from 4 to 6. The unusual numbers are most frequently the result of fusion or splitting of adjacent lobes or the complete loss of a lobe. This feature is maintained in garden cultivated plants grown from seed.

The lobes are most often triangular in shape. Following Stearn (pp 318-319, 1978), they are called "broadly triangular" if the length to width ratio is less than or equal to 1.2, "triangular" if the ratio is between 1.5 -2.0, and "narrowly triangular" if the ratio is greater than 3.0. The lobes are sometimes cuspidate, usually from in-rolling of the thin margin. The lower edges are sometimes auriculate and may overlap adjacent lobes. The margins are either entire or ragged or fimbriate. They may also be brown rather than the usual green.

The abaxial surface of the calyx lobe is either glabrous or indumented. The type of indumentum is usually similar to that of the hypanthium although the hairs may be shorter or longer The indumentum appears most frequently to be single layered. When densely indumented it may consist of more than one layer but this character is very difficult to ascertain. The adaxial surface of the lobes may be glabrous or indumented, but because of variability this was not found to be a useful taxonomic character.

The calyx lobes may have more or less conspicuous glands. These have no taxonomic utility. The calyx lobes may either fall completely from the hypanthium at the end of flowering or as the fruits

mature or they may variously become woody in the lower portions only, or completely woody and remain as part of the mature fruit. This character is of great taxonomic significance.

Petals alternate with the calyx lobes. They consist of a narrow limb which arches outwards at anthesis to spread the petals widely. Above the limb, the petal expands rapidly into an almost hemispheric lamina. The central portion of the lamina is thick and contains a variable number of oil glands. It is surrounded by a much thinner zone which is either continuous or variously ragged to finely if unevenly fimbriate. The whole of the lamina is coloured similarly though usually not so brightly as the filaments. The petals fall at the end of flowering.

Stamens are epipetalous in origin and thus appear opposite the petals. The filaments are variously fused at the base to form a short to long claw. When filament numbers are low, the filaments are arranged in a single plane, but when numbers increase the claw becomes thicker with filaments appearing to arise from the back and front of the claw as well as from its distal edge. The claws may be free from each other or they may fuse slightly at the base to form a ring. The degree of fusion is variable on individual plants and within populations and was not found to be taxonomically useful. The free portions of the filaments are either narrow-linear and tapering only shortly at the apex or they show a narrow club-like swelling in the distal portion which then tapers to the apex. The surface of the filaments is either smooth or only slightly undulate or the surface of the cells may become shortly papillose. The filaments fall after anthesis. Either each bundle may fall separately, or in individuals with fused claws, the whole set or groups of bundles may fall as a unit. Filaments are coloured usually with only one colour and this is of considerable taxonomic value. In some populations colour is absent or greatly reduced in varying degrees from portions of the filaments leaving pale or white zones in purple and pink flowered species or pale yellow filaments in orange flowered species. These pale colours are not of general taxonomic value although they may be of horticultural interest.

Anthers are basifixed with two large loculi on either side of a simple connective. Dehiscence is by longitudinal or diagonal slits. Small glands are usually present in the connective and may be found at the base, the middle, or top, but the character is not taxonomically useful as what little variation there is, is not consistent. The base of the integument is sometimes a little swollen and may contain oil glands. The anthers are yellow which varies in intensity from light to dark.

The ovary is three-chambered. The top is closed by three pairs of valves which at flowering may be above, below or at the level of the rim of the hypanthium. The outer surface of the valve is densely indumented with hairs of one length in all but two species (*E. ebracteata* and *E. purpurea*) where there is a conspicuous but sparse upper layer of very much longer hairs. The valves become indurated (woody) in the fruit *q.v.*

The *placenta* is axile and bi-lobed. Ovules are produced over its surface. Their number varies from (7)10-14(23), but generally the larger the ovary the more ovules there are. The ovules are arranged generally with 2 or 4 in the central area and a ring of up to 15 around the periphery. Not all ovules develop into seed. It is not obvious at the time of flowering which ovules will become seed and which chaff.

Seeds are produced at a rate of about 1 to 6 per fruit. They are elongate polygonal structures with longitudinal angles formed by compression from the tightly packed adjacent ovules. Seeds develop wings along the compression lines out of a single layer of elongate cells which resemble a palisade. Infertile ovulodes have no wings. The surfaces of the seeds are glabrous or minutely chaffy, especially

near the junction of seed and wing. The seeds are brown although there is mottling of dark and light patches on some seeds, but this does not have taxonomic significance.

The embryo is essentially straight or slightly arcuate. The variation is minor and is related to the degree of deformation of the seed as it matures. Seeds attached to the central part of the placenta and surrounded on all sides, parallel to the seed axis, by either other seeds or ovulodes, remain straight. Seeds attached to the periphery of the placenta become arcuate as they are pressed, by seeds and ovulodes, against the inner curvature of the ovary wall.

The primary axis of the cotyledons in the seed form a continuation of the straight axis of the radicle. In a more or less obvolute manner, they envelope each other. The pattern of folding is not consistent between seeds on one plant, nor between taxa.

Woody *fruits* are formed from the enlarged hypanthium. They are of various shapes from cup to barrel shaped. The outer surface is either smooth or rough depending upon whether the epidermis of the hypanthium is retained as the fruit matures, producing a rough texture, or is shed leaving a fairly smooth surface. The rim of the hypanthium may be plain, undulate over the hardened bases of the calyx lobes or distinctively lobed from the indurated calyx. When dry, the valves open and reflex to varying amounts. In deeply included valves, they essentially become erect, in others, they may reflex out and over the rim of the hypanthium. The surface of the valves is ornamented either with two lobes or with several small callosities. The degree of development of the ornamentation varies between taxa. These have some taxonomic value. The smooth-fruited taxa, of subgenus *Eremaea*, have two generally hemispherical smooth lobes at the apex of the valves. The rough-fruited taxa, of subgenus *Okriocarpa*, have two generally triangular lobes covered at the top with several small callosities. Fruits vary in colour from dull pale brown to various shades of golden brown to dark and almost purplish brown. Most characters of the fruit are very significant taxonomically.

Seedlings

Seedlings of most taxa were raised in shade house conditions at the Western Australian Herbarium. There was very little variation between taxa. Larger seeds tended to produce larger cotyledons, but this was not taxonomically useful. All taxa had obvolute cotyledons in the seed which quickly opened out and spread horizontally after germination. Germination was epigeal.

Hybridisation

Natural hybridisation appears to have occurred in many places and at many times in *Eremaea*. Confirmation of this comes from both morphometric analyses reported here, and from isozyme studies (Coates & Hnatiuk 1990).

Hybridisation between taxa of different Sections appears to produce products which are sufficiently stable and different to be recognised taxonomically as is done with *E.* x *codonocarpa* and *E.* x *phoenicea*. These taxa are both generally more variable than other species of *Eremaea* but the suite of defining characters appears robust. This is borne out in the isozyme analyses of *E.* x *codonocarpa*. Hybrids appear to set smaller numbers of fruits and seeds, but seeds are fully viable and produce offspring similar to the maternal parent.

Hybridisation between taxa in the same Section or within a species complex tends to produce minor variants of the parents. Thus for example, *E. beaufortioides* and *E. pauciflora* are extreme variations within Section *Eremaea*, but there are many intergrades found in the wild. Some of these are sufficiently consistent and frequent to be taxonomically recognised, as in the varieties of these two species, but finer grades of intermediates will be found which are difficult to place. At the level of variety in these species, the taxa defined here provide some indication of the major trends in morphological patterns, but care is needed in using them.

Horticulture

The masses of brilliant flowers found on most species of *Eremaea*, coupled with the small shrub growth form of many species, has attracted comment on the great potential for use in gardens. However, the genus is still very seldom seen in nurseries or in gardens. Success has been limited and variable in eastern Australia as well as in Perth. Improper soil conditions together with summer rain have been implicated in the lack of horticultural success to date. There is much room for horticultural research with this genus.

Fresh seed germinates readily, as does seed at least 9 years after collection. Iron chlorosis can occur in young seedlings but is easily corrected with a weak solution of chelated iron. Most species seem able to strike from cuttings though problems have been reported with *E. violacea* subsp. *raphiophylla*. General notes on cultivation can be found in Hubbard 1978, and Elliot and Jones 1984.

Discussion

The richness of the species-rich shrublands of south-western Australia has been known since the days of the early European collectors. The bipolar distribution of richness between the "northern" and "southern" sandplains was commented on by Diels (1906) and further confirmed by Speck (1958). The concentration of certain taxa in shrublands of the deep sand *versus* those on the rocky laterite was elaborated by Hnatiuk & Hopkins (1981) and more recently by Brown (1989).

The variation in morphology and isozymes appears to be very similar in *Eremaea*. The same infra-generic groupings were found in the separate analyses and the same geographic pattern of variation was found in the two studies. The close relationship of some of the taxa to each other was also confirmed.

Testing of seed from a number of taxa showed that they produced new plants that were identical with their parents - there was no obvious segregation in the progeny. The isozyme analyses, however, found greater variability within taxa than between them. Samples were small in each case and further work is needed before firm conclusions can be drawn about genetic and morphologic stability of populations.

Hybridisation, relatively but not very recent, has been strongly indicated for *E.* x *codonocarpa* and *E.* x *phoenicea*, and suggested for another, *E. dendroidea*, although perhaps at some more remote time, but many of the taxa are very closely related (*cf.* Coates & Hnatiuk 1990).

The study of *Eremaea* has contributed to our understanding of the species-rich shrublands north of Perth by demonstrating how one genus has developed in the region. *Eremaea* has split into two main evolutionary lines, subgenera *Eremaea* and *Okriocarpa*. The former has evolved four distinctive sections, three of which have several species and lower taxa. Subgenus *Okriocarpa* has four species (Table 2). It is my express intention to indicate that in my judgement all four of these species belong to the same Section. This decision is based on the same kind of assessments as applied to the assignment of species to Sections in subgenus *Eremaea*. The International Code of Botanical Nomenclature (Greuter *et al.* 1988) does not provide for naming this Section of *Okriocarpa* until such time as another Section, not including the type of subgenus *Okriocarpa*, is established. In the light of present knowledge, a second Section is not known to exist, only one section, but several species.

Although the topography of the northern sandplain is noted for its subdued relief, the species often seem to have sorted themselves according to the subtle but significant differences in the landscape. The distinction between the deep sands of the coastal plain and those on the archaean shield show up in section *Violacea* for example. Some speciation in *Eremaea* appears to correlate well with the margin between the archaean shield and the coastal plain, for example, the spatial sequence of some species in section *Eremaea* (*E. dendroidea*, *E. pauciflora* var. *lonchophylla* and *E. blackwelliana*). In subgenus *Okriocarpa*, speciation has produced primarily a north-south alignment of taxa which has *E. brevifolia* in the north followed southwards by *E. acutifolia*, *E. asterocarpa* subsp. *histoclada*, *E. ectadioclada*, *E. asterocarpa* subsp. *asterocarpa*, and *E. asterocarpa* subsp. *brachyclada*.

There are suggestions in the isozymic analyses that these north-south and east-west alignments of taxa developed in a variety of ways. It seems that the oldest taxa of section *Eremaea* and subgenus *Okriocarpa* occur roughly from about the Burma Road reserve to Alexander Morrison National Park, along the western boundary of the archaean shield. From here speciation occurred towards the north, east, south and west. In contrast, however, taxa of sections *Violacea* and *Ebracteata* seem to have proceeded to evolve from the most northerly taxa, *E. violacea* and *E. dendroidea* respectively, to the two other species and one subspecies of section *Violacea* and the two varieties of *E. ebracteata* which themselves are separated along an east-west alignment more than a north-south one.

Geologically and edaphically, the coastal plain is very complex. It is composed of many small subunits. Close study of the distribution of a wider range of species in relation to this detailed geology and the current geomorphology would be rewarding.

Perhaps the most striking distribution pattern in *Eremaea* is the contrast of the high density of taxa in the relatively small Darling-Irwin districts in contrast to the very widespread but single variable species *E. pauciflora* var. *pauciflora* throughout much of the rest of the Southwest Botanical Province. The isozymic analyses suggest that this widespread taxon is perhaps the most recent of section *Eremaea*. If this is so, then it represents recent and rapid spreading into new territory. The lack of speciation within such a widespread area is less puzzling if it is seen as being of recent origin. How recent cannot be said from the data, but the postulated droughts of the Pleistocene era and again as recently as a few thousand years ago must have had a major impact on the distribution of species in the southwest. The last period of major aridity in south-western Australia was only as recent as 18,000 - 16,000 years before the present (Bowler 1976). Perhaps the widespread distribution of *E. pauciflora* var. *pauciflora* dates from a rapid re-invasion of land with a sparse vegetation after more mesic conditions returned. The winged seeds of *Eremaea* may have assisted in dispersal by the wind.

The seeming morphologic uniformity within each population in this widespread distribution suggests that each population could have been founded by one or a few propagules which is consistent with the hypothesis of recent wind dispersal. The isozyme study did not sample the geographic range of *E. pauciflora*, and only one population came from the region of extensive distribution. This population was at Tutanning, and was second only to two populations of *E. fimbriata* in observed heterozygosity (Coates & Hnatiuk 1990). While this hints strongly that the hypothesis of spreading suggested here may be correct, further data are required. Given sufficient time, genetic isolation could be expected to result in many more "species" across this large area.

Further research

Significant questions remaining unresolved concern details of the evolutionary relationships between populations and taxa in section *Eremaea*, in particular, the complex of taxa included in *E. beaufortioides* and *E. pauciflora*. Further field work is needed, but the extensive clearing in the area roughly bounded by Gingin, Jurien, Eneabba and Windsor, as well as throughout the 'wheatbelt' region, may have destroyed many of the important populations.

In need of testing and confirmation are the hypotheses raised here concerning relative ages of taxa and the directions of speciation and geographic spreading.

Eremaea

Eremaea Lindley, Sketch Veg. Swan R. xi (1829).

Non Eremia Don, Ericaceae; *Non Eremaeopsis* Kuntze, *nom. illeg.*

Typus: not specified. *Lectotype* (here chosen): *Eremaea ericifolia* Lindley (= *E. pauciflora* (Endl.) Druce.) (*Lectotype*: CGE; photos CBG, PERTH).

Shrubs or small trees; with or without lignotubers. *Branches* spreading or ascending, sometimes very densely intergrown; indumentum on young branchlets commonly two-layered, inner layer tomentose and glabrescent, the outer pilose may persist. *Overwintering bracts* (perules) numerous, conspicuously surrounding flowers in species that flower on old wood. *Leaves* linear, oblong, ovate, elliptic, or obovate, straight, reflexed or incurved, mucronate or obtuse; indumentum as for perules; longitudinal veins on lower surface none, 1 or many; leaves flat or triquetrous in cross-section. *Flowers* axillary although appearing terminal in species where the flowers are the first growth following winter dormancy; single or in conflorescences up to about 9; flowers on old or new wood. *Hypanthium* campanulate, glabrous and shiny and occasionally glutinous, or variously indumented and dull. *Calyx* of five triangular lobes, in a few populations 4 or 6 lobes occur and are genetically fixed, with or without thin auriculate lower margins; glabrous or variously indumented; persistent or caducous in part or in total. *Petals* narrow at base, greatly expanded and somewhat hemispheric in upper part, the centre of the upper part thick and glandular, surrounded by a thin margin that is wide at the sides and either wide or narrow at the apex, margin entire or variously ciliate to ragged; wide-spreading; coloured similar to stamens but less intensely. *Filaments* fused into a claw usually of 1/2-1/4 length of stamens forming five groups alternate with petals; groups may be free or slightly and irregularly fused together at their basal edges; free portions of filaments in two or more irregular

rows at top of claw, smooth or papillose, cylindrical or slightly swollen distally, narrowed at apex, brightly coloured violet, pink, rose, or orange, rarely white or pale yellow; anthers basifixed, bilocular with erect or oblique pores, connective with or without small glands at base or apex or in between, occasionally slightly swollen at base or apex, bright yellow. *Ovary* trilocular, placenta axile, bi-lobed, 7-23 ovules per loculus only some of which become seed, the remainder remaining as chaff; densely indumented on exterior apex, rarely sparsely pilose over the dense tomentum. *Style* glabrous or indumented, similar in length to stamens or exceeding them; stigma small, apical. *Fruit* woody, cupulate, urceolate, or globose; outer wall smooth or rough, with or without corky outgrowths; light brown, coppery brown, dark purplish brown or dark grey brown; rim smooth or variously lobed; valves bi-lobed, deeply included, reaching to rim, exserted, or exserted and reflexed, lobes smooth or variously finely mammillate or warty. *Seeds* variously obovoid, longitudinally finely ridged with palisade-like wings along all vertical and the distal, horizontal ridges; sides smooth or slightly chaffy; brown or somewhat mottled; in most cases (except *E. fimbriata*) shed freely when branch to which fruit is attached dries.

Endemic in south-western Australia.

The genus is clearly defined by its basifixed anthers, single axillary flowers, stamens in five bundles, characteristically shaped woody fruits and characteristically shaped and winged seeds. Its closest relatives are *Beaufortia* from which it differs in having generally oblique anther pores, the ovary with more than 2 ovules and the seeds with several wings rather than a single terminal wing. From *Calothamnus* it differs in having flowers arising on old wood at the apex of stems, or on new wood and not in conflorescences on only one side of the stem, and in having winged seed that are much greater in diameter than in *Calothamnus*. From *Regelia* it differs in having oblique anther pores, flowers generally not in globular clusters, and in the winged seeds. Initial trials in the isozymic study showed differences between *Eremaea* and *Beaufortia* and *Calothamnus* to be too great to be readily useful, but further work could clarify the relationship. At this stage it appears that *Eremaea* is a clearly defined genus, without any suggestion that it needs splitting into segregate genera, and it is well separated from its nearest neighbours.

Key to infrageneric taxa and species

1. Outer surface of fruit smooth (i.e. epidermis all or nearly all shed) although it may appear lumpy from subsurface swellings or have corky outgrowths; valves smooth and having 2 more or less hemispheric lobes ... subg. *Eremaea* 2
1. Outer surface of fruit rough (i.e. epidermis present but disintegrated), flaky; valves 2-lobed with surface of each finely warty or irregularly mammillate ..... subg. *Okriocarpa* 14
2. Fruit valves deeply included 3
2. Fruit valves reaching rim of fruit or only shallowly included 5
2. Fruit valves exserted and enclosed or not by lower part of lobes 10
2. Fruit valves exserted and reflexed 12
3. Filaments pink, or dark pink, fruit urceolate with very narrow orifice ..... 1. *E. fimbriata*
3. Filaments orange, fruit not as above 4
4. Leaves linear or narrowly elliptic ..... 5. *E. pauciflora*
4. Leaves elliptic or ovate ..... 7. *E. beaufortioides*

5. Flowers borne on last season's wood 6
5. Flowers borne on current season's wood 8
6. Filaments orange 7
6. Filaments pink, or dark pink ..... 16. *E.* x *phoenicea*
7. Flowers terminal on long branches, fruits cylindrical to slightly obconic ..... 9. *E. dendroidea*
7. Flowers terminal on short laterals along long branches, fruits globose .... 6. *E. blackwelliana*
8. Filaments pink ..... 10. *E. purpurea*
8. Filaments orange 9
9. Fruit rim without lobes, leaves narrowly elliptic to oblong, a small tree when mature ..... 9. *E. dendroidea*
9. Fruit rim undulate, leaves linear, or obovate-ellipitic and broadly boat-shaped when dry, shrub to about 1 m when mature ..... 8. *E. ebracteata*
10. Flowers borne on last season's wood ..... 15. *E.* x *codonocarpa*
10. Flowers borne on current season's wood 11
11. Filaments orange, leaves linear, or obovate-elliptic ..... 8. *E. ebracteata*
11. Filaments pink, or dark pink, leaves narrow, ovate, elliptic to obovate ..... 10. *E. purpurea*
12. Leaves strongly mucronate 13
12. Leaves not mucronate ..... 3. *E. atala*
13. Leaves straight or reflexed in upper part, >1.2 mm wide, longest perules >3 mm long ..... 4. *E. hadra*
13. Leaves sinuate, or up-turned in upper part, <1.2 mm wide, longest perules <3mm long ..... 2. *E. violacea*
14. Leaf veins seen on lower surface 0 or 1 15
14. Leaf veins seen on lower surface 3 17
14. Leaf veins seen on lower surface 5 or more 18
15. Filaments orange, fruiting valves with two densely tomentose, mammillate lobes 16
15. Filaments pink, or dark pink, fruiting valves with two glabrescent, smooth lobes surrounded by fringe of hairs ..... 15. *E.* x *codonocarpa*
16. Flowers terminal on long branches, longest perules attenuate, tomentose ..... 13. *E. ectadioclada*
16. Flowers terminal on short laterals along long branches, longest perules contracted at apex, mostly glabrous or ciliate ..... 12. *E. acutifolia*
17. Filaments orange, leaves broad and multiveined ..... 14. *E. asterocarpa*
17. Filaments pink, or dark pink, leaves triquetrous, rarely flat, 1- or 3-veined ..... 15. *E.* x *codonocarpa*
18. Perules ciliate, back glabrous or distally tomentose ..... 14. *E. asterocarpa*
18. Perules villous ..... 11. *E. brevifolia*

Taxonomy

The only previous comprehensive study of *Eremaea* which has been done is that of Bentham (1867). The results of the present study, based on extensive field survey and large numbers of specimens, has shown a much wider range of variation than was known to Bentham. All four methods used in the present study (intuitive, morphometric/phenetic, isozyme distance, and isozyme cladistics) indicate that there are distinct infrageneric groupings in *Eremaea*.

Infrageneric classification

At the highest level, there are two subgenera that can be distinguished:

subg. *Eremaea*: the "smooth, unlobed-fruit group" and

subg. *Okriocarpa*: the "rough, lobed-fruit group".

Subgenus *Eremaea* readily subdivides into four Sections, and subgenus *Okriocarpa* into only one.

Two species recognised in the isozymic and morphologic analyses as unusual are also placed in this structure. *E. purpurea* is clearly part of subgenus *Eremaea* in both the isozymic study and the morphologic study. These two analyses do not agree on placement within the group. One isozymic analysis placed it within section *Pauciflora* while another placed it outside any of the four sections of the subgenus. The morphologic analysis placed it with section *Ebracteata*. For the present time and until further data clarifies the situation, it has been placed in section *Ebracteata* with which it shares the unusual features of sparse long hairs on the top of the ovary, fruits with corky growths which may or may not erupt through the surface of the fruit, and it also flowers late in the season. It flowers on new wood, a feature shared with section *Ebracteata* but also with part of section *Violacea*.

The other unusual species is *E. fimbriata* which is the most different species in the genus. One isozymic analysis placed it as a sister group to all other *Eremaea* species, while the other analysis placed it within subg. *Eremaea,* but on its own. The morphologic analysis placed it within section *Violacea*, but separate from all other species of the section. While it is clearly a species of *Eremaea* (flowers single, stamens fused into 5 groups, anthers basifixed with oblique slits, seeds with characteristic shape and wings), it does not fit well into any other section. It is here placed in a monospecific section, *Fimbriata*, in subg. *Eremaea.*

The taxa of putatively hybrid origin are not placed within the classification. *E.* x *codonocarpa* appears to be a stabilised hybrid between subgenera *Eremaea* and *Okriocarpa*, while *E.* x *phoenicea* appears to be a stabilised hybrid between sections *Pauciflora* and *Violacea*. Hybridisation appears to be continuing and "hybrid swarms" occur.

Infraspecific taxa have been described here for the first time in *Eremaea*. The categories "subspecies" and "variety" have been used. The distinction between these levels was largely based on the following criteria. If the taxa were not geographically isolated, and they were morphologically and isomatically close, then they were classed as varieties. If the taxa were geographically distinct and could be distinguished consistently by a suite of morphological characters, then "subspecies" was

used. In the case of *E. ebracteata*, where geographic separation existed, but only one conspicuous character distinguished the taxa, then "variety" was used.

The classification is summarised in Table 2. Formal descriptions of new infrageneric taxa follow.

Eremaea Lindley subg. **Eremaea**

Shrubs or small trees with leaves linear to elliptic, flowers surrounded by few or numerous perules, stamens conspicuous, violet, pink or orange, anthers yellow, basifixed, opening by longitudinal or oblique slits; fruits woody, smooth outer wall, valves bi-lobed and smooth, seeds with several palisade-like wings.

A subgenus of four sections (*Ebracteata, Eremaea, Fimbriata,* and *Violacea)* containing 10 species.

Eremaea sect. **Eremaea**

Shrubs, with or without lignotubers; leaves linear, narrowly or broadly elliptic, veins 1-7, rarely 0; flowers with numerous perules; anthers orange; fruits light or coppery brown, valves deeply included or at rim of fruit.

A section of three species and six varieties - *E. beaufortioides* var. *beaufortioides, E. beaufortioides* var. *lachnosanthe, E. beaufortioides* var. *microphylla, E. blackwelliana, E. pauciflora* var. *pauciflora, E. pauciflora* var. *calyptra, E. pauciflora* var. *lonchophylla.*

Eremaea sect. **Ebracteata** R.J. Hnatiuk sect. nov.

Frutices vel arbores parvae, cum vel sine lignotuberibus; folia linearia, oblonga, ovata vel elliptica, venis 1 raro 0 vel 3; flores perulis paucis vel multis; stamina aurantiaca vel rosea; fructus pallide brunneus, cupreus vel cano-brunneus, laevis sed interdum eruptionibus suberosis; valvae fructus lobis 2 laevis labia equantes vel exserta.

Typus: *E. ebracteata* F. Muell.

Shrubs or small trees, with or without lignotubers; leaves linear, oblong, ovate or elliptic, veins 1 rarely 0 or 3; flowers with few or many perules; stamens orange or pink; fruit light brown, coppery or grey brown, smooth but sometimes with corky eruptions; valves with two smooth lobes reaching rim or exserted.

A section of three species and two varieties - *E. dendroidea, E. ebracteata* var. *brachyphylla, E. ebracteata* var. *ebracteata, E. purpurea.*

Eremaea sect. **Fimbriata** R.J. Hnatiuk sect. nov.

Frutices interdum lignotuberibus; folia angusta ovata, venis 0 vel 1; plerumque in Julio florentes; stamina rosea; fructus late urceolatus, orificio angustissimo, atropurpureo-brunneus vel atrocano-brunneus; valvae fructus lobis 2 parvis, profunde inclusae.

Typus: *E. fimbriata* Lindl.

Shrubs, sometimes lignotuberous; leaves narrowly ovate, veins 1 or rarely 0; flowers typically in July; stamens pink; fruit broadly urceolate with very narrow orifice, dark purple-brown or dark grey-brown, valves with two small lobes, deeply included.

A section of one species - *E. fimbriata.*

Eremaea sect. **Violacea** R.J. Hnatiuk sect. nov.

Frutices erecti vel patentes, sine lignotuberibus; folia linearia ad anguste elliptica, venis 1 vel 3; flores perulis paucis vel multis; stamina violacea, raro alba vel rosea; fructus cupulatus vel globosus, laevis, atropurpureo-brunneus; valvae fructus bilobatae, laeves, exsertae, reflexae.

Typus: *E. violacea* F. Muell.

Shrubs, erect or spreading, without lignotubers; leaves linear to narrowly elliptic, veins 1 or 3; flowers with few or many perules, stamens violet, rarely white or pink; fruit cupulate or globose, smooth, dark purple-brown, dark grey-brown or light brown, valves bi-lobed and smooth, exserted and reflexed.

A section of three species and two varieties - *E. atala, E. hadra, E. violacea* subsp. *violacea, E. violacea* subsp. *raphiophylla.*

Eremaea subg. **Okriocarpa** R.J. Hnatiuk subg. nov.

Frutices cum vel sine lignotuberis; folia late ovata, spathulata vel anguste ovato-elliptica, venis 1, 3, 5, 7 vel raro pluribus; flores perulis multis circumcinctis; stamina aurantiaca, raro rosea; fructus extus asper pallide brunneus, orificio lato, labio undulato vel lobis prominentibus; valva fructus exsertae sed non reflexae, verrucis parvis numerosis.

Typus: *E. asterocarpa* R.J. Hnatiuk

Shrubs, with or without lignotubers; leaves broadly ovate, spathulate or narrowly ovate-elliptic, veins 1, 3, 5, 7 or rarely more; flowers surrounded by many perules; stamens orange, rarely pink; fruit with rough light brown exterior, orifice wide, rim undulate or with prominent lobes, valves exserted but not reflexed, with numerous small callosities.

A subgenus containing one section, four species and three subspecies - *E. acutifolia, E. asterocarpa* subsp. *asterocarpa, E. asterocarpa* subsp. *brachyclada, E. asterocarpa* subsp. *histoclada, E. brevifolia, E. ectadioclada.* (Taxonomically they belong to the same section, even though nomenclaturally this section does not attract a name at present.)

Etymology. The subgeneric names comes from the Greek *okrios* (rough) and *karpa* (fruit), in reference to the roughness of the outer wall of the fruit of each member of this group.

Table 2. Summary classification of the genus *Eremaea*

Group	Species	Infraspecies
1. subg. *Eremaea* (smooth fruited)		
1.1 sect. *Fimbriata*	*fimbriata*	
1.2 sect. *Violacea*	*violacea*	subsp. *violacea*
		subsp. *raphiophylla*
	atala	
	hadra	
1.3 sect. *Eremaea*	*pauciflora*	var. *pauciflora*
		var. *calyptra*
		var. *lonchophylla*
	blackwelliana	
	beaufortioides	var. *beaufortioides*
		var. *lachnosanthe*
		var. *microphylla*
1.4 sect. *Ebracteata*	*ebracteata*	var. *ebracteata*
		var. *brachyphylla*
	dendroidea	
	purpurea	
2. subg. *Okriocarpa* (rough fruited)		
(taxonomically all in one section)		
	brevifolia	
	acutifolia	
	ectadioclada	
	asterocarpa	subsp. *asterocarpa*
		subsp. *histoclada*
		subsp. *brachyclada*
3. species of putative hybrid origin		
3.1	x *codonocarpa*	
3.2	x *phoenicea*	

The most important suite of characters found to be useful in classifying *Eremaea* have been: the surface of the fruits, the lobing of the fruits, the positioning of the valves relative to the rim of the fruit; the number of veins visible on the undersurface of the leaves and leaf shape. Stamen colour can be useful.

Some recent major publications dealing with *Eremaea* have used a number of codes to designate taxa. The current names applying to these codes are given in Table 3.

Table 3. Code names for *Eremaea* taxa used in recent publications with their current names as well as can be determined

Code name and source	Current name
"Flora of the Perth Region" Marchant *et al.* (1987)	
E. sp. A	*E. asterocarpa* subsp. *asterocarpa* and *E. asterocarpa* subsp. *brachyclada*
"Encyclopaedia of Australian Plants" Elliot & Jones (1984)	
E. aff. *acutifolia* A	*E. ectadioclada*
E. aff. *acutifolia* B	*E. asterocarpa* subsp. *histoclada*
E. aff. *acutifolia* C	*E.* x *codonocarpa*
E. aff. *beaufortioides*	*E.* x *phoenicea*
E. aff. *brevifolia*	*E. asterocarpa* subsp. *asterocarpa*
E. aff. *ebracteata*	*E. dendroidea*
E. aff. *pauciflora*	*E. pauciflora* var. *lonchophylla*
"How to know Western Australian Wildflowers" Part IIIA 2nd ed. Blackall & Grieve (1980)	
E. sp. (p.p., not Northampton)	*E. asterocarpa*
E. sp. var. (p.p. not Mt Lesueur)	*E. brevifolia*
Coates and Hnatiuk (1990)	
E. aff. *pauciflora* 1 (AP1)	*E. blackwelliana*
E. aff. *pauciflora* 2 (AP2)	*E. pauciflora* var. *lonchophylla*
E. aff. *pauciflora* 3 (AP3)	*E. ?beaufortioides* var. *microphylla*
E. aff. *pauciflora* 4 (AP4)	*E. dendroidea*
E. aff. *ebracteata* 1 (EA1)	*E. ebracteata* var. *brachyphylla*
E. violacea	*E. violacea* subsp. *raphiophylla*
E. aff. *violacea* 1 (AV1)	*E. atala*
E. aff. *violacea* 2 (AV2)	*E. hadra*
E. aff. *brevifolia* 1 (AB1)	*E. asterocarpa* subsp. *histoclada*
E. aff. *brevifolia* 2 (AB2)	*E. ectadioclada*
E. aff. *brevifolia* 3 (AB3)	*E. asterocarpa* subsp. *asterocarpa*
E. aff. *brevifolia* x *violacea* (ABV)	*E.* x *codonocarpa*

1. Eremaea fimbriata Lindley, Sketch Veg. Swan R. xi (1829). (Figure 3)

Typus: not specified; *lectotype* (here chosen) "Swan River, Drummond, 1839" (lectotype: CGE, isolectotype: K; photos CBG, K, PERTH). These specimens appear identical and likely therefore to be from the same gathering and to represent the material used by Lindley in compiling his description. The K specimens have been annotated by Bentham as *Eremaea fimbriata* Lindley.

Eremaea rosea Gardner and George, Journal of the Royal Society of Western Australia 46:134 (1963) is a taxonomic synonym. *Typus*: "Maida Vale, in sand, *A.S. George* 4161, September 10, 1962." (PERTH).

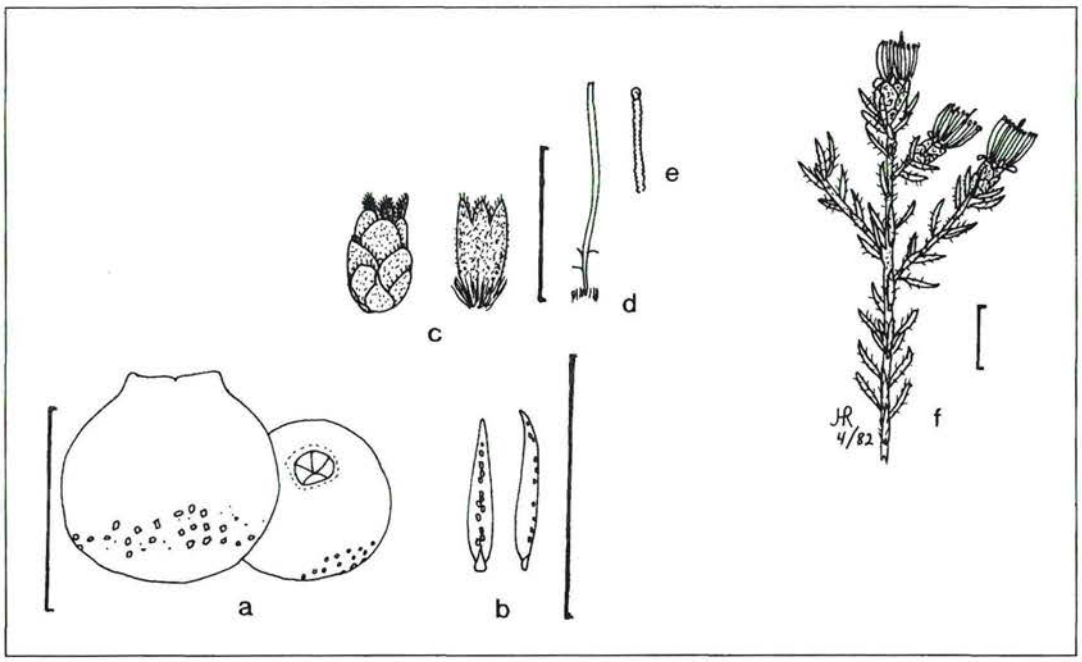

Figure 3. *E. fimbriata*: **a**: fruits, side view and oblique view of top; **b**: leaves, side and back views; **c**: hypanthium and calyx, on left with perules, on right perules removed; **d**: style and top of ovary; **e**: stamen; **f**: habit. 6 km W of Brand Hwy on S-most road to Nambung Natl Pk, *R.J. Hnatiuk* 780100 (PERTH). All scale bars = 10 mm.

Shrub, 50 cm tall; sometimes lignotuberous. *Branches* spreading to ascending. *Branchlet indumentum* two-layered with sparse pilose outer layer, inner densely tomentose. *Over-wintering bracts* 16-18 per terminal bud; ovate to oblong; 4.5-6.2 mm long, 3.2-4.2 mm wide; indumentum one-layered, tomentose on edges and all over back; smooth. *Leaves* narrowly ovate; acute; 4-8 mm long, 0.5-4 mm wide; 1 vein below or rarely none visible in thick leaves or 3 in wide, rapidly grown leaves; indumentum two-layered, upper pilose (max. length of hairs 1.1 mm), lower densely tomentose; dry leaf cross-section flat, thin (slightly incurved at margins). *Petioles* 0.2-1 mm long. *Flowers* terminal on long branches, (occasionally terminal on short laterals but not as in *E. violacea*) along long branches on last season's wood; 1 per inflorescence. *Hypanthium* campanulate, 4-4.7 mm, 2-3.5 mm wide; indumentum two-layered, upper layer dense villous only on lower half of hypanthium, lower layer dense tomentose all over; smooth, outer surface dull, but wrinkled longitudinally when dry. *Calyx* lobes triangular; 1.5-2 mm long, 1.4-2.5 mm wide; sparsely to densely pubescent with tuft at tip; caducous. *Petals* 2.8-4.6 mm long, 3.5 mm wide; glands sparse; thin-margin narrow at apex and

wide at sides, weakly fringed. *Stamens* 13-18 per bundle; filaments fused in lower quarter; papillose; 7.8-8 mm long; pink, or dark pink; swollen distally; claw 1.5-2.5 mm long, 1.5-2 mm wide. *Ovary* with 12-13 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 9.4-13.5 mm long; glabrous or indumented on lower quarter. *Fruit* urceolate; 8.6-11 mm long 3.5-6.5 mm wide; smooth; dark purplish brown, or dark grey-brown; without lobes, or very slightly undulate; valves deeply included, finely warty at apex. *Seeds* 2.2 mm long; rough; shed when fruit decays or is burnt.

Selected specimens examined. WESTERN AUSTRALIA: 86 mls (138.4 km) NNW of Gingin, *T.E.H. Aplin & R. Coveny* 3178 (NSW, PERTH); 5 mls (8 km) N of Perth, *K. Beamish*, NSW146288 (NSW); Junction Gillingarra Rd & Badgingarra Rd, near (NE of) Regans Ford, *M. Blackwell*, 16 Aug. 1978 (PERTH); Crystal Brook, Old Lesmurdie Road, *R.W. Blake* 51395 (PERTH); 4.3 km E of Regans Ford, *M.L. Clark* 202 (MEL, PERTH); Namman Rd & Gillingarra Rd, Regans Ford, *R.J. Cranfield* 1295 (AD, PERTH); Kalamunda, c. 20 km E of Perth, *Jean Galbraith* 9 Sept. 1964 (MEL); Maida Vale, *A.S. George* 4161 (MEL); 6 km W of Brand Hwy on south-most road of Nambung National Park, *R.J. Hnatiuk 780101* (PERTH); 20 mls [32 km] SW of Three Springs, *K. Newbey* 2264 (PERTH); 3.7 km S of Greenhead Coorow Rd and 5.5 km N of Cockleshell Gully, *B.L. Rye* 77045 (PERTH).

Distribution. Southern Irwin and Darling Districts (Figure 4).

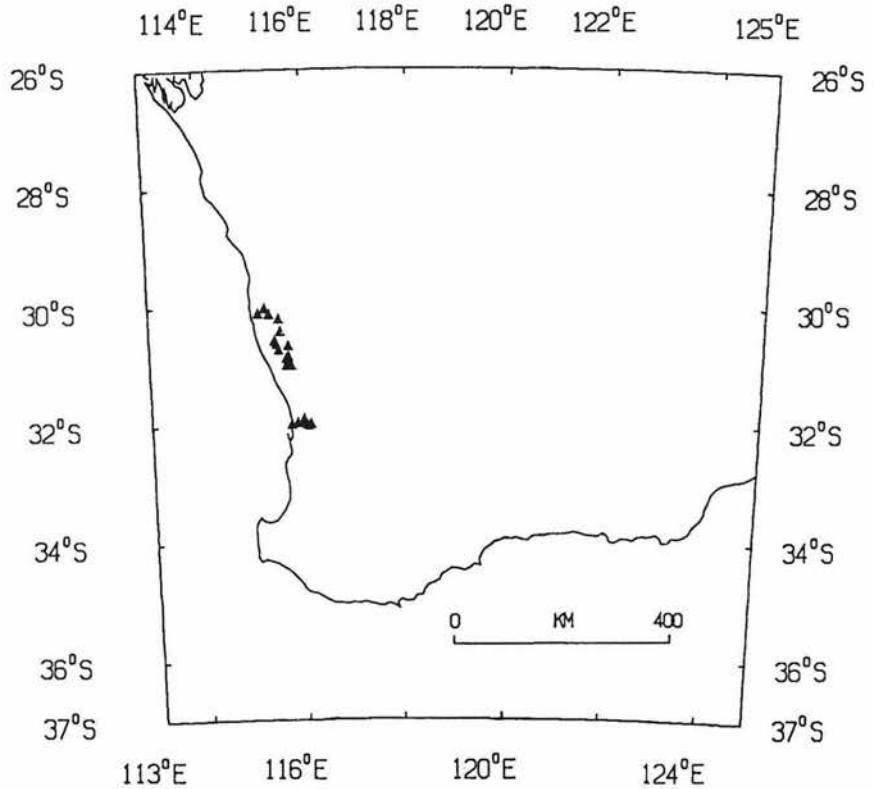

Figure 4. Distribution of *E. fimbriata*.

Habitat. Lateritic uplands to coastal plains; associated vegetation low open heath, or low woodland (of *Banksia* spp. with dense 50 cm tall understorey); soil grey sand over laterite, light brown sand, or lateritic gravel.

Flowering period. July to September.

Notes. E. fimbriata is the species most morphologically, ecologically, and isozymatically distinctive within *Eremaea*. Its leaves are narrow, densely arranged, tending to the erect. It flowers in mid-winter before any other species flowers. Its fruits are unique in shape. The orifice of the fruit is generally too small to allow the winged seeds to come out when the fruit dries. This means that seeds are dispersed generally only after the fruits have been burned or otherwise decay. Its distinctness from other species was reinforced in the isozyme studies of Coates and Hnatiuk (1990).

Conservation status. This species is probably not threatened.

Etymology. The name comes from the Latin word *fimbriatus* meaning fringed, and may refer to the often persistent long hairs on the margins of leaves, though the author of the name, Lindley, did not specify this.

2. Eremaea violacea F. Muell. Fragm. 11:10 (1878)

Typus: "Upper Irwin's and Arrowsmith's Rivers, Nov. 1877, F. Muell." (holo: MEL; iso: K; photos: CBG, PERTH).

Distribution. Irwin District between Hill and Greenough Rivers.

Habitat. On lateritic gravels and grey deep sand in species-rich low kwongan.

Etymology. The name comes from the Latin word *violaceus* meaning violet coloured and refers to the colour of the stamens.

There are two subspecies.

Key to subspecies

Leaves flat, at least on top, not needle-like ..... 2a. subsp. *violacea*
Leaves needle-like, terete or ovoid in cross-section ..... 2b. subsp. *raphiophylla*

2a. Eremaea violacea F. Muell. subsp. **violacea** (Figure 7l)

Shrub, 100 cm tall; not lignotuberous. *Branches* almost prostrate to very spreading. *Branchlet indumentum* two-layered, sparsely pilose outer layer, inner pubescent. *Over-wintering bracts* 13-39 per terminal bud; oblong, 0.6-0.7 mm long, 0.25-0.35 mm wide; indumentum one-layered, pilose, ciliate or glabrous; finely striate. *Leaves* narrowly obovate, narrowly ovate to linear, acute, mucronate; 7-12 mm long, 0.9-1.1 mm wide; 1 vein below; indumentum two-layered, outer layer pilose; inner tomentose; dry leaf cross-section flat or triangular where the midrib is prominent on the undersurface. *Petioles* 0.9-1 mm long. *Flowers* axillary on current season's wood, but with only a

few new leaves present between perules and flower; fragrance sweet; 1-7 per inflorescence. *Hypanthium* campanulate; 3-4 mm long, 2.5-3.5 mm wide; indumentum two-layered, upper layer densely villous; lower layer densely tomentose all over; outer surface uneven, dull, finely mammillate. *Calyx* lobes triangular; 1.3-3.2 mm long, 2-2.7 mm wide; indumentum sparse or dense, villous to glabrous; caducous, or very rarely persistent. *Petals* 2.3-4.5 mm long; glands absent or sparse; thin-margin wide, weakly fringed. *Stamens* 29-32 per bundle; filaments fused in lower quarter; papillose (especially in upper parts); 7.2-9 mm long; violet; swollen distally; claw 2-2.5 mm long, 0.8-2.3 mm wide. *Ovary* with 10-12 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 4.9-5.1 mm long, glabrous, or rarely indumented on lower quarter. *Fruit* cupulate, or globose; 5-8 mm long, 6-7.5 mm wide; smooth; light brown or coppery brown; without lobes, or rarely with small pointed lobes; valves exserted and reflexed, apex with two prominent irregularly hemispherical lobes. *Seeds* 1.5-2 mm long; rough to smooth; shed freely when fruit is dry.

Selected specimens. WESTERN AUSTRALIA: 17.6 km SW of Arrino, *R.J. Hnatiuk* 780394 (PERTH); on Casuarinas-Mingenew Road, *B. Jack*, 13 Sept. 1977 (PERTH); Ajana, *D.H. Perry*, Sept. 1958 (PERTH).

Distribution. Irwin District between Irwin and Greenough Rivers (Figure 5).

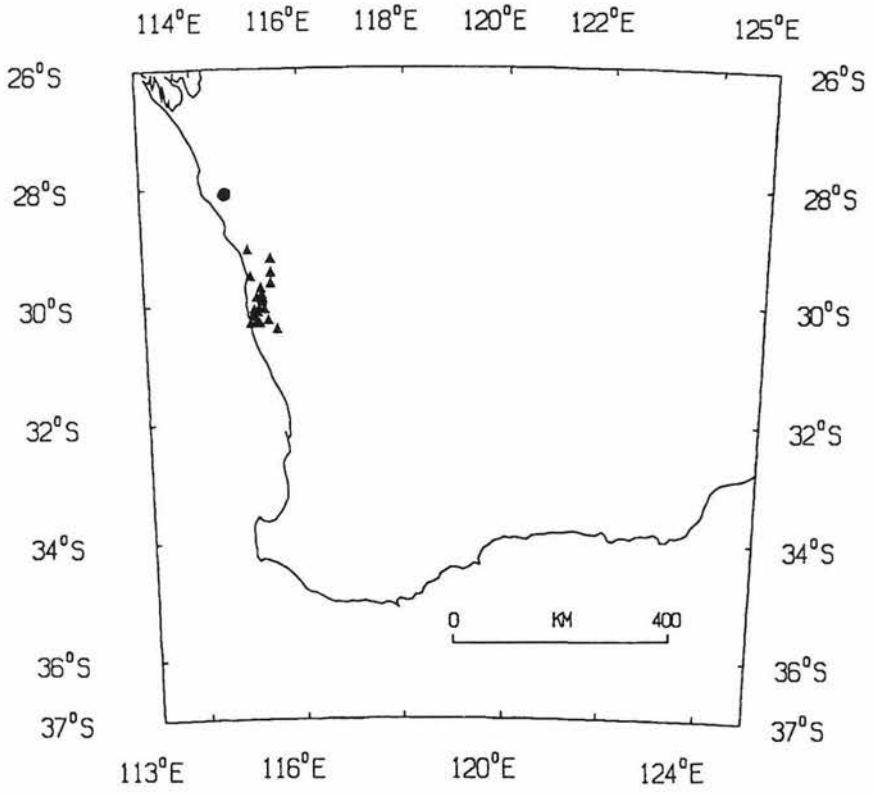

Figure 5. Distribution of *E. violacea* subsp. *violacea*. (●) and *E. violacea* subsp. *raphiophylla* (▲)

Habitat. Lateritic and broad uplands; associated vegetation kwongan: open heath, or low closed heath; soil grey sand over red-brown clayey sand, grey sand over laterite, or rarely light brown sand.

Flowering period. September to October.

Notes. *E. violacea* subsp. *violacea* belongs to section *Violacea*. It is distinguished from *E. atala* by its pattern of branching which combines major branches along with numerous short lateral shoots, and narrow, generally incurving leaves (see notes under *E. atala* for further details). From subspecies *raphiophylla* it is distinguished by its leaves that are flattened on top and frequently have a prominent midrib below; flowers are frequently produced on new wood, even though there are usually only a few new leaves between the perules and hypanthium.

The Type and Isotype of *E. violacea* subsp. *violacea* have localities which are all north of the Arrowsmith River and therefore represents indisputably the northern taxon of the section. Until now, the name has been applied to any violet flowered *Eremaea* of which the populations around Eneabba have become the best known. The Eneabba-Mt Lesueur taxon is however distinct from the northern taxon and is now distinguished as subspecies *raphiophylla*.

In the protologue of *E. violacea*, Mueller refers to the great similarity of *E. violacea* to *E. acutifolia*. This similarity is strong between the northern subspecies of *E. violacea*, but less so with south-western subspecies (*raphiophylla*). The similarities of *E. violacea* subsp. *violacea* to *E. acutifolia* are in the flowering often being on very short laterals along long major branches, in the shape and disposition of the leaves, especially as they grow old and deflex, and in the tendency for the fruits to be depressed-ovoid in outline rather than cupulate. These two taxa differ in the colour of the stamens and the ornamentation and degree of reflexing of the fruiting valves.

Conservation status. This subspecies is known from only a few populations. It is classified as Priority Two - Poorly Known Taxa.

2b. Eremaea violacea subsp. **raphiophylla** R.J. Hnatiuk subsp. nov. (Figure 6)

Frutex sine lignotubero. Folia anguste obovata, in sectione transversali ovoidea, mucronata, glabra; vena in pagina inferiore 0 vel 1. Flores in ramulis brevibus lateralibus ramorum longorum anni proximi terminales 1-7, per inflorescentia. Hypanthium campanulatum, indumento bistrato, strato supero villoso, infero parce pubescente. Lobi calycis triangulares, glabri vel villosi, caduci. Stamina in parte quarta inferiore connata, papillosa, violacea, raro alba et violacea. Fructus cupulatus ad globosus, laevis, elobatus, atro-violaceo - brunneus; valvae exsertae reflexiae ad apicem lobis 2 prominentibus hemisphericis ornatae.

Typus: 6 km N of Jurien rd on Cockleshell Gully rd; 30°14' S lat., 115°10' E long., *R.J. Hnatiuk* 780192, 17 Oct. 1978.

Shrub, 50 cm tall; not lignotuberous. *Branches* almost prostrate to ascending. *Branchlet indumentum* two-layered, densely pilose outer layer, inner densely pubescent. *Over-wintering bracts* 13-39 per terminal bud; oblong, 2.1-3.5 mm long, 1.5-2.5 mm wide; indumentum one-layered, pilose, on edges and rarely on upper (distal) back; finely striate. *Leaves* narrowly obovate to linear, acute, pungent, mucronate; 6.1-12.5 mm long, 0.4-1.2 mm wide; 0 or occasionally 1 vein below; incurved; glabrous or indumentum two-layered, outer layer pilose; inner tomentose; dry leaf cross-section

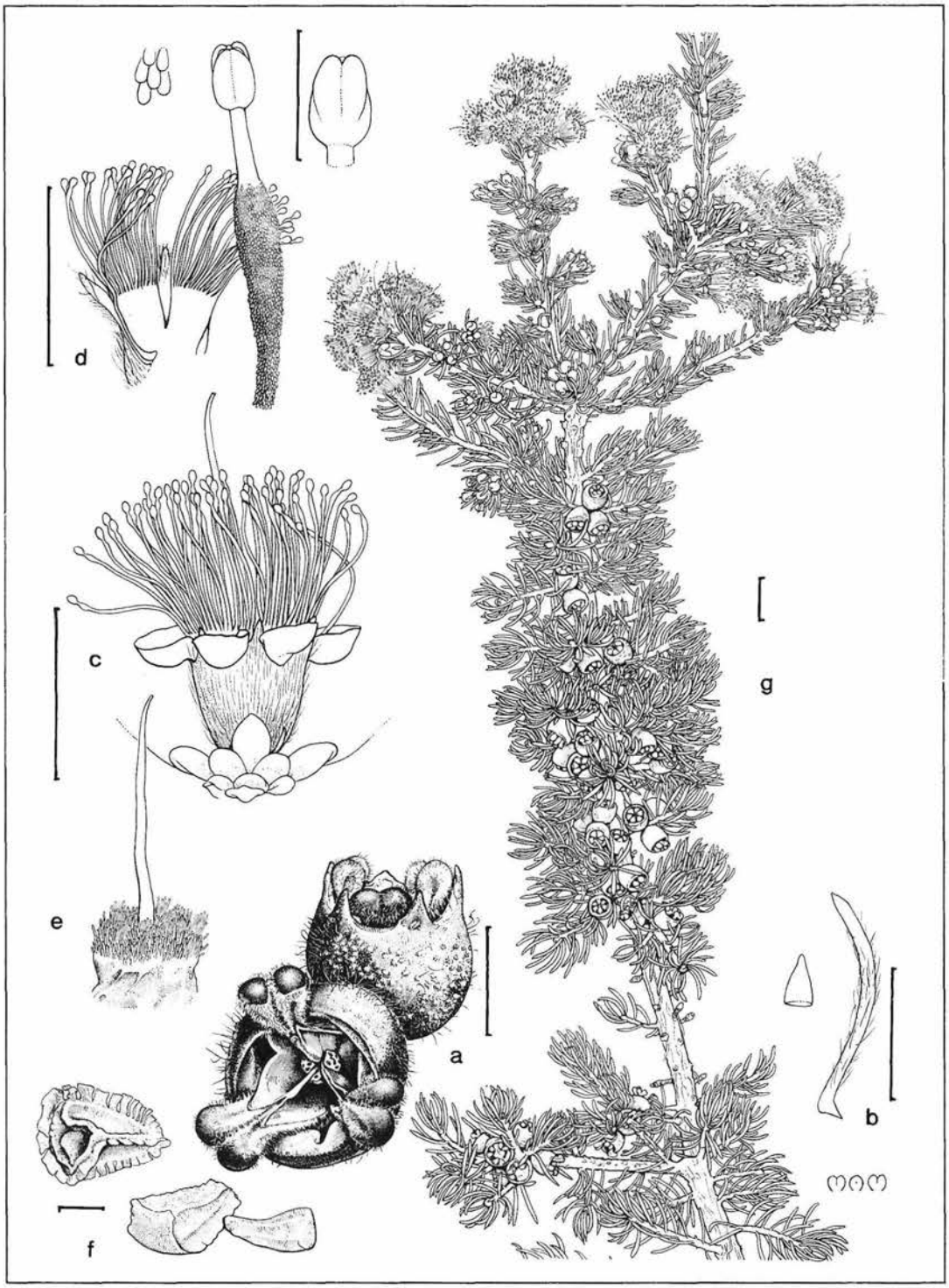

Figure 6. *E. violacea* subsp. *raphiophylla*: **a**: fruits, upper one is not fully mature; **b**: leaf with detail of apex (scale bar 5 mm); **c**: flower (scale bar 5 mm); **d**: two staminal bundles, detail of stamen and anther (scale bar of details 1 mm); **e**: style and top of ovary (scale bar 5 mm); **f**: seed and chaff (scale bar 1 mm); **g**: habit. 26 km S of Eneabba, *R.J. Hnatiuk* 780343 (PERTH). Scale bars, not indicated otherwise, 10 mm.

triangular or ovoid. *Petioles* 0.3-1 mm long. *Flowers* terminal on short laterals along long branches of last season's wood; fragrance sweet; 1-7 per inflorescence. *Hypanthium* campanulate; 3-4 mm long, 2.5-3.5 mm wide; indumentum two-layered, upper layer densely villous; lower layer densely tomentose all over; outer surface, uneven, dull, finely mammillate. *Calyx* lobes broadly triangular; 1.3-3.2 mm long, 2-2.7 mm wide; indumentum sparse or dense, villous to glabrous; caducous, or persistent, but not enlarging. *Petals* 2.3-4.5 mm long; glands sparse; thin-margin wide, weakly fringed. *Stamens* 24-32 per bundle; filaments fused in lower quarter; papillose (especially in upper parts); 7.2-9 mm long; violet (rarely whitish or pinkish); swollen distally; claw 2-2.5 mm long, 0.8-2.3 mm wide, joined variously to adjacent claws. *Ovary* with 10-12 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 8-13 mm long, glabrous, or rarely indumented on lower quarter. *Fruit* cupulate, or globose; 5-6 mm long, 6-7.5 mm wide; smooth; dark purplish brown, rarely paler; without lobes, or rarely with small pointed lobes; valves exserted and reflexed, apex with two prominent irregularly hemispherical lobes. *Seeds* 1.5-2 mm long; rough to smooth; shed freely when fruit is dry.

Selected specimens. WESTERN AUSTRALIA: between Jurien Bay and Gingin, *D. Clyne* NSW no. 146264 (NSW); Mt Lesueur, N along Cockleshell Gully Rd, *R.J. Cranfield* 828 (PERTH); approx. 20 miles [34 km] south of Eneabba, *H. Demarz* 749 (PERTH); Badgingarra, *C.A. Gardner* 10257 (PERTH); Western Titanium Leases, 8 km S of Eneabba, *E.A. Griffin* 1173 (PERTH); 19 km E of Green Head on Green Head-Jurien road, foothills of Gairdner Range, *J.A. Halliday* 146 (AD, PERTH); c. 12 km N of Eneabba, *R.J. Hnatiuk* 760247 (PERTH); on roadside, 5 km S of Coomallo Creek on Brand Highway, *R.J. Hnatiuk* 761451 (PERTH); 1 km E of Lake Indoon, *R.J. Hnatiuk* 761418 (PERTH); 6 km N of Jurien Rd on Cockleshell Gully Rd, *R.J. Hnatiuk* 780192, 780193, 780194, 780196, 780198 (PERTH); 10 km S of Eneabba on Western Titanium Rd, *R.J. Hnatiuk* 780216 (PERTH); 7 km E of junction of Coorow-Greenhead Rd and Cockleshell Gully Rd, *R.J. Hnatiuk* 780263, 780264, 780265 (PERTH); 10 mls [16 km] east of Jurien Bay, *K. Newbey* 2351 (PERTH).

Distribution. Irwin District, between the Arrowsmith and Hill Rivers (Figure 5).

Habitat. On the coastal plain and isolated mesa of the Gairdner Range. Associated vegetation kwongan: open heath or low, closed heath; soil: grey sand over red-brown clayey sand, or grey sand over laterite, or light brown sand.

Flowering period. September to October.

Notes. E. violacea subsp. *raphiophylla* belongs to section *Violacea.* It is distinguished from *E. atala* by narrow, needle-like, incurved leaves and flowering on last season's short lateral shoots, and habit which is low and spreading. The low habit and narrow leaves also distinguish it from *E. hadra.* From subsp. *violacea* it is distinguished by leaves that are ovoid in transection, not flat on top; by leaves that only incurve, not decurve with age; and flowers that are only on old wood, not new wood.

The populations near Eneabba tend to have flowering on well developed short laterals, whereas those to the east of the Gairdner range show this character less strongly and also have more needle-like leaves than those near Eneabba.

Conservation status. This species seems well protected in several national parks and reserves in the area. The security of sites from gross disturbance as from open-pit mining must be monitored as regeneration appears to be very adversely affected by such disturbance.

Etymology. The name comes from the Greek word *raphis* meaning needle shaped and refers to the shape of the pungent leaves.

3. Eremaea atala R. Hnatiuk sp. nov. (Figure 7h-k)

Frutex sine lignotubero. Folia anguste obovata, acuta ad obtusa, sine mucronata, glabra vel indumento bistrato, strato supero piloso, infero piloso; vena in pagina inferiore 1. Flores in ramis longis anni huius axillares, vel in ramis longis terminales, 1-5 per infloresentia. Hypanthium campanulatum, indumento uni strato supero dense villoso. Lobi calycis anguste triangularibus, dense, pilosi vel tomentosi, caduci. Stamina in parte quarta inferiore connata, papillosa, violacea. Fructus cupulatus ad campanulatus, elobatis, laevis, atro-cinereo-brunneus, pallide brunneus, cupreus vel cano-brunneus, valvis exsertis reflexis ad apicem lobis 2 hemisphaericis ornatis.

Typus: 27.1 km from E (Gunyidi) end of Marchagee Track, 30°09'S lat., 115°46'E long., 5 Dec. 1978, *R.J. Hnatiuk* 780401 (holo: PERTH; photo: CBG).

Shrub, 120 cm tall; not lignotuberous. *Branches* very spreading to erect. *Branchlet indumentum* two-layered, upper layer dense to sparse, pilose; lower layer short sparsely pilose. *Over-wintering bracts* 10-12 (bracts below flowers 2-3) ovate to obovate; 1.5-3 mm long, 0.9-1.5 mm wide; indumentum one-layered, ciliate; striate. *Leaves* narrowly obovate; acute to obtuse; 7.3-10 mm long, 0.8-1.5 mm wide; 1 vein below; glabrous or indumentum two-layered, upper layer long pilose, lower layer short pilose; dry leaf cross-section flat, thin. *Petioles* 0.3-0.8 mm long. *Flowers* axillary along long branches of current season's and occasionally terminal to last season's wood; 1-5 per inflorescence (usually 3); fragrance unknown. *Hypanthium* campanulate; 4-4.5 mm long, 2.6-3.2 mm wide; indumentum one-layered, dense, villous all over, uneven, dull, finely mammillate. *Calyx* lobes narrowly triangular; 2.8-3.7 mm long, 1.8-2 mm wide; indumentum dense, pilose and tomentose; caducous. *Petals* 3.2-4.5 mm long, 3.9-5 mm wide; glands abundant; thin-margin wide; very weakly fringed. *Stamens* 19-20 per bundle; filaments fused in lower quarter; papillose; 8-9.5 mm long; violet; swollen distally; claw 1.5-2.5 mm long; 1.3-1.7 mm wide. *Ovary* with 9-10 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 11-13 mm long; indumented on lower quarter to lower half. *Fruit* cupulate to campanulate; 5-5.5 mm long; smooth; light brown, coppery brown or grey-brown; 3.5-4.8 mm wide; without lobes; valves exserted and reflexed, ornamentation of 2 smooth hemispherical lobes at apex. *Seeds* 1.8 mm long; rough; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: Allanooka South, S of Geraldton, *A.C. Burns* 118 (PERTH); 38 mi [60.8 km] W of Coorow, on Greenhead Rd, *C. Chapman* 15 Jan. 1967 (PERTH); 16 km W of Coorow, *H. Demarz* D7269 (PERTH); Mingenew, *W.V. Fitzgerald* NSW146266 (NSW); Public Recreation Reserve on Coorow-Greenhead Road, 4 km E of Brand Hwy, *E.A. Griffin* 1712 (PERTH); 15 km S of Tathra National Park, E of Eneabba, *E.A. Griffin* 1806 (PERTH); SE of Alexander Morrison National Park, *R. Hnatiuk 780129* (PERTH); 35 km W of Watheroo, near border of South Irwin and Avon District, *D.J. Whibley* 4954 (AD, PERTH).

Distribution. Irwin District between the Arrowsmith and Hill Rivers (Figure 8).

Habitat. Broad uplands; on the plateaux to the east of the wide coastal plain between Jurien and Eneabba. Associated vegetation kwongan: closed heath, or open heath with emergent *Banksia* and *Xylomelum* species and *Eucalyptus todtiana;* soil light brown sand, or white sand over laterite.

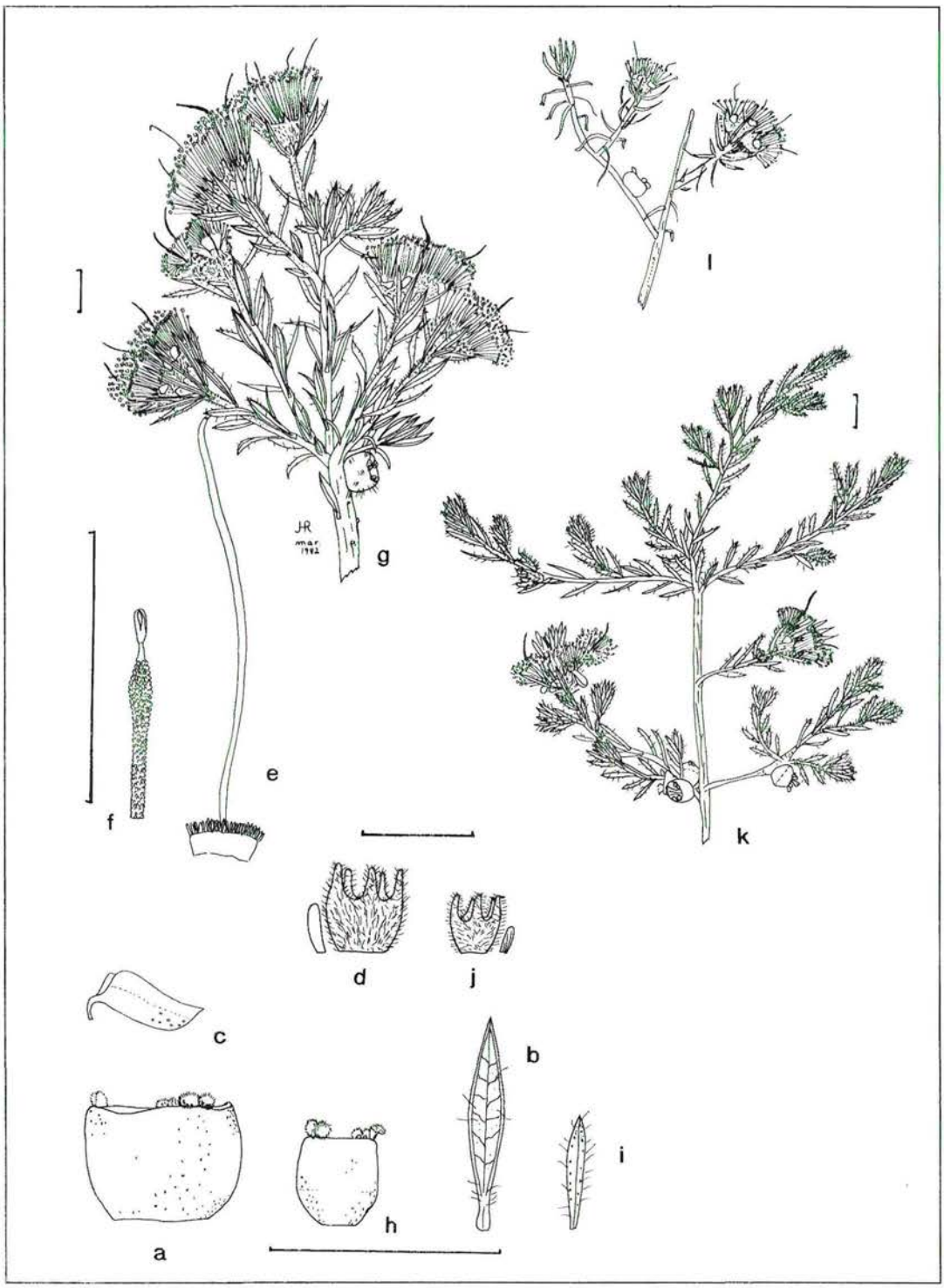

Figure 7. *E. hadra*: **a**: fruit; **b**: leaf; **c**: petal; **d**: hypanthium and calyx; **e**: style and top of ovary; **f**: detail of stamen; **g**: habit. 7.7 km E of junction of Brand Hwy and Badgingarra Rd, *R.J. Hnatiuk* 780327 (PERTH). *E. atala*: **h**: fruit; **i**: leaf; **j**: hypanthium and calyx; **k**: habit. 27 km from E end of Marchagee Track, *R.J. Hnatiuk* 780401 (survey specimen # 21) (PERTH). **l**: *E. violacea* subsp. *violacea* habit. Allanooka South, S of Geraldton, *A.C. Burns* 118 (PERTH). All scale bars 10 mm.

Flowering period. November to January.

Notes. *E. atala* is a member of section *Violacea*. It is most closely related to *E. violacea* subsp. *raphiophylla* and *E. hadra*. *E. atala* can be distinguished from *E. hadra* by its narrow, soft leaves, the spreading more delicate branching habit, the generally smaller flowers and fruits, and the flowering which is generally on new wood. The two species may co-exist along their southern boundary of occurrence. *E. atala* can be distinguished from *E. violacea* subsp. *raphiophylla* by the straight, soft, non-pungent leaves, the lack of short side branches which terminate in flowers, and the flowering on new wood. The two taxa are not known to co-occur: *E. atala* is confined to the top of the plateaux and *E. violacea* subsp. *raphiophylla* occurs only on the coastal plain and isolated mesa of the Gairdner Range. *E. atala* is distinguished from *E. violacea* by the upright habit, having non-mucronate leaves which do not have a prominent midrib below, and by leaves which do not stongly reflex with age. The fruits of *E. atala* are most often dark grey-brown whereas those of *E. violacea* are most often light brown.

Conservation status. I recommend that the conservation status of this variety should be Priority Four - Rare Taxa. Although its range is less than 100 km across, it appears to be well represented in Alexander Morrison and Tathra National Parks.

Etymology. The name comes from the Greek word *atalos* meaning tender, delicate, soft and refers to the softness of the leaves in strong contrast to *E. violacea* subsp. *raphiophylla*, *E. violacea* subsp. *violacea* and *E. hadra*.

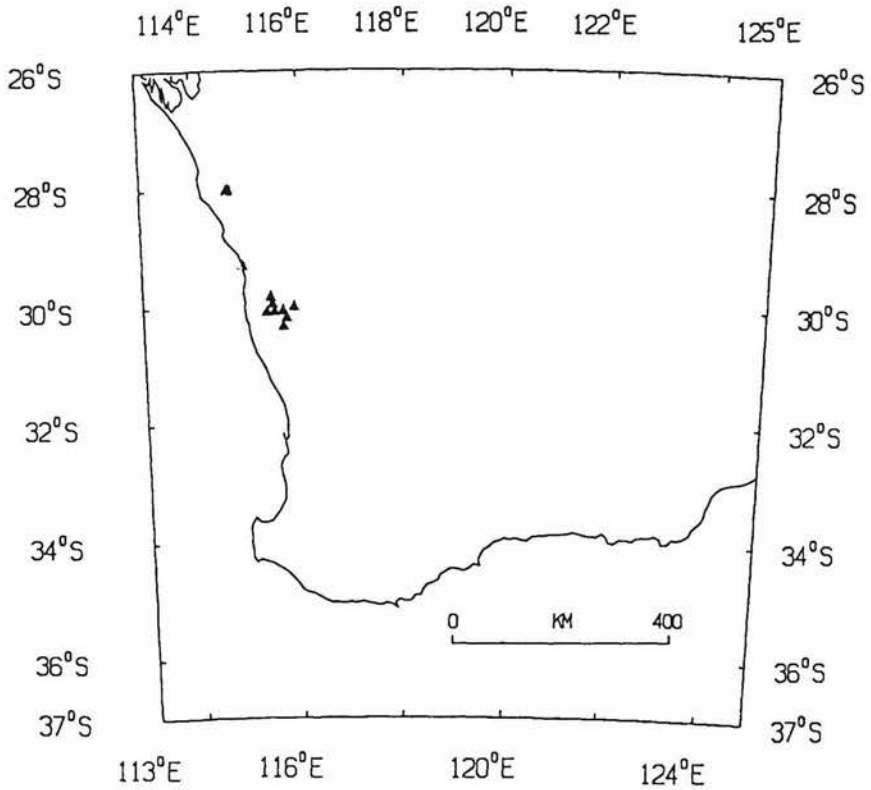

Figure 8. Distribution of *E. atala*.

4. Eremaea hadra R. Hnatiuk sp. nov. (Figure 7a-g)

Frutex sine lignotubero. Folia anguste obovata ad anguste elliptica, acuta, muronata, indumento bistrato, strato supero piloso, infero tomentoso, vel breviter strigoso; vena in pagina inferiore 1 vel raro 3. Flores in ramis longis terminales, vel in ramulis brevibus lateralibus ramorum longorum anni proximi terminales, 2-9 per infloresentia. Hypanthium campanulatum, indumento bistrato, strato supero dense villoso, infero parce pubescente. Lobi calycis anguste triangulares, villosi, caduci. Stamina in parte quarta inferiore connata, papillosa, violacea. Fructus cupulatus ad globosus, laevis, elobatus, atro-violaceo-brunneus, valvis exsertis reflexis ad apicem lobis 2 prominentibus hemisphaericis ornatis.

Typus: 7.7 km E of Junction of Brand Hwy and Badgingarra Road, c. 30°25'S lat., 115°34'E long., 14 Nov. 1978, *R.J. Hnatiuk* 780327 (holo: PERTH; photo: CBG). (isotypes *RJH* 780324, *RJH* 780330).

Illustrations. R.J. Hubbard, Australian Plants 10:16 (1978), as "*Eremaea violacea*"; W.R. Elliot & D.L. Jones, Encyclopaedia of Australian Plants 3:427 as "*Eremaea* aff. *violacea* B".

Shrub, 140 cm tall; not lignotuberous. *Branches* ascending to erect, but becoming spreading in mature plants. *Branchlet indumentum* two-layered with densely or sparsely, pilose outer layer; inner densely or sparsely, coarsely tomentose. *Over-wintering bracts* 17-36 per terminal bud; elliptic to oblong; 6.2-7.4 mm long, 2.7-3.5 mm wide; glabrous, or indumentum one-layered tomentose all over back or rarely fimbriate; striate. *Leaves* narrowly obovate to narrowly elliptic, acute, strongly mucronate; 7.6-12.3 mm long, 1.2-2.6 mm wide; 1 rarely 3 veins below; indumentum two-layered, upper layer pilose, lower layer tomentose to shortly strigose; dry leaf cross-section flat, thin. *Petioles* 0.5-1 mm long. *Flowers* terminal on long branches, or on short laterals along long branches of last season's wood; 2-9 per inflorescence; fragrance faint, sweet. *Hypanthium* campanulate; 3.5-5 mm long 3-4 mm wide; indumentum two-layered, upper layer dense, villous; lower layer sparse, pubescent, all over; outer surface uneven, dull, finely mammillate. *Calyx* lobes narrow-triangular; 2.7-5.5 mm long, 2-3 mm wide; villous; caducous. *Petals* 4.4-5.2 mm long, 4.3-5.3 mm wide; glands sparse; thin-margin wide, weakly fringed. *Stamens* 19-25 per bundle; filaments fused in lower quarter or lower half; papillose; 10.5-11.6 mm long; violet; swollen distally; claw 2-2.5 mm long, 2-2.7 mm wide. *Ovary* with 10-13 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 13.5-17 mm long; indumented on lower quarter to lower half. *Fruit* cupulate to globose; 5.6-6.5 mm long; smooth; dark purplish brown; 5-6.8 mm wide; without lobes; valves exserted and reflexed, tips of valves each with two prominent hemispheric lobes. *Seeds* 1.3-2 mm long; rough; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: Badgingarra, *A.M. Ashby* 762 (AD); 39 miles [62.4 km] West of Coorow on road to Eneabba, *H. Demarz* 2935 (PERTH); Alexander Morrison National Park, Coorow-Greenhead Rd, east of Brand Hwy, *E.A. Griffin* 1556 (PERTH); 48 km from E (Gunyidi) end of Marchagee Track, near Dewar Rd junction, *R.J. Hnatiuk* 780405 (PERTH); Mingenew, *H. Steedman* NSW146263 (NSW); c. 3 km E of Badgingarra, *D.J.E. Whibley* 4858 (AD, PERTH).

Distribution. Irwin District between Arrowsmith and Hill Rivers, but confined to the edges of the plateaux which rise to the east, above the coastal plain between Eneabba and Jurien (Figure 9).

Habitat. Edge of escarpments; associated vegetation kwongan: open heath, closed heath, or low closed heath; soil grey sand over laterite, or white sand.

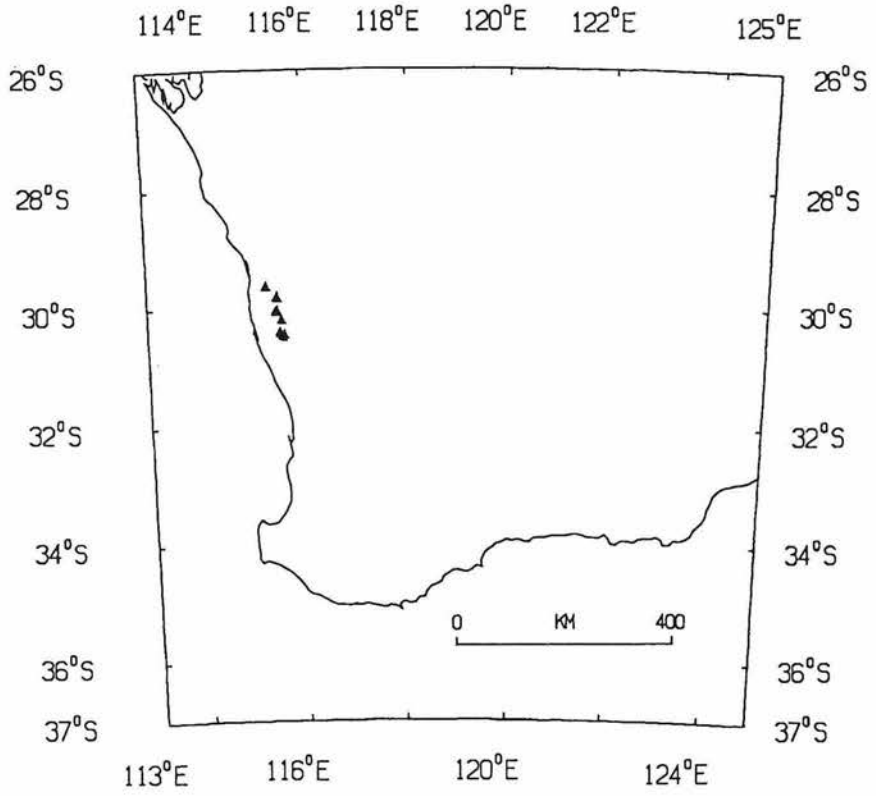

Figure 9. Distribution of *E. hadra*.

Flowering period. October to December.

Notes. E. hadra is a member of section *Violacea*. It is characterised by its robust erect growth habit. Its leaves, flowers and fruits are generally larger than its nearest relatives - *E. atala*, *E. violacea* subsp. *raphiophylla* and *E. violacea* subsp. *violacea*. It may hybridise with *E. atala* in some places, but with so few populations, and these mostly near or in disturbed areas, it is hard to know whether the hybridisation is only recent or also ancient. The variety was collected before any major disturbance of the land by Europeans occurred. Whether disturbance from fire, either natural or Aboriginal, could have stimulated recent hybridisation is not known. Isozyme studies only show a very close relationship between the sampled population and that of *E. atala*. The distinctive but small morphological difference, and the geographic distribution which is wholly marginal to its nearest relative make it reasonable to recognise the taxon as a separate species.

Horticulture. The plant is readily grown from cuttings or seed. The large clusters of flowers of deep violet stamens topped with bright yellow anthers are very attractive.

Conservation status. I recommend that the conservation status of this variety should be Priority One - Poorly Known Taxa. Its geographic range is less than 100 km across. Its occurrence in Reserves is not known. It is only known from small populations along the edge of the archaean shield. Further field work is needed.

Etymology. The species name comes from the Greek word *hadros* meaning well-developed, large, strong, and refers to the distinctively robust character of the plant in comparison to its closest relatives.

5. Eremaea pauciflora (Endl.) Druce, Bot. Exch. Club Soc. Brt Isles Rep. 1916, Suppl.2 :622 (1917)

Base name: *Metrosideros pauciflora* Endl.; Enumeratio Plantarum...*Huegel* (1837): 50.

Typus: Swan River (*Hugel.*). (holo:W; photos: CBG, K, PERTH)

Distribution. Irwin, Drummond, Dale, Menzies, Warren, Eyre, Roe, Avon, and Coolgardie Districts.

Habitat. Lateritic uplands to coastal plains; associated vegetation kwongan: low closed heath, low woodland, or open low woodland; soil grey sand, or grey sand over light brown or yellow sand.

Notes. E. pauciflora is a member of section *Eremaea.* It is the most widespread of *Eremaea* species. It occurs throughout the South West Botanical Province as a series of isolated populations. Morphological variation is high, but suites of linked characters have not been found which would allow ready recognition of infraspecies. The isozyme studies of Coates and Hnatiuk (1990) did not sample the geographic range of this species. Much more detailed work is needed to understand the nature of variation in this "species".

Etymology. The name comes from the Latin words *paucus* meaning few and *flora* meaning flower. The name refers to the few flowers seen on some specimens.

Key to varieties

1. Leaves narrowly elliptic, leaf veins 1 or 3 ..... 5b. var. *lonchophylla*
1. Leaves linear or very narrowly obovate, leaf veins 1
2. Hypanthium covered by large, clasping, spathulate bracts, fruits with orifice nearly as wide as fruit ..... 5c. var. *calyptra*
2. Hypanthium closely covered by usually ovate concavo-convex bracts, fruits with orifice much less than width of fruit ..... 5a. var. *pauciflora*

5a. Eremaea pauciflora (Endl.) Druce var. **pauciflora** (Figure 10)

E. ericifolia Lindley, "Swan River, N. Holland, Drummond"; *E. pilosa* Lindley, "N.B. Ward dirt., Swan River District, Comm. I. Mangles 1837".

Shrub, 200 cm tall; with or without lignotubers. *Branches* spreading, forming low mounded shrubs to tall, infundibular large shrubs. *Branchlet indumentum* one-layered, dense, tomentose, glabrescent. *Over-wintering bracts* 12-24 per terminal bud; ovate to obovate; 2-6.7 mm long, 1-4.7 mm wide; indumentum one-layered, finely puberulous and ciliate; on edges to all over back; striate. *Leaves* linear, rarely narrowly elliptic to obovate, obtuse; 2.9-7.9 mm long, 0.6-1.6 mm wide; 0-1 veins below; glabrous, or indumentum one- or two-layered, upper layer dense pilose, lower layer dense tomentose; dry leaf cross-section triangular. *Petioles* 0.6-1.1 mm long. *Flowers* terminal on long branches of last season's wood; 1 rarely 2 per inflorescence; fragrance none or faint, sweet. *Hypanthium* long, campanulate; 2.9-5 mm long, 2.8-3.9 mm wide; glabrous, or indumentum one-two-layered, very dense, velutinous upper layer (at base only sometimes), lower layer tomentose; all over

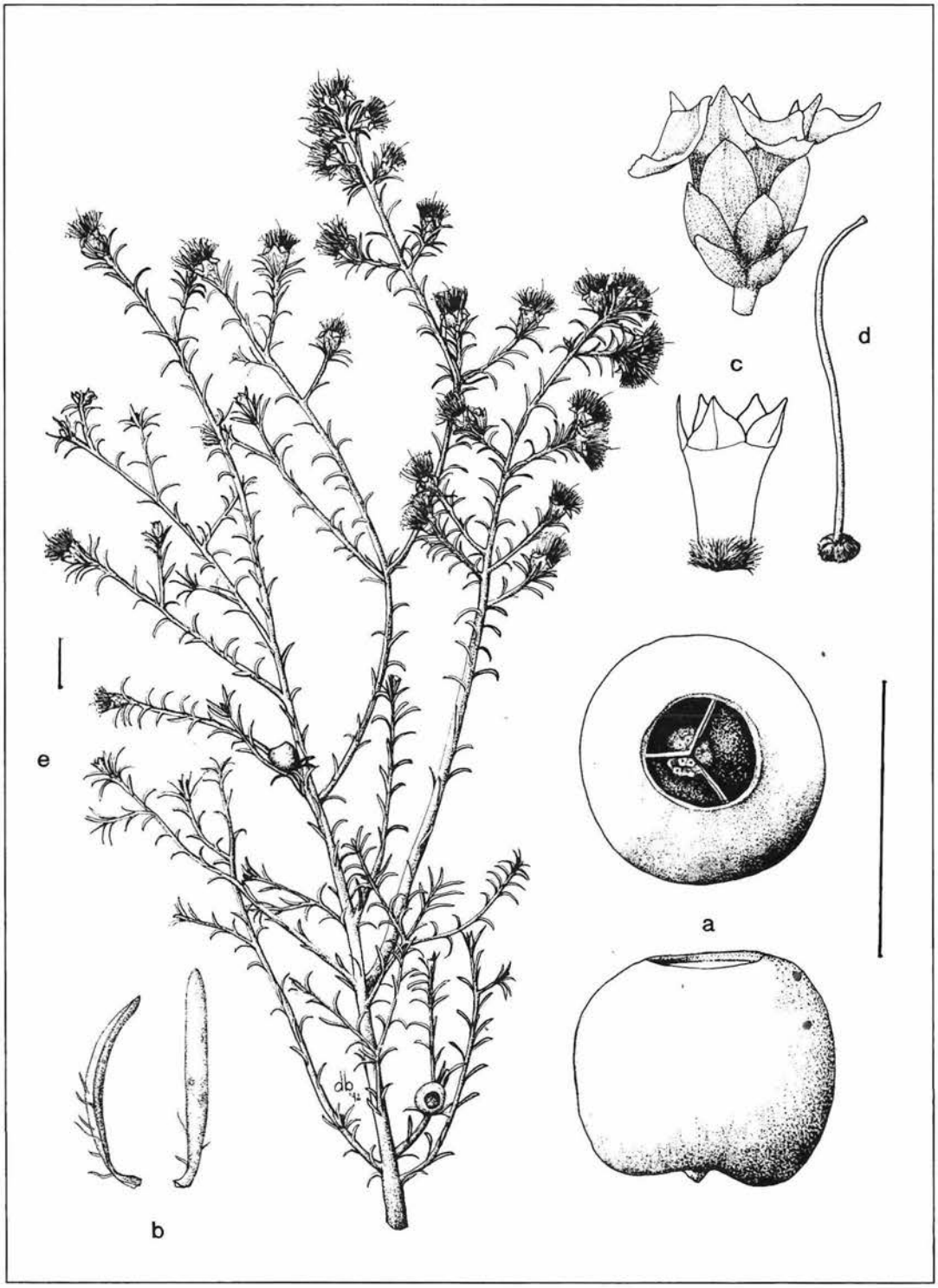

Figure 10. *E. pauciflora* var. *pauciflora*: **a**: fruits, side and top views; **b**: leaf, side and ventral views; **c**: hypanthium: top figure with perules, bottom figure with perules removed; **d**: style; **e**: habit. Hillview Terrace and Berwick Street, Victoria Park, *R.J. Cranfield* 1180 (PERTH). All scale bars 10 mm (left one refers to two habit drawings (e), right one refers to details (a-d).

or variously indumented and glabrous; outer surface uneven, finely mammillate to tuberculate to smooth, usually shiny, but wrinkled longitudinally when dry. *Calyx* lobes cuspidate, broadly triangular, lower margins somewhat auriculate; 1.3-3 mm long, 1.5-2.5 mm wide; indumentum sparse to dense, pubescent and ciliate, or glabrous; caducous. *Petals* 2.5-5.7 mm long; glands abundant; thin-margin narrow at apex to wide at sides; weakly fringed. *Stamens* 17-32 per bundle; filaments fused only shortly at base to filaments fused in lower quarter; smooth; 4.5-8 mm long; orange (rarely pale yellow); not swollen, or swollen distally; claw 0.5-2 mm long; 1.4-2.8 mm wide. *Ovary* with 7-14 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 7-11 mm long; glabrous. *Fruit* globose but very variable in shape (Figure 12), 6-9.2 mm long; smooth; light brown to coppery brown; orifice 2-3 mm wide; without lobes; valves deeply included, ornamented by 2 inconspicuous apical lobes. *Seed* 1-2 mm long; rough; shed freely when fruit is dry.

Selected specimens. WESTERN AUSTRALIA: Bayswater, *C. Andrews,* Oct. 1907 (PERTH); 17 mi [27.2 km] east of Pingelly, *T.E.H. Aplin* 788 (PERTH); Ruabon-Ludlow, *T.E.H. Aplin* 1184 (PERTH); Armadale, c. 27 km SSE of Perth, *A.M. Ashby* 487 (AD); South of Ongerup on the Toompup Road, *A.M. Ashby* 3092 (AD); Cunderdin, *E.T. Bailey* 126 (PERTH); about 4 mi [6.2 km] north of Muntadgin, *E.T. Bailey* 247 (PERTH); Lake King-Norseman Rd between rabbit proof fence and 100 m tank, *J.S. Beard* 3788 (PERTH); between Goomalling and Meckering *J.S. Beard* 8041 (PERTH); Yanchep National Park, 32 mi [51.2 km] N of Perth, *E.M. Bennett* 65 (PERTH); 5 miles [8 km] N of Yanchep on Moore River Rd, *B.G. Briggs*, 6 Oct. 1969 (NSW); 57 miles [91.2 km] W of Coolgardie, *B.G. Briggs,* 30 Sept. 1960 (NSW); Mogumber Rd, S of Moore River (E of Moore River National Park), *N.T. Burbidge* 8066 (NSW, PERTH); Canning River foreshore, 1.5 miles [2.4 km] south of Canning Bridge, *M.L. Clark* 172 (PERTH); between Harrissmith & Lake Grace, N of Kukerin, *M.G. Corrick* 8748 (MEL); Boundary Rd, Wattle Grove, *R. Coveny* 8073 (PERTH); Palm Terrace, Forestfield, *R.J. Cranfield* 131 (MEL, PERTH); opposite turn-off to Stirling Ranges on rd to Esperance, *R.J. Cranfield* 984 (PERTH); 75 km E of Ravensthorpe, *R.J. Cranfield* 998 (PERTH); Swan District Burswood, *Diels & Pritzel* 258 (PERTH); Tammin Reserve, *H. Demarz* 4667 (PERTH); 22 miles [35.2 km] east of Newdegate, *A.S. George* 1655 (PERTH); Rabbit proof fence, NW of Jerramungup, *A.S. George* 7003 (PERTH); c. 3 km by road SE of Kondut PO on road to Cadoux. *L. Haegi* 1107 (AD); Possum Rd, Tuttanning Reserve, 17 mi [27.2 km] E of Pingelly, *G. Heinsohn* 27 (PERTH); Subiaco, *R. Helms,* 12 Dec. 1897 (MEL, PERTH); 16 km S of Kulin, *R.J. Hnatiuk* 780038 (PERTH); near Boongarra, NE of Two Rocks, *R.J. Hnatiuk* 780150 (PERTH); 17 km E of Coorow Rd-Brand Hwy junction, *R.J. Hnatiuk* 780286 (PERTH); 17 km due NE of Brookton, between Jurakine Rock & Yenyening pools, *R.J. Hnatiuk* 790125, 790126 (PERTH); 80 km W of Southern Cross, *R.J. Hnatiuk* 800092 (PERTH); c. 22 km SW of Round Top Hill, c. 122 km ENE of Hyden, *R.J. Hnatiuk* 800198 (PERTH); Swan River, *Hugel* 11 (V); Jandakot, 15 mi [24 km] S of Perth, *A.M. James* 137 (MEL, PERTH); crossroad c. 6 km SSE of Lake Chidnup, main Ravensthorpe Rd c. 48 km by rd SE of Lake King, *E.N.S. Jackson* 3431 (AD, MEL); Cowcowing, *M. Koch* 995 (MEL, NSW); 3.5 mi [5.6 km] NE of Borden, *K. Newbey* 584 (PERTH); 2 km E of Koorarawaylee, c. 72 km E of Southern Cross, *K. Newbey* 6090 (PERTH); Tone River, *Oldfield* 389 (MEL); 58 mi [92.8 km] W of Coolgardie, *M.E. Phillips* 022849 (AD, CBG); 2 mi [3.2 km] N of Wongan Hills, Research station area, *M.E. Phillips* (AD, CBG, MEL); between Bruce Rock & Quairading, *W. Rogerson* 293 (PERTH); along N-S transect running through middle of Reserve, Jandakot Marsupial Breeding Station, Perth, *A.S. Weston* 7429 (PERTH).

Distribution. This is the most widespread of species. It occurs in the Irwin, Darling, Avon, Roe, Eyre and Coolgardie Districts (Figure 11).

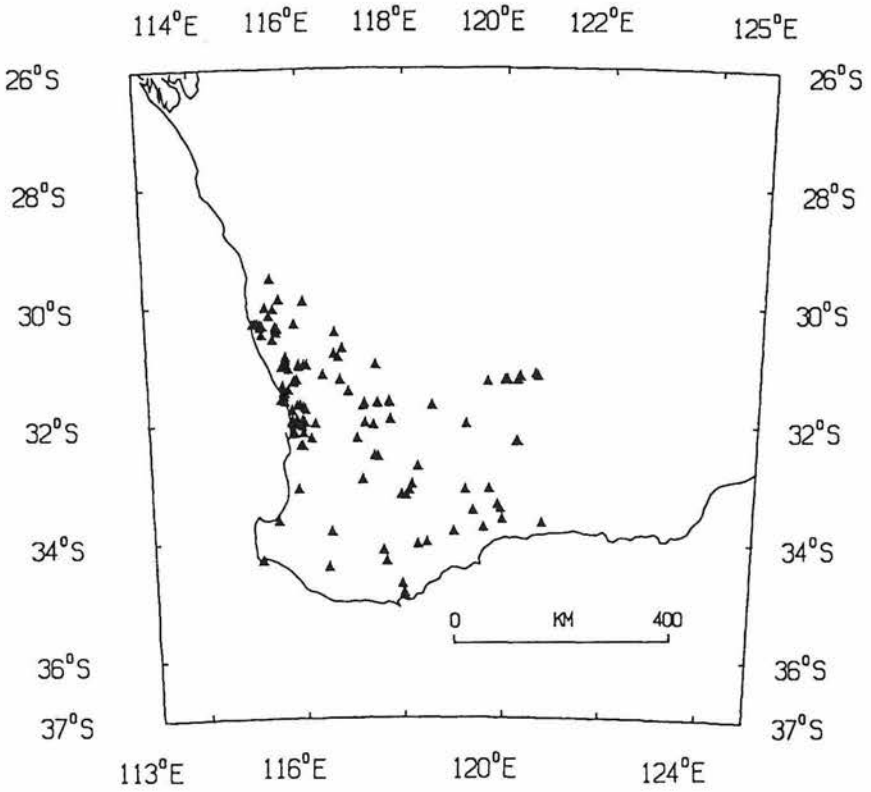

Figure 11. Distribution of *E. pauciflora* var. *pauciflora.*

Habitat. Broad uplands, or from lateritic uplands to coastal plains; associated vegetation kwongan: low open heath, low closed heath, low woodland, or open low woodland (*Banksia* woodland); soil grey sand, grey sand over laterite, sand over laterite, or yellow sand.

Flowering period. July to November.

Notes. E. pauciflora var. *pauciflora* is part of section *Eremaea.* It is morphologically variable, but the populations that are recognisable are not sufficiently consistent in the suites of characters to allow recognition of individual taxa, even though some of them are striking. Some of the more prominent variations are in the amount and location of indumentum, the thickness of the leaves (to some extent the thick leaved variants are more common in the south of the range), the presence or absence of lignotubers (lignotuberous plants coincide with low, multi-stemmed, generally less than 1m high plants, whereas non-lignotuberous forms tend to be taller, broom-bush shaped plants); the shape and size of the over-wintering bracts and the degree to which they cover the hypanthium; the size and shape of the fruits and the size of the orifice at the top of the fruit.

Conservation status. Taken as a whole, this subspecies is not endangered. The status of the many population variants is not known.

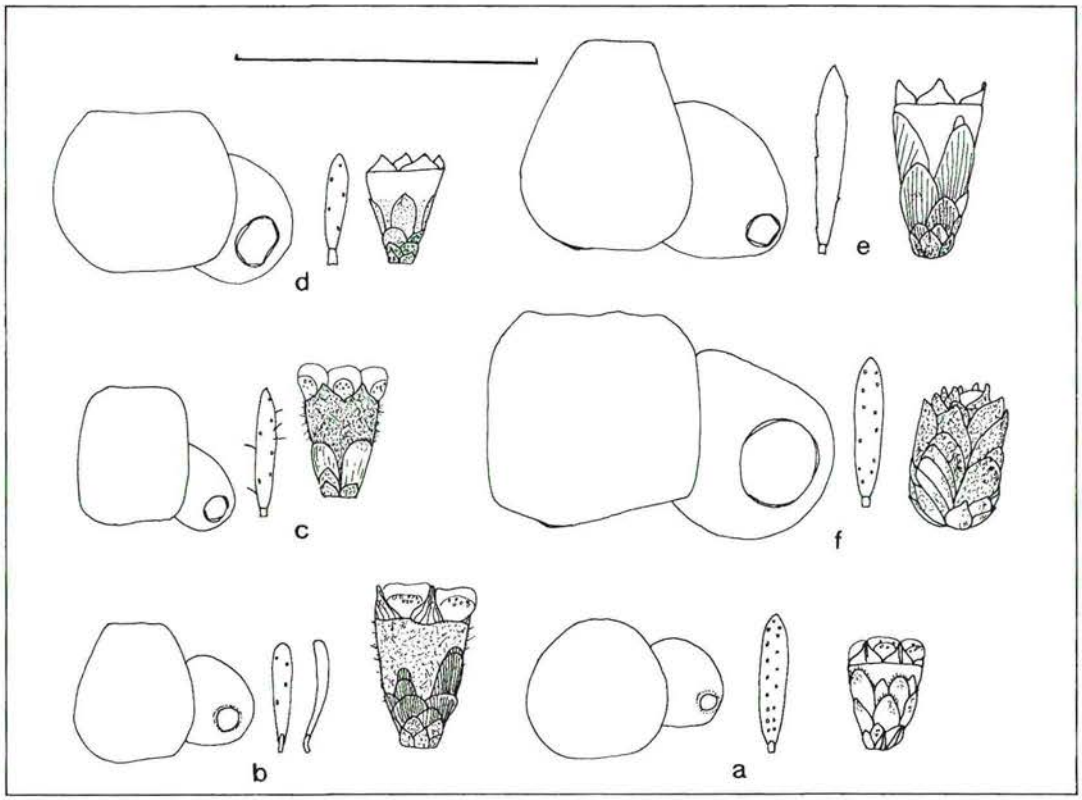

Figure 12. *E. pauciflora* var. *pauciflora*: fruits, leaves and flowers covered with perules; **a**: Round Top Hill, 120 km E of Hyden, *R.J. Hnatiuk* 800198 (survey specimen # 65). **b**: Mallee Rd, c. 62 km W of Ravensthorpe, *R.J. Hnatiuk* 800126 (survey specimen # 64) (PERTH). **c**: Neaves Rd, NE of Wanneroo, *R.J. Hnatiuk* 790193 (survey specimen # 77) (PERTH). **d**: Jarrah Rd, S Perth, *R.J. Hnatiuk* 771537 (PERTH). **e**: Forrestfield, Perth, *R.J. Hnatiuk* 780139 (PERTH). *E. pauciflora* var. *calyptra*: **f**: fruits, leaf and flower covered with perules. Munbinea Rd, SE of Jurien, *R.J. Hnatiuk* 780173 (PERTH). Scale bar 10 mm.

5b. Eremaea pauciflora (Endl.) Druce var. **lonchophylla** R.J. Hnatiuk var. nov. (Figures 13, 19f, g, h)

Frutex sine lignotubero. Rami patentes ad erecti (infundibulares). Folia elliptica, angusta, acuta vel obtusa, glabra vel pilosa, vena in pagina inferiore 0 vel 1. Flores in ramis longis anni proximi terminales, 1 vel interdum 3 per inflorescentia, graveolentes dulce odorati. Hypanthium campanulatum, longum, indumento unistrato vel raro bistrato, strato supero denso, velutino, infero denso, tomentoso. Fructus doliiformis, laevis, pallide brunneus ad cupreus, elobatus, valvis profunde inclusis.

Typus: c. 10-20 km E of Tathra National Park, 28 July 1980, *R.J. Hnatiuk* 800054. (holo: PERTH; photo: CBG) [plus 1 dupl.].

Shrub, 200 cm tall; not lignotuberous. *Branches* spreading to erect (infundibular). *Branchlet indumentum* glabrous or two-layered, sparse, pilose outer layer, inner sparsely puberulous. *Overwintering bracts* 11-21 per terminal bud; ovate to obovate; 2.4-2.9 mm long, 1.9-2.6 mm wide; indumentum one-layered, ciliate, rarely finely puberulous, on edges and occasionally on upper (distal) back; striate. *Leaves* narrowly elliptic, acute or obtuse; 3.1-5.1 mm long, 0.9-3.3 mm wide; 1-3 veins below; glabrous, or pilose; dry leaf cross-section flat, thick. *Petioles* 0.5-1.1 mm long. *Flowers* terminal on long branches of last season's wood; 1 sometimes 3 per inflorescence; fragrance strong, sweet, light or spicy. *Hypanthium* campanulate; 3.2-3.6 mm long, 3-4 mm wide; indumentum

one- or rarely two-layered, upper layer dense, velutinous; lower layer dense, tomentose; all over or sparse to glabrous near rim; smooth, usually shiny, but wrinkled longitudinally when dry. *Calyx* lobes semicircular to obtusely triangular; 0.9-1.4 mm long, 1.8-2.2 mm wide; glabrous or indumentum dense, ciliate and occasionally pubescent; caducous (usually bases remain as an undulate rim). *Petals* 3-4.7 mm long; glands abundant; thin-margin wide, weakly fringed. *Stamens* 24-47 per bundle; filaments fused only shortly at base; smooth; 5.5-7.5 mm long; orange; not swollen, or swollen distally; claw 0.1-0.5 mm long; 1.5-2 mm wide. *Ovary* with 10-12 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 7.5-10.2 mm long; glabrous or variously indumented. *Fruit* doliform; 5.1-6.7 mm long; smooth; light brown to coppery brown; 2.6-4.2 mm wide; without lobes; valves deeply included, ornamented with 2 inconspicuous lobes at apex. *Seed* 1.4-1.6 mm long; rough; shed freely when fruit is dry.

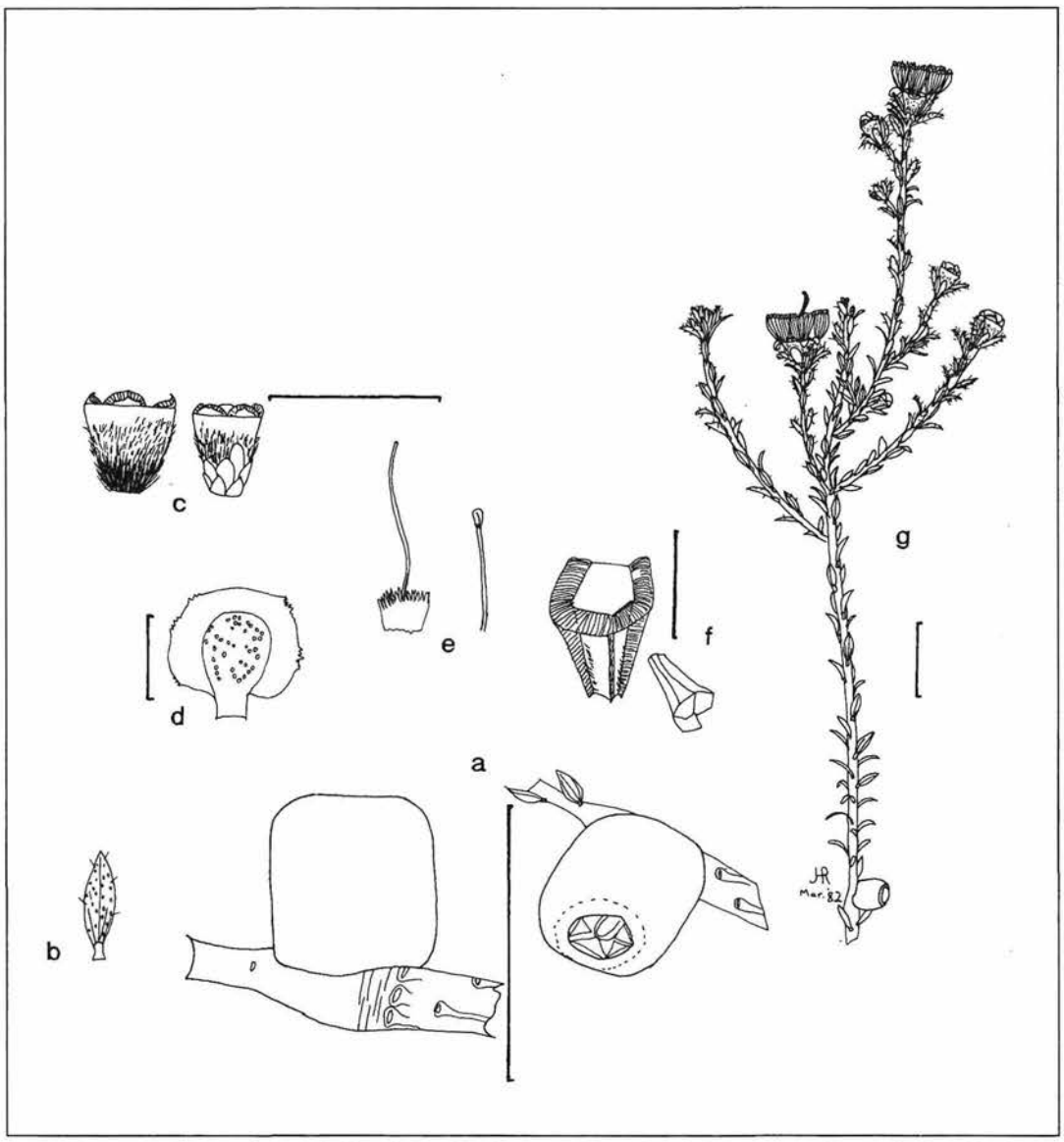

Figure 13. *E. pauciflora* var. *lonchophylla*: **a**: fruits, side view and oblique of top; **b**: leaf; **c**: hypanthium and calyx, left without perules, right with perules; **d**: petal (scale bar 2.5 mm); **e**: style and top of ovary; **f**: seed and chaff (scale bar 2 mm); **g**: habit. 16 km from Yarra Yarra Lakes towards Tathra Natl Pk, *R.J. Hnatiuk* 800054 (survey specimen # 54) (PERTH). All scale bars, not indicated otherwise, 10 mm.

Selected specimens examined. WESTERN AUSTRALIA: west of Coorow, *W.E. Blackall* 3956 (PERTH); west of Three Springs, *W.E. Blackall,* Sept. 1940 (PERTH); 25 km (by road) W of Winchester, *C. Chapman*, 23 March 1979 (PERTH); Alexander Morrison National Park, Coorow-Greenhead Rd, *E.A. Griffin* 1559 (PERTH); 23 km S of Eneabba on Brand Hwy, *R.J. Hnatiuk* 780238 (PERTH); 1 km E of Brand Hwy on Coorow Rd, *R.J. Hnatiuk* 780271 (PERTH); 8 km S of New Badgingarra, *R.J. Hnatiuk* 780315 (PERTH); 15 km due W of Coorow, *S.D. Hopper* 1552 (PERTH); cultivated in Kings Park, chromosome count voucher, *B.L. Rye* 76036 (PERTH).

Distribution. On the eastern plateaux of the Irwin District (Figure 14).

Habitat. Broad uplands; associated vegetation kwongan: closed heath, low open heath, high shrubland, low woodland, or open low woodland (of *Banksia* and *Xylomelum* species with dense shrub understorey); soil deep light brown sand, grey sand over laterite, light brown sand, white sand over laterite, yellow sand or light brown loam and lateritic gravel.

Flowering period. July to January.

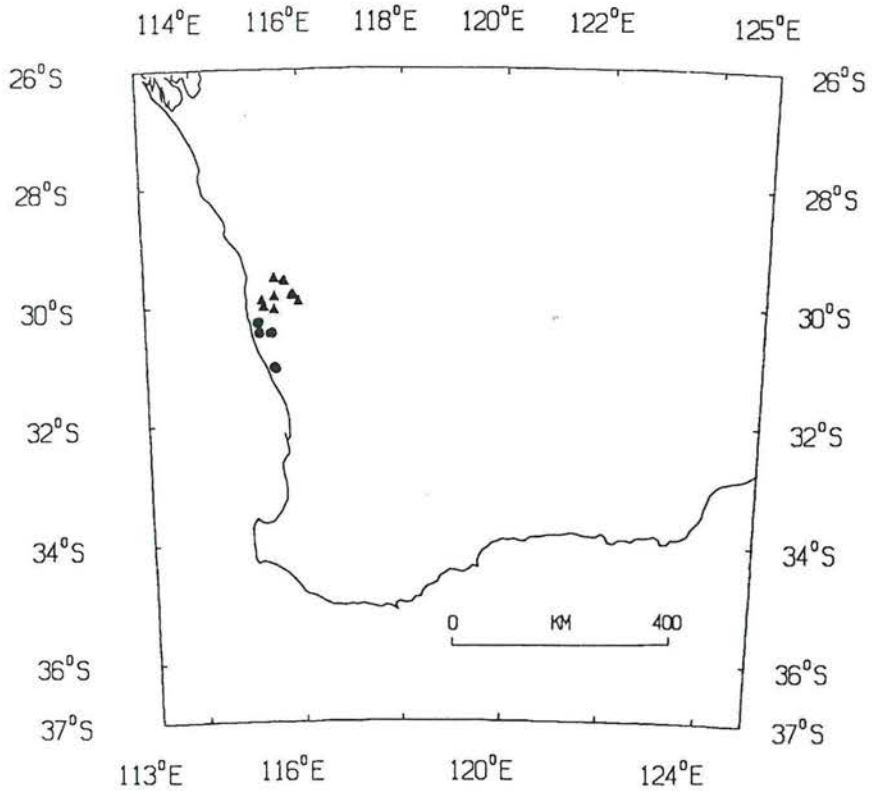

Figure 14. Distribution of *E. pauciflora* var. *lonchophylla* (▲) and *E. pauciflora* var. *calyptra* (●)

Notes. *E. pauciflora* var. *lonchophylla* differs from variety *pauciflora* in the broad thick leaves, the usual presence of 1-3 leaf veins. The variety *lonchophylla* co-occurs with *E. beaufortioides* var. *lachnosanthe*. Morphological intermediates between them can be found.

The major area of occurrence is on the lateritic upland which contains Tathra and Alexander Morrison National Parks. These populations have thick leaves with often obtuse apices. To the south, towards Badgingarra, populations with narrower, thinner, more pointed, and often more crowded leaves occur. To the west near Eneabba, a complex set of populations occurs, generally with narrower, thinner leaves. These variants are visually distinctive. More study of them is required.

Conservation status. I recommend that the conservation status of this variety should be Priority Two - Poorly Known Taxa. Its range is less than 100 km across and its field condition is poorly known. It is known from only scattered populations.

Etymology. The name comes from the Greek words *loncho* meaning spear or lance and *phylla* meaning leaf. It refers to the spearhead shaped leaves.

5c. Eremaea pauciflora (Endl.) Druce var. **calyptra** R.J. Hnatiuk var. nov. (Figure 12f)

Frutex sine lignotubero. Rami patentes ad erecti. Folia obovata ad linearia, angusta, obtusa, glabra vel indumento uni- vel bistrato, strato supero piloso, infero parce puberuloso, vena in pagina inferiore 0-1. Flores in ramis longis anni proximi terminales, 1 vel 2 per inflorescentia, non vel leviter et dulce odorati. Hypanthium campanulatum, longum, velutinum, indumento unistrato, interdum tantum ad basin. Stamina per fasciculo 17-32, in parte quarta inferiore connata, laevia, aurantia. Fructus doliiformis, turbinatus vel globosus, laevis, pallide brunneus ad cupreus, orificio 2-3 mm lato, labro undulato lobis parvis acutis, valvis profunde inclusis.

Typus: 8 km S of Jurien Road on Munbinea Road, 30°22' S lat., 115°13'E long, *R.J. Hnatiuk* 780180, iso: 780181, 780182, 780183, 780185. (holo: PERTH; photo: CBG).

Shrub, 150 cm tall; not lignotuberous. *Branches* spreading to erect. *Branchlet* glabrous, or indumentum two-layered, dense, pilose outer layer; inner dense, tomentose. *Over-wintering bracts* 12-24 per terminal bud; spathulate or ovate to obovate; 2-6.7 mm long, 1-4.7 mm wide; indumentum one-layered, tomentose and ciliate, on edges and all over back, or on upper (distal) back; striate. *Leaves* narrowly obovate to linear; obtuse; 2.9-7.9 mm long, 0.6-1.6 mm wide; 0-1 vein below; glabrous, or indumentum one- or two-layered, pilose upper layer, lower layer very sparse puberulous; dry leaf cross-section triangular, or flat, thick. *Petioles* 0.6-1.1 mm long. *Flowers* terminal on long branches of last season's wood; 1-2 per conflorescence; fragrance none to faintly sweet. *Hypanthium* campanulate; 2.9-5 mm long, 1.6-3.9 mm wide; indumentum one-layered, densely to thinly velutinous; near base only to all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes broadly triangular; 1.3-3 mm long, 1.5-2.5 mm wide; sparse; velutinous; apical portion caducous. *Petals* 2.5-5.7 mm long; glands abundant; thin-margin wide, weakly fringed. *Stamens* 17-32 per bundle; filaments fused in lower quarter; smooth; 4.5-8 mm long; orange; not swollen; claw 0.5-2 mm long, 1.4-2.8 mm wide. *Ovary* with 7-14 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 7-11 mm long; sparsely indumented on lower half. *Fruit* doliform, turbinate, or globose; 6-9.2 mm long; smooth; light brown to coppery brown; orifice 2-3 mm wide; rim undulate with small pointed lobes; valves deeply included, ornamented with none or 2 inconspicuous apical lobes. *Seed* 1-2 mm long; rough.

Selected specimens examined. WESTERN AUSTRALIA: Reserve on Hill River 10 km east of Jurien, *E.A. Griffin* 1796 (PERTH); c. 8 km E of Jurien Bay, *R.J. Hnatiuk* 780126 (PERTH); Orange Springs Rd, c. 6 km NE of Cowalla Rd, *R.J. Hnatiuk* 780159, 780160 (PERTH); 12 km S of Jurien Rd on Munbinea Rd, *R.J. Hnatiuk* 780173, 780174, 780176 (PERTH); 8 km S of Jurien Rd on Munbinea Rd, *R.J. Hnatiuk* 780180, 780181, 780182, 780183, 780184 (PERTH).

Distribution. Irwin District between Jurien and the Brand Highway (Figure 14).

Habitat. Lateritic uplands to coastal plains; associated vegetation kwongan: low closed heath, low woodland, or open low woodland; soil grey sand, or grey sand over light brown sand.

Flowering period. October.

Notes. E. pauciflora var. *calyptra* is distinguished from other varieties of *E. pauciflora* primarily by its stocky or robust branching, somewhat coarser leaves, the development of large, spathulate, clasping over-wintering bracts (perules) which conspicuously cover the hypanthium, and fruits with a conspicuously wide orifice and undulate rim.

Some of the key characters of the taxon appear to integrade with other taxa. Towards the south, the bracteose character is found on plants with linear leaves, gracile branches, and fruits with a narrow orifice and would otherwise fit well within var. *pauciflora*. Towards the northeast, near Eneabba, plants with fruits with wide orifices occur with leaves that resemble those of var. *lonchophylla*. These plants with some intermediate characters are for the time being placed in var. *pauciflora* and var. *lonchophylla* respectively.

Further detailed study may indicate that varietal recognition is not warranted or it may indicate that other varieties should also be segregated. The "*pauciflora*" complex is widespread, diverse and complex. The full details of its variation patterns have not been determined in this study.

Conservation status. I recommend that the conservation status of this variety should be Priority Two - Poorly Known Taxa. The variety occurs over a range of less than 100 km. It occurs in several small, but often dense populations. Its occurrence on reserves has not been determined.

Etymology. The name comes from the Greek word *kalyptra* meaning to cover or conceal in reference to the prominence of the large, clasping over-wintering bracts (perules) which conceal the hypanthium.

6. Eremaea blackwelliana R.J. Hnatiuk sp. nov. (Figure 15)

Frutex. Folia linearia, acuta, indumento unistrato, piloso; vena in pagina inferiore 1. Flores in ramulis brevibus lateralibus ramorum longorum anni proximi terminales, 1 per infloresentia. Hypanthium campanulatum, laevis, plerumque nitens, in dimidio infero dense villoso. Lobi calycis late triangulares, cuspidati, ad basin aliquantum auriculati, glabri, caduci. Stamina in parte quarta inferiore connata, papillosa, aurantiaca. Fructus cupulatus, elobatus, laevis, pallide brunneus ad cupreus, valvis vadose inclusis, ad apicem lobis 2 hemisphaericis laevis ornatis.

Typus: Darling District, 11.4 km from Toodyay along road to Clackline, 31°39'S, 116°28' E, 30 Oct. 1990, *R.W. Purdy* 3893 (holo: CBG; iso: PERTH).

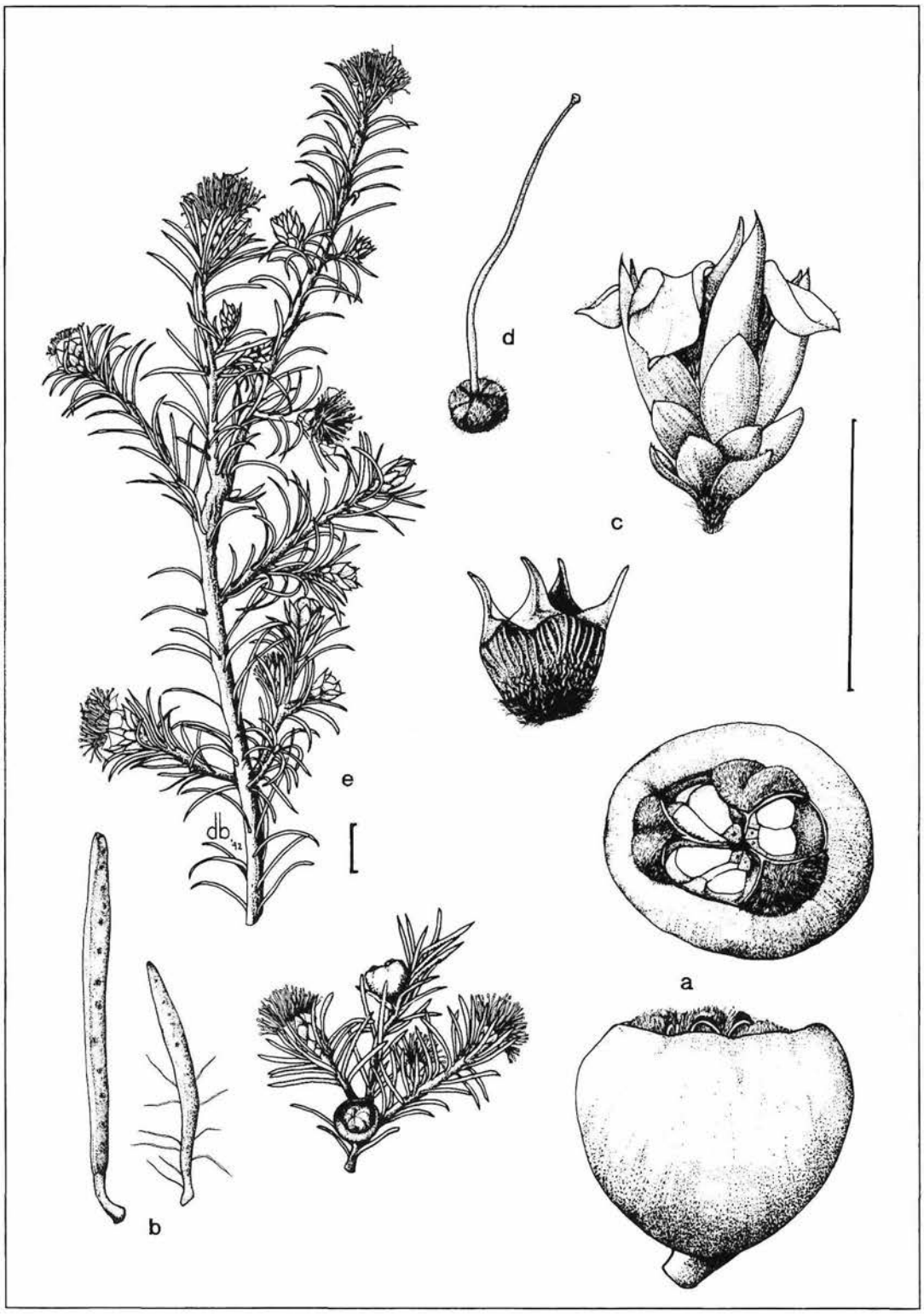

Figure 15. *E. blackwelliana*: **a**: fruits; **b**: leaves; **c**: hypanthium and calyx with and without perules; **d**: style and top of ovary; **e**: habit. Clackline, *D. Coates* CL1 23/10/86 (PERTH). Scale bars all 10 mm (left hand one refers to the two habit drawings (e) and the right one to the detailed drawings (a-d)).

Shrub, 300 cm tall. *Branches* ascending to spreading. *Branchlet indumentum* one-layered, dense, strigose, tomentose. *Over-wintering bracts* 25 per terminal bud, obovate, 8.2-9 mm long, 5.7-6.3 mm wide; indumentum one-layered, finely puberulous on edges; smooth to finely striate. *Leaves* linear, acute; 8.8-9.7 mm long, 0.6-0.9 mm wide; 1 vein below; indumentum one-layered, pilose; dry leaf cross-section triangular. *Petioles* 0.5-1.2 mm long. *Flowers* terminal on short laterals along long branches of last season's wood; 1 per inflorescence; fragrance not recorded. *Hypanthium* campanulate; 3.3-4.1 mm long, 4.4-5.4 mm wide; indumentum one-layered, densely villous, on lower half; smooth, usually shiny, but wrinkled longitudinally when dry. *Calyx* lobes cuspidate, broadly triangular, lower margins somewhat auriculate, 1.5-1.7 mm long, 1.5-1.7 mm wide; glabrous; caducous. *Petals* 2.8-3.4 mm long, 3.3-3.9 mm wide; glands abundant; thin-margin wide; entire. *Stamens* 20-26 per bundle in two rows on top of each claw; filaments fused in lower quarter; papillose; 7.3-8.9 mm long; orange; swollen distally; claw 1.8-2.2 mm long, 0.8-1 mm wide. *Ovary* with 16-17 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 7.7-8.5 mm long; glabrous. *Fruit* cupulate; 7.5-8.1 mm long; smooth; light brown to coppery brown; 5.5-6.2 mm wide; without lobes; valves shallowly included, 2 smooth hemispheric lobes at apex. *Seeds* 1.2-1.7 mm long; rough; shed freely when fruit is dry.

Selected specimens. WESTERN AUSTRALIA: Clackline Nature Reserve, *D.J. Coates* CL9 (PERTH).

Distribution. Avon District (Figure 16).

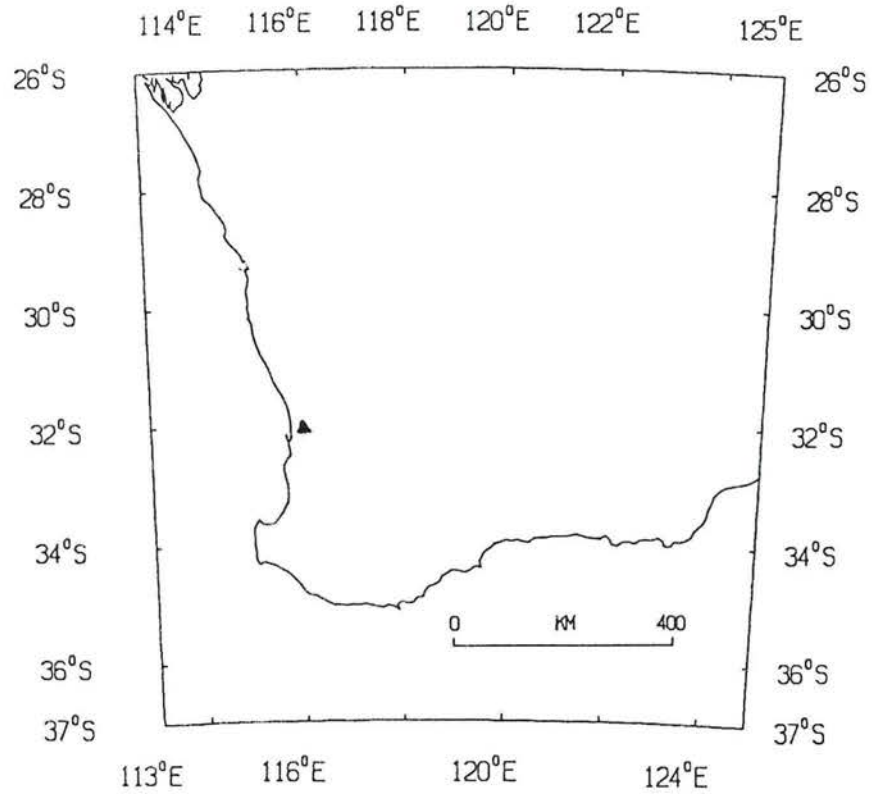

Figure 16. Distribution of *E. blackwelliana*.

Habitat. Broad uplands; associated vegetation open low Marri woodland; soil grey sand.

Flowering period. October to November.

Notes. E. blackwelliana is a member of section *Eremaea.* It is very localised on the western margin of the Avon District. It is distinguished by its glabrous hypanthium, valves only shallowly included, flowers on short shoots along long branches, and tall shrub habit.

Conservation status. I recommend that the conservation status of this species should be Priority Two - Poorly Known Taxa. Its range is less than 100 km across and is known from only two collections. Further field work is needed to assess its status.

Etymology. The name honours Marion Blackwell, keen observer of native plants in the bush and a landscape designer who for many years has promoted the aesthetic and practical use of Australian plants in landscaping.

7. Eremaea beaufortioides Benth. Fl. Austral. 3:182 (1867)

Typus: "W. Australia. Between Moore and Murchison Rivers, Drummond 6th coll. n.79" (holo: K).

Illustrations. Australian Plants 16 no. 125:40 (1990); C.A. Gardner, Wildflowers of Western Australia, 11 edn. (1973).

E. beaufortioides is part of section *Eremaea.*

Three varieties are recognised and can be separated as follows.

Key to varieties

1. Leaves thick, leaf veins 3 or fewer ..... 8c. var. *microphylla*
1. Leaves thin, leaf veins 3-5 or more 2
2. Leaves broadly elliptic, leaf veins 5 or more, hypanthium glabrous ... 7a. var. *beaufortioides*
2. Leaves narrowly elliptic, leaf veins 3, hypanthium densely pilose or villous ..... 7c. var. *lachnosanthe*

7a. Eremaea beaufortioides Benth. var. **beaufortioides** (Figure 17)

Illustrations. Australian Plants 16 no. 125:40 (1990); C.A. Gardner, Wildflowers of Western Australia, 11 edn. (1973).

Shrub, 2.2 m tall; not lignotuberous. *Branches* spreading. *Branchlet indumentum* two-layered;. with dense, pilose outer layer; inner dense, tomentose. *Over-wintering bracts* 18-38 per terminal bud; ovate to obovate; c. 3.2 mm long, c. 2.6 mm wide; indumentum one-layered, ciliate on edges; striate. *Leaves* broadly ovate to elliptic, acute or obtuse; 4.5-5.6 mm long, 2.5-3.3 mm wide; 3-7 veins below; glabrous or pilose on margins; dry leaf cross-section flat, thin. *Petioles* 0.5-0.7 mm long. *Flowers*

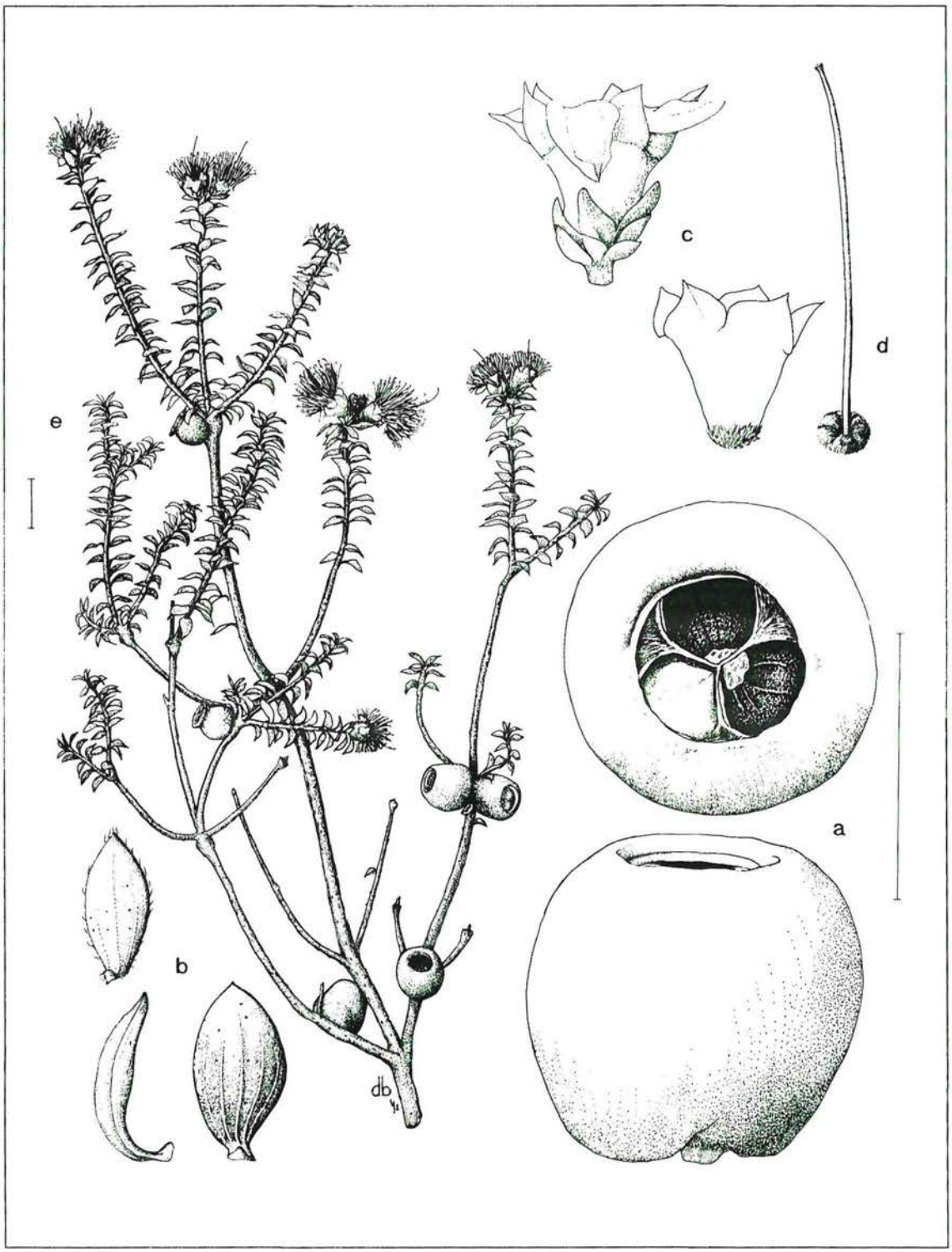

Figure 17. *E. beaufortioides* var. *beaufortioides*: **a**: fruits: slightly oblique and top views; **b**: leaves, side and ventral views; **c**: hypanthium, upper drawing with perules and petals, lower drawing with perules and petals removed; **d**: style; **e**: habit. 5 km west of Lake Indoon, *E.A. Griffin* 1278 (PERTH). All scale bars 10 mm (left one refers to habit (e); right one refers to details (a-d).

terminal on long branches of last season's wood; 1-6 per conflorescence; fragrance sweet. *Hypanthium* long; campanulate; 4.5-7 mm long, 3.6-5.2 mm wide; glabrous or rarely indumentum one-layered sparse tomentose near base only; smooth, usually shiny, but wrinkled longitudinally when dry. *Calyx* lobes broadly triangular, or cuspidate (very variable); 2.3 mm long, 3 mm wide; glabrous to ciliate; caducous, or rarely persistent in some populations near Eneabba. *Petals* 3.7 mm long; glands abundant; thin-margin wide; weakly fringed. *Stamens* c. 34 per bundle; filaments fused in lower quarter, bundles frequently fused into a ring; smooth; 7.5 mm long; orange; not swollen, or swollen distally (not consistent within flowers); claws c. 1 mm long, c. 2.6 mm wide. *Ovary* with c. 15 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* c.10.8 mm long; glabrous. *Fruit* doliform; 8-11 mm long, 3-6 mm wide; smooth; light brown to coppery brown; without lobes, or slightly undulate, rarely with prominent points; valves deeply included; with 2 small inconspicuous apical lobes. *Seeds* 2.1 mm long; smooth to slightly rough; shed freely when fruit is dry.

Selected specimens examined . WESTERN AUSTRALIA: c. 12 km south of Eneabba, *C. Chapman*, 27 Nov. 1977 (PERTH); 5 km west of Lake Indoon, *E.A. Griffin* 1278 (PERTH); 20 mi [32 km] S of Casuarinas, *R.J. Hnatiuk* 760290 (PERTH); 8 km S of Jurien rd on Munbinea rd, *R.J. Hnatiuk* 780187 (PERTH); west of Dandaragan, *K. Richards* (PERTH); cultivated at Kings Park, voucher for chromosome count, *B.L. Rye* 76019 (PERTH).

Distribution. Irwin District (Figure 18).

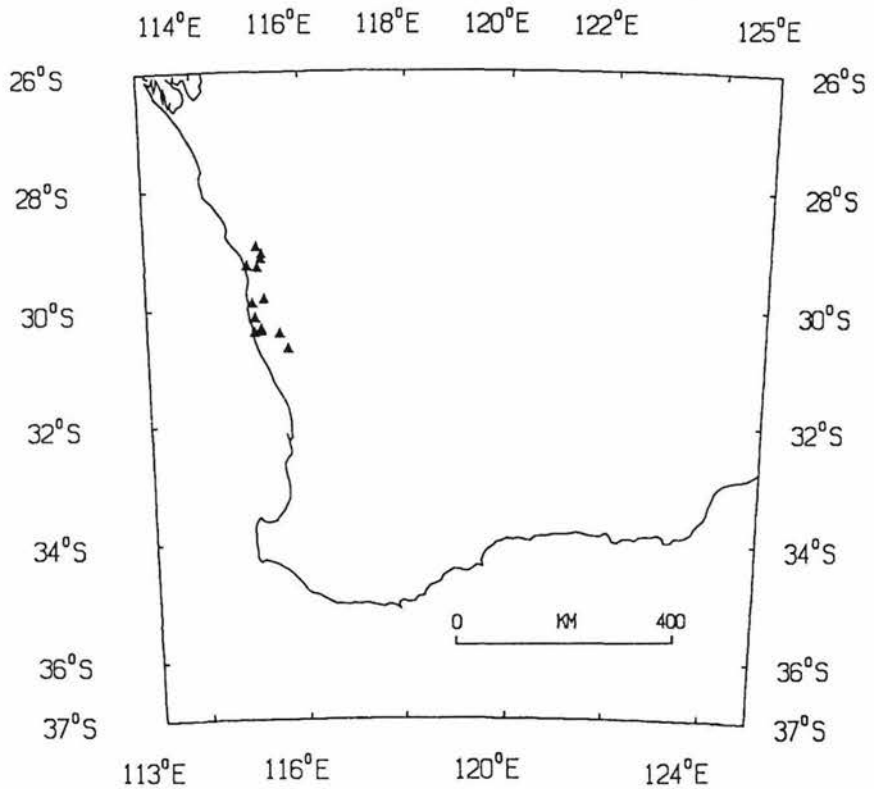

Figure 18. Distribution of *E. beaufortioides* var. *beaufortioides*.

Habitat. Lateritic uplands to coastal plains, and broad uplands (in NE part of range); associated vegetation open heath, closed heath, low open heath, or open low woodland; soil deep light brown sand, grey sand, grey sand over laterite, grey sand over orange sand and massive limestone, or limestone derived soil.

Flowering period. September to December.

Notes. E. beaufortioides is part of section *Eremaea.* It is distinguished by its strongly reflexed, multi-veined leaves, its virtually glabrous hypanthium that is frequently very glossy and usually only about half or less is covered by the over-wintering bracts. Its large, conspicuous, bright orange flowers make it very attractive to horticulture.

Etymology. The name alludes to a similarity with the genus *Beaufortia.* G. Bentham, the author of the name, did not specify the similarity he saw.

7b. Eremaea beaufortioides Benth. var. **microphylla** R.J. Hnatiuk var. nov. (Figure 19)

Frutex sine lignotubero. Rami patentes ad erecti. Folia elliptica, obtusa, glabra; vena in pagina abaxiali (0)-3 vel raro 5 sed interdum obscura. Flores in ramis longis anni proximi terminales, 1 vel 2 per inflorescentia. Hypanthium campanulatum, longum, glabra, laevia, plerumque nitentia sed in sicco longitudinaliter rugosa. Stamina per fasciculo 38-48, in parte quarta inferiore connata, et fasciculis in annulo connatis, aurantiis. Fructus doliiformis ad turbinatus, laevis, labro elobato, pallide brunneus ad cupreus (vel rufo-brunneus), valvis profunde inclusis.

Typus: 18 km S of Eneabba on Brand Hwy, 29°56'S lat., 115°16'E long., 18 Oct. 1978, *R.J. Hnatiuk* 780234 (holo: PERTH; photo: CBG).

Shrub, 200 cm tall; not lignotuberous. *Branches* spreading to erect. *Branchlets* glabrous, occasionally sparsely villous or tomentose. *Over-wintering bracts* 17-23 per terminal bud; ovate to obovate; 3.5-5.5 mm long 2.7-3.2 mm wide; indumentum one-layered ciliate at tip and on edges; striate. *Leaves* elliptic obtuse; 2.9-4.3 mm long, 1.4-2.2 mm wide; 0-3 or rarely 5 veins below which may be difficult to see; glabrous; dry leaf cross-section flat, thick. *Petioles* 0.5-0.9 mm long. *Flowers* terminal on long branches of last season's wood; 1-2 per inflorescence; fragrance not recorded. *Hypanthium* long; campanulate; 4.5-6 mm long, 3.6-4.2 mm wide; glabrous; smooth, usually shiny, but wrinkled longitudinally when dry. *Calyx* lobes cuspidate; 5.3-6 mm long, 1.8-2.8 mm wide; sparse; caducous. *Petals* 4.8-5.7 mm long; glands abundant; thin-margin narrow at apex, wide at sides, weakly fringed. *Stamens* 38-48 per bundle; filaments fused in lower quarter, bundles of fused filaments, themselves fused near the base into a ring; smooth; 7.5-9.5 mm long; orange; swollen distally; claw 0.5-1 mm long; 2.2-3.2 mm wide. *Ovary* with 14-18 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 12.5-13.5 mm long; glabrous. *Fruit* doliform to turbinate; 8-11 mm long; smooth; light brown to coppery brown (to reddish brown); 2.8-6.1 mm wide; without lobes; valves deeply included, with two inconspicuous small apical lobes. *Seeds* 1.9-2 mm long; rough; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 15 km SE of Eneabba, *R.J. Cranfield*, 20 Oct. 1979 (PERTH); Alexander Morrison National Park, Coorow-Greenhead Rd, *E.A. Griffin* 1560 (PERTH); 12 km N of Eneabba, *R.J. Hnatiuk* 760254 (PERTH); 18 km S of Eneabba on Brand Hwy, *R.J.Hnatiuk* 780231 (PERTH).

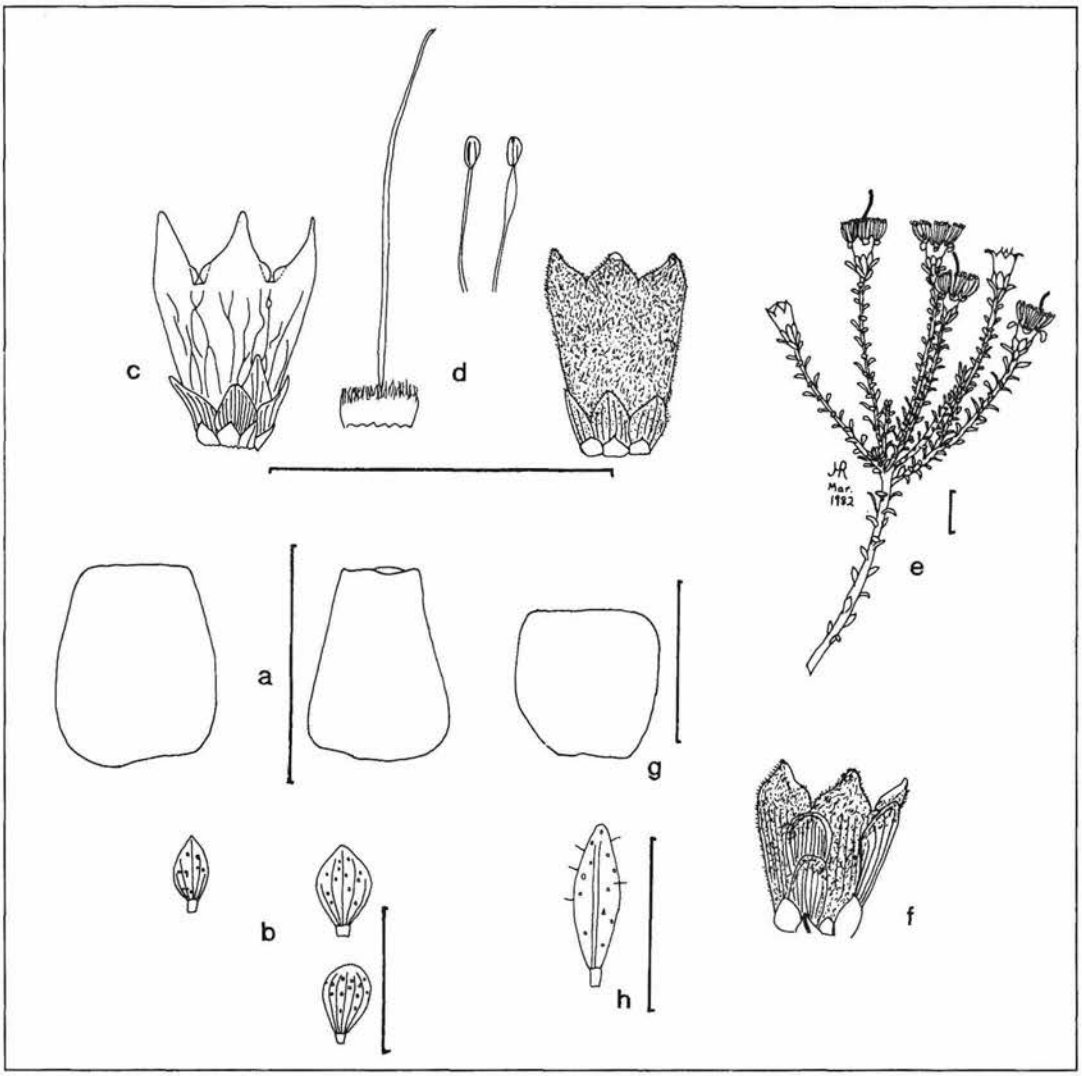

Figure 19. *E. beaufortioides* var. *microphylla*: **a**: fruits; **b**: leaves (scale bar 5 mm); **c**: hypanthium, calyx and perules; **d**: style and top of ovary, stamens; **e**: habit. 26 km SW of Three Springs, *R.J. Hnatiuk* 810017 (PERTH). *E. pauciflora* var. *lonchophylla*: **f**: hypanthium, calyx and perules; **g**: fruit; **h**: leaf (scale bar 5 mm). 23 km S of Eneabba [survey specimen # 73], *R.J. Hnatiuk* 780238 (PERTH). Scale bars, not otherwise indicated, 10 mm.

Distribution. Irwin District (Figure 20).

Habitat. Broad uplands, or from lateritic uplands to coastal plains; associated vegetation kwongan: low open heath, or low closed heath; soil deep grey sand, or lateritic gravel and sand.

Flowering period. October to November.

Notes. E. beaufortioides var. *microphylla* is sympatric with the southern part of the range of var. *beaufortioides*. From var. *beaufortioides* it is distinguished by its small, thick leaves that generally have only 3 veins, are less pointed and less reflexed. The leaves are frequently so thick that the veins are difficult to see.

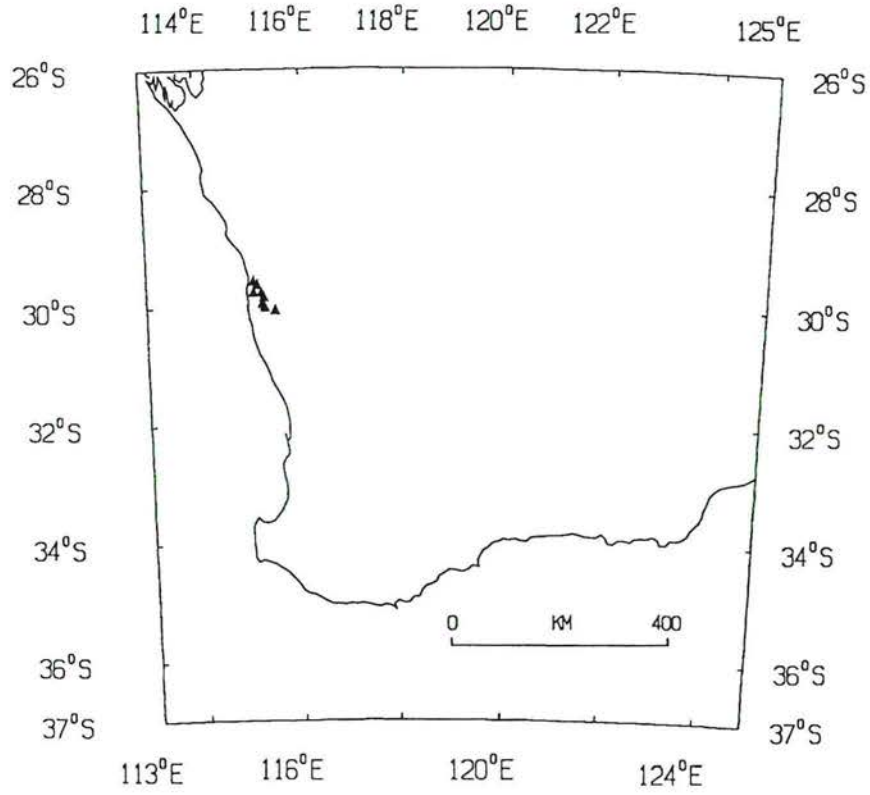

Figure 20. Distribution of *E. beaufortioides* var. *beaufortioides*.

Conservation status. I recommend that the conservation status of this variety should be Priority Two - Poorly Known Taxa. Its range extends less than 100 km. Further field work is needed to properly assess its status.

Etymology. The varietal name comes from the Greek words *mikros,* small and *phylla,* leaf in reference to the smaller leaves in comparison with the type variety.

7c. Eremaea beaufortioides var. **lachnosanthe** R.J. Hnatiuk

Frutex sine lignotubero. Folia elliptica, lata vel angusta, acuta vel obtusa, fimbriata; vena in pagina inferiore 3 vel 5. Flores in ramis longis anni proximi terminales, 1-5 per inflorescentia. Hypanthium campanulatum, longum, indumento bistrato, strato supero denso, velutino, infero denso, puberulo, dimidio supero raro glabro. Lobi calycis late triangulares, dense puberuli ad velutini vel glabri, caduci. Stamina in parte quarto inferiore connata, aurantia. Fructus urceolatus ad doliiformis, pallide brunneus ad cupreus vel cano-brunneus, elobatus vel labro undulato, valvis profunde inclusis.

Typus: On roadside, Brand Hwy just south of Lake Indoon Rd, *R.J. Hnatiuk* 800208 (holo: PERTH; iso: CBG).

Shrub, 150 cm high; not lignotuberous. *Branches* spreading to erect. *Branchlet indumentum* two-layered, with dense, pilose outer layer, inner dense pubescent *Over-wintering bracts* 16-26 per terminal bud; elliptic to obovate; 2.4-5.3 mm long, 1.8-3.9 mm wide; indumentum one-layered, or rarely glabrous, ciliate and finely puberulous; on edges and all over back; striate. *Leaves* broadly elliptic, obtuse; 4-5.2 mm long, 2.4-4.2 mm wide; 5, rarely 3, veins below; indumentum fimbriate, occasionally two-layered with upper sparse pilose and ciliate and lower tomentose, glabrescent; dry leaf cross-section flat, thin. *Petioles* 0.4-1.2 mm long. *Flowers* terminal on long branches of last season's wood; 1-5 per conflorescence; fragrance not recorded. *Hypanthium* long campanulate; 5.4-7.2 mm long, 3.9-6.6 mm wide; indumentum two-layered, upper layer dense, velutinous; lower layer dense puberulous; all over, or rarely on lower half only; outer surface uneven, dull, finely mammillate. *Calyx* lobes broadly triangular; 2 mm long, 3 mm wide; indumentum dense, puberulous to velutinous, or glabrous; caducous. *Petals* 3.5 mm long; glands abundant; thin-margin wide, weakly fringed. *Stamens* c. 43 per bundle; filaments fused in lower quarter; smooth; 5.5 mm long; orange; swollen distally; claw 2.5 mm long, 2.5 mm wide. *Ovary* with 13-15 ovules per loculus; valves densely short-pubescent without sparse long hairs; style 11.9 mm long; glabrous. *Fruit* urceolate to doliform; 9.7 mm long; smooth; light brown to coppery brown, or grey brown; 3.5-5.2 mm wide; without lobes, or undulate (rarely strongly); valves deeply included, ornamented with 2 smooth inconspicuous lobes at apex. *Seeds* surface rough; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 20 km E of Jurien Bay along Jurien Road, *R.J. Cranfield* 1206 (PERTH); 22 km S of Junction Brand Hwy & Jurien Bay Rd, *R.J. Hnatiuk* 761372 (PERTH); 15 km S of Eneabba, along Brand Hwy, *R.J. Hnatiuk* 761447 (PERTH); near Morawa, *A. Kiesey*, Nov. 1936 (PERTH); 3 mi [4.8 km] south of Diamond Springs, *K. Newbey* 2350 (PERTH); Jurien-Greenhead Rd, 19 km east of Green Head, *A.E. Orchard* 4228 (AD, PERTH); McQueen's Caravan Park, Arrowsmith River, *E. & S. Pignatti* 584 (PERTH).

Distribution. Irwin District (Figure 21).

Habitat. Broad uplands, associated vegetation kwongan: low closed heath, or high shrubland (of *E. todtiana* with dense understorey); soil deep light brown sand, brown coarse sand, or white sand over nodular sandstone.

Flowering period. September to November.

Notes. E. beaufortioides var. *lachnosanthe* is distinguished from var. *beaufortioides* primarily by its indumented hypanthium, but also by its narrowly elliptic rather than broadly elliptic leaves with fewer veins on the undersurface. It is also closely related to *E. pauciflora* and specimens with intermediate morphology can be found. More detailed studies of its status are needed.

Conservation status. I recommend that the conservation status of this variety should be Priority Two - Poorly Known Taxa. Its range is less than 100 km. It is known only from several scattered populations, mostly on road verges. Further field assessment is needed.

Etymology. The name comes from the Greek words *lachnos*, woolly and *anthos*, flower and refers to the conspicuously indumented hypanthium.

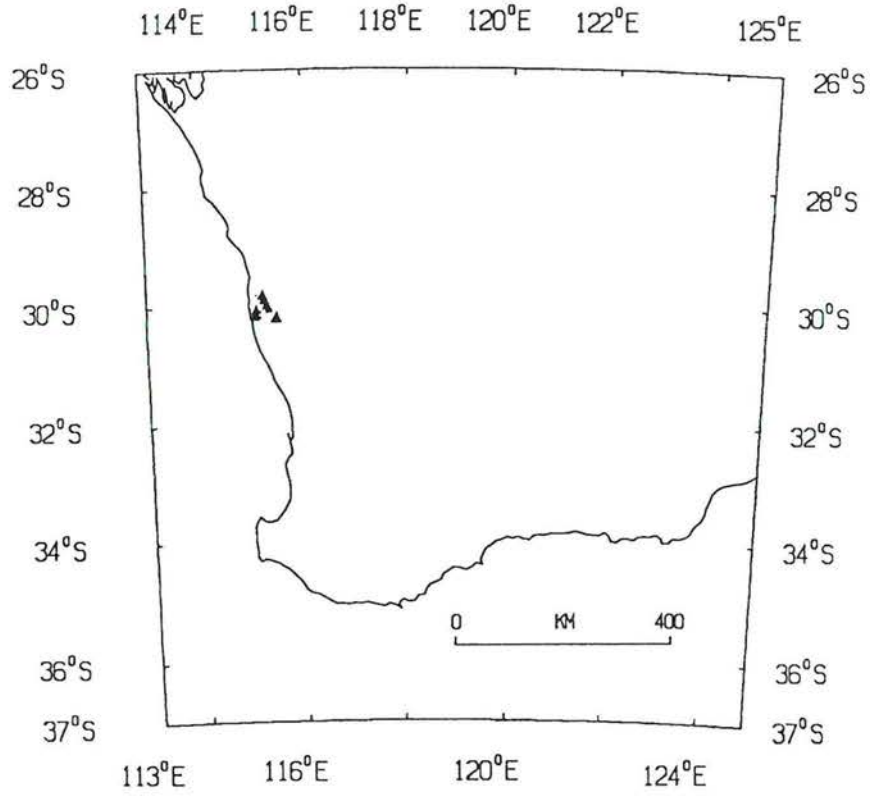

Figure 21. Distribution of *E. beaufortioides* var. *lachnosanthe*.

8. Eremaea ebracteata F. Muell. Fragm. 2:29 (1860)

Typus: "Ad fluvium Murchison. A. Oldfield" (holo: MEL; iso: K; photos: CBG, PERTH).

Shrub; leaves linear or elliptic; flowers produced on new wood thus surrounding perules absent and only 3 small caducous bracts evident; stamens orange; fruits frequently with corky outgrowths.

A species with two varieties.

Key to varieties

1. Leaves linear ..... 8a. var. *ebracteata*
1. Leaves elliptic or obovate ..... 8b. var. *brachyphylla*

8a. Eremaea ebracteata F. Muell. var. **ebracteata** Fragm. 2:29 (1860). (Figure 22a-f)

Shrub, 100 cm tall. *Branches* spreading to erect. *Branchlet indumentum* two-layered; with dense, pilose outer layer; inner dense tomentose. *Over-wintering bracts* 3 per terminal bud, very small and falling early; ovate; 1-2.7 mm long, 0.8-2.2 mm wide; indumentum one-layered, ciliate; smooth. *Leaves* linear to oblong, obtuse; 4.5-8.2 mm long, 0.5-1 mm wide; 1 vein below; indumentum one-layered becoming glabrous, outer layer pilose; dry leaf cross-section triangular. *Petioles* 0.2-0.9 mm long. *Flowers* terminal on long branches of current season's wood; 1-3 per inflorescence; fragrance sweet. *Hypanthium* long campanulate; 3.5-4 mm long 3.5-4.1 mm wide; indumentum one- or two-layered, upper layer dense velutinous, lower layer dense puberulous; all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes semicircular, broadly triangular, slightly cuspidate and auriculate with adjacent lobes overlapping; 2 mm long 2.5-3.5 mm wide; indumentum dense pubescent (continuation of underlayer of hypanthium), ciliate, and puberulous; apical portion caducous. *Petals* 6.5-6.7 mm long; glands abundant; thin-margin narrow; weakly fringed. *Stamens* c. 60 per bundle; filaments fused in lower quarter to half; smooth; 10-11.6 mm long; orange; not swollen; claw 2-3.5 mm long, 2.8-3 mm wide. *Ovary* with 7-9 ovules per loculus; valves densely short-pubescent with sparse long hairs. *Style* 14-15.5 mm long; glabrous. *Fruit* campanulate to globose; rough, lumpy or mammillate especially in lower parts, or corky often with very conspicuous protrusions; light brown to coppery brown; 5.8-9.5 mm wide, 5.8-7.9 mm long; strongly undulate rim; valves reaching rim of fruit, or occasionally exserted and backed by lower part of calyx lobes, ornamentation of 2 small finely warty lobes at apex. *Seeds* 1.7-2.1 mm long; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 2.5 mls [4 km] on road to Loop, Kalbarri National Park, *K.M. Allan* 204 (PERTH); Murchison House Station, *J.S. Beard* 6883 (PERTH); East Yuna Flora Reserve, NE of Geraldton, *A.C. Burns* 127 (PERTH); 26 mi [41.6 km] S of Red Bluff, Ogilvie West Rd, *D. Butcher* 1183 (MEL, PERTH); 410 mile peg, Carnarvon Rd, *H. Demarz* D5537 (PERTH); Western Australia, *J. Drummond* 78 (6th collection), 1854 (MEL, NSW); Northampton, *Jean Galbraith* 541 (MEL).

Distribution. Northern Irwin District (Figure 23).

Habitat. Open heath, low open heath, low woodland, or open low woodland; soil yellow sand, or light brown sandy loam.

Flowering period. November to December.

Notes. E. ebracteata var. *ebracteata* is a member of section *Ebracteata*. From the other species in the group, *E. dendroidea*, it can be distinguished by its linear leaves, exserted fruit valves, and its fruits tending to become very corky with age. It is not a rare species and is well represented within Kalbarri National Park.

Conservation status. This variety is rated as not threatened. It is fairly widespread and well represented in Kalbarri National Park. The status of outlying populations at the extremes of its range is not known.

Etymology. The name comes from the Latin prefix *"e-"* meaning without or lacking and *bracteate* having bracts, thus referring the contrast of this species with most others where the flowers are

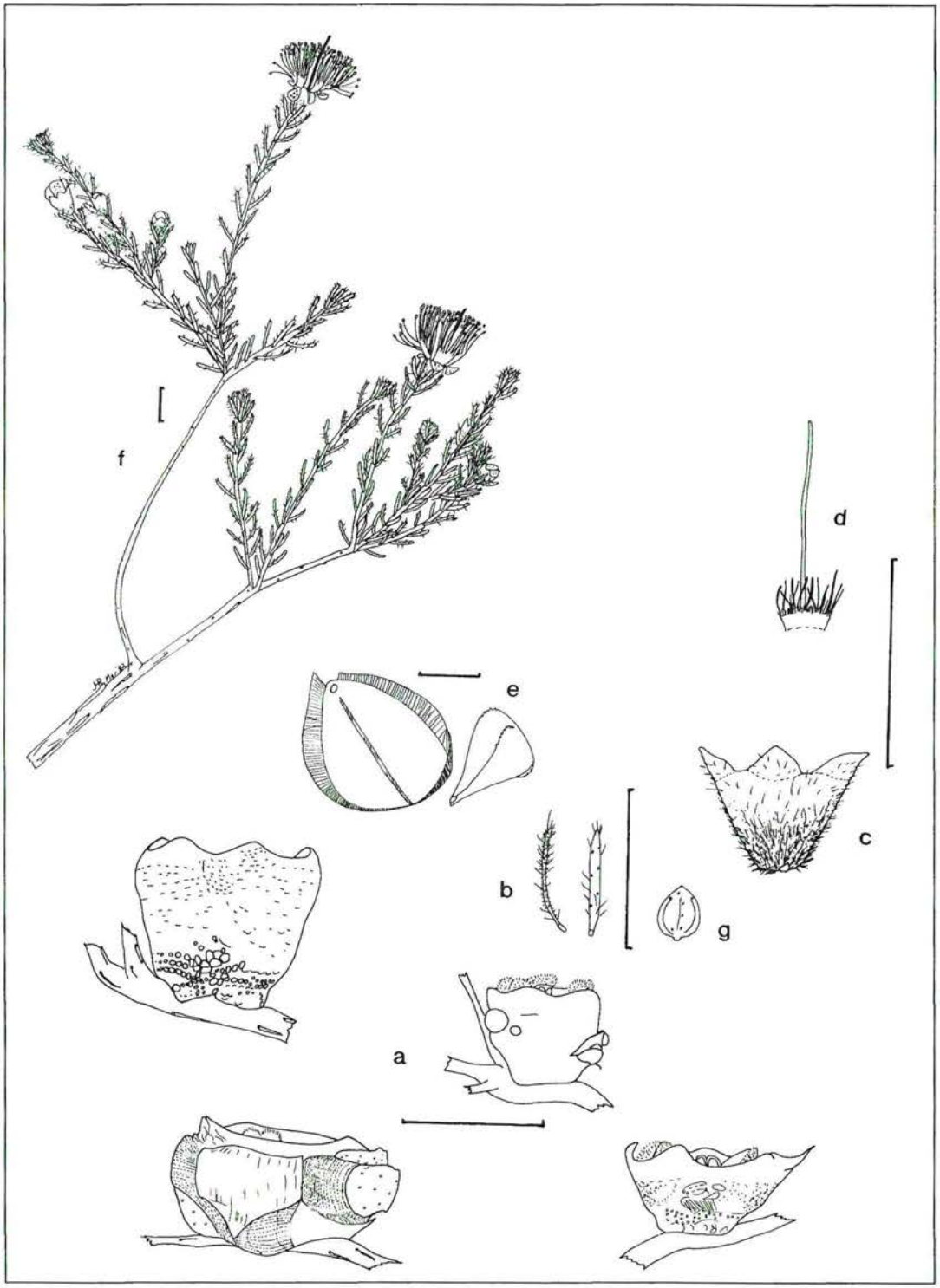

Figure 22. *E. ebracteata* var. *ebracteata*: **a**: fruits; **b**: leaves; **c**: hypanthium and calyx; **d**: style and top of ovary; **e**: seed and chaff (ovulode); **f**: habit. Kalbarri Rd, 21 km W of NW Coastal Hwy, *R.J. Hnatiuk* 780362 (PERTH). *E. ebracteata* var. *brachyphylla*: **g**: leaf. Balla Wheat Bin, N of Yuna, *R.J. Hnatiuk* 780388 (survey specimen # 82) (PERTH). Scale bars 10 mm.

surrounded by numerous over-wintering bracts (perules). The flowers do have 3 small bracts, but these fall very soon, thus are not often noticed.

8b. Eremaea ebracteata F. Muell. var. **brachyphylla** R.J. Hnatiuk var. nov. (Figure 22g)

Frutex. Rami patentes. Folia elliptica, lata, obtusa, glabra vel pilosa indumento unistrato; vena in pagina inferiore 1, raro 3. Flores in ramis longis anni huius terminales, 1 vel raro 2 per inflorescentia. Hypanthium campanulatum, longum, indumento unistrato velutinum, vel raro etiam strato altero infero sparso. Stamina per fasciculo 43-50, in parte quarto inferiore connata, aurantia. Fructus campanulatus ad globosus, rugosus, irregulariter pustulatus, vel mammillatus praecipue ad basin, vel suberosus, pallide brunneus ad cupreus, labro undulato, valvis labro aequantibus vel exsertis lobis 2 terminalibus parvis subtiliter rugosis ornatis.

Typus: Near The Casuarinas, on roadside, *R.J. Hnatiuk* 810022; iso: 810021, 810019 (holo: PERTH; photo: CBG).

Shrub, 50 cm tall. *Branches* spreading. *Branchlet indumentum* one- or rarely two-layered, with dense pilose outer layer of often curved or contorted hairs; inner sparse, tomentose. *Over-wintering bracts* 2-4 per terminal bud, very small and falling early; oblong to ovate; 1.4-2.3 mm long, 0.8-1.4 mm wide; indumentum one-layered; ciliate; smooth. *Leaves* broadly elliptic or obovate, cymbiform when dry, obtuse; 2.5-3.1 mm long, 1.3-1.7 mm wide; 1 or rarely 3 veins below; glabrous, or indumentum one-layered, pilose; dry leaf cross-section flat, thick. *Petioles* 0.2-0.4 mm long. *Flowers* terminal on long branches of current season's wood; 1 or rarely 2 per inflorescence; fragrance not recorded. *Hypanthium* long, campanulate; 3.4-4 mm long, 3.1-3.9 mm wide; indumentum one-layered, rarely with sparse underlayer, upper layer dense, velutinous, lower layer tomentose; all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes broadly triangular, and slightly cuspidate; 1.1-2.1 mm long, 2-2.8 mm wide; indumentum glabrous or sparse to dense, pubescent, ciliate; apical portion caducous. *Petals* 5.4 mm long; glands abundant; thin-margin narrow at apex to wide at sides, weakly fringed. *Stamens* c. 40-45 per bundle; filaments fused in lower quarter; smooth; 7 mm long; orange; not swollen; claw 2.3 mm long 2.2 mm wide. *Ovary* with 7-9 ovules per loculus; valves densely short-pubescent with sparse long hairs; style 10.5 mm long; glabrous. *Fruit* campanulate to globose, shape variable depending on degree of development of corky tissue; 7.3-8.4 mm long, 5.7-7.5 mm wide; rough, lumpy or mammillate especially in lower parts, or corky; light brown to coppery brown; rim undulate; valves reaching rim of fruit, or exserted and backed by lower part of lobes, ornamentation 2 small finely warty lobes at apex. *Seeds* 1.9-2.1 mm long; smooth; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: On Eneabba-Mingenew Rd just round corner S of Arrino West Rd, Three Springs Shire, *J. Coleby-Williams* 267 (PERTH); Valentine Rd, 19.2 km S of junction with Nabawa Rd (SE of Yuna), *R.J. Hnatiuk* 780389 (PERTH); 2.2 km S of Casuarina, *R.J. Hnatiuk* 780390 (PERTH); 32.9 km S of Casuarina *R.J. Hnatiuk* 780391 (PERTH).

Distribution. Irwin District (Figure 23).

Habitat. Low woodland with dense shrub understorey; soil deep light brown sandy loam.

Flowering period. November to December.

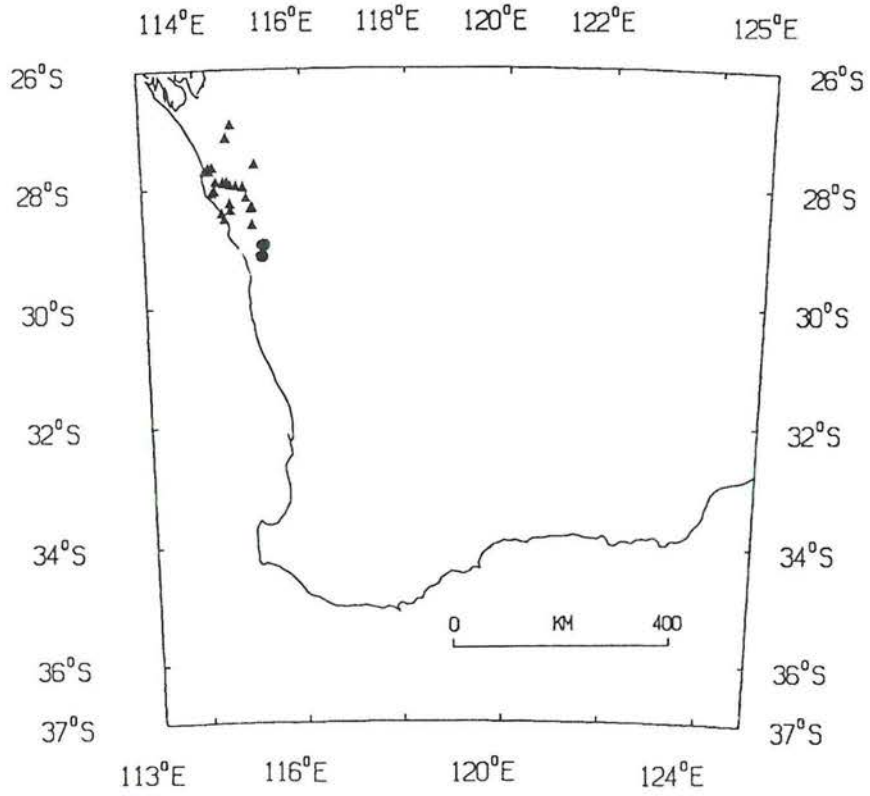

Figure 23. Distribution of *E. ebracteata* var. *ebracteata* (▲) and *E. ebracteata* var. *brachyphylla* (●)

Notes. *E. ebracteata* var. *brachyphylla* is closely related to *E. ebracteata* var. *ebracteata* from which it differs in the small elliptic leaves. Most populations of var. *brachyphylla* have branchlets with only one layer of indumentum, but some with a sparse underlayer occur. It is known from only a few populations, all of which are to the south east of the known range of var. *ebracteata*.

Conservation status. I recommend that the conservation status of this variety should be Priority One - Poorly Known Taxa. It has a range of less than 100 km across. It has only been collected on roadsides in areas extensively cleared for agriculture. Its status needs urgent confirmation from field study.

Etymology. The variety name is derived from the Greek words *brachys*, short and *phylla*, leaf in reference to the shortness of the leaves in contrast to those of subsp. *ebracteata*.

9. Eremaea dendroidea R.J. Hnatiuk sp. nov. (Figure 24)

Arbor parva sine lignotubero. Rami ascendentes ad erecti, deinde patentes. Folia oblonga, ovata vel elliptica, angusta, obtusa, glabra; vena in pagina abaxiali 0 vel 1. Flores in ramis anni proximi vel huius terminales, 1 vel 2 per infloresentia. Hypanthium campanulatum, vadosum, dense ad sparse tomentosum indumento unistrato ad labrum sparso. Lobi calycis semiorbiculati, ciliati, indumento

sparso, caduci. Stamina per fasciculo 46-49, in parte quarto inferiore connata, laevia, aurantia. Fructus cupulatus, labro elobato, laevis, cano-brunneus, sine lobis, valvis labrum aequantibus.

Typus: "Cooloomia Nature Reserve c. 13 km W of Cooloomia homestead" *S.D. Hopper* 1348, 18 Sept. 1979. (holo: PERTH; photo: CBG).

Small *tree*, 350 cm tall; not lignotuberous. Branches ascending to erect, then spreading. *Branchlet indumentum* two-layered with dense, pilose outer layer; inner dense tomentose. *Over-wintering bracts* 4-25 per terminal bud; ovate; 1.1-2.5 mm long, 0.7-1.8 mm wide; indumentum one-layered, ciliate; smooth. *Leaves* narrowly oblong, narrowly ovate to narrowly elliptic; obtuse; 2.8-5.2 mm long, 0.7-2.2 mm wide; 0-1 vein below; glabrous; dry leaf cross-section flat, thick. *Petioles* 0.3-0.7 mm long. *Flowers* terminal on long branches of last season's or current season's wood; 1-2 per conflorescence; fragrance not recorded. *Hypanthium* shallow, campanulate; 3-3.2 mm long; indumentum one-layered, dense to sparse, tomentose all over, becoming sparse near rim; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes semicircular to very broadly triangular; 0.4-1.5 mm long, 1.8-3.5 mm wide; indumentum sparse, ciliate; caducous. *Petals* 3-4.4 mm long; 4-4.5 mm wide; glands abundant; thin-margin narrow at apex to wide at sides, very weakly fringed. *Stamens* 46-49 per bundle; filaments fused in lower quarter to half; smooth; 4.5-7 mm long; orange; not swollen; claw 2-2.2 mm long, 1.8-2.2 mm wide. *Ovary* with 10-14 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 9 mm long, glabrous. *Fruit* cupulate, 5-8.6 mm long; smooth; grey brown; 4.2-4.9 mm wide; without lobes; valves reaching rim of fruit; tips of valves with 2 lobes. Seed 1.3-1.7 mm long; rough; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 413 mile peg [661 km], North-West Coastal Hwy, *A.M. Ashby* 4855 (AD); No. 8 Tank, Carnarvon Rd, *C.A. Gardner* 12292 (PERTH); 5.2 km east of Ajana on NW Coastal Hwy, *R.J. Hnatiuk* 780382 (PERTH); Cooloomia Nature Reserve, c. 17 km WSW of Cooloomia Hmstd, *S.D. Hopper* 1379 (PERTH); c. 20 km SW Hamelin Pool Homestead, c. 5 km W of crossing to Tamala, *J.Z. Weber* 5045 (AD).

Distribution. Northern Irwin District (Figure 25).

Habitat. Lateritic uplands to coastal plains; associated vegetation low woodland; soil deep yellow sand.

Flowering period. September.

Notes. E. dendroidea is the most northern *Eremaea* and is a member of section *Ebracteata.* It is distinguished by its small tree habit, its leaves which are thick, the tendency to flower on both old and new wood, and the location of the fruit valves at the rim of the fruit when dried. The shape of the fruit is also characteristic. The closest relatives appear from isozyme analyses to be *E. ebracteata* (Coates and Hnatiuk 1990). The isozyme study suggested that it might have its origins in ancient hybridisation between *E. pauciflora* and *E. ebracteata.*

Conservation status. I recommend that the conservation status of this species should be Priority Three - Poorly Known Taxa. Its geographic range is greater than 100 km across, but its degree of protection is not known.

Etymology. The name is derived from the Greek word *dendroid,* tree-like in reference to the growth form which contrasts with most other species.

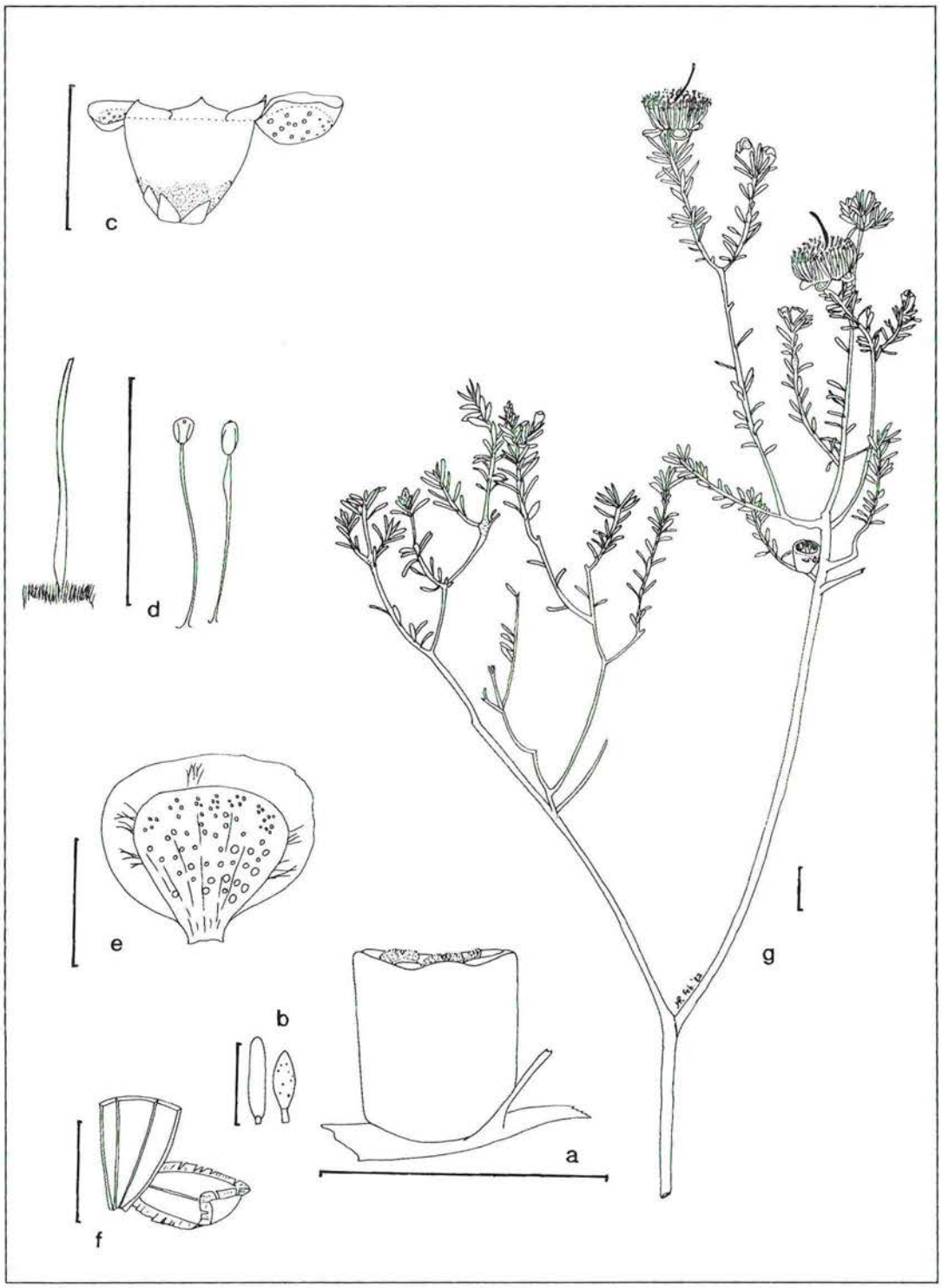

Figure 24. *E. dendroidea*: **a**: fruit; **b**: leaves (scale bar 5 mm); **c**: hypanthium, calyx and perules; **d**: style, top of ovary and stamens; **e**: petal (scale bar 2.5 mm); **f**: seed and chaff (ovulodes); **g**: habit. 5.2 km E of Ajana, *R.J. Hnatiuk* 780382 (PERTH). Scale bar, not otherwise marked, 10 mm.

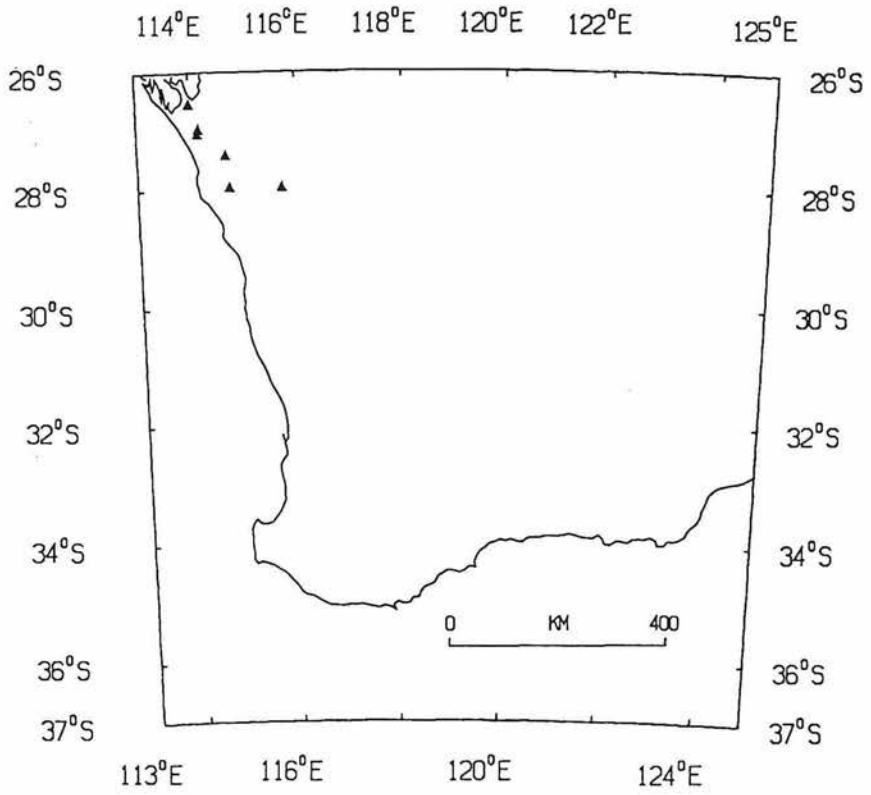

Figure 25. Distribution of *E. dendroidea.*

10. Eremaea purpurea C. Gardner, Journ. Roy. Soc. W. Austral. 47: 61 (1964). (Figure 26)

Typus. "Hab. in distr. Darling prope Culalla, in arenosis humidis, fl. m Decem." *C.A. Gardner s.n.* (holo: PERTH).

Shrub, 110 cm tall; not lignotuberous. *Branches* ascending to erect. *Branchlet indumentum* two-layered, dense, pilose outer layer (hairs bent and contorted); inner dense, tomentose. *Over-wintering bracts* 7-20 per terminal bud (bracts below flowers = 3, broadly ovate, ciliate and with varying but small amount of hair on mid-back); ovate; 2.2-2.4 mm long, 2-2.2 mm wide; indumentum one-layered, ciliate, or pubescent, on edges and occasionally on upper (distal) back; smooth, or occasionally striate. *Leaves* narrowly elliptic to ovate, acute, or obtuse; 2-4.5 mm long, 0.8-1.3 mm wide; 0-1 vein below; indumentum one-layered, hairs primarily on edges and upper surface, outer layer pilose; dry leaf cross-section flat, thick; petioles 0.2-0.4 mm long. *Flowers* terminal on long branches of both last season's wood and current season's wood; (1)-2-(3) per conflorescence; fragrance faint, fresh. *Hypanthium* campanulate; 2.6-3.2 mm long, 2.7-3.3 mm wide; indumentum two-layered, dense, velutinous upper layer; lower layer dense, tomentose; all over (densest at base); outer surface uneven, dull, finely mammillate.. *Calyx* lobes broadly triangular, and slightly cuspidate, edges brown and membranous; 2-2.2 mm long, 2.5-2.8 mm wide; indumentum sparse to dense, pubescent, ciliate, and glabrous near tip; caducous. *Petals* 4.2-4.5 mm long; glands abundant; thin-margin narrow at apex and wide on sides, weakly fringed. *Stamens* 14-33 per bundle; filaments fused

in lower quarter; papillose; 6.2-7 mm long; pink, or dark pink, rarely white; swollen distally; claw 0.8-1.3 mm long, 1.7-1.8 mm wide. *Ovary* with 9-11 ovules per loculus; valves densely short-pubescent with sparse long hairs. *Style* 8-8.2 mm long; glabrous. *Fruit* cupulate or campanulate, becoming irregular with development of corky tissue; 5.4-6.5 mm long; smooth, or rough, lumpy or mammillate especially in lower parts, or rarely corky; light brown to coppery brown, or grey-brown; 4.2-6.2 mm wide; without lobes, or slightly undulate; valves exserted and backed or not by lower part of lobes, with two lobes at apex of each valve; seed 1.5-1.7 mm long; smooth; shed freely when fruit is dry.

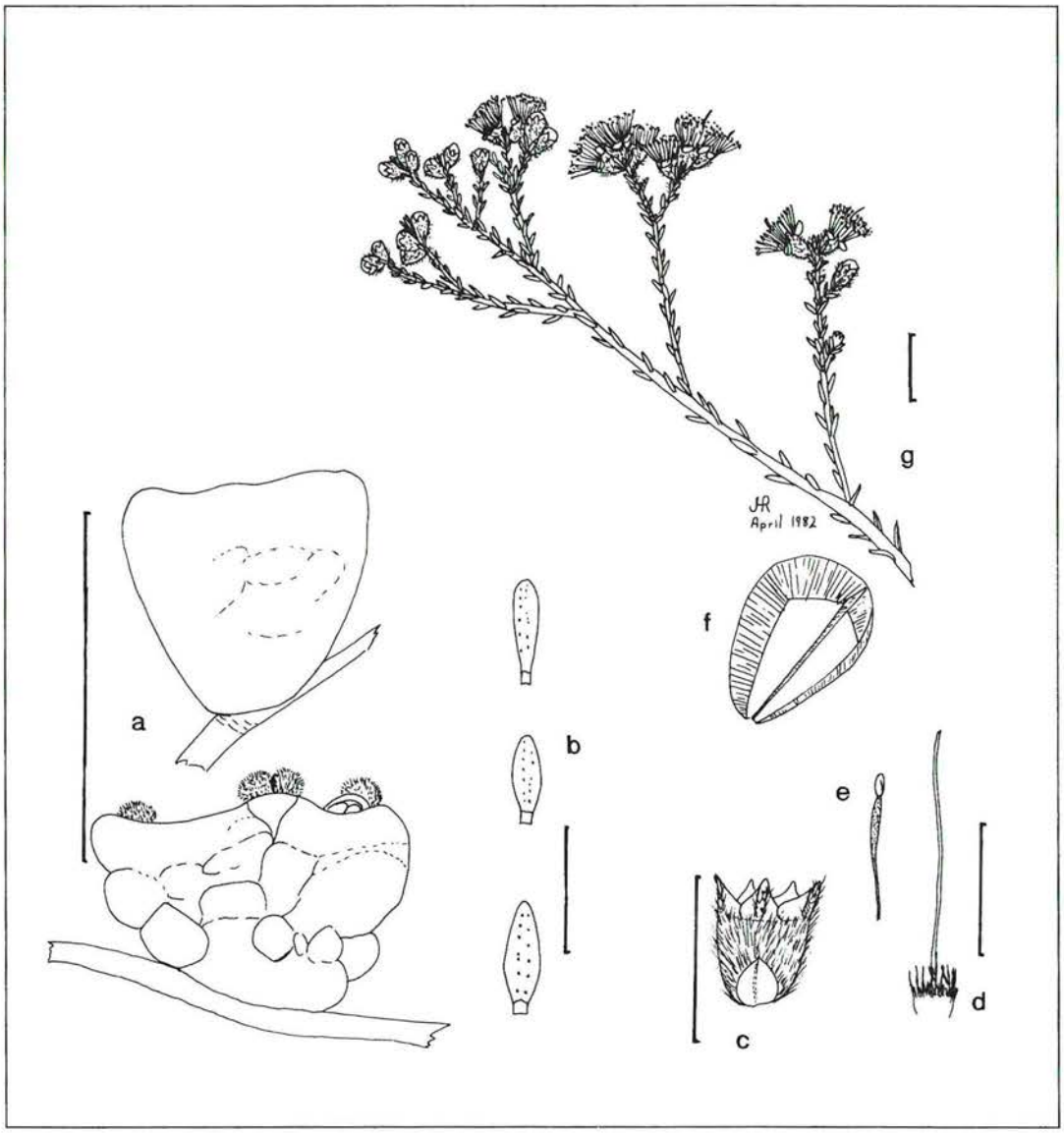

Figure 26. *E. purpurea*: **a**: fruits; **b**: leaves (scale bar 5 mm); **c**: hypanthium, calyx and perules; **d**: style and top of ovary (scale bar 5 mm); **e**: stamen; **f**: seed; **g**: habit. NE of Lake Pinjar, *R.J. Hnatiuk* 790196 (PERTH). Scale bar, not otherwise indicated, 10 mm.

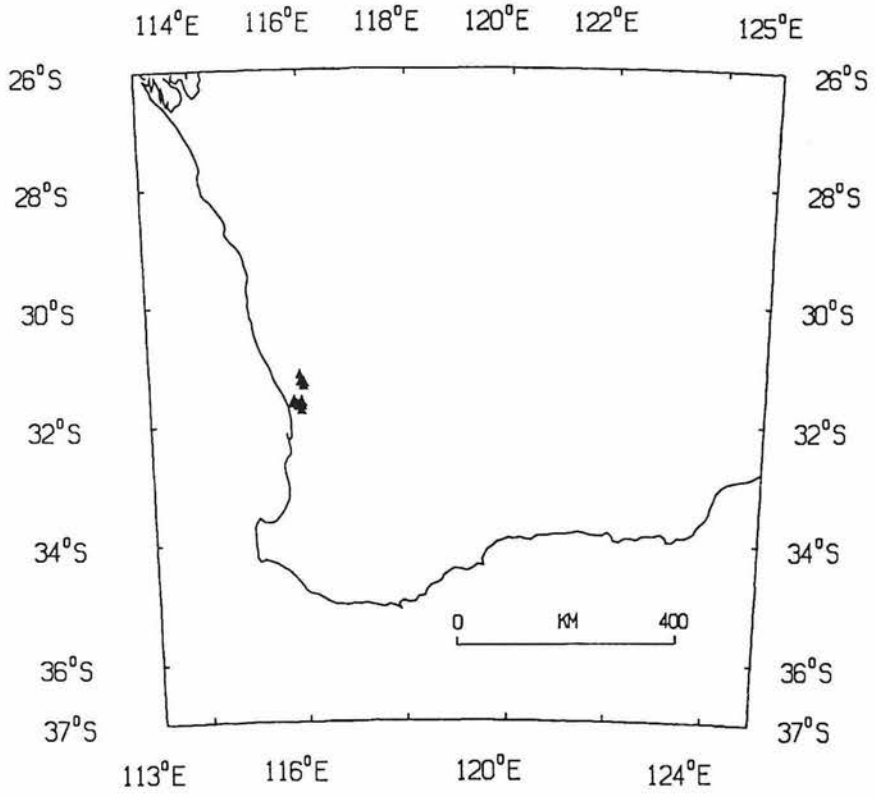

Figure 27. Distribution of *E. purpurea*.

Selected specimens examined. WESTERN AUSTRALIA: 5.9 km W of Upper Swan, *D. Halford* 14/12/2 (PERTH); 0.62 km S of Cullalla Stn, *D. Halford* 15/12/5 (PERTH); NE of Wanneroo, 0.9 km N of Neaves Rd on Seismic Rd, *R.J. Hnatiuk* 790194 (PERTH); Pinjar on road to Bullsbrook, *M.E. Phillips,* 27 Oct. 1962 (CBG, NSW); Muchea, *H. Steedman*, 2 Feb. 1935 (PERTH); Bullsbrook, *L.Steenbohm*, 13 Dec. 1959 (PERTH); 12 km W of Beverley, *G. Tindale-Davies,* June 1991 (CBG).

Distribution. Darling District. A recent specimen from near Beverley extends its range considerably to the east and into the Avon District (Figure 27).

Habitat. Lateritic uplands to coastal plains; associated vegetation low woodland, or open low woodland; soil bright yellowish brown sand, deep grey sand, or white sand over brownish grey sand.

Flowering period. December to January.

Notes. E. purpurea is part of section *Ebracteata*, but is only distantly related to other members as measured in the isozyme study (Coates & Hnatiuk 1990). Morphologically it is also isolated, but the presence of unusual features such as long hairs on top of the ovary, flowering on new wood, and corky eruptions on the fruits are shared with *E. ebracteata*.

Conservation status. I recommend that the conservation status of this species should be Priority Four - Rare Taxa. Its range is less than 100 km across, but the extent to which it occurs on reserved land is not known to me.

Etymology. The name comes from the Latin word *purpura* meaning purple in reference to the colour of the flower.

11. Eremaea brevifolia (Benth.) Domin, Vestn. Kral. Ceske Spolecn. Nauk, Tr. Mat.-Prir. 2:2 (1921). Base name: *Eremaea fimbriata* var. *brevifolia* Benth. (Figure 28)

Typus: "Valley of the Hutt River, Oldfield", (holo: MEL 84206; iso: K; photos: CBG, PERTH).

Shrub, 220 cm tall. *Branches* ascending to erect. *Branchlet indumentum* two-layered with very dense pilose outer layer; inner densely tomentose. *Over-wintering bracts* 13-19 per terminal bud, narrowly triangular to narrowly elliptic; 4.8-6.5 mm long; indumentum one-layered, very densely villous, white, on edges and all over back; striate. *Leaves* broadly obovate, crowded and overlapping, obtuse, 4.5-7.2 mm long, 3.3-5.8 mm wide; 5-9 veins below; indumentum one-layered, villous, becoming glabrous; dry leaf cross-section flat, thin. *Flowers* terminal on long branches of last season's wood; 1 per inflorescence. *Hypanthium* shallow, campanulate; 3.5-4.8 mm long, 3.9-5.6 mm wide; indumentum two-layered, upper layer very densely silky to villous, white; lower layer densely tomentose; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes broadly triangular; 1.8-4.5 mm long, 4 mm wide; very densely villous, white, sometimes yellowish; persistent. *Petals* 3.8-6.8 mm long; glands sparse to abundant; thin-margin narrow at apex, to wide at sides, weakly minutely fringed or jagged or entire. *Stamens* 50-70 per bundle; filaments fused only shortly at base to filaments fused in lower quarter; smooth; 8.2-8.5 mm long; orange; swollen slightly on long filaments; claw 0.5-4.3 mm long, 3.7-3.8 mm wide. *Ovary* with 13-14 ovules per loculus; densely short-pubescent without sparse long hairs. *Style* 11-12 mm long, indumented very sparsely on lower half. *Fruit* cupulate, 7 mm long, smooth to rough, lumpy or mammillate especially in lower parts, densely villous glabrescent; light brown to coppery brown; 8.5-11.5 mm wide; undulate, or with prominent pointed lobes; valves exserted and backed or not by lower part of lobes. *Seeds* 1.8 mm long; smooth; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: South of Ogilvie, *J.S. Beard* 2104 (PERTH); 5 miles [8 km] W of Nanson, 24 miles [38.4 km] NNE of Geraldton by road, *R. Coveny* 3063 (PERTH); Geraldton, *R. Filson* 101 (MEL); 12 miles [19.2 km] N of Northampton, *C.A. Gardner* 1960 (PERTH); Howatharra Hill Reserve, 21 road mls [33.6 km] N of Geraldton, *D. & N. McFarland* 1138 (PERTH); 7 miles [11.2 km] south of Northampton, *F.W. Went* 32 (PERTH).

Distribution: Irwin District (Figure 29).

Habitat. Lateritic uplands to coastal plains; associated vegetation low closed heath; soil red laterite to sand.

Flowering period. August to October.

Notes. *E. brevifolia* is the most northern member of subgenus *Okriocarpa*. It is distinguished by its large fruits with a conspicuously undulate rim, its broadly expanded, multi-veined leaves which are crowded and overlapping, and the long, villous or almost silky, white, conspicuous hairs around the upper leaves, perules and flowers.

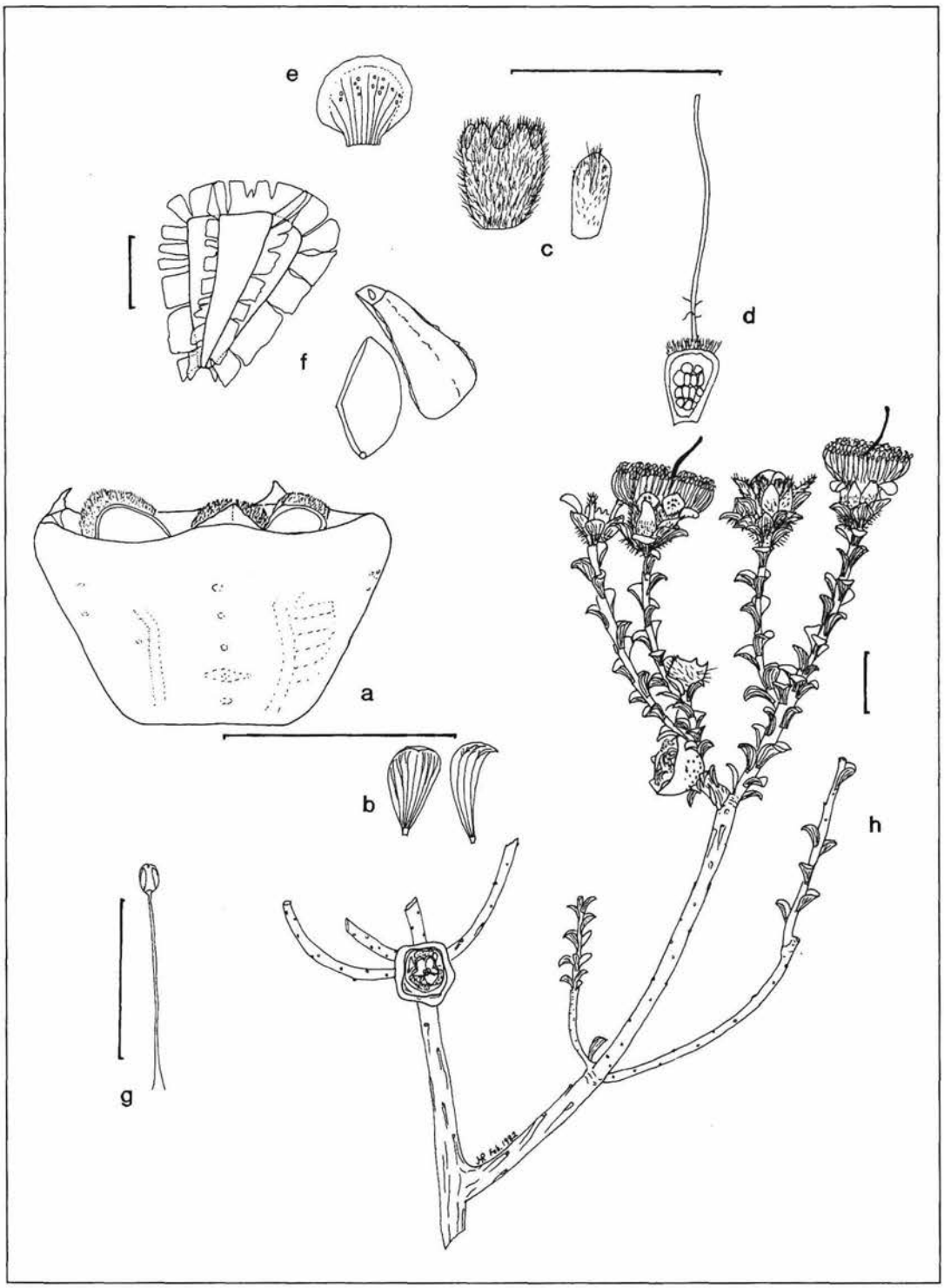

Figure 28. *E. brevifolia*: **a**: fruit; **b**: leaves; **c**: hypanthium, calyx and perule; **d**: style and ovary (longitudinal section); **e**: petal; **f**: seed and chaff (scale bar 1 mm); **g**: stamen (scale bar 5 mm); **h**: habit. Ogilvie, *J.S. Beard* 2104 (survey specimen # 36) (PERTH). Scale bars, unless otherwise indicated, 10 mm.

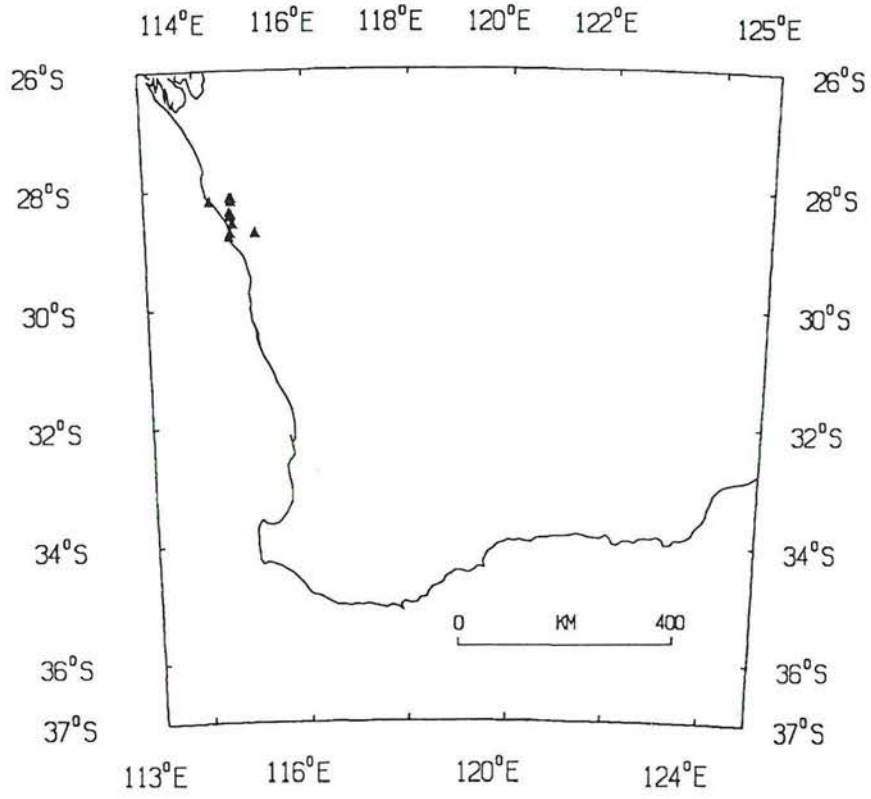

Figure 29. Distribution of *E. brevifolia*.

Conservation status. I recommend that the conservation status of this species should be Priority Two - Poorly Known Taxa. Its range of occurrence is less than 100 km across. I have not observed it in the field. Further, current observations are needed.

Etymology. "*Brevifolia*" is derived from the Latin words *brevi-* meaning short and *folia* meaning leaf. It appears to have been chosen to contrast the leaves of this taxon with those of the related taxon now called *E. asterocarpa* subsp. *asterocarpa* (originally and incorrectly called *E. fimbriata* var. *brevifolia*).

12. Eremaea acutifolia F. Muell., [X1] Fragm. 2:30 (1860). (Figure 30)

Typus: "Ad sinum Champion Bay. Walcott" (holo: MEL 526440; iso: K; photos: CBG, PERTH).

Illustrations. R. Erickson, A.S. George, N.G. Marchant & M.K. Morecombe, Flowering Plants of Western Australia: Figure 303 (1979).

Shrub, 70 cm tall; not lignotuberous. *Branches* spreading to erect. *Branchlet indumentum* two-layered, glabrescent, with sparse pilose outer layer; inner dense tomentose (when young). *Over-wintering* bracts 13-15 per bud, obovate; 3-3.5 mm long, 1.1-1.7 mm wide; indumentum two-layered, pilose to tomentose on edges and all over back; smooth, or striate. *Leaves* narrowly elliptic to linear

acute, 3.6-9.5 mm long, 0.5-1.2 mm wide; 1 vein conspicuous on lower surface; glabrous or indumentum one-layered, pilose (with hairs 1.1-1.3mm long). Dry leaf cross-section triangular. *Petioles* 0.3-0.8 mm long. *Flowers* terminal on short laterals along long branches; on last season's wood; 1 per inflorescence (rarely 2); fragrance not recorded. *Hypanthium* shallow campanulate, 2.5-5 mm long; indumentum one-layered, very dense, velutinous all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes triangular, 3-3.5 mm long, 2-2.5 mm wide; indumentum dense, velutinous, persistent (lasting till fruit matures but not permanent). *Petals* 3-4 mm long (held erect or spreading); glands sparse; thin-margin narrow; weakly fringed. *Stamens* 28-34 per bundle, filaments fused in lower quarter; smooth; 5.5-7.5 mm long; orange, or rarely dark pink; may or may not be swollen distally; 1.2-2.5 mm long, 1.7-2.1 mm wide. *Ovary* with 11-13 ovules per loculus. *Valve* outer surface densely short-pubescent without sparse long hairs. Style 8.5-10 mm long, glabrous, or indumented near apex. *Fruit* turbinate, 3.5-6 mm long, outer surface rough, lumpy or mammillate especially in lower parts; light brown to coppery brown; 8-9 mm wide; when dry, valves with many small callosites, exserted and not enclosed by lower part of lobes. *Seeds* 2 mm long, smooth or rough; shed freely when fruit is dry. "Rusty Eremaea".

Figure 30. *E. acutifolia*: **a**: fruit; **b**: leaf (scale bar 5 mm); **c**: style and top of ovary; **d**: stamen; **e**: hypanthium, calyx and perules; **f**: habit. 257 mile peg, Geraldton Hwy, *A.S. George* 9223 (PERTH). Scale bars, unless otherwise indicated, 10 mm.

Selected specimens examined. WESTERN AUSTRALIA: 15 mi [24 km] south of Geraldton-Mullewa Rd on Casuarina Rd, *A.M. Ashby* 2284 (AD, PERTH); 39 km NW of Strawberry on Burma Rd, *M.G. Corrick* 8287 (MEL); near 257 mile peg, Geraldton Highway, *A.S. George* 9223 (PERTH); 17 miles [27.2 km] from Geraldton, *M.E. Phillips* 019323 (CBG, NSW); Flumina Moore et Murchison, *E. Pritzel* 606 (NSW); Kojerina, east of Geraldton, *E. Wittwer* 16 (PERTH). (Approximately 30 specimens examined in Australia.)

Distribution. Found in the Irwin Botanical District east of Geraldton (Figure 31).

Habitat. Broad uplands, dominated by kwongan (open heath) on grey or yellow deep sand.

Flowering period. August to November.

Notes. E. acutifolia is a member of section *Okriocarpa.* It is distinguished by its needle-like leaves, and tendency to flower on short lateral shoots as in *E. violacea* but from which it is distinguished by its orange stamens, rough surface to the fruit and valves that have numerous small callosities compared to only two callosities or lobes in *E. violacea.*

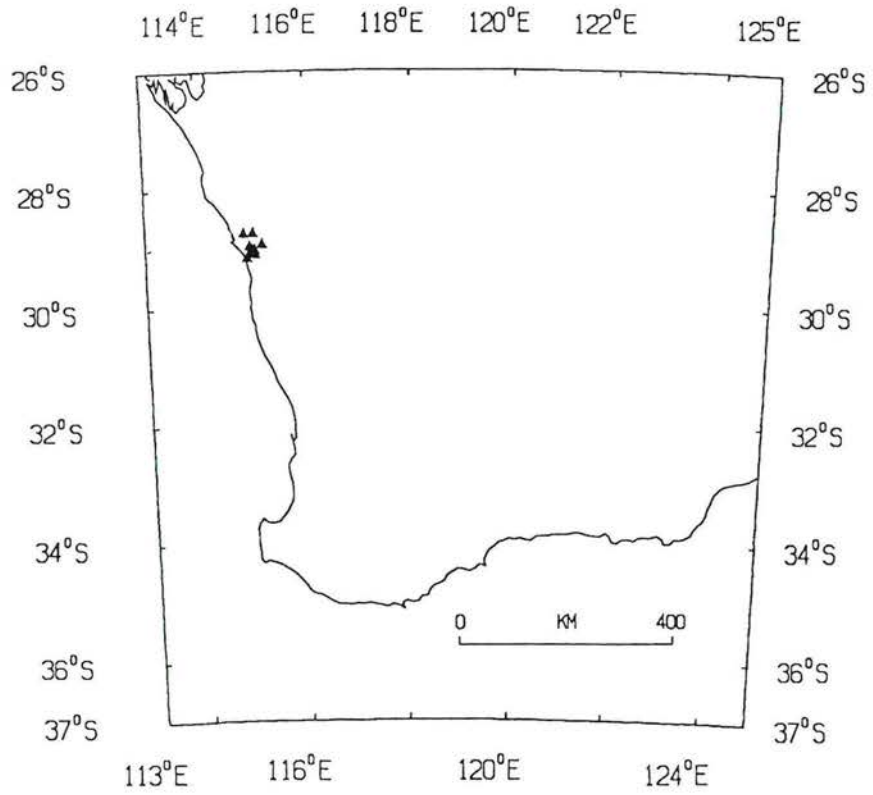

Figure 31. Distribution of *E. acutifolia.*

Conservation status. I recommend that the conservation status of this species should be Priority Two - Poorly Known Taxa. Its range is less than 100 km across and is represented in the Burma Road Reserve. Field survey is required to confirm current status.

Etymology. *"Acutifolia"* comes from Latin words *acuti-* meaning pointed and *folia* meaning leaves in reference to the shape of the leaves.

13. Eremaea ectadioclada R.J. Hnatiuk sp. nov. (Figure 32)

Frutex, interdum cum lignotubero. Rami patentes ad arcuati. Folia ovata, angusta, acuta, glabra vel indumento unistrato; vena 1 vel raro 3 in pagina abaxiali visibilia. Flores in ramis anni proximi terminales, 1 vel 2 per inflorescentia, suaveolentes. Hypanthium vadosum ad longo-campanulatum; indumentum bistratum, strato supero densissimo velutino, infero dense pubescente. Stamina per fasciculo 24-60, in parte quarta inferiore connata, aurantia. Fructus turbinatus, scaber, irregulariter pustulatus, vel mammillatus praecipue in dimidio infero, lobis prominentibus acutis, valvis exsertis callis parvis aliquot ornatis.

Typus: c. 4 km S of Eneabba on Western Titanium Rd, 29°52'S lat., 115°16'E long., 18 Oct. 1978, *R.J. Hnatiuk* 780205 (holo: PERTH; photo: CBG) [plus 1 dupl.].

Shrub, 70 cm tall; sometimes lignotuberous. *Branches* spreading to arching. *Branchlet indumentum* two-layered with sparse, pilose outer layer, inner dense, tomentose. *Over-wintering bracts* 6-20 per terminal bud, obovate to rarely ovate; 3.5-7.4 mm long, 1.1-2.8 mm wide; indumentum one-layered, pilose or tomentose on edges and on upper (distal) back; smooth or finely striate. *Leaves* narrowly ovate, acute; 4-10 mm long, 0.4-2 mm wide; 1 or rarely 3 veins below; glabrous, or indumentum one-layered, outer layer pilose with hairs 0.5-1.3mm long; dry leaf cross-section triangular; petioles 0.2-1.7 mm long. *Flowers* terminal on long branches of last season's wood; 1 or sometimes 2 per inflorescence; fragrance sweet. *Hypanthium* shallow to long campanulate; 2.7-3.8 mm long, 3-4 mm wide; indumentum two-layered, very dense, velutinous; lower layer dense pubescent all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes triangular to broadly triangular; 3-6 mm long, 2.2-5 mm wide, villous; caducous or persistent. *Petals* 4-6.7 mm long; glands abundant; thin-margin narrow, weakly fringed. *Stamens* 24-60 per bundle; filaments fused in lower quarter; papillose; 5-9 mm long; orange; swollen distally; claw 1.7-4 mm long, 1.7-3 mm wide. *Ovary* with 9-18 ovules per loculus (usually 12-13); valves densely short-pubescent without sparse long hairs. *Style* 10-12.6 mm long; indumented on lower quarter, rarely to near apex. *Fruit* turbinate; 6-8 mm long; rough, lumpy or mammillate especially in lower parts; grey brown; 7.4-12.5 mm wide; with prominent pointed lobes or undulate rim (variable); valves with several callosities, exserted and backed by lower part of lobes. *Seeds* 1.6-2.2 mm long; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 25 km by road W of Winchester, *C. Chapman*, 23 March 1979 (PERTH); Track SW of Mt Lesueur, *R.J. Cranfield* 1252 (PERTH); Alexander Morisson Natl Park, Coorow-Greenhead Rd, *E.A. Griffin* 1561 (PERTH); Western Titanium Leases, 8 km S of Eneabba, *E.A. Griffin* 1183 (PERTH); E of Lake Indoon, *R.J. Hnatiuk* 771034 (PERTH); 7 km E of Junction of Coorow-Greenhead Rd and Cockleshell Gully Rd, *R.J. Hnatiuk* 780261 (PERTH); 6 km N of Badgingarra, *R.J. Hnatiuk* 790050 (PERTH); Tathra National Park, *R.J. Hnatiuk* 800051 (PERTH); Eneabba Flora Reserve, *A. Kessell* 6138 (PERTH).

Figure 32. *E. ectadioclada*: **a**: fruit; **b**: leaves; **c**: hypanthium, calyx, and perules; **d**: staminal bundle; **e**: style and top of ovary (scale bar 5 mm); **f**: seed and chaff (scale bar 1 mm); **g**: habit. 4 km S of Eneabba, *R.J. Hnatiuk* 780205 (PERTH). Scale bars, unless otherwise indicated, 10 mm.

Distribution. Irwin District on the coastal plain from just north of Eneabba to Jurien (Figure 33).

Habitat. From lateritic uplands to coastal plains; associated vegetation species rich kwongan: open heath, low open heath, or low closed heath; soil deep grey sand, or grey sand over laterite.

Flowering period. October to November.

Notes. E. ectadioclada is a member of section *Okriocarpa*. It is most closely related to *E. asterocarpa* from which it differs in the narrowness and straightness of its leaves which usually have only 1 vein (rarely 3) visible on the underside of the leaves; the relative sparseness of leaves on branches; and the low, spreading and arching branching habit.

Conservation status. I recommend that the conservation status of this species should be ?Priority Three - Poorly Known Taxa. Its range is less than 100 km across, probably occurs in reserves in the area which could mean that it was not threatened. Further field work is required to confirm status.

Etymology. The name is derived from the Greek words *ektadios* meaning outstretched and *klados* meaning branch and refers to the wide spreading habit of the branches in contrast to those of its close relative, *E. asterocarpa.*

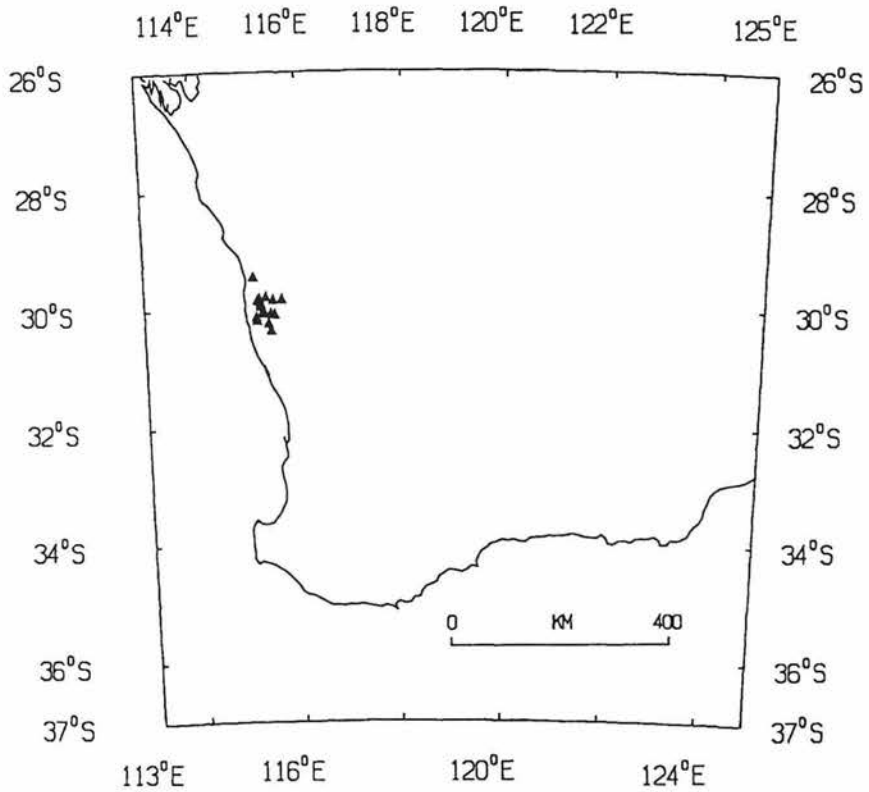

Figure 33. Distribution of *E. ectadioclada.*

14. Eremaea asterocarpa R.J. Hnatiuk sp. nov.

Frutex cum vel sine lignotubero. Folia obovata ad elliptica, angusta ad lata, ad apicem recurva, in parte quarta distali cymbiformia, acuta vel obtusa, glabrescentia; vena in pagina abaxiali 3, 5 vel 7. Flores in ramis longis anni proximi terminales, 1 vel 2 per inflorescentia, ut in *Mus* odorati. Hypanthium campanulatum, vadosum; indumentum bistratum, strato supero sparsim strigoso ad densissime villoso, infero dense pubescenti ad puberulo. Lobi calycis late triangulares, dense villosi ad densissime pilosi, in fructu persistentes. Fructus doliiformis, cupulatus vel campanulatus, scaber, irregulariter pustulatus, inferne mammillatus vel raro laevis, pallide brunneus vel cupreus, lobis prominentibus acutis vel labro undulato, valvis exsertis.

Typus: 5 km S of Coorow-Greenhead Rd on Cockleshell Gully Rd, 30°07'S lat., 115°07'E long., 19 Oct. 1978, *R.J. Hnatiuk* 780256 (holo: PERTH; photo: CBG).

Shrub, 130 cm tall; with or without lignotubers. *Branches* spreading, ascending or erect, or short and contorted. *Branchlet indumentum* two-layered with dense, pilose outer layer; inner dense, pubescent or tomentose. *Over-wintering bracts* 6-14 per bud; obovate to spathulate; 2.5-5.9 mm long, 2.1-3.5 mm wide; indumentum one-layered; usually glabrous on back and fimbriate, but also tomentose all over back or villous on upper (distal) back and fimbriate; finely striate. *Leaves* narrowly to broadly obovate to elliptic, recurved at apex and cymbiform in distal quarter, acute or obtuse; 3.4-8.3 mm long, 1.0-4.5 mm wide; 3, 5 or 7 veins visible on undersurface; indumentum one-layered pilose and fimbriate, glabrescent; dry leaf cross-section flat, thin. *Petioles* 0.4-1.4 mm long. *Flowers* terminal on long branches of last season's wood; 1 or rarely 2 per inflorescence; scent musty. *Hypanthium* shallow, campanulate, 2.0-3.8 mm long, 2.7-4.6 mm wide; indumentum two-layered, upper layer sparsely pilose to very densely villous; lower layer dense, pubescent to puberulous all over outer surface which is uneven, dull, and tuberculate from the large bases of hairs. *Calyx* (lobes) broadly triangular; 2.2-4.0 mm long, 2.0-4.3 mm wide; indumentum densely villous to very densely pilose, persistent in part in mature fruit. *Petals* 4.0-6.0 mm long; glands sparse to abundant; the thin-margin of the lamina wide or narrow, weakly fringed or entire. *Stamens* 16-36 per bundle, filaments fused in lower half; smooth; filaments 7.5-10.0 mm long; orange; swollen distally; claw 1.5-4.5 mm long, 1.3-3.3 mm wide. *Ovary* with 9-23 ovules per loculus; upper surface of valves densely short-pubescent without sparse long hairs. *Style* 8.2-10.5 mm long; indumented on lower quarter or occasionally to near apex. *Fruit* doliform, cupulate or campanulate; 6.9-8.0 mm long; rough, lumpy, mammillate in lower parts or rarely smooth; light brown to coppery brown; 10.5-17 mm wide with prominent pointed lobes or undulate rim; valves exserted but backed by lower part of lobes. *Seeds* 2.0- 2.3 mm long; smooth; shed freely when fruit is dry.

Distribution. This species occurs in the Irwin and Darling districts and is probably the second most widespread species of the genus.

Habitat. From lateritic uplands to coastal plains; vegetation kwongan: closed heath, low open heath, low closed heath, high shrubland or open low woodland; soils diverse: deep grey sand, grey sand over red brown clayey sand, grey or light brown sand over laterite, laterite and sand, or yellow sand.

Flowering period. July to November.

Notes. For some time this species was wrongly called *E. fimbriata.* This dates from Bentham's "Flora Australiensis". From specimens he appears to have seen, it is clear that he saw both the true *E. fimbriata* and the present taxon. However, in the published account, under the name *E. fimbriata*

Lindley, was inserted the description of a taxon, which is here given the name *E. asterocarpa*. Because of the confusion, the name *E. rosea* Gardner & George was published for the true *E. fimbriata,* but was later found by A. George (pers. comm.) to be a synonym of *E. fimbriata*.

E. asterocarpa is a member of subgenus *Okriocapra*. From *E. brevifolia* it is distinguished by having narrower leaves with generally fewer veins, by a much less dense indumentum around the leaves and perules of the over-wintering stem apices, by the generally smaller fruits with prominent woody calyx lobes (only an undulating rim to the fruit of most *E. brevifolia*) and a roughened surface. The arrangement of leaves in *E. asterocarpa* is not as dense and the leaves are more spreading than in *E. brevifolia*.

Within *E. asterocarpa*, there is considerable variation in growth form and branching pattern. This variation is described here as a number of subspecies. These taxa appear to be geographically separate from one another.

Etymology. The name is derived from the Greek words *astero-* meaning star and *karpa* meaning fruit in reference to the characteristically star-shaped fruits formed from the indurated and usually spreading calyx lobes.

Key to subspecies

1. Leaves with 3 (rarely 5) veins, generally narrow and widest about the middle, distal portions only very slightly recurved; non lignotuberous; fruits sometimes with 4 or 6 lobes ..... 14b. subsp. *histoclada*
1. Leaves with 5-7 or more veins, generally recurved in upper quarter; fruits always with only 5 prominent lobes 2
2. Plants erect with straight or slightly arching branches; leaves widest above the middle ..... 14a. subsp. *asterocarpa*
2. Plants low with branches short, zig-zag or contorted; leaves generally widest about the middle ..... 14c. subsp. *brachyclada*

14a. Eremaea asterocarpa R.J. Hnatiuk subsp. **asterocarpa** (Figure 34a-c)

Shrub, 130 cm tall; frequently lignotuberous. *Branches* spreading to ascending. *Branchlet indumentum* two-layered with dense, pilose outer layer; inner dense tomentose. *Over-wintering bracts* 6-11 per terminal bud; obovate; 3-5.9 mm long, 2.6-3.5 mm wide; frequently glabrous and fimbriate, but occasionally indumentum one-layered, tomentose all over back, occasionally pilose and fimbriate; finely striate. *Leaves* broadly obovate to occasionally elliptic, recurved at apex, acute or obtuse; 4.4-8.3 mm long, 2.4-4.5 mm wide; 5 or 7 rarely 9 veins visible on undersurface; indumentum one-layered, pilose and fimbriate, glabrescent; dry leaf cross-section flat, thin. *Petioles* 0.4-1.1 mm long. *Flowers* terminal on long branches of last season's wood; 1 or rarely 2 per inflorescence; scent musty. *Hypanthium* shallow, campanulate, 2.3-3.8 mm long, 2.7-4 mm wide; indumentum two-layered, upper layer sparse, pilose; lower layer dense, puberulous all over outer surface which is uneven, dull, and tuberculate from the large bases of hairs. *Calyx* (lobes) broadly triangular to triangular; 3-4 mm long, 2.7-4.3 mm wide; indumentum very dense, pilose, persistent in mature fruit. *Petals* 4.6-6 mm long; glands sparse or rarely abundant; the thin-margin of the lamina wide, weakly fringed. *Stamens* 23-30 per bundle, filaments fused in lower half; smooth; filaments

7.5-9 mm long; orange; swollen distally; claw 1.5-4.5 mm long, 2-3.3 mm wide. *Ovary* with 14-23 ovules per loculus; upper surface of valves densely short-pubescent without sparse long hairs. *Style* 8.2-9.7 mm long; indumented on lower quarter or occasionally to near apex. *Fruit* cupulate or campanulate; 7.2-8 mm long; rough, lumpy or rarely smooth; light brown to coppery brown; 10.8-17 mm wide with prominent pointed lobes; valves bi-lobed with surface of each lobe irregularly mammillate, exserted but backed by lower part of lobes. *Seeds* 2.3 mm long; smooth; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 5 miles [8 km] NW of Badgingarra, Hill River district, *B.G. Briggs s.n.* (NSW 146256); 10 km N of Yanchep, *N. Byrnes* 3962 (PERTH); Cockleshell Gully Rd, c. 0.8 km S of junction with Greenhead Rd, *M.G. Corrick* 8065 (MEL); 6 km W of Brand Hwy on S-most road to Nambung National Park, *R.J. Hnatiuk* 780099 (PERTH); 12 km S of Jurien Rd on Munbinea Rd, *R.J. Hnatiuk* 780167 (PERTH); 5 km S of Coorow-Greenhead Rd on Cockleshell Gully Rd, *R.J. Hnatiuk* 780256 (PERTH); S arm of McNammara Rd, 3.4 km E of Brand Hwy, *R.J. Hnatiuk* 790045 (PERTH); between Seismic & Perry Rds, NE of Lake Pinjar, *R.J. Hnatiuk* 790200 (PERTH); 27 miles [43.2 km] from Gingin towards Regan's Ford, *M.E. Phillips*

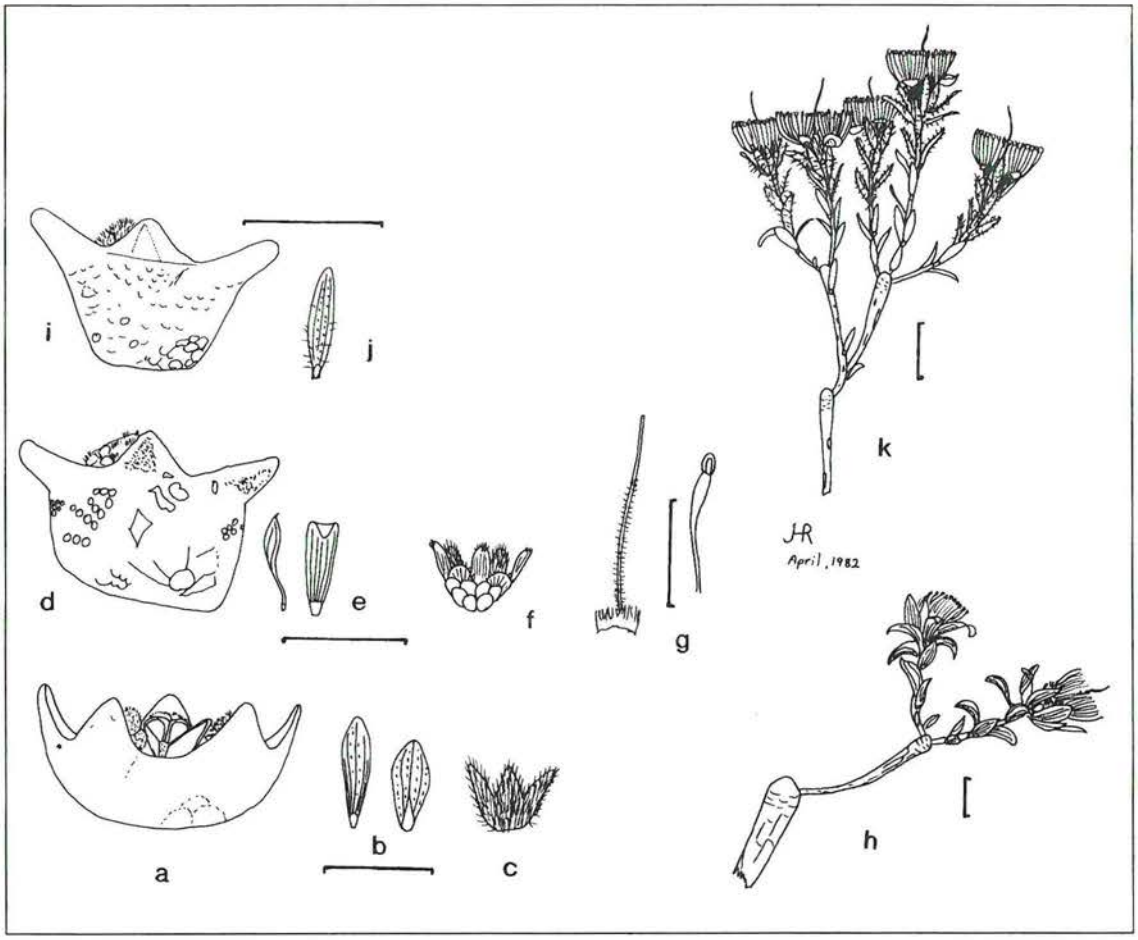

Figure 34. *E. asterocarpa* subsp. *asterocarpa*: **a**: fruit; **b**: leaves; **c**: hypanthium and calyx. 5 km S Coorow-Greenhead Rd on Cockleshell Gully Rd, *R.J. Hnatiuk* 780256 (PERTH). *E. asterocarpa* subsp. *brachyclada*: **d**: fruit; **e**: leaves; **f**: hypanthium, calyx and perules; **g**: style, top of ovary and stamen (scale bar 5 mm); **h**: habit. Base of Darling Scarp, *Cranfield* 27 (PERTH). *E. asterocarpa* subsp. *histoclada*: **i**: fruit; **j**: leaf; **k**: habit. 23 km S of Eneabba, *R.J. Hnatiuk* 780115 (PERTH). Scale bars, unless otherwise indicated, 10 mm.

1829 (CBG, NSW); 24 miles [38.4 km] from Jurien Bay towards Eneabba, *M.E. Phillips s.n.* (AD 96928343, CBG 026709); Mogumber-Regan's Ford Rd, 3/4 mi [1.2 km] W of Mission turn-off 9 mi [14.4 km] WNW Mogumber, 65 mi [104 km] directly NNE of Perth, *R.V. Smith* 66/134 (MEL); South Irwin (South West) c. 8 km W of New Badgingarra, *D.J.E. Whibley* 4790 (AD, PERTH).

Distribution: Irwin and Darling Districts (Figure 35).

Habitat. From lateritic uplands to coastal plains; vegetation closed heath, low open heath, low closed heath, or open low woodland; soils range over deep grey sand, grey sand over red brown clayey sand, grey sand over laterite, laterite and sand, or yellow sand.

Flowering period. August-October.

Notes. E. asterocarpa subsp. *asterocarpa* is the most widespread of the subspecies of *E. asterocarpa* and the most variable. In the northwest of the range it produces the most robust plants (e.g. NW of Mt Peron), and occurs in both woodland and kwongan vegetation.

Conservation status. This subspecies is thought not to be threatened. It is fairly widespread and occurs on a number of reserves. The protection of the extremes of the range is not known.

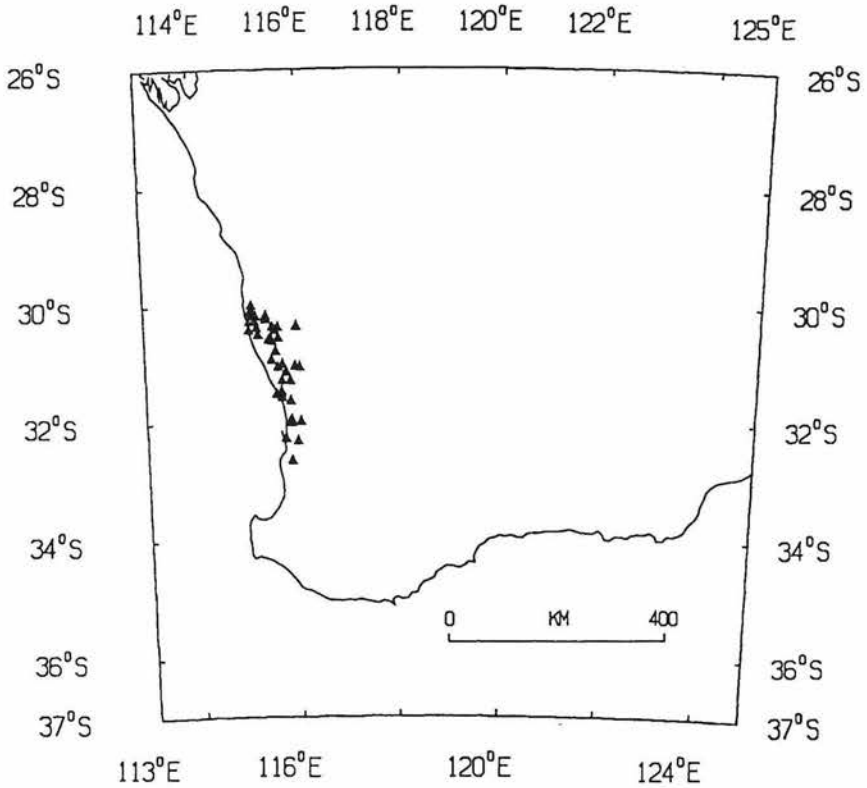

Figure 35. Distribution of *E. asterocarpa* subsp. *asterocarpa*.

14b. Eremaea asterocarpa R.J. Hnatiuk subsp. **histoclada** R.J. Hnatiuk subsp. nov. (Figure 34i-k)

Frutex sine lignotubero. Folia ovata vel parum obovata, angusta, acuta, indumento uniseriato, piloso; vena in pagina abaxiali 3, raro 5. Flores in ramis longis anni proximi terminales, 1 per inflorescentia. Hypanthium campanulatum, vadosum; indumentum biseriatum, strato supero densissime villoso, infero dense pubescenti. Lobi calycis late triangulares, dense villosi, in fructu persistentes. Stamina per fasciculo 16-36, ad medium connata, filamentis aurantiis. Fructus campanulatus ad doliiformis, scaber, irregulariter pustulatus, vel mammillatus praecipue in parte infero, pallide brunneus ad cupreus, lobis 4-6 acutis prominentibus, vel labro undulato; valvis exsertis.

Typus: 21 km E of Eneabba on road to Three Springs, 29°44'S lat., 115°28'E long., 12 Sept. 1978, *R.J. Hnatiuk* 780132 (holo: PERTH; iso: CBG, MEL, K; photo: CBG).

Illustration. R.J. Hubbard, Australian Plants 10 no. 77:13 (1978) as "*Eremaea fimbriata*".

Shrub, 110 cm tall; not lignotuberous. *Branches* ascending to erect. *Branchlet indumentum* two-layered with dense, pilose outer layer; inner pubescent. *Over-wintering bracts* 11-14 per terminal bud, obovate to spathulate; 2.5-3.8 mm long, 2.1-2.7 mm wide; usually glabrous and fimbriate, but occasionally indumentum one-layered, silky, on edges and on upper (distal) back; finely striate. *Leaves* narrowly ovate or slightly obovate, acute; 3.4-7.6 mm long, 1-2.4 mm wide; 3 to rarely 5 veins visible on underside; indumentum one-layered, pilose; dry leaf cross-section flat, thin. *Petioles* 0.4-1.4 mm long. *Flowers* terminal on long branches of last season's wood; 1 per inflorescence; fragrance musty. *Hypanthium* shallow, campanulate; 2-2.8 mm long, 3-4.6 mm wide; indumentum two-layered, upper layer very dense, villous; lower layer dense, pubescent; indumented all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* (lobes) broadly triangular, 2.2-3 mm long, 2-2.5 mm wide; indumentum dense, villous, persistent in mature fruit. *Petals* 4-5 mm long, 4-6.2 mm wide; glands abundant; thin-margin narrow, weakly fringed, or entire. *Stamens* 16-36 per bundle; filaments fused in lower half, 1.5-2.5 mm long, 1.3-2 mm wide; filaments 7.5-10 mm long, smooth, swollen distally, orange. *Ovary* with 9-14 ovules per loculus; densely short-pubescent without sparse long hairs. *Style* 10-10.5 mm long; indumented on lower quarter to near apex. *Fruit* campanulate to doliform; 6.9-7.9 mm long; rough, lumpy or mammillate especially in lower parts; light brown to coppery brown; 10.6-12.2 mm wide; with prominent pointed lobes, 4 and 6 lobes are frequent, or undulate; valves bi-lobed with the surface of each irregularly mammillate, exserted and backed by lower part of lobes. *Seeds* 2-2.1 mm long; smooth; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: Moora, about 140 km N of Perth, *A.M. Ashby* 63 (AD, PERTH); 19 mls [30.4 km] West of Watheroo, *M.I.H. Brooker* 1912 (AD, PERTH); 40 miles [64 km] west from Three Springs, *C.A. Gardner* 9136 (PERTH); 23 km S of Eneabba-Three Springs Rd, 38 km E of Eneabba, *R.J. Hnatiuk* 780115 (PERTH); 21 km E of Eneabba on road to Three Springs, *R.J. Hnatiuk* 780132 (PERTH); Tathra National Park, *R.J. Hnatiuk* 800052 (PERTH).

Distribution. Irwin District (Figure 36).

Habitat. From lateritic uplands to coastal plains; vegetation closed heath, low open heath, high shrubland, or open low woodland; soil deep grey sand, light brown sand over laterite, or lateritic gravel. Found on the plateaux immediately to the east of the coastal plain between Jurien and Eneabba.

Flowering period. July to November.

Notes. *E. asterocarpa* subsp. *histoclada* is distinguished from subspecies *asterocarpa* by its upright growth form, its total lack of lignotubers, its frequent production of flowers with aberrant calyx lobes and its generally smaller and less reflexed leaves. The apparent lack of lignotubers indicates that this subspecies relies upon seed for regeneration following fire, unlike the other two subspecies.

Conservation status. I recommend that the conservation status of this variety should be Priority Two - Poorly Known Taxa. Its range is less than 100 km across, it is known from reserves, but it is not well known, nor is its status in reserves known with certainty.

Etymology. The name is derived from the Greek words *histos* meaning erect and *klad*os meaning branch in reference to the very erect growth form of the plant.

14c. Eremaea asterocarpa subsp. **brachyclada** R.J. Hnatiuk subsp. nov. (Figure 34d-h)

Frutex cum lignotubero. Folia ovata ad elliptica, lata, ad apicem recurva, obtusa; vena 5 vel 7 in pagina abaxiali visibilia. Flores in ramis anni proximi terminales, 1 per inflorescentia. Hypanthium campanulatum, vadosum; indumentum bistratum, strato supero denso, piloso ad strigoso, infero denso, puberulo. Lobi calycis late triangulares, dense pilosi, in fructu persistentes. Stamina per fasciculo 20-25, ad medium connata, filamentis aurantiis. Fructus cupulatus vel campanulatus, scaber, irregulariter pustulatus, vel raro laevis, pallide brunneus ad cupreus, lobis acutis prominentibus, valvis exsertis.

Typus: Base of Darling Scarp, WA, 12 Oct. 1977, *R.J. Cranfield* 27 (holo: PERTH; photo: CBG.)

Shrub, 70 cm tall; lignotuberous. *Branches* spreading to ascending, or short and contorted. *Branchlet indumentum* two-layered with dense, pilose outer layer; inner dense, tomentose. *Overwintering* bracts c. 10 per bud; obovate to spathulate; 3.7-4.7 mm long, 2.5-2.9 mm wide; usually glabrous and fimbriate, but occasionally indumentum one-layered, tomentose all over back or villous on upper (distal) back and fimbriate; finely striate. *Leaves* narrowly obovate to narrowly elliptic, slightly recurved at apex, obtuse; 5.6-6.6 mm long, 2.1-2.4 mm wide; 5 or 7 veins visible on undersurface; indumentum one-layered, pilose; dry leaf cross-section flat, thin. *Petioles* 0.3-0.4 mm long. *Flowers* terminal on "long" branches of last season's wood; 1 per inflorescence; scent has been recorded as "faint" otherwise not known. *Hypanthium* shallow, campanulate, 2.4-2.8 mm long, 3.6-4.3 mm wide; indumentum two-layered, upper layer densely villous to pilose; lower layer dense, puberulous all over outer surface which is uneven, dull, and tuberculate from the large bases of hairs. *Calyx* lobes broadly triangular; c. 2.1 mm long, c. 2.0 mm wide; indumentum densely pilose, persistent in part in mature fruit. *Petals* c. 4.5 mm long; glands sparse; the thin-margin of the lamina wide at sides and narrow at apex, weakly fringed. *Stamens* 20-25 per bundle, filaments fused in lower half; papillose; filaments 4.0-4.5 mm long; orange; swollen distally; claw c. 2 mm long, 1.7-2.0 mm wide. *Ovary* with 7-9 ovules per loculus; upper surface of valves densely short-pubescent without sparse long hairs. *Style* 5.3-8.0 mm long; indumented on lower half. *Fruit* cupulate or campanulate; 7-9 mm long; rough, lumpy, mammillate in lower parts or rarely smooth; light brown to coppery brown; 8-11 mm wide with prominent pointed lobes or undulate rim; valves bi-lobed with surface of each lobe irregularly mammillate or smooth, exserted but backed by lower part of lobes, apex with two irregular smooth or callosed lobes. *Seeds* 2.0- 2.3 mm long; smooth; shed freely when fruit is dry.

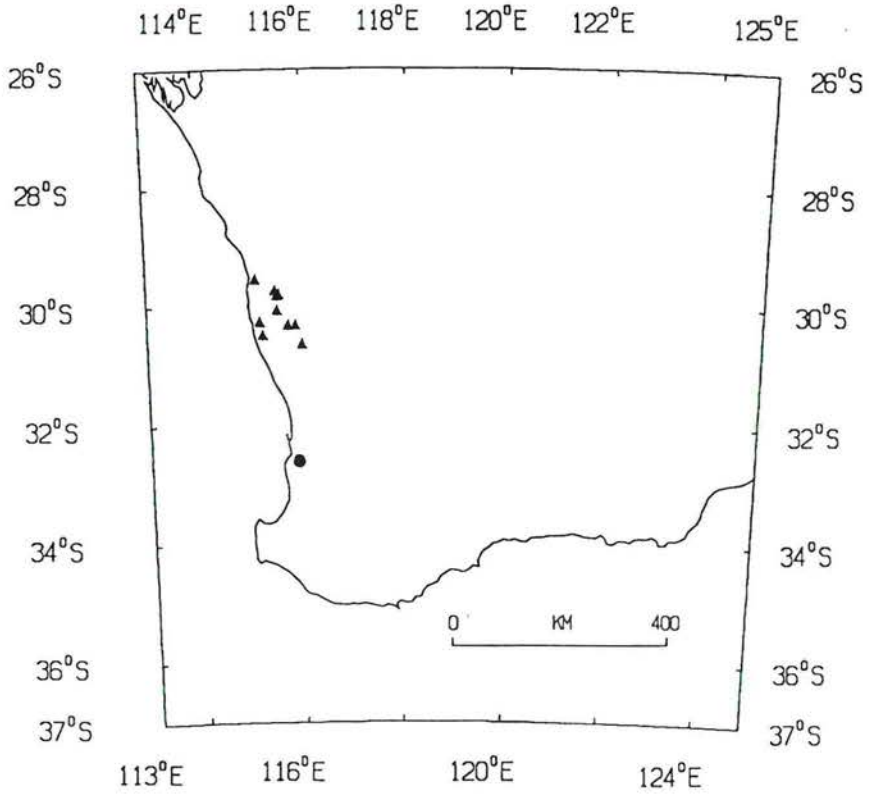

Figure 36. Distribution of *E. asterocarpa* subsp. *histoclada* (▲) and *E. asterocarpa* subsp. *brachyclada* (●)

Selected specimens examined. WESTERN AUSTRALIA: *R.J. Cranfield* 27 (PERTH); *R.J. Hnatiuk* 830059 (PERTH); *M.E. Phillips* 21/10/62(CBG). [Precise localities withheld.]

Distribution. Darling District south of Perth on the coastal plain (Figure 36).

Habitat. This subspecies occurs in kwongan and woodland vegetation on deep grey sand over yellow sand.

Notes. *E. asterocarpa* subsp. *brachyclada* is a shrub very similar to *E. asterocarpa* subsp. *asterocarpa*, but *E. asterocarpa* subsp. *b. achyclada* is lower in height, lignotuberous, and its branches are short (about 2-6 cm per growth cycle), zig-zag, or contorted. The fruits are usually smaller than those of subsp. *asterocarpa*.

It is not common and forms the southernmost outliers of the species and the section. Its unusual growth form, which is maintained in cultivation, and its geographic isolation, form the basis for its taxonomic recognition.

Conservation status. I recommend that the conservation status of this variety should be Priority One - Poorly Known Taxa. It is known from very few collections in areas south of Perth that are under heavy pressure to clear native vegetation for other uses. It needs to be assessed urgently.

Etymology. The name is derived from the Greek words *brachy-* meaning short and *klad*os meaning stem referring to the shortness of the branchlets produced each growth cycle.

15. Eremaea x codonocarpa R.J. Hnatiuk sp. nov. (Figure 37)

Frutex. Rami fere prostrati ad erecti. Folia anguste ovata ad linearia, acuta, indumento unistrato, glabrescentia; vena in pagina abaxiali 1-3. Flores in ramulis brevibus ramorum anni proximi terminales, 1-3 per inflorescentia, leviter et dulce odorati. Hypanthium vadosum, campanulatum, dense velutinum indumento unistrato. Stamina per fasciculo 18-33, in parte dimidio inferiore connata, laevia, rosea vel atrorosea, raro violacea vel alba basi rosea. Fructus campanulatus vel globosus, laevis ad furfuraceus, cano-brunneus, labro undulato vel lobis parvis acutis, valvis exsertis.

Typus: 6 km N of Jurien Rd on Cockleshell Gully Rd, 30°15'S lat., 115°10'E long., 17 Oct. 1978, *R.J. Hnatiu*k 780200 (holo: PERTH; photo: CBG).

Shrub, 70 cm tall. *Branches* almost prostrate to erect (variable). *Branchlet indumentum* two-layered, with dense, pilose outer layer; inner densely tomentose. *Over-wintering bracts* 6-15 per terminal bud; ovate; 3.2-4.3 mm long, 1.7-3 mm wide; indumentum one-layered, finely puberulous and ciliate; on back and edges; finely striate. *Leaves* narrowly ovate to linear, acute; 4.1-11.2 mm long, 0.6-1.8 mm wide; 1-3 veins below; indumentum one-layered becoming glabrous, outer layer pilose; dry leaf cross-section triangular. *Petioles* 0.5-1.9 mm long. *Flowers* terminal on short laterals along long branches of last season's wood; 1-3 per inflorescence; fragrance faint, sweet. *Hypanthium* shallow, campanulate; 3.5-6 mm long, 3.5-4 mm wide; indumentum one-layered, densely velutinous all over; outer surface uneven, dull, finely mammillate to tuberculate. *Calyx* lobes triangular to broadly triangular; 2-4.5 mm long, 2.2-3 mm wide; densely velutinous on apical portion; caducous, or persistent. *Petals* 3-5.7 mm long, 3.5 mm wide; glands sparse; thin-margin narrow, weakly fringed. *Stamens* 18-33 per bundle; filaments fused in lower quarter to half; smooth; claw 5-9 mm long; pink, or dark pink, or rarely violet or white with pink bases; not swollen; 1.5-4.5 mm long, 1.7-2.5 mm wide. *Ovary* with 10-14 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 9.5-12 mm long; glabrous, or indumented on lower quarter. *Fruit* campanulate, or globose; 5-11 mm long, 5.8-7.4 mm wide; smooth to very flakey; grey brown; undulate, or with small pointed lobes; valves bi-lobed, surface of each lobe smooth; exserted and backed or not by lower part of lobes. *Seeds* 1-2.4 mm long; smooth; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: Mt Lesueur, N along Cockleshell Gully Rd, *Cranfield* 830 (PERTH); 18 km S of Eneabba on Brand Hwy, *R.J. Hnatiuk* 780225 (PERTH); 7 km E of junction of Coorow-Greenhead Rd and Cockleshell Gully Rd, *R.J. Hnatiuk* 780266 (PERTH).

Distribution. Irwin District (Figure 38).

Habitat. Lateritic uplands to coastal plains; associated vegetation, kwongan: low open heath, or low closed heath; soil deep light brown sand, deep grey sand, grey sand over laterite, white sand over clay colluvium, or red brown clay loam.

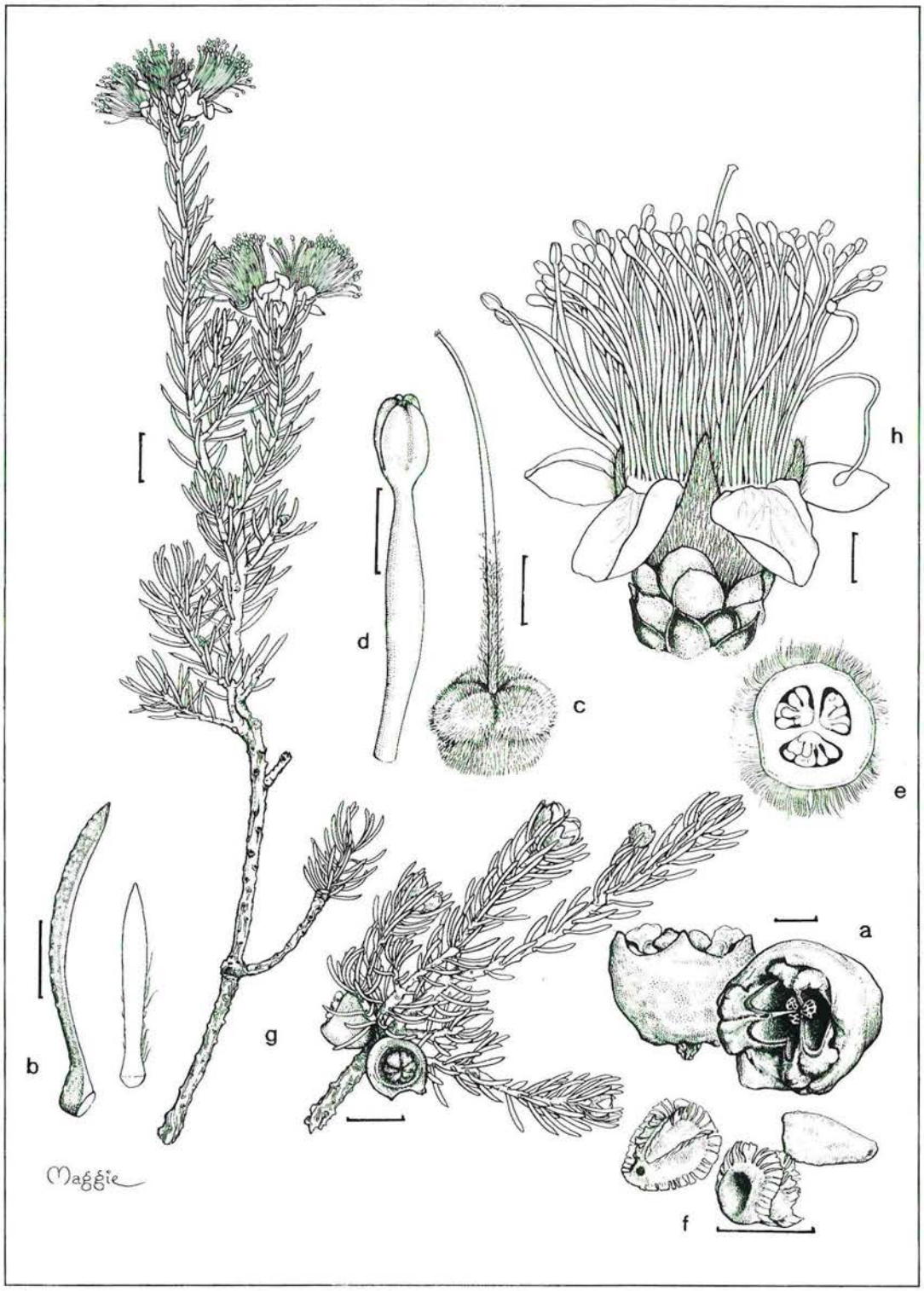

Figure 37. *E.* x *codonocarpa*: **a**: fruits; **b**: leaves (scale bar 2 mm); **c**: style and top of ovary (scale bar 2 mm); **d**: detail of stamen (scale bar 1 mm); **e**: transverse section of ovary (scale bar 2 mm); **f**: seeds and ovulode; **g**: habit; **h**: flower. Scale bars, unless otherwise indicated, 10 mm.

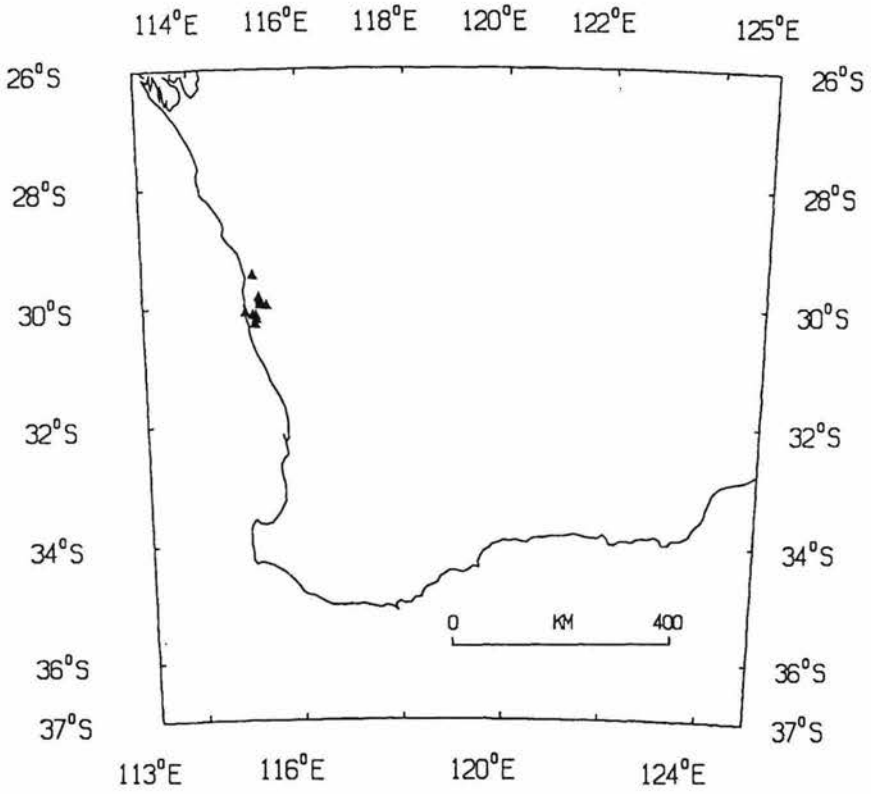

Figure 38. Distribution of *E.* x *codonocarpa.*

Flowering period. October to November.

Notes. E. x *codonocarpa* is believed to be a stabilised natural hybrid between *E. asterocarpa* var. *asterocarpa* and *E. violacea* subsp. *raphiophylla.* It occurs commonly on disturbed roadsides where the two putative parents occur together, but it also occurs in undisturbed vegetation with the two parents. The earliest specimen collected is significant. It is a fragment collected last century by an unknown woman. It was sent to von Mueller in Melbourne and recorded as "Coolgardie". This unlikely location may have been the place from which it was sent rather than collected. The area from which it probably came was very unlikely to have been "disturbed" as we know this term now, thus providing an indication that the hybrids are unlikely to be only a modern response to extensive habitat disturbance. Hybridisation is probably still occurring as there is no obvious reason for crossing not to continue. The taxon, although still variable, is generally recognisable. It is distinguished by leaves that are narrow, but wider than those of *E. violacea* subsp. *raphiophylla*; a hypanthium that is indumented, but less spreading at the top than in *E. asterocarpa*; stamens that are pink, not violet nor orange; and fruits that have undulate rims often with the remains of calyx lobes as small points. The plants generally produce very few seeds, but these are viable and produce offspring which closely resemble the maternal parent, but the sample size has been small. Isozyme analyses give further evidence of the hybrid nature of this taxon (Coates and Hnatiuk 1990).

Conservation status. I recommend that the conservation status of this species should be Priority Two - Poorly Known Taxa. Its range is less than 100 km across, it is not abundant, but does occur in reserves. Its status needs checking in the field.

Etymology. The name is derived from the Greek word *kodon* (bell) and *karpos* (fruit) in reference to the shape of the fruit.

16. Eremaea x phoenicea R.J. Hnatiuk sp. nov. (Figure 39)

Typus: c. 18 km S of Eneabba on Brand Hwy, 29°56'S lat., 115°16'E long., 18 Oct. 1978, *R.J. Hnatiuk* 780220 (holo: PERTH; iso: CBG; photo: CBG).

Frutex cum vel sine lignotubero. Rami patentes ad erecti. Folia obovata ad anguste elliptica, indumento unistrato piloso-tomentoso vel raro bistrato; vena in pagina inferiore 1 vel interdum 3. Flores in ramulis brevibus lateralibus ramorum longorum anni proximi terminales, 1-4 per inflorescentia (plerumque 2), non vel manifeste odorati ut in *Pimpinella anisum*. Hypanthium campanulatum longum, pilosum ad sericeum indumento unistrato vel raro glabrum. Stamina per fasciculo 19-26, ad basin vel raro in dimidio inferiore connata, rosea vel rubra. Fructus urceolatus ad globosus, laevis, cano-brunneus, labro elobato vel undulato vel lobis parvis acutis, valvis labro aequantibus vel brevioribus lobis apicalibus 2 hemisphaericis laevibus ornatis.

Shrub, 150 cm tall; with or without lignotubers. *Branches* spreading to erect. *Branchlet indumentum* one- to two-layered, with dense, pilose outer layer, inner dense tomentose. *Overwintering bracts* 12-23 per terminal bud; ovate; 2.7-4.2 mm long, 2.5-2.7 mm wide; indumentum one-layered, ciliate; finely striate. *Leaves* obovate to narrowly elliptic, acute; 4.2-6.8 mm long, 0.8-1.7 mm wide; 1 occasionally 3 veins below; indumentum one- or rarely two-layered, outer layer pilose tomentose; dry leaf cross-section triangular. *Petioles* 0.74 mm long. *Flowers* terminal on short laterals along long branches of last season's wood; 1-4 per conflorescence (usually 2); fragrance none to strong, aniseed. *Hypanthium* long, campanulate; 3.6-4.2 mm long, 2.5-4 mm wide; indumentum one-layered, or rarely glabrous, dense, pilose to silky; all over; outer surface uneven, dull, finely mammillate. *Calyx* lobes broadly triangular; 1.5-2.8 mm long, 1.5-2.5 mm wide; indumentum sparse, villous; apical portion caducous. *Petals* 3.5-4.6 mm long, 3.5 mm wide; glands sparse; thin-margin wide, weakly fringed. *Stamens* 19-26 per bundle; filaments fused only shortly at base to rarely fused in lower half; smooth; 7-8.8 mm long; rose or red; swollen distally; claw 0.8-2.4 mm long, 1.8-2.5 mm wide. *Ovary* with 10-14 ovules per loculus; valves densely short-pubescent without sparse long hairs. *Style* 9.2-12 mm long; glabrous. *Fruit* urceolate to globose; 5.8-7 mm long; smooth; grey brown; 4.6-6.4 mm wide; without lobes, or undulate, or with small pointed lobes; valves reaching rim of fruit, occasionally slightly below, ornamented by 2 smooth hemispheric apical lobes. *Seeds* 1.5-1.8 mm long; rough; shed freely when fruit is dry.

Selected specimens examined. WESTERN AUSTRALIA: 2.5 km SE of Mt Peron, NE of Jurien, *E.A. Griffin* 2468 (PERTH); 18 km S of Eneabba on Brand Hwy, *R.J. Hnatiuk* 780222, 780223, 780224, 780235 (PERTH); 23 km S of Eneabba on Brand Hwy, *R.J. Hnatiuk* 780242 (PERTH); 1 km E of Brand Hwy on Coorow Rd, *R.J. Hnatiuk* 780277 (PERTH); road off Brand Hwy, just south of Arrowsmith River going east, *B. Jack*, 12 Oct. 1977 (PERTH); 1-2 km E of Rose Rd on Greenhead Rd, E of Brand Hwy, *V. Syme & B. Jack*, 2 Nov. 1979 (PERTH).

Distribution. Irwin District (Figure 40).

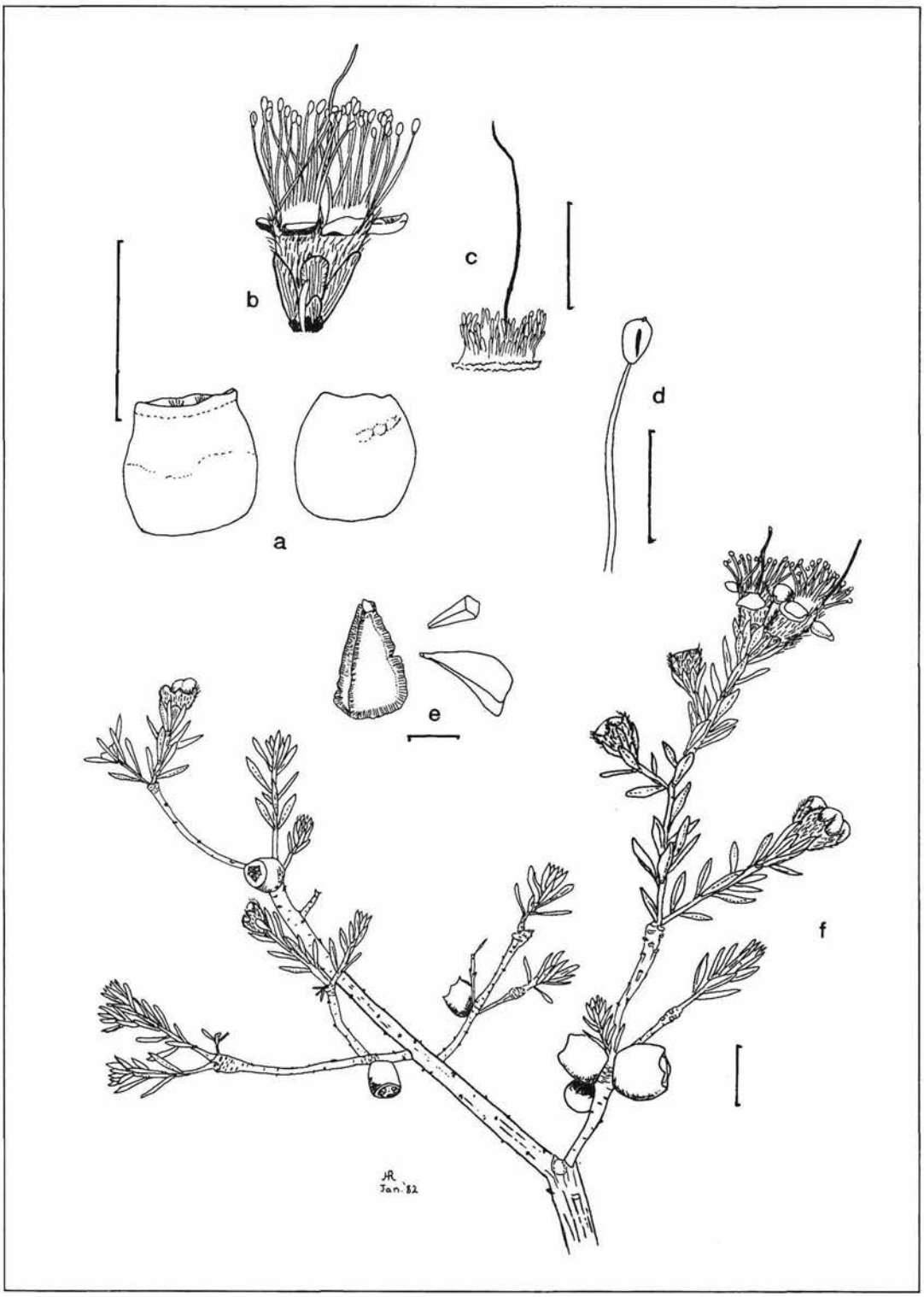

Figure 39. *E.* x *phoenicea*: **a**: fruits; **b**: flower; **c**: style and top of ovary (scale bar 5 mm); **d**: stamen; **e**: seed and ovulodes (scale bar 1 mm); **f**: habit. 18 km S of Eneabba, *R.J. Hnatiuk* 780223 (PERTH). Scale bar, unless otherwise indicated, 10 mm.

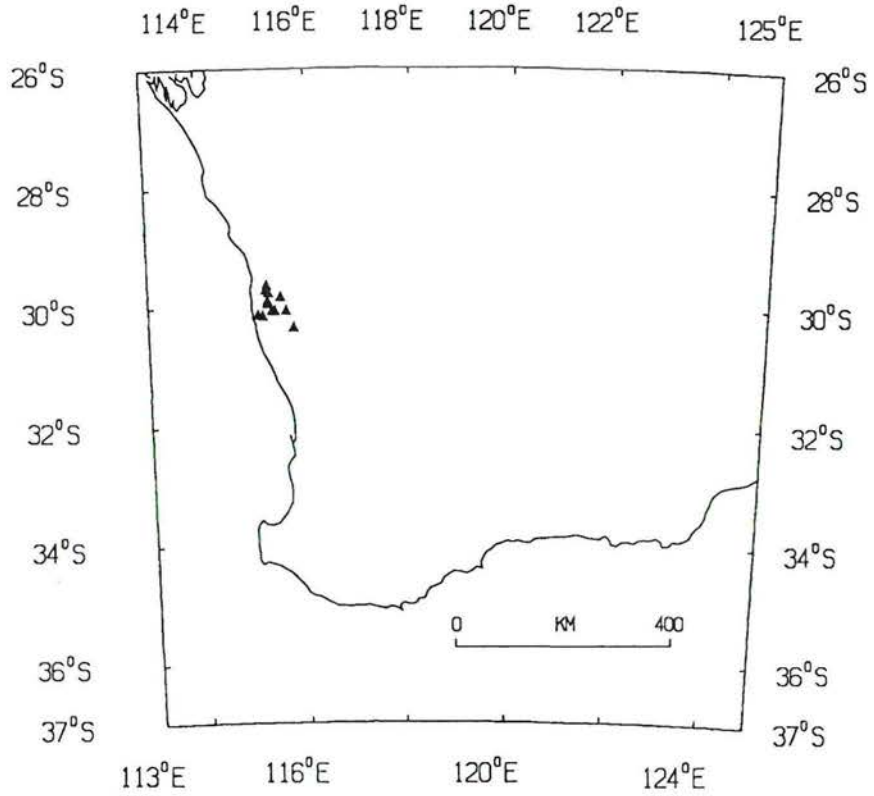

Figure 40. Distribution of *E.* x *phoenicea*.

Habitat. Lateritic uplands to coastal plains; associated vegetation kwongan: low open heath, low closed heath, or low scrub; soil deep grey sand, or grey sand over laterite.

Flowering period. October to November.

Notes. It appears that *E.* x *phoenicea* may be a hybrid between *E. beaufortioides* and *E. violacea* subsp. *raphiophylla*. It was not sampled in the isozyme study of Coates and Hnatiuk (1990), but in the morphological analysis (see Figure 2) the specimens representing this taxon are included in both the section *Violacea* and section *Eremaea*. It is a particularly rare species, which I have only seen a few times in the field, and then only on road verges. It can be distinguished from its closest relatives (*E. beaufortioides* and *E. pauciflora*) by its leaves which are narrower than those of *E. beaufortioides* but wider than those of *E. pauciflora*; its stamens which are brilliant rose, red or deep reddish pink; and its fruits which are smaller than those of *E. beaufortioides* and narrower than those of *E. pauciflora*. The rim of the fruit may be undulate, and the valves reach to or rise just above the rim - characters which also are different from either of its orange-flowered relatives. From *E. violacea* subsp. *raphiophylla* it differs in its wider leaves (elliptic not linear), its stamens are not violet, and the fruiting valves are close to the rim of the fruit and not strongly exserted and reflexed.

Conservation status. I recommend that the conservation status of this species should be Priority Two - Poorly Known Taxa. Its range extends less than 100 km across. Surveys of the areas around where

it has been collected have been numerous and few plants have been found, so it is unlikely that there are extensive populations. Detailed field work is required for clearly assessing its status.

Etymology. The name comes from the Greek word *phoinix* meaning red-purple and refers to the colour of the stamens.

Acknowledgements

This work was supported by several employers. I wish to thank the Directors and Chief Executives of the Western Australian Herbarium, The Bureau of Flora and Fauna, the Department of Arts, Sport, the Environment, Tourism and Territories, and the Australian National Parks and Wildlife Service. I am also grateful to the Directors of several herbaria for loans of specimens: PERTH, NSW, AD, MEL, K, and W. I wish to acknowledge assistance from Bruce Maslin, Australian Botanical Liaison Officer at Kew. Several generations of technical assistants transcribed label data for me, and Warren Ganter converted data to DELTA format and mapped collections. I am grateful to Toni Paine and Mike Dallwitz for assistance in working with DELTA, to Alex George and Tony Orchard for providing Latin translations, to Margaret Menadue and Diane Boyer for several of the drawings of *Eremaea*, and to Bob Makinson and anonymous referees for critically commenting on the manuscript. I am grateful to my family for giving up much time so that I could work on *Eremaea*.

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INDEX

Nemcia effusa (Fabaceae: Mirbelieae), a new species from south-west Western Australia, and a key to *Nemcia*

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Abstract

Crisp, M.D. and Mollemans, F.H. *Nemcia effusa* (Fabaceae: Mirbelieae), a new species from south-west Western Australia, and a key to *Nemcia.* Nuytsia 9 (2): 223-232 (1993). A new species of *Nemcia*, *N. effusa* Crisp & Mollemans, is described from the north-west part of Lake Grace shire, south-west Western Australia. The species is quite distinct with no clear affinities. It is named for its habit with rigid, diffuse stems and branchlets. In some respects similar to *N. stipularis* (Meissner) Crisp, it differs in the leaves spreading widely and being broader (3-4 mm) and impressed-punctate below, and with stipules shorter (2-3 mm). It is also similar to *N. punctata* (Turcz.) Crisp in the leaves being impressed-punctate below, but differing in having conspicuous stipules and longer leaves (1-2.5 cm) that are spreading widely but scarcely recurved. Only two plants of *N. effusa* were found at the type locality, and the species was not observed elsewhere during surveys of remnant vegetation (by the second author) of c. 71,250 km^2 of the southern wheatbelt region of Western Australia. This suggests that *N. effusa* is neither widespread nor common.

Introduction

During the latter half of 1992, surveys of remnant vegetation were being carried out by the second author in the southern wheatbelt region of Western Australia, a total of c. 71,250 km^2 having been surveyed during 1991 and 1992. Late in the day on the 26th of August the second author was travelling along a road in the north-west corner of Lake Grace Shire, when the abundant growth of yellow, flowering specimens of *Asterolasia squamuligera* (Hook.) Benth. (a significant range extension - Paul G. Wilson, pers. comm.) caused a stop for collections and photographs. In the course of carrying out this work a *Nemcia* was observed, a collection made and photographs taken. Further research has since indicated that this *Nemcia* is a distinct, previously undescribed taxon. The new species is described here.

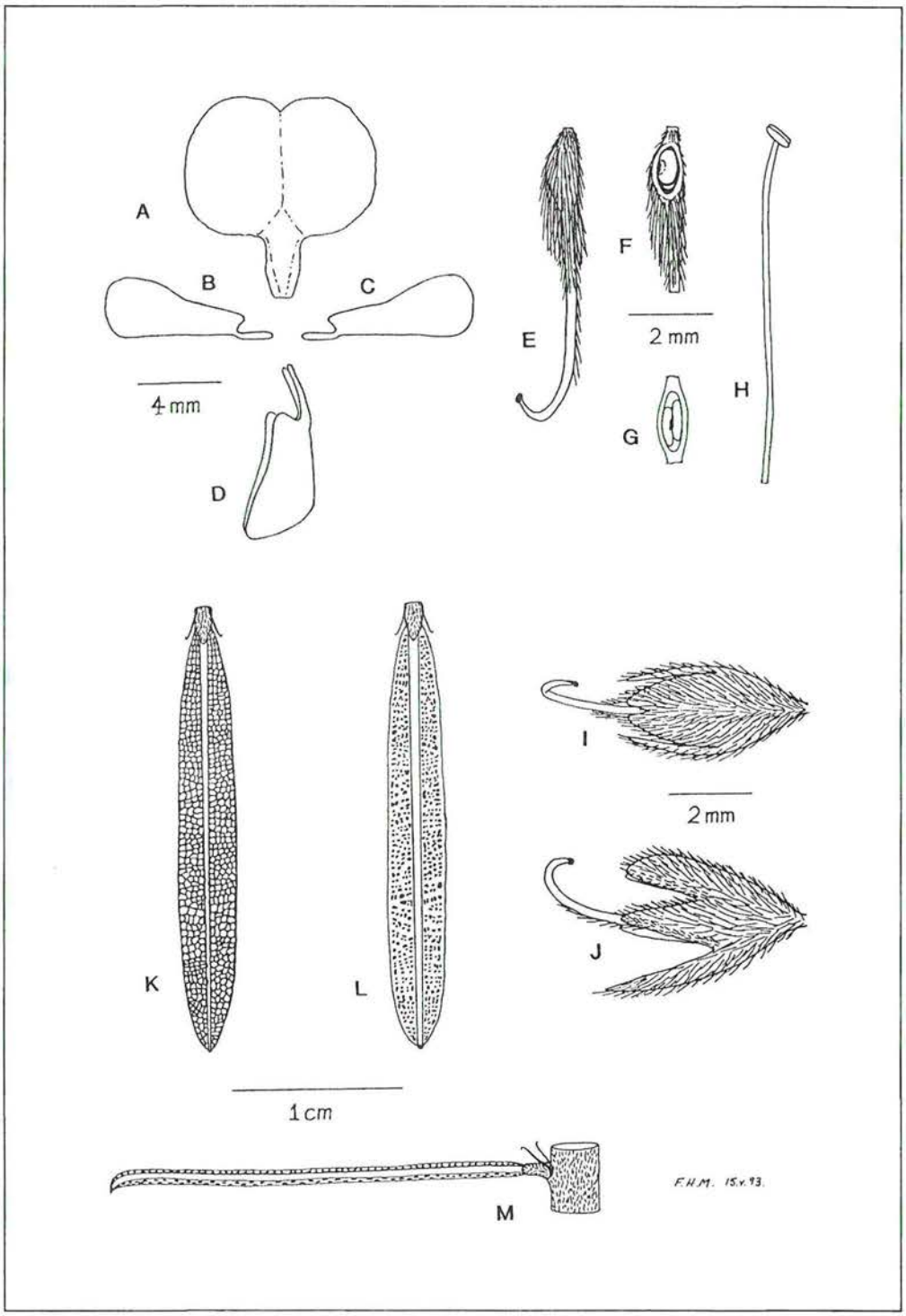

Figure 1. *Nemcia effusa*. A - standard; B, C - wings; D - keel; E - gynoecium; F - sectioned ovary showing ovules; G - adaxial view of sectioned ovary showing ovule arrangement; H - stamen, lateral view; I - calyx, adaxial view; J - calyx, lateral view; K - leaf, adaxial view; L - leaf, abaxial view; M - leaf, lateral view with stipules and section of branchlet. Drawn from the type.

Taxonomy

Nemcia Domin

Nemcia effusa Crisp & Mollemans, sp. nov. (Figures 1-3)

Species propria caulibus ramulisque rigidis diffusus; *N. stipulari* (Meissner) Crisp similis sed foliis patentibus latioribus (3-4 mm latis) subtus impresso-punctata stipulis brevioribus (2-3 mm longis) differt; *N. punctatae* (Turcz.) Crisp similis foliis subtes impresso-punctatis sed stipulis conspicuis foliis longioribus (1-2.5 cm longis) patentibus autem vix recurvis differt.

A distinctive species with rigid, diffuse stems and branchlets. Similar to *N. stipularis* (Meissner) Crisp but differing in the leaves spreading widely and being broader (3-4 mm) and impressed-punctate below, and with stipules shorter (2-3 mm). Similar to *N. punctata* (Turcz.) Crisp in the leaves being impressed-punctate below, but differing in having conspicuous stipules and longer leaves (1-2.5 cm) that are spreading widely but scarcely recurved.

Typus: Western Australia: Wheatbelt (SE); Lake Grace Shire; SE of Kukerin [precise locality withheld], 26 August 1992, *F.H. Mollemans* 4260 (holo: PERTH; iso: CBG). (Figure 1)

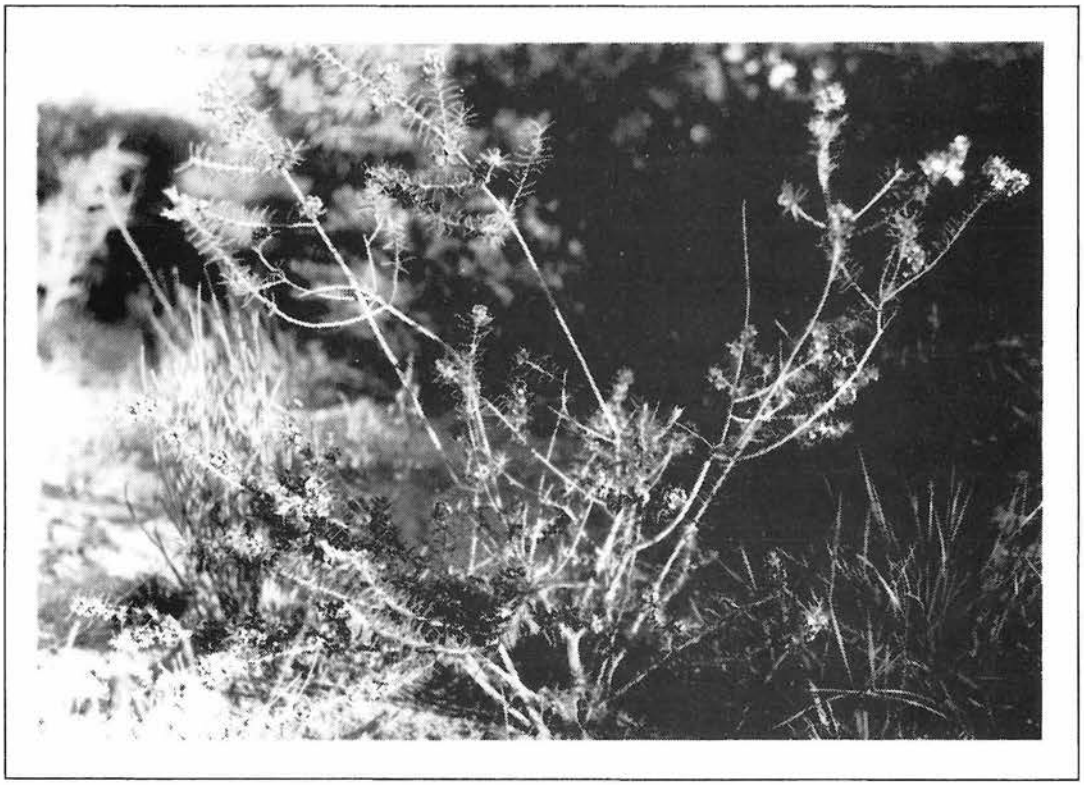

Figure 2. Habit of *Nemcia effusa* in mallee over mixed scrub 1-1.2 m high on gravelly soil in the north-west corner of Lake Grace Shire. (Photo: F.H. Mollemans).

Diffuse, open, spreading, straggling *shrubs* to c. 1 m tall and across. *Stems* and *branchlets* rigid, diffuse, grey-velutinous. *Leaves* widely spreading, ternate, simple, entire, narrowly oblong-elliptic, rigid, gently sigmoid, scarcely recurved at apex, mucronate, 1-2.5 cm long, 3-4 mm wide, glabrous; *mid-nerve* shallowly impressed above, thickened and prominent below; venation densely reticulate, very thick below with areoles impressed-punctate; *petiole* c. 2 mm long, grey-velutinous; *stipules* conspicuous, filiform, 2-3 mm long. *Flowers* 2-6 in very condensed, fascicle-like axillary racemes, subsessile on pedicels to 0.5 mm long, 10 mm long; *bracts* caducous, trifid, grey-sericeous, c. 4 mm long. *Calyx* 4-5 mm long, white-villous; lobes triangular, upper two united for 7/8 of length, broadly acute, lower three acute; *standard* strongly exserted from calyx, transversely broad-elliptic, retuse, 6 mm long (excluding 3.5 mm claw), 9 mm wide, adaxially apricot-coloured with red-maroon markings towards centre, abaxially red-maroon; *wings* obovate, 8 mm long, apricot-coloured in distal half, otherwise red-maroon; *keel* longitudinally half broad-obovate, 8 mm long, red-maroon. *Stamens* free, 8 mm long; *ovary* 2 mm long, shortly pubescent at base, otherwise covered with antrorse silky hairs to 2 mm long; ovules 2. *Pod* not seen.

Distribution. Endemic to the Stirling Botanical District of south-west Western Australia, with one known locality in the north-west corner of Lake Grace Shire. (Figure 3)

Habitat. Grows in mallee over mixed scrub 1-1.2 m high on gravelly soil. Vegetation is typical (for the region), diverse natural scrub with mixed species composition including *Dryandra* spp., *Allocasuarina humilis* (Otto & Dietr.) L. Johnson, *Lambertia*, *Daviesia*, and *Leptospermum*.

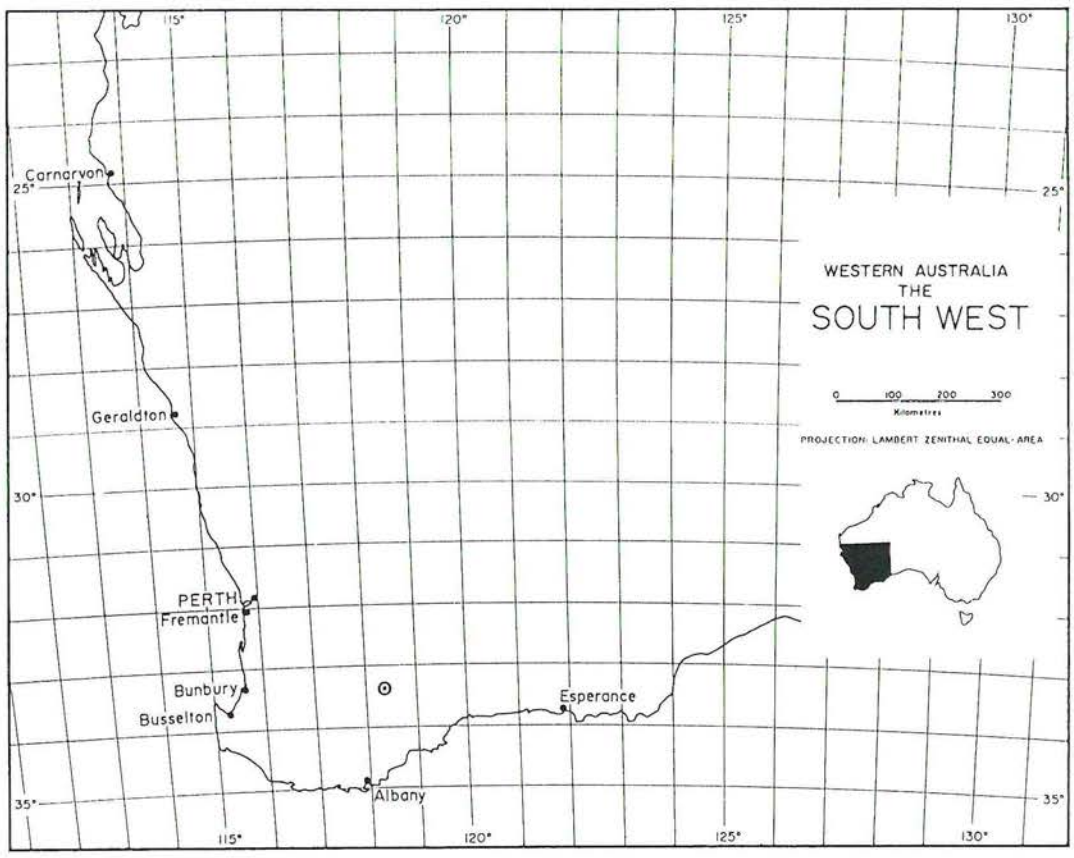

Figure 3. Distribution of *Nemcia effusa*.

Flowering period. Plants were in full flower in late August 1992. That year was, however, an exceptional one in which flowering of many wheatbelt taxa was delayed for up to 4 weeks by an extended, cold, wet winter. Under the circumstances, it is considered that the flowering period for *N. effusa* in an average season would be July-August.

Conservation status. Poorly known, CALM Priority 1. Only two plants of *N. effusa* were observed at the type locality, and the species has not been observed elsewhere during surveys of remnant vegetation (by the second author) of c. 71,250 km^2 of the southern wheatbelt region of Western Australia. This suggests that *N. effusa* is not widespread or common.

Etymology. The specific epithet *effusa*, from Latin, means straggling or spreading, and refers to the growth habit of this species.

Affinity. Nemcia is an endemic genus in south-west Western Australia with c. 40 known species, ten of which are undescribed. One, *N. lehmannii*, is presumed extinct, and several others, including *N. effusa*, are very restricted in distribution. The following key includes all known species, the undescribed ones being referred to by a specimen number.

The present circumscription of *Nemcia* was defined by Crisp & Weston (1987), who resurrected the genus from synonymy and expanded it to include species of *Gastrolobium* with obviously trifid bracts, no fluoro-acetate, erect calyx-lobes and condensed inflorescences. Members of the latter group all have two ovules, whereas in its original circumscription, *Nemcia* was characterised by more than two ovules (Domin 1923). *Nemcia* is now diagnosed by its distinctive inflorescence which is a condensed raceme (often head-like or cluster-like) with a short stout rachis and few flowers (generally <10). The bracts are distinctive too, being obviously trifid, silky, caducous, and often enclosing the inflorescence in a globular bud. *Nemcia* is closely related to *Brachysema* and *Jansonia*. Both differ in having large, red and/or green bird-pollinated flowers, and *Brachysema* has more openly racemose inflorescences. However, a recent cladistic analysis by Crisp (in press) has indicated that *Jansonia* and *Nemcia* may be congeneric. Both have the same type of inflorescence, and some species of *Nemcia* have large red bird-pollinated flowers, *viz. N. leakeana*, *N. rubra* and *N. vestita*, albeit with different floral morphology from *Jansonia*. If these genera are combined, then the name *Jansonia* has priority. The first author is carrying out molecular studies in an attempt to resolve the relationship of these genera; meanwhile it seems sensible to maintain their distinction. A key to all the genera of the tribe Mirbelieae, including *Nemcia*, is provided by Crisp & Taylor (1993).

No attempt has been made to resolve relationships within *Nemcia*, and no infrageneric classification exists. *Nemcia effusa* belongs to the group with two ovules, yet is very distinctive. It shows some similarity to *N. stipularis* by virtue of the conspicuous stipules and narrow leaves, but the latter differs in having erect, linear (c. 2 mm wide) leaves with craspedodromous venation which lacks deeply impressed areoles beneath, and the stipules are longer (up to 12 mm). *Nemcia punctata* also is similar, especially in having impressed-punctate leaf venation below, but its leaves are much shorter (c. 5 mm long) and more strongly recurved, and there are no stipules.

Key to *Nemcia* species

1 Flowers large (calyx >8 mm long); petals predominently red (bird-pollinated group) 2

2 Expanded leaves velvety beneath, with recurved margins ..... *N. vestita* Domin

2* Expanded leaves glabrate beneath, never velvety; margins not or scarcely recurved 3

3 Calyx villous, tube ventricose at base; wing- and keel-petals ovate; leaves narrowly oblong-elliptic, scarcely emarginate ..... *N. rubra* Crisp

3* Calyx sericeous, tube not ventricose; wing- and keel-petals elliptic; leaves elliptic to broad-elliptic, emarginate to obcordate ..... *N. leakeana* (Drumm.) Crisp

1* Flowers smaller (calyx <8 mm long); petals predominently yellow or orange with dark red markings 4

4 Leaves all alternate, scattered, ovate; flowers 1-3 per axil; calyx 7-8 mm long ..... *N.* sp. [*Crisp* 6727]

4* Leaves opposite (a few may be alternate), whorled or very crowded, variously shaped; flowers usually >3 per axillary unit inflorescence; calyx usually <7 mm long 5

5 Stipules absent or minute 6

6 Leaves spreading from the base, 10-15 mm long; apex with a long pungent point ..... *N. epacridoides* (Meissner) Crisp

6* Leaves very crowded, appressed (at least at the base), imbricate, <7 mm long 7

7 Leaves opposite and decussate ..... *N.* sp. [*Crisp* 6496]

7* Leaves ternate (in whorls of three) 8

8 Venation of lower leaf surface very thick, with areoles reduced to pin-pricks; leaves broadest towards the base ..... *N. punctata* (Turcz.) Crisp

8* Venation of lower leaf surface openly reticulate; leaves broadest near or slightly below the middle ..... *N. carinata* Crisp

5* Stipules present, setaceous or filiform, usually conspicuous 9

9 Calyx indumentum two-toned: at least partly golden or rust-coloured; with silver hairs present also, especially towards base of calyx 10

10 Leaves cuneate or obtrullate, or narrowly so 11

11 Leaves with margins recurved, especially towards the bilobed apex; upper surface darker than lower, rugose with obscure venation; lower surface silver- or grey-sericeous and scarcely glabrescent ..... *N. emarginata* (S. Moore) Crisp

11*Leaf margins not recurved, sometimes undulate or crisped; surfaces similar in colour, glabrous or soon glabrescent; venation conspicuous, finely reticulate 12

12 Leaves obtrullate, trilobed; middle lobe equal to or longer than lateral lobes ..... *N.* sp. [*Oxylobium dilatatum* Benth. var. *trilobum* Meissner]

12*Leaves obovate or cuneate, usually narrow, never obtrullate; apex variable, rarely sub-trilobed and if so, middle lobe much shorter than lateral lobes 13

13 Leaf margins crisped ..... *N.* sp. [*Patrick* 458]

13*Leaf margins not crisped 14

14 Leaves 30-50 x 10-20 mm; margins evenly tapered to the base; apex very variable: emarginate, bilobed, trilobed, rounded, obtuse or acuminate ..... *N. dilatata* (Benth.) Crisp

14*Leaves 5-40 x 3-11 mm, mostly <25 x 8 mm; rounded at base; apex strictly emarginate ..... *N. retusa* (Lindley) Domin

10*Leaves orbicular, ovate, elliptic, oblong, or narrowly so 15

15 Inflorescences, young stems and sometimes young leaves densely hirsute with rust-coloured hairs ..... *N. pyramidalis* (T. Moore) Crisp

15*Inflorescences and young stems sericeous to villous, usually silvery 16

16 Leaves silvery sericeous below, very tardily glabrescent 17

17 Leaf-margins strongly recurved to revolute; flowers 4-6 per unit-inflorescence; leaves narrowly oblong-elliptic ..... *N.* sp. [*Keighery*, PERTH 01041126]

17*Leaf-margins not or slightly recurved; flowers 8-many per unit-inflorescence; leaf shape very variable: orbicular, ovate, oblong, elliptic, or narrowly so ..... *N. coriacea* (Smith) Domin

16*Leaves glabrate below 18

18 Unit-inflorescences forming dense clusters in leaf-axils, or on very short (1-2 mm) peduncles; leaves narrow-oblong to -cuneate ..... *N. retusa* (Lindley) Domin

18*Axillary unit-inflorescences head-like on distinct peduncles 5-15 mm long; leaves obovate-oblong, usually broad ..... *N. crenulata* (Turcz.) Crisp

9* Calyx indumentum uniform in colour: usually silver, sometimes buff-coloured 19

19 Leaves with 3 or more prickly lobes or teeth 20

20 At least some leaves per specimen with >3 prickly lobes or teeth; leaf margins recurved; lamina tending to undulate between depressed main veins ..... *N. ilicifolia* (Meissner) Crisp

20*All leaves with 3 pungent apices; leaf margins not recurved; lamina somewhat plicate (folded up lengthwise) but otherwise flat ..... *N. tricuspidata* (Meissner) Crisp

19*Leaves either entire or with not more than 1 pungent apex 21

21 Leaves crowded, linear, 1-2 mm broad; stipules 5-10 mm long ..... *N. stipularis* (Meissner) Crisp

21*Leaves scarcely or not crowded, >2 mm broad; stipules <5 mm long 22

22 Leaves pungent, usually tapered to base; standard <12 mm broad; ovules 2 23

23 Leaves in whorls of 3 or 4, broadest at or below middle, tapered to apex ..... *N. acuta* (Benth.) Domin

23*Leaves decussate or ternate (rarely some scattered), broadest at or above middle, tapered to base (in *N. obovata*, tapered to apex as well) 24

24 Leaves bluish, cuneate, more or less truncate at apex ..... *N.* sp.

24*Leaves sometimes glaucous but never bluish, variously shaped 25

25 Leaves obtrullate or rhombic, plicate; flowers per axillary unit-inflorescence 6 or more ..... *N. obovata* (Benth.) Crisp

25*Leaves obovate, spathulate or linear, usually plicate but occasionally nearly flat; flowers per unit-inflorescence 1-4 26

26 Leaves yellow-green, not glaucous, strongly plicate, falcate overall and hooked at apex; accessory shoots in axils ..... *N.* sp. [*Cranfield* 4538; may in fact be *plicata*]

26*Leaves more or less glaucous, strongly to scarcely plicate, straight or scarcely falcate and with the apex at most slightly recurved; accessory shoots lacking 27

27 Calyx 4.5-7 mm long, sericeous to villous or tomentose; leaves obovate or spathulate, often narrow, sometimes nearly flat; broadest part of leaf 3-9 mm from midrib to margin ..... *N. plicata* (Turcz.) Crisp [syn. *N. pauciflora* (C. Gardner) Crisp]

27*Calyx 3.8-4.2 mm long, more or less sericeous; leaves linear, strongly plicate; broadest part of leaf 1.9-4.1 mm from midrib to margin ..... *N.* sp. [*Groves*, PERTH 01052160]

22*Leaves not pungent, or if tending to be so, then leaves rounded at base (*N. hookeri*) or ovules >3 and standard 14-15 mm broad (*N. reticulata*) 28

28 Branchlets angular with yellow ribs; leaves as broad as long or broader, rounded-cuneate or -rhombic, orbicular or ovate ..... *N.* sp. [*Braine*, PERTH 01052683]

28*Branchlets terete, or if angular, then lacking distinct yellow ribs; leaves longer than broad, variously shaped 29

29 Venation of lower leaf surface very thick, with areoles reduced to pin-pricks ..... *N. effusa* Crisp & Mollemans

29*Venation of lower leaf surface openly reticulate 30

30 Ovules 4 or more; calyx >5 mm long 31

31 Standard 14-15 mm broad; indumentum tomentose (to villous); leaves glabrate; leaves basically obovate, broad to linear ..... *N. reticulata* (Meissner) Domin

31*Standard 10-12 mm broad; indumentum sericeous or calyces tending to be villous; leaves more or less persistently sericeous beneath; leaves basically ovate to elliptic (rarely obovate), broad to linear 32

32 Nodes per axillary unit-inflorescence 2, buds 4 (terminal inflorescences may have more nodes and buds); calyces sericeous; leaves narrow to linear ..... *N. capitata* (Benth.) Domin

32*Nodes per axillary unit-inflorescence 3(4), buds 6(8); calyces villous; leaves usually broad, rarely narrow ..... *N. axillaris* (Meissner) Crisp

30*Ovules 2; calyx not >5 mm long 33

33 Leaves neither plicate nor with apices recurved; outlines oblong-elliptic (or tending to ovate, obovate, orbicular or slightly cuneate); apices rounded or truncate, usually retuse, never pungent 33

34 Mature leaves sericeous beneath ..... *N. lehmannii* (Meissner) Crisp

34*Mature leaves glabrate 35

35 Leaves cordate, 11-35 x 8-22 mm; calyces somewhat villous ..... *N.* sp. [*Dilkes*, PERTH 01052705]

35*Leaves rounded at base, 6-22 x 4-14 mm; calyces sericeous ..... *N. pulchella* (Turcz.) Crisp

33*Leaves either plicate or with apices manifestly recurved, usually both; outlines cuneate, spathulate or oblong-elliptic (the last with recurved, semi-pungent apices) 36

36 Leaves rounded at base, oblong-elliptic to somewhat cuneate in outline, apices semi-pungent ..... *N. hookeri* (Meissner) Crisp

36*Leaves with tapered or cuneate bases; outlines cuneate or spathulate; apices mucronate but not pungent 37

37 Leaves spathulate, ternate ..... *N. spathulata* (Benth.) Crisp

37*Leaves cuneate, decussate ..... *N.* sp. A (aff. *hookeri*)

Notes on key

1. *Contra* Crisp & Weston (1987: 124), *Nemcia brownii* (Meissner) Crisp should be treated as *Gastrolobium brownii* Meissner. Its morphology is closer to *Gastrolobium*, and it contains fluoroacetate (T. Aplin, unpublished data; S. Patrick, pers. comm.).

2. Similarly, *N. truncata* (Benth.) Crisp proves on closer investigation to have the bracts, inflorescence and calyx of *Gastrolobium*, whence it came and to which it now should return, as *G. truncata* Benth. We do not know whether it has been tested for toxicity.

3. *N. pauciflora* is probably a taxonomic synonym of *N. plicata*, although this question needs more investigation.

4. *N.* sp. A aff. *hookeri* is variable and needs detailed study. It includes the types of *Gastrolobium stowardii* S. Moore, *G. spathulatum* Benth. var. *latifolium* Benth. and *G. tricuspidatum* Meissner var. *subinerme* Meissner, any of which may be distinct species.

Acknowledgements

The second author made the only collection, the type, of *Nemcia effusa* while employed on contract by the Western Australian Department of Agriculture to survey remnant vegetation in the southern wheatbelt, a project funded by the Australian National Parks and Wildlife Service "Save the Bush" Program. F. Mollemans wishes to acknowledge the funding body.

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Wurmbea calcicola (Colchicaceae), a new species from Cape Naturaliste, south western Australia

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Abstract

Macfarlane, T.D. *Wurmbea calcicola* (Colchicaceae), a new species from Cape Naturaliste, south western Australia. Nuytsia 9 (2): 233-236 (1993). The new species is described and illustrated with a line drawing. It has a very restricted distribution, occurring only on limestone, and is officially listed as endangered.

Introduction

In 1986 during a survey of the flora of a national park, S.D. Hopper and A.P. Brown discovered a species of *Wurmbea* in fruit which did not match any known Western Australian species. Although tentatively identified with the central and South Australian *W. centralis*, flowering plants collected the following season showed the species to be new, so it is formally described here.

Wurmbea calcicola T. Macfarlane, sp. nov. (Figure 1)

Folia 3, infima 2 basalia conferta 10-18 mm lata, folia superiora parva approximata vel distantia. Flores 2-5, bisexuales. Tepala angusta, per quartem longitudinis connata, alba; nectaria 2, vix discreta, nec pegmatoidea, ad medium tepali attingentia, rosea. Stamina nectaria aequantia vel eis breviora. Antherae c. 1 mm longae purpureae. Styli discreti. Ovula 6-12 per loculum.

Typus: Cape Naturaliste area, Western Australia, 33° 32' S, 115° 01' E, 19 June 1987, *S.D. Hopper* 5871 (holo: PERTH; iso: CANB, PERTH). [Precise locality withheld.]

Illustration. Hopper *et al.* (1990), fig. 235, p. 81.

Plant 8-18 cm tall. *Leaves* 3, lower 2 basal, close together, upper one slightly to much higher, separated by an exposed internode (not enclosed by leaf sheaths); lowest leaf ascending, tapering, 10-18 mm wide, flat to somewhat conduplicate, not dilated basally, glossy; middle leaf similar, not or only slightly dilated basally; upper leaf erect, exceeding the flowers, dilated and concave in the lower half, the upper half narrow, tapering. *Inflorescence* open, the rachis zig-zag; growing well

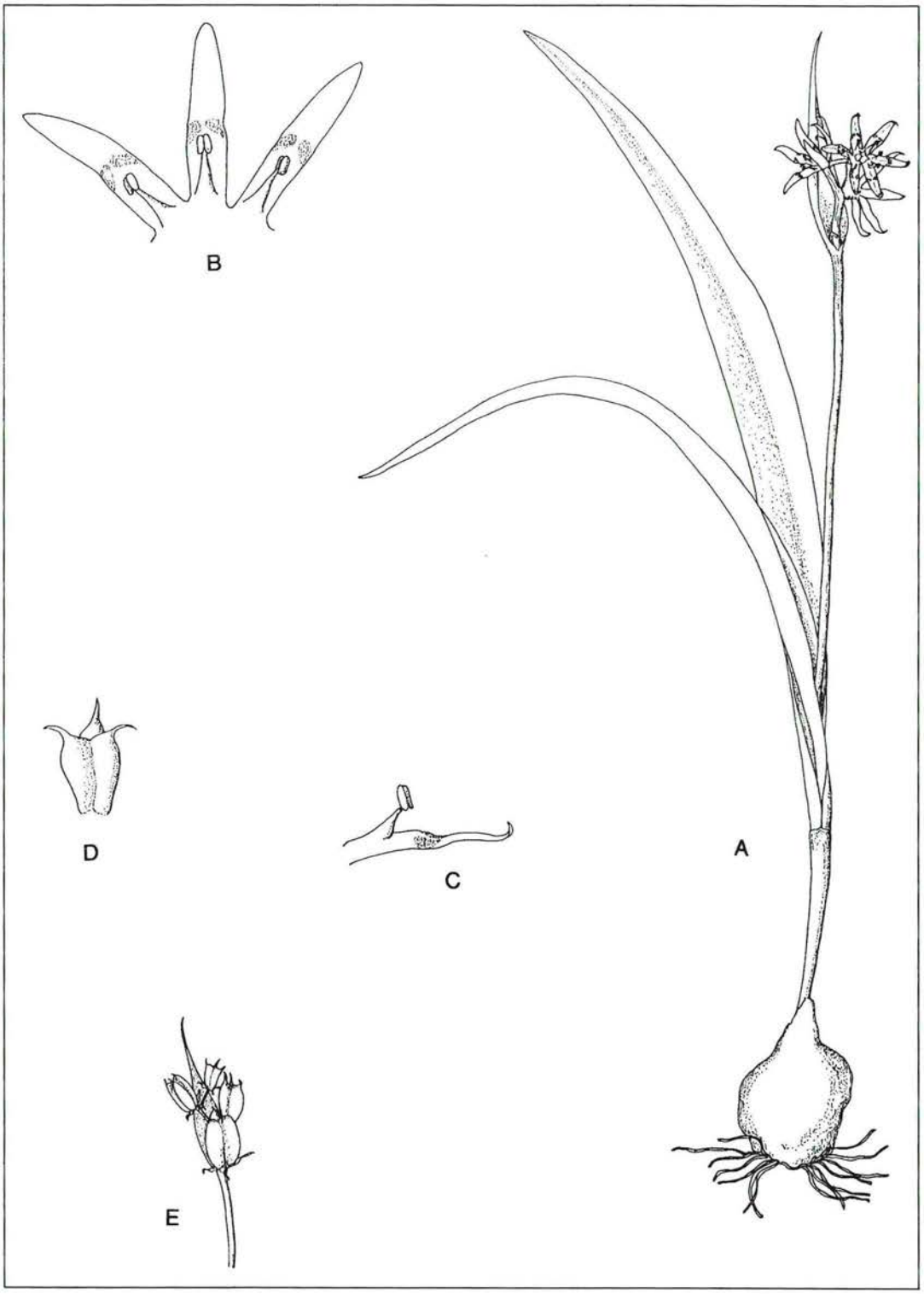

Figure 1. *Wurmbea calcicola.* A - habit (tunics of corm removed); B - perianth and stamens, in part, (nectaries shown by mottling); C - tepal and stamen, lateral view; D - gynoecium; E - immature capsules. Drawn by S.J. Patrick from the type.

beyond leaves, erect in flower, decumbent in fruit. *Flowers* 2-5, bisexual. *Perianth* 11-15.5 mm long; tepals 6, narrow, narrowly ovate to narrowly elliptical or almost linear, connate for 1/4 of their length into a well developed tube, white except for the nectary; nectaries 2 per tepal, scarcely separate, only narrowly separated in young flowers by a central longitudinal groove (sometimes appearing undivided in dried material), more widely separated by spreading of the groove in older flowers, at or slightly below the middle of the tepal, each rhomboidal in outline, together forming a curved slightly interrupted band, not shelf-like (i.e. not rising abruptly at lower margin with the remainder more or less flat and horizontal) but with a distinct thickened lower margin and indistinct upper margin, pink. *Stamens* about half as long as tepals, reaching to slightly below or to slightly above the nectaries; anthers c. 1 mm long, oblong, purple. *Styles* free, abruptly delimited from the ovary; ovules 6-12 per locule.

Other specimens examined. WESTERN AUSTRALIA: Cape Naturaliste area, *S.D. Hopper* 5509 (PERTH); *G.S. McCutcheon* 1816 (PERTH).

Distribution. Known only from a very restricted area in the Cape Naturaliste area, Leeuwin-Naturaliste National Park, Western Australia.

Habitat. Occurs in small colonies in brown loam in pockets on coastal limestone cliffs, in open or shaded places in low shrubland of *Melaleuca huegelii*, *M. acerosa*, *Spyridium globosum*, *Beyeria viscosa*, *Olearia axillaris*, *Guichenotia ledifolia*, *Templetonia retusa*, *Acacia* sp. and *Acanthocarpus preissii*.

Flowering and fruiting periods. Flowering June-July. Fruiting July-August.

Discussion. The new species resembles variants of *Wurmbea centralis*, indeed the fruiting plants which were first found were originally identified as that species. However *W. calcicola* differs in having white flowers (other than the nectaries) instead of pink, less shelf-like (i.e. without an abrupt rise at proximal margins) and less separated nectaries, and narrower tepals with a tube more than twice as long. Some variants of *W. centralis* differ further in one or more of the following features: more flowers per inflorescence; the leaves all separated by exposed internodes (see above) and different from one another in shape; styles basally connate.

The key to the species of *Wurmbea* in Flora of Australia (Macfarlane 1987) can accommodate *W. calcicola* by the following changes.

Modified couplet:

20 Nectaries usually above middle of tepals ..... *W. graniticola*

20: Nectaries at or below middle of tepals

New couplet to follow the first lead of couplet 26 (from which *W. biglandulosa* should be deleted):

26a Lowest leaf usually 1-2.5 mm wide; perianth tube c. 1/10 of perianth length ..... *W. biglandulosa*

26a: Lowest leaf 10-18 mm wide; perianth tube c. 1/4 of perianth length ..... *W. calcicola*

The new species conforms well to the current generic descriptions (Macfarlane 1987, Nordenstam 1986) in all respects except ovule number, for which it has an unusually low number. Australian *Wurmbea* species have previously been recorded as having 10-25 ovules per locule (Macfarlane 1987). Apparently the situation is similar in African species, where one species has been recorded as having an exceptionally low number, 4-6 ovules per locule (Sterling 1973).

Wurmbea pygmaea (*Hopper* 5872) grows nearby in similar soil conditions to *W. calcicola*. *W. monantha,* another coastal, limestone inhabiting species could also be expected, although it has not so far been collected at the type locality of *W. calcicola*. Two other species often found on limestone, although occurring several hundred kilometres further north, are *W. inframediana* and *W. odorata*.

Conservation status. Wurmbea calcicola was declared rare in September 1987 as *Wurmbea* sp., Cape Naturaliste, *S.D. Hopper* 5871, and currently has the conservation code R (Declared Rare Flora, Atkins 1992). No further populations have been discovered since then. All the known plants are in the Leeuwin-Naturaliste National Park. Consequently, although its restricted distribution in an area subject to human recreational usage places the species at risk, it has legal and management protection.

Etymology. The epithet is from the Latin *calcium,* calcium or lime and *-cola*, dweller referring to its growing over limestone.

Acknowledgements

I am grateful to S.D. Hopper for bringing the species to my attention, for taking trouble to provide fresh plants for study and for making the illustration available. Knowing that the species was rare from the results of the regional survey which led to its discovery, he also ensured that it was promptly declared rare. S.J. Patrick is thanked for her skilful drawing. Paul G. Wilson kindly translated the description into Latin.

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New species and taxonomic changes in *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia

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Abstract

Olde, Peter M. and Marriott, Neil R. New species and taxonomic changes in *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia. Nuytsia 9 (2): 237-304 (1993). Eight new species and 8 new subspecies are described; 3 currently accepted subspecies are raised to specific rank; 1 species currently in synonymy is reinstated at specific rank. Keys are provided to enable separation from closely related species. An index to taxa is given on page 304.

Introduction

This paper presents some of the results of our ongoing studies in the genus *Grevillea*. These studies have involved extensive field work over a period of four flowering seasons as well as relevant herbarium studies, particularly on specimens at NSW and PERTH. With the exception of *G. coccinea* subsp. *lanata,* all taxa have been studied as natural populations. Keys are provided where small, closely related groups are involved. Conservation codes follow those required by the Department of Conservation and Land Management, Western Australia. Synonymy and typification details where applicable are drawn from McGillivray (1993).

Eight new species are described: *Grevillea adpressa* P. Olde & N. Marriott, *G. althoferi* P. Olde & N. Marriott, *G. corrugata* P. Olde & N. Marriott, *G. crowleyi* P. Olde & N. Marriott, *G. prominens* P. Olde & N. Marriott, *G. pythara* P. Olde & N. Marriott, *G. rara* P. Olde & N. Marriott and *G. superba* P. Olde & N. Marriott. Eight new subspecies are described: *G. coccinea* Meissn. subsp. *lanata* P. Olde & N. Marriott, *G. curviloba* McGillivray subsp. *incurva* P. Olde & N. Marriott, *G. dryandroides* C.A. Gardner subsp. *hirsuta* P. Olde & N. Marriott, *G. haplantha* F. Muell. ex Benth. subsp. *recedens* P. Olde & N. Marriott, *G. insignis* Kippist ex Meissn. subsp. *elliotii* P. Olde & N. Marriott, *G. pilosa* A.S. George subsp. *redacta* P. Olde & N. Marriott, *G. synapheae* R. Brown subsp. *pachyphylla* P. Olde & N. Marriott, *G. thyrsoides* Meissn. subsp. *pustulata* P. Olde & N. Marriott. Three currently accepted subspecies *G. pilosa* A.S. George subsp. *dissecta* McGillivray, *G. acrobotrya* Meissn. subsp. *uniformis* McGillivray, *G. disjuncta* F. Muell. subsp. *dolichopoda* McGillivray are respectively raised to specific rank as *Grevillea dissecta* (McGillivray) P. Olde & N. Marriott, *G. uniformis* (McGillivray)

P. Olde & N. Marriott, and *G. dolichopoda* (McGillivray) P. Olde & N. Marriott. One species, *G. flexuosa* (Lindley) Meissn., referred to synonymy by McGillivray (1993), is reinstated at specific rank.

The paper is divided into 6 parts. Part 1: species 1-5 (*G. curviloba, G. rara, G. corrugata, G. adpressa, G. uniformis*), species referable to Section 11 *Manglesia sensu* Bentham. This group is distinguished in having pedicels elongate, filiform; perianth actinomorphic; pistils very short (2.5-6.5 mm long), glabrous and with styles strongly constricted above the ovary below a conspicuous dilation beyond which the style tapers to a conical style-end; fruits oblong-ellipsoid. Part 2: species 6-8 (*G. synapheae, G. flexuosa, G. prominens*) , species referable to Section 9 *Conogyne sensu* Bentham. This group is distinguished by its conflorescences with development basipetal, perianth strongly curled in young bud; pistils glabrous, <10 mm long with styles retrorse to sigmoid after anthesis and with an erect, conical pollen-presenter; nectary absent. Part 3: species 9-12 (*G. thyrsoides, G. dryandroides, G. crowleyi, G. coccinea*), species referable to Section 1 *Eugrevillea* Series 2 *Hebegyne sensu* Bentham. This group is distinguished by its conflorescences usually secund; perianth zygomorphic and glabrous on the inner surface; ovary densely hairy and either sessile or shortly stipitate; fruits with an indumentum of reddish or purple-coloured stripes or blotches. Part 4: species 13-15 (*G. pilosa, G. dissecta, G. insignis*). This assemblage was partially placed by McGillivray (1993: 454) in his Group 12. These species have conflorescences with development basipetal; torus very oblique; ovarian stipe adnate at its base to the inside of the torus, usually refracted at right angles at the upper margin of the torus; perianth zygomorphic, the tepals strongly ridged, the limb with segments impressed along their margins; ovary densely hairy; fruits oblong-ellipsoid with bony pericarp. Part 5: species 16-17 (*G. haplantha, G. dolichopoda*). These species are referable to Section 1 *Eugrevillea* Series 3 *Plagiopoda sensu* Bentham, a group distinguished by its leaves simple and entire, conflorescences axillary or cauline and generally few-flowered; torus oblique; perianth zygomorphic, dilated at the base, hairy on both surfaces; ovary densely hairy, shortly stipitate; pollen-presenter very oblique to lateral. Part 6: species 18-20 (*G. althoferi, G. pythara, G. superba*); a group of three unrelated species whose affinities are discussed within the text.

New taxa are described at specific and subspecific ranks some of which have not been previously recognised. Perhaps the most controversial aspect of the paper will be the decision to rank at specific rank three taxa recently described at subspecific rank (McGillivray 1986), to restore one species from synonymy and to recognise taxa at both specific and subspecific rank that have been treated informally in the recently published revision of the genus (McGillivray 1993). As this paper will be followed by a book on the genus by the two authors in which other similar changes may be made and further new taxa will be either restored or newly described, it is proper and reasonable that a brief outline of our species concept be given in order that the reasons for our actions can be understood and our position in relation to the McGillivray revision can be evaluated.

We should make it clear from the outset that our treatments are not intended to diminish McGillivray's revision, which stands as a taxonomic document of significant internal integrity, erudition and research and will remain the standard reference for many years against which we and others can make valid taxonomic comparisons. Rather, we put forward a different perspective in the admittedly more subjective area of interpretation and ranking which reflects our adoption of a somewhat narrower, biologically orientated species concept as the basic unit of practical human recognition. To some extent, this approach is more concordant with historically accepted species concepts within the genus. Therefore we do not argue anything particularly new, nor do we assert any empirical error on the part of others but rather our disagreement centres on the classification

hierarchy erected, especially in relation to populations in sympatry, and the broad concepts adopted in relation to some species *sensu* McGillivray, many of which might better be regarded as taxonomically unresolved super-species.

We would assert that a classification hierarchy should be founded on the dictum that reproductively isolated, self-reproducing populations exhibiting morphological consistency (that is morphologically discontinuous from other closely related populations) should be regarded as species, irrespective of the kind and degree of morphological distinction. It is therefore axiomatic to our species concept that when such populations occur sympatrically and most especially where sympatric occurrence occurs more than once, then these populations represent biological species. There is thus an implication that one centred on the phenetic similarity of flowers alone or one requiring too high a level of discontinuity is liable to distort the biological reality and although useful in the elucidation of phylogeny, often obscures discontinuity exhibited in other, sometimes more obscure but equally valid features such as habit, leaf and fruit morphology, flowering time, flower and foliage colour, floral orientation and ontogeny, and pollinators (often yet to be ascertained).

Ranking of allopatric populations exhibiting only slight morphological discontinuity may involve a degree of subjective assessment and needs to be balanced against the number of populations involved, the degree of variation and the number of other closely related species accepted. Here we would acknowledge the value of the rank of subspecies or variety or a mixture of the two. In this system, some morphological overlaps can be tolerated between discrete infraspecific populations. Indeed, they are perhaps desirable and add support to their conspecific assignation. For practical purposes, however, these populations should nonetheless be visually recognisable as different. We would assert that, at least in Western Australia, it is reasonable to assume reproductive isolation in geographically disjunct populations, as it is a matter of direct observation, at least in Proteaceae, that there is a very low degree of genetic interchange among wild populations. Even in Section *Manglesia sensu* Bentham, which is often claimed to be genetically labile, it has been our observation that, by and large, the group consists of reproductively isolated wild species, exhibiting no greater tendency to hybridise than species in other groups.

The narrower, biologically based species concept which we apply necessitates recognition of a much greater number of taxa at specific rank than does a conceptually broad one. Widened species circumscriptions tend to obscure polymorphism and sometimes even create polyphyletic, biological entities, even when some infraspecific recognition is accorded them. The priority for us is to describe all taxa and thus give a clearer picture of the biological entities involved. Some might misinterpret this as an obsession with naming. However, we would reply that formal rather than informal nomenclature is more satisfying to the end-user in that it validates perceptions of the biological diversity observed, provides a better avenue of communication and very often leads to a different legal and conservation imperative.

McGillivray (1993) has delimited and provided data about a large number of informal entities, which *prima facie* in our concept, warrant more formalised nomenclature. In some cases, our research has provided additional evidence to strengthen his observations. In others, it has confirmed the reality of the biological entity to which the clues provided by McGillivray point, without providing any new evidence.

Along with a number of other authors, we have enjoyed, from 1986 to 1990, privileged consultatory rights to the manuscript of the *Grevillea* revision (McGillivray 1993) through the kind

permission of its author. This revision has acted as a foundation stone and catalyst to our own work and enabled us to progress exponentially in knowledge about this beautiful genus. Although our views are now, in some instances, at variance with those of its author, Mr McGillivray has continued to promote our interest, encouraged us to develop our critical faculties beyond their early rudimentary state and, both then and now, urged us to form our own views in the interest of advancing knowledge.

Morphology and methods

Species descriptions and terminology follow McGillivray (1993) and measurements have been made on most character states used in this revision to enable objective comparison. In that revision, the indumentum term 'tomentose' is defined as a moderately dense, often untidy indumentum of ascending hairs, more or less intermediate between subsericeous and subvillous. This more restricted usage applies to a condition frequently found in *Grevillea* (McGillivray 1993: 11). Other morphological terms follow those given in a prior paper (Olde & Marriott 1993: 401) and in Hewson (1988).

All taxa have been re-measured using dried specimens at PERTH and NSW as well as our own collections. Where large numbers of specimens are involved, approximately 20 were first measured to gain upper and lower limits and compared with measurements given in McGillivray (1993). They were then compared by visual check with all other specimens to check conformity. Where small numbers of specimens were involved, all were measured. Re-measurement has provided significant differences in the measures of some character states for some species.

Perianth length is the distance measured at right angles from the mid-point of the torus to the top of the flower. In zygomorphic flowers this is usually where the perianth curves, not the apex of the limb.

1. Grevillea curviloba McGillivray in New Names in Grevillea: 4 (1986). (Figure 1)

Replaced synonym (McGillivray 1986: 4) *Grevillea vestita* var. *angustata* Meissn. in Lehmann [ed.], Pl. Preiss. 1: 549 (1845), 'ß* angustata'. *Lectotype* (McGillivray 1993: 412): Swan River, *Drummond* 1839 (lecto: photo seen, G-DC; isolecto: *(n.v.)* [*J. Drummond* I. 622]: CGE, G, MEL 52541, P).

Grevillea diversifolia var. *rigida* Meissn. in Candolle, Prodr. 14: 368 (1856), '* rigida'. *Lectotype: (n.v.)* (*fide* McGillivray 1993: 412) Drummond Coll. 1848 n. 286! hb. Shuttl. (lecto: NY - packet at left of sheet; isolecto: [*Drummond* IV, 286] CGE, G, K - (Neg. No. Kew 2312), MEL 47020, P - 2 sheets, TCD.

Juveniles: prostrate, sprawling, dense shrubs with sparsely sericeous foliage. *Adults:* prostrate to erect shrubs 0.1-2.5 m high, 1-2 m wide, with weakly ascending to erect floral branches; branchlets slightly angular, brittle, glabrous or sparsely tomentose, slightly ridged. *Leaves* pale green, 1-5.2 cm long, < 1.5 cm wide, sessile to shortly petiolate, crowded, pinnatifid and usually obovate-cuneate in outline or secund-subpinnatisect; leaf rachis medially grooved, straight to incurved; primary lobes 3-5, ascending, sometimes with secondary or tertiary division; ultimate lobes 0.4-1.5 cm long, 0.7-1.5 mm wide, triangular to linear, straight to incurved, scarcely pungent, the basal lobes of pinnatisect leaves (3.5)6-20 mm from the axis of attachment, the intervening rachis with revolute margin on either side except at the axis; upper surface glabrous or sparsely sericeous, the venation obscure, usually grooved along the midvein of leaves and lobes; lower surface exposed and glabrous or sprinkled with

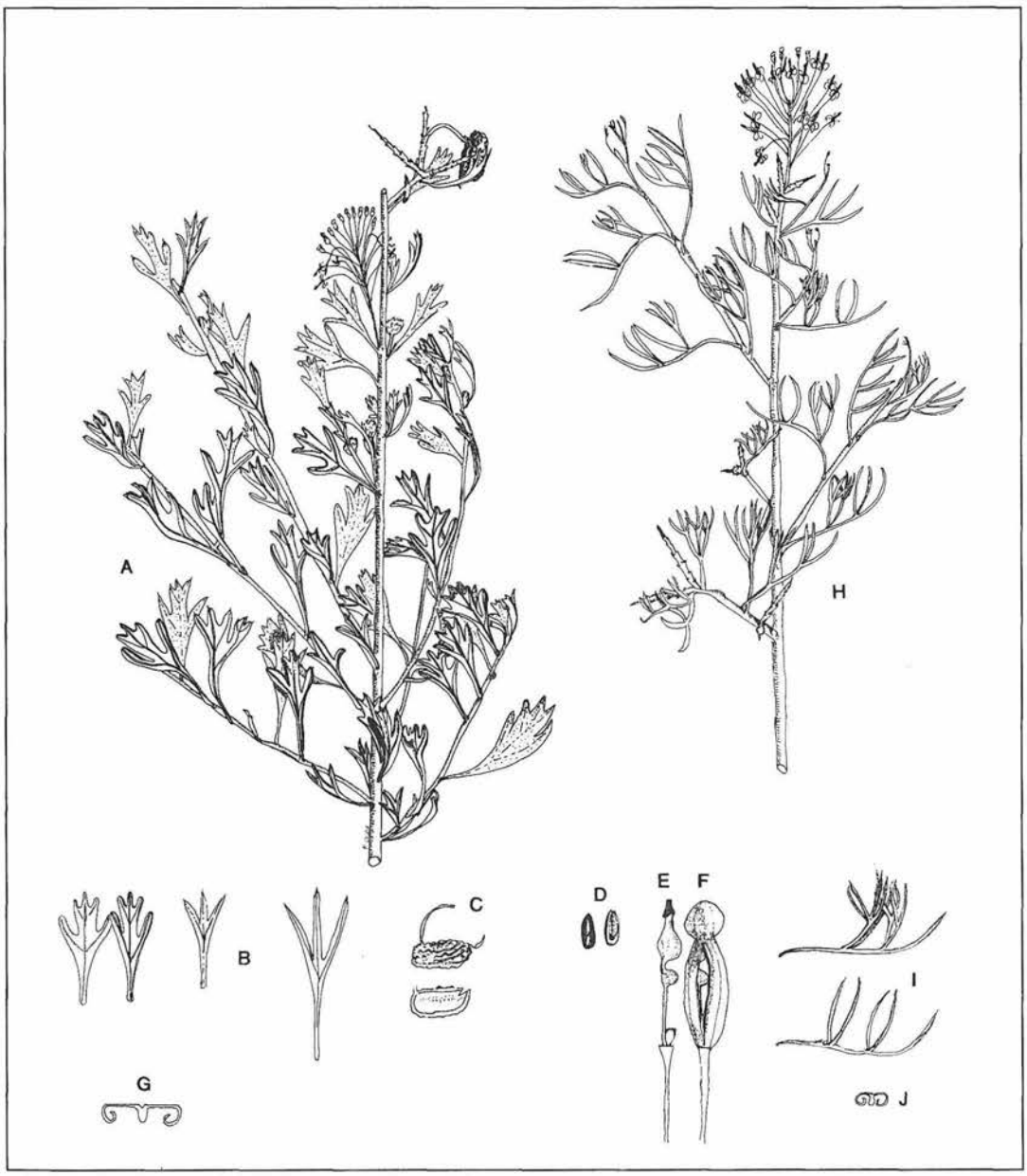

Figure 1. *G. curviloba* subsp. *curviloba* A - habit, B - leaf shapes, C - fruit, D - seed, E - pistil, F - perianth, G - cross-section of leaf lobe. *G. curviloba* subsp. *incurva* H - habit, I - leaves, J - cross-section of leaf lobe.

appressed hairs, sometimes mostly enclosed and obscured by the margin except at the sinuses or beside the midvein, the midvein and lateral veins smoothly rounded, protuberant and surmounted on raised lamina; margin smoothly recurved to loosely revolute, not firmly abutting the midvein over its entire length. *Conflorescence* sessile, mostly axillary, sometimes terminal, mostly on conspicuous floral branches, simple to 5-branched at the base; unit conflorescence 1-3 cm long, 1.5-2.5 cm wide at the base, ovoid to subglobose, loose, usually partially exceeding the foliage, development acropetal; floral rachis 1-3 cm long, glabrous, sometimes sparsely tomentose at the base, usually much-thickened after anthesis; floral bracts 1.5-3 mm long, 1.5-3 mm wide, imbricate, ovate-cupuliform

to oblong-ovate or ovate-acuminate, glabrous to sparsely tomentose outside with ciliate margins, caducous. *Flowers* usually glabrous: pedicels 7-10 mm long; nectary erect, U-shaped to oblong with the apex slightly lipped, extending 0.1-0.2 mm above the toral rim; *perianth* white to cream, 3.5-4 mm long 0.8-1 mm wide, actinomorphic, oblong-obovoid below the limb, rarely a few hairs below the limb inside; tepals medially ribbed, separating below the limb before anthesis, free to the base and rolling back after; limb 1 mm long, 1.5 mm wide, ovoid to subglobose, the apex sometimes depressed, the segments ribbed, firmly enclosing the style-end before anthesis; pistil 3.5-6.5 mm long; stipe 1.4-2 mm long; ovary c. 1 mm long, globose; style white, constricted above the ovary below an abrupt and conspicuous dilation, the zone of constriction 0.2-0.5 mm long, the dilation ovoid 0.5-0.7 mm wide, again contracted beneath a slightly expanded style-end; pollen-presenter erect, conical, its base 0.5-0.6 mm wide, oblique, wider than the style; stigma 0.1-0.2 mm across. *Fruit* 10-13 mm long, 6-9 mm wide, oblong-ellipsoid, echinulo-rugose with irregular raised asperities sometimes joined in continuous ridges; pericarp 0.9-1.2 mm thick. *Seed* 7-9 mm long, 3-3.5 mm wide, obovoid to ellipsoid with a shortly apiculate or tapered apex and base, biconvex; outer face shiny, slightly wrinkled; inner face with a broad, waxy border surmounted by a smooth, central elliptic section.

Affinities. G. curviloba is closely related to a number of species including *G. corrugata, G. paniculata, G. phanerophlebia, G. rara* and *G. vestita*, for which a key is provided (Key 1, see page 250). The diagnostic features that enable sure identification of *G. curviloba* are: ascending to erect floral branches; branchlets glabrous or sparsely tomentose; leaves with obscure venation on the upper surface and usually grooved along the midvein, the undersurface either clearly exposed or visible at the sinuses or beside the margin and with protuberant rounded veins surmounted on raised lamina, margin loosely revolute; floral rachises glabrous in the apical half and usually thickened after anthesis; floral bracts broadly ovate, glabrous or almost so except the margins ciliate; fruits strongly rugose and enlarged with pericarp 0.8-1.2 mm thick.

Discussion. There are two visually distinct morphological entities in *G. curviloba*. Field collections and herbarium study of these entities show that they occur in homogeneous populations that are geographically disjunct, admittedly by only a few kilometres. Both entities grow in grey sand in winter-wet, low-lying depressions in heath. This species has high horticultural usage and conservation value and, as there is considerable confusion as to the identity of one of these entities, we consider it appropriate to divide the species into two subspecies, subsp. *curviloba* and subsp. *incurva* P. Olde & N. Marriott. Re-measurement of specimens showed considerable quantitative differences to those given for floral bract and pistil length in McGillivray (1993).

Key to subspecies of *Grevillea curviloba*

1 Leaves usually pinnatifid, sometimes subpinnatisect but with broad sinuses and with the leaf undersurface clearly exposed; simple leaves or primary leaf lobes > 1.5 mm wide, mostly obovate-cuneate with ascending lobes, sometimes linear; secondary division mostly lacking or -fid if present ..... subsp. *curviloba*

1* Leaves secund-subpinnatisect, the undersurface either not visible or very inconspicuously so at the sinuses or beside the midvein; primary leaf lobes 0.8-1.2 mm wide, narrow-linear to subulate; secondary -sect division of the basal vegetative leaves usually present ..... subsp. *incurva*

Grevillea curviloba subsp. **curviloba**

Leaves 1.5-5 cm long, mostly pinnatifid, obovate-cuneate and coarsely divided either with apical toothing or more deeply cleft with strongly ascending lobes, rarely simple, entire and linear; simple leaves or leaf lobes mostly 1.5-2 mm wide, triangular to narrowly so, occasionally a deeply cleft lobe with -fid division of the apex; undersurface exposed over most of its area, glabrous or sparsely tomentose; pistil 3.5-4.5 mm long.

Selected specimens (6 examined). WESTERN AUSTRALIA: Warbrook Rd, South of Bullsbrook, *Olde* 91/78, 12 Sep. 1991 (NSW); RAAF base, Bullsbrook, *Olde* 88/63, 9 Oct. 1988 (NSW); 2 km N of Bullsbrook, *Olde* 86/283, 9 Sep. 1986 (NSW); Between Wanneroo and Bullsbrook at railway crossing, *Olde* 88/61, 9 Oct. 1988 (NSW); Bullsbrook, *Demarz* 3945, Oct. 1972 (PERTH); Bullsbrook, *Morrison*, 14 Aug. 1900 (PERTH).

Distribution. Restricted to an area near Bullsbrook, where often scattered in degraded situations.

Habitat and ecology. Winter-wet heath in grey sand. The flowers are attended by numerous insects, including wasps.

Flowering period. Spring.

Affinities. In the overall outline of its leaves, subsp. *curviloba* is most closely allied with *G. vestita* (Endl.) Meissn. subsp. *vestita*. Indeed, *G. vestita* var. *angustata* Meissn. is the replaced synonym of *G. curviloba*. Endlicher's (Endlicher 1839: 26) original description is worth noting in part, 'foliis ...cuneatis apice trifidis' (the leaves...cuneate, apically trifid) as well as Meissner's (Meissner 1845: 549) description of var. *angustata*...'lobis dimidium laminae aequantibus v. superantibus' (the lobes cleft about half the length of the lamina or a little more). The visual similarity of its leaves notwithstanding, *G. vestita* differs from *G. curviloba* in its villous branchlets, its leaves densely hairy on the undersurface, its persistent floral bracts and in its smooth fruits.

Conservation status. CALM Priority One.

Grevillea curviloba subsp. **incurva** P. Olde & N. Marriott subsp. nov.

A subspecie typica foliis secundis, subpinnatisectis, foliorum lobis incurvis angustioribus (0.8-1.2 mm latis) cum lamina infra ab margine revoluta pro parte maxima occulta differt.

Typus: Western Australia: Steer St, Muchea, *P. Olde* 92/108, 26 Sep. 1992 (holo: NSW; iso: PERTH).

Differs from the type in its secund, subpinnatisect leaves, the lobes narrower (0.8-1.2 mm wide) and incurved, the leaf undersurface almost entirely enclosed by the revolute margin.

Leaves 1.8-5.2 cm long, secund, tripartite to bipinnatisect, the first lobe arising 6-32 mm from the leaf base, with three to five narrow-linear primary lobes, sometimes the lower lobes bi- or trisect; ultimate lobes 7-20 mm long, 0.8-1.2 mm wide, strongly incurved, narrow-linear to subulate, weakly pungent; lower surface bisulcate, the lamina either obscured by the margin or almost so; pistil 4-6.5 mm long.

Selected specimens (10 examined). WESTERN AUSTRALIA: Brand Hway, Muchea, *Olde* 86/632, 25 Sep. 1986 (NSW); Near Muchea, *McGillivray* 3273 & *George*, 10 June 1976 (NSW, PERTH); Muchea Townsite Reserve, *Keighery* & *Alford* 83, 27 Aug. 1985 (PERTH); 1 mi. N of Muchea, *Newbey* 1674, 26 Aug. 1964 (PERTH); Muchea, *Steedman*, Sep. 1927 (PERTH).

Distribution. Western Australia, near Muchea.

Habitat and ecology. Winter-wet heath in grey sand. The flowers are attended by numerous insects, including wasps.

Flowering period. Late Winter-early Spring.

Affinities. There is a very close relationship with *G. rara.* The distinguishing features are listed in Table 1 (see page 246).

Notes. The description of subsp. *incurva* regrettably results in a further modification to the name of a widely cultivated taxon which has been, for many years, misidentified as *G. biternata* Meissn.

Conservation status. As for subsp. *curviloba.*

Etymology. The subspecific epithet is derived from the Latin *incurvus* - curved inwards, in reference to the leaf lobe curvature.

2. Grevillea rara P. Olde & N. Marriott sp. nov. (Figure 2)

Ad *Grevilleam curvilobam* McGillivray affinis sed ramulis dense tomentosis, rhachidibus conflorescentiarum omnino tomentosis, foliorum lobis plerumque angustioribus (0.3-0.8 mm latis) lamina subtus non exposita, pedicellis brevioribus (3.5-4.5 mm longis), nectario obscuro differt.

Typus: Western Australia: 14.5 km N of Collie on road to Tallanalla, 33° 11'S, 116° 08'E, *P.M. Olde* 86/1008, 31 Oct. 1986 (holo: PERTH; iso: NSW).

Aff. *Grevillea curviloba* McGillivray, but differs in its densely tomentose branchlets, its floral rachises entirely tomentose, in its mostly narrower leaf lobes (0.3-0.8 mm wide), the lamina on the undersurface not exposed, in its shorter pedicels (3.5-5 mm long) and in its obscure nectary.

Juveniles: prostrate sprawling densely foliaged shrubs with young leaves sericeous. *Adults:* dense, prickly, irregular shrubs to 2 m high, 1 m wide; branches irregularly spreading, dense to the ground; branchlets angular to smoothly rounded, densely tomentose-pubescent. *Leaves* 1.5-2.5 cm long, <1.5 cm wide, ascending to erect, sessile to shortly petiolate, crowded, secund-subpinnatisect, sometimes the apical lobe divaricate; leaf rachis medially and longitudinally channelled, straight to slightly incurved along its axis or, very often slightly refracted or recurved at the junction of the nodes, the axis between the nodes slightly incurved; primary leaf lobes 3-5, ascending, sometimes with secondary bi- or tripartite division, the apical lobe simple; ultimate lobes 0.4-2 cm long, 0.3-0.8 mm wide, narrow-linear, straight to very slightly incurved, apex scarcely pungent, the basal lobes 5-7 mm from the axis of attachment and with a narrow, tightly revolute margin abutting the rachis on either side; upper surface smooth, glabrous, the venation obscure; lower surface bisulcate, the lamina enclosed by the margin, the grooves glabrous, the midvein rounded, level with or raised slightly above the abutting margin; margin smoothly revolute. *Conflorescence* 1-2 cm long, 1-1.5 cm wide, sessile to shortly pedunculate, terminal or axillary and crowded in the upper axils, simple, shortly cylindrical

to subglobose, dense, scarcely to not exceeding the foliage, development acropetal; floral rachis 1-1.5 cm long, tomentose; floral bracts 1.2 mm long, 1.2-1.8 mm wide, imbricate, broadly ovate-cupuliform to almost square, tomentose or sparsely so outside with ciliate margins, caducous. *Flowers* glabrous; pedicel 3.5-5 mm long; torus 0.5 mm across, oblique at c. 10-30°; nectary obscure, extending 0.1 mm above the toral rim; *perianth* white to pale pink, all white at anthesis, 3-3.5 mm long, 0.8 mm wide, actinomorphic, narrowly oblong-obovoid, slightly constricted below the much broader limb; tepals medially ribbed, separating below the limb before anthesis, becoming free to the base and rolling independently back after; limb 1 mm long, 1.3-1.5 mm wide, spheroidal, apically depressed, the segments ribbed, firmly enclosing the style-end before anthesis; *pistil* 3.5 mm long; stipe 1.5 mm long, flexuous, inserted on the dorsal rim of the torus; ovary 0.8 mm long, subglobose; style white with occasional pink tinges on the pollen-presenter, constricted for 0.2-0.5 mm above the ovary, then dilating 0.3-0.5 mm wide, the dilation ovoid to almost cylindrical, tapered to 0.3 mm wide just below the style-end; pollen-presenter 0.5-0.6 mm ıg, erect, truncate-conic to subcylindrical, the base 0.5 mm wide, slightly oblique and scarcely bro er than the style; stigma 0.3 mm wide. *Fruits* oblong-ellipsoid, rugose on young fertilised ovarie *Seeds* not seen.

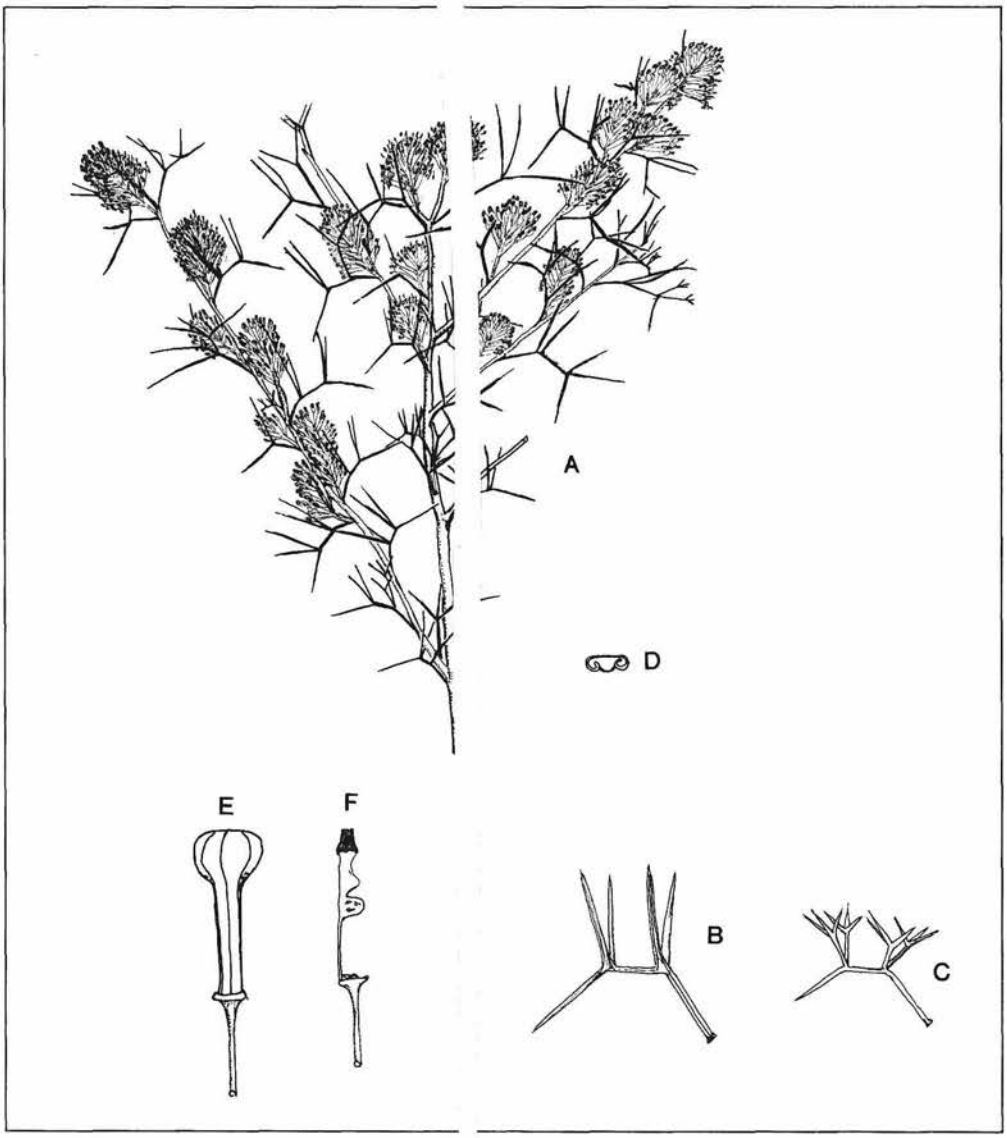

Figure 2. *G. rara* A - habit, B, C - leaves.) - leaf lobe in cross-section, E - perianth, F - pistil.

Distribution. Western Australia: known only from 2 sites approximately 1 km apart, at 14.5 and 15.5 km north of Collie, both of which have been flooded by the Harris River Dam.

Habitat and ecology. Occurs along creek lines in lateritic loam in jarrah forest. Pollination probably by insects. Regeneration appears to be from seed only.

Flowering period. Spring.

Affinities. This species is close to *Grevillea curviloba* McGillivray especially subsp. *incurva* P. Olde & N. Marriott. The differences are listed in Table 1. In *G. curviloba* subsp. *incurva* the leaf margins are revolute but do not firmly and consistently abut the midvein on the undersurface. It is unfortunate that fruits were unavailable for comparison.

The combination of important features assisting recognition of *G. rara* are: branchlets with a dense indumentum of short, ascending to spreading hairs; leaves subpinnatisect with the margin smoothly rounded and completely enclosing the undersurface, the upper surface with obscure venation, ultimate lobes < 1 mm wide, slightly divaricate, inflorescences unbranched with rachises densely hairy to the apex and pedicels 3.5-5 mm long.

Conservation status. A code of Priority One is recommended. Although now extinct at the Type locality, the species was propagated successfully from cuttings sent in 1986 and is being grown at Stawell, Victoria by Neil Marriott and, more recently, at Mt Annan Botanic Garden, New South Wales. Further searches along creek lines in the general area may relocate the plant in the wild.

Etymology. The epithet is derived from the Latin *rarus* - rare, in reference to the conservation status of this species.

TABLE 1

	G. curviloba subsp. **incurva**	**G. rara**
Branchlet indumentum	absent to sparse	dense
Leaf lobes	0.7-1.5 mm wide incurved ascending	0.3-0.8 mm wide mostly straight divaricate
Leaf undersurface	partially exposed	obscured
Conflorescence	branched or simple	simple
Floral rachis	glabrous in the distal half	densely hairy all over
Pedicels	7-10 mm long	3.5-5 mm long
Nectary	prominent	obscure
Habitat	open heath winter-wet swamp	Eucalypt forest creek line
Soil	grey sand	lateritic loam

3. Grevillea corrugata P. Olde & N. Marriott sp. nov. (Figure 3)

Ad *Grevilleam curvilobam* McGillivray affinis praecipue subsp. *incurvam* P. Olde & N. Marriott sed habitu erecto, foliis remotis latioribusque (plerumque 5-9 cm latis) inter basem et lobum infimum plerumque alatis, foliorum lobis pro parte maxima longioribus (2-2.5 cm longis) rectis divaricatisque, costa in pagina superna visibile, rhachidibus conflorescentiarum omnino tomentosis-villosis, florum bracteis extra villosis differt.

Typus: Western Australia: c. 10 km S of Bindoon [precise locality withheld], *P. Olde* 92/230, 4 Oct. 1992 (holo: NSW; iso: PERTH, CANB.)

Aff. *Grevillea curviloba* McGillivray especially subsp. *incurva* P. Olde & N. Marriott but differs in its erect habit, its distant leaves wider (usually 5-9 cm wide) and with the base usually winged between the lowest lobe and the base, its leaf lobes mostly longer (2-2.5 cm long), straight and divaricate, the midvein evident on the upper surface, its floral rachises tomentose-villous all over, its floral bracts villous.

Juveniles not seen. *Adults:* single-stemmed dense shrubs 1.5-2.5 m tall, 1.5-2 m wide with numerous spreading to ascending branches; branchlets slightly angular and conspicuously villous when very young, rounded and openly to sparsely subvillous with age, longitudinally ribbed. *Leaves* 4-6 cm long, 5-9 cm wide, ascending, sessile, subpinnatisect, sometimes tripartite or pinnate, usually biternate, occasionally the central lobe with up to 5 secondary lobes with rare tertiary bi- or tripartite division; leaf rachis channelled, straight to slightly refracted; ultimate lobes (0.8)1.5-3(3.4) cm long, 0.7-1.2 mm wide, linear-subulate, straight, pungent, the basal lobes patent to spreading; distance from axis of attachment to first lobe 2-20 mm, during branchlet elongation the distance reducing from 20 mm on first-formed leaves to 5-10 mm on the fifth-formed leaf, the intervening rachis on late-formed leaves with a strip of unfurled lamina 1-1.2 mm wide on either side of the midvein extending from basal lobe to the axis of attachment and bearing a flat margin; upper surface glabrous or sparsely tomentose, the midvein and faint edge-veins also evident on some leaf lobes; lower surface mostly enclosed by the margin but with some exposure at the sinuses or occasionally beside the midvein, glabrous or with a few wavy hairs, midvein rounded, protuberant and surmounted on raised laminal tissue; margin loose, smoothly to angularly recurved or revolute. *Conflorescences* subsessile, simple to 3-branched at the base, usually terminal on short axillary branchlets and subtended by a vegetative branchlet, sometimes axillary; unit conflorescence 1-2.5 cm long, 2 cm wide at the base, ovoid to subglobose, open, partly exceeding the foliage, development acropetal; floral rachises 0.8-2 cm long, loosely tomentose-villous; floral bracts 3.5-4 mm long, 3 mm wide, ovate-cymbiform, villous or sparsely so outside, caducous. *Flowers* mostly glabrous; pedicels 7-9 mm long; torus c. 0.5 mm across, ± straight; nectary U-shaped to sublinguiform, extending c. 0.25 mm above the toral rim, slightly lipped at the margin; *perianth* white, 4 mm long, 0.7 mm wide, actinomorphic, narrowly oblong-obovoid to ellipsoid, sometimes a few scattered, erect trichomes on the inner surface 1.5-2 mm from the base; tepals separating below the limb before anthesis, free to the base and rolling independently back after; limb 1-1.2 mm long, 1.2 mm wide, subglobose, the segments ribbed, the style completely enclosed before anthesis; *pistil* 3.5-4 mm long, glabrous; stipe 1.5 mm long, flexuous; ovary c. 1 mm long, globose; style white, constricted for c. 0.2 mm above the ovary, dilating to c. 0.5 mm wide, the dilation ovoid, tapering above to the style-end; pollen-presenter 0.5-0.8 mm long, conico-cylindrical, its base 0.4 mm wide, straight to slightly oblique, scarcely to not broader than the style, the stigma 0.25-0.3 mm wide. *Fruits* (almost mature) 7-11 mm long, 3-6 mm wide, 3-5 mm deep, ± perpendicular to the stipe, oblong-ellipsoid, echinulo-rugose with irregular raised asperities sometimes joined in

continuous ridges; style deciduous; pericarp 0.8 mm thick. *Seed* (released from immature fruit) 7 mm long, 3 mm wide, obovoid, biconvex; outer face smooth; inner face with a broad waxy intramarginal border; margin shortly recurved.

Specimens studied. Known only from the Type collection.

Distribution. Western Australia, where confined to an area near Bindoon.

Habitat and ecology. Grows in gravelly loam in a roadside situation in partially cleared *Eucalyptus* woodland. The species is probably insect-pollinated and regenerates from seed, judging from the number of fruits freely setting.

Flowering period. ?August-September.

Fruiting period. October-November.

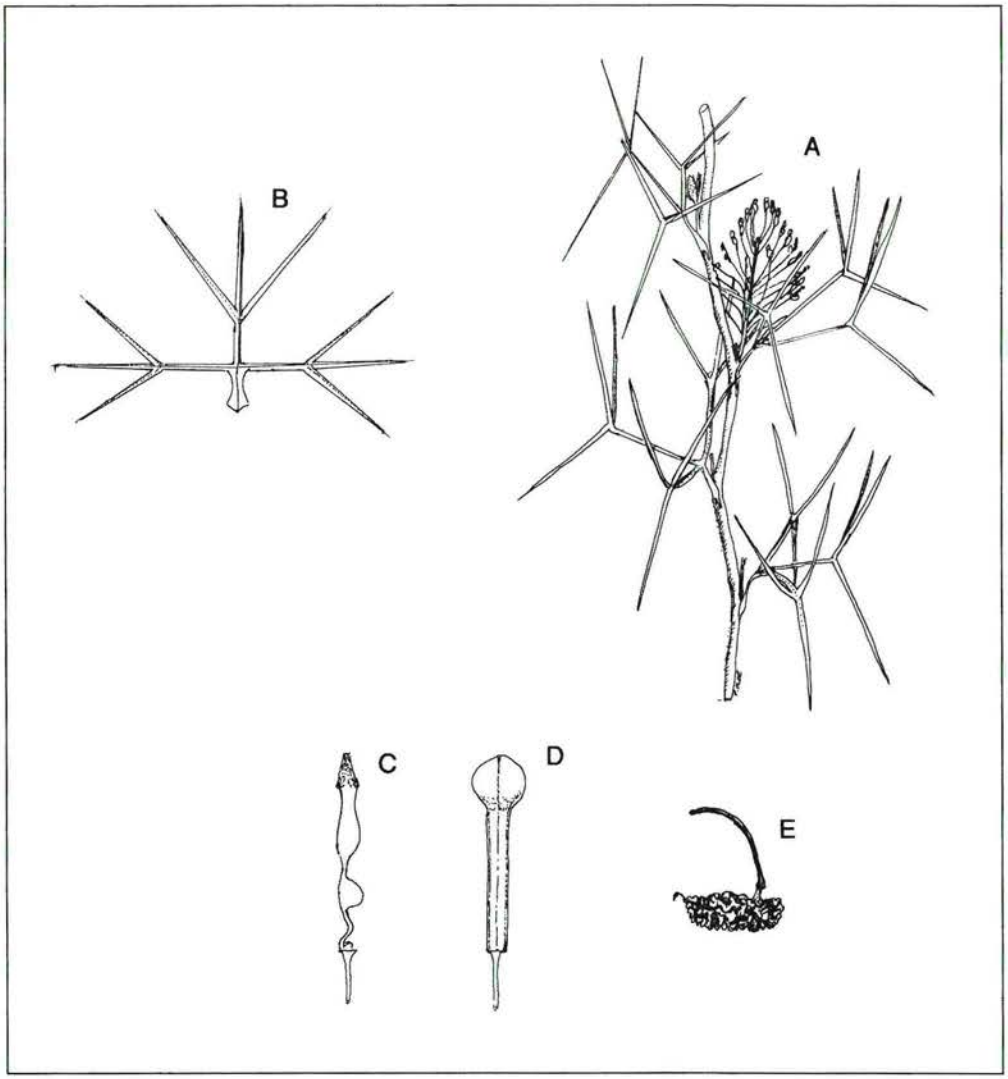

Figure 3. *G. corrugata* A - habit, B - adult leaf, C - pistil, D - perianth, E - fruit.

Affinities. *G. corrugata* is closely related to *G. curviloba*, especially subsp. *incurva*, with which it shares enlarged (*cf.* related species), strongly rugose fruits with thickened pericarp, 'loose' leaf margins leaving the undersurface at least partially exposed, smoothly rounded, protuberant midveins on the leaf undersurface. The new growth of *G. corrugata* is conspicuously villous and an overall impression of hoariness is gained about the shrub, and the pollen-presenter is conico-cylindrical with its base scarcely to not wider than the style. *G. curviloba* differs in its bushy to prostrate habit with one to several, weakly ascending to erect floral branches, its more crowded, narrower, secund leaves with the lobes incurved and usually shorter (mostly 1-1.5 cm long) and with the upper surface medially grooved and the venation obscure, its floral rachises glabrous or sometimes a few hairs at the base and its glabrous floral bracts with ciliate margins. The hairs on new growth are somewhat appressed and sparsely distributed and there is an overall impression of glabrescence about the plants. The pollen-presenter is conical to conic-apiculate with its base slightly broader than the style and its stigma more narrowed (0.1-0.2 mm across). Strongly rugose fruits are also evident on *G. paniculata* Meissn. *sens. str.* but this species differs in its thinner pericarp (c. 0.3-0.7 mm thick), its refracted leaf margins completely enclosing the leaf undersurface and in its more conspicuously conical pollen-presenter.

Discussion. Our reason for recognising *G. corrugata* as a distinct species lies mostly in its leaf morphology. The pattern of distance-reduction between the point of attachment and the basal lobes (reducing from 20 mm to 5-10 mm within approximately 5 leaves) as the branchlet elongates, in combination with the broad lamina on the lower rachis of late-formed leaves constitutes a clear synapomorphy in Section *Manglesia sensu* Bentham. This tissue consists of leaf lamina that unfurls at the sinus of the basal lobes and is then broadly continuous on both sides of the midvein to the point of leaf attachment. The character of unfurling lamina on subpinnatisect leaves is sometimes noted in *G. curviloba* subsp. *incurva* but only at the point of leaf attachment.

Nonetheless, the possibility that our *G. corrugata* is the product of hybridisation between *G. curviloba* and another species (?*G. vestita* (Endl.) Meissn., ?*G. phanerophlebia* Diels) cannot be discounted. However, the population of *G. corrugata*, numbering some 20-30 plants at two shortly distant sites (50-100 m) expresses itself in a morphologically consistent manner. A search of the area along the roadside (by Olde) showed that there are no other related species (Section *Manglesia sensu* Bentham) of *Grevillea* at the collection site, although part of the area had been cleared and there was some roadside disturbance.

Although there is a collection, cited by McGillivray (1993), of *G. curviloba* at Badgingarra (*Steenbohm s.n.* Sep. 1960), and some from uncertain locality (*McHard* 1883, *Drummond* 1, 622) the distribution of *G. curviloba sens. lat.* is otherwise confined to the winter-wet lowland in the Muchea and Bullsbrook area, in a habitat distinctively different and locality quite disjunct from that of *G. corrugata.*

Conservation. A code of CALM Priority One is recommended. The species was discovered in 1992 but a full search of the locality was not made as it is mostly private property. There are about 10-20 plants (not counted) at the Type locality although there are more at a further location a short distance along the road.

Etymology. Latin *corrugatus* - strongly wrinkled, in reference to the fruit surface.

KEY 1

Key to related species in Section *Manglesia sensu* Bentham

1 Fruits rugulose to rugose
2 Leaf undersurface enclosed, the margin firmly abutting the midvein
3 Midvein visible on the upper surface; floral bracts usually < 1 mm wide ..... *G. paniculata sens. lat.*
3* Venation obscure on the upper surface; floral bracts > 1 mm wide ..... *G. rara*
2* Leaf undersurface partially or completely exposed
4 Venation of the leaf upper surface obscure ..... *G. curviloba*
4* Venation of the leaf upper surface clearly evident
5 Leaves ± flat, coarsely divided, pinnatifid; leaf lobes triangular, extremely pungent ..... *G. phanerophlebia*
5* Leaves with divaricate, narrow-linear to subulate lobes, subpinnatisect; leaf lobes pungent
6 Leaf rachis broadly winged between the basal lobes and the leaf node on some or all leaves ..... *G. corrugata*
6* Leaf rachis not winged between the basal lobes and the leaf node ..... *G. paniculata*
1* Fruits smooth
7 Floral bracts persistent to anthesis; branchlets with a spreading indumentum; leaf lobes not linear-subulate ..... *G. vestita*
7* Floral bracts caducous; branchlets glabrous or with an appressed indumentum; leaf lobes linear-subulate ..... *G. paniculata sens. lat.*

4. Grevillea adpressa P. Olde & N. Marriott sp. nov. (Figure 4)

A *Grevillea amplexanti* foliorum lamina subtus hirsuta differt.

Typus: Western Australia; 5.6 km W of Arrino on Arrino West Rd, *P. Olde* 91/112, 16 September 1991 (holo: NSW).

Differs from *Grevillea amplexans* in its hairy leaf undersurface.

Irregular shrub to 1-2 m high, 1-2 m wide; branchlets white-sericeous or tomentose. *Leaves* 0.7-1.2 cm long, 1-1.5 cm wide, patent to spreading, sessile, amplexicaul, rhomboid to angularly ovate, broadly dentate with basal lobes consistently retrorse; venation conspicuous, palmate, the primary and sometimes secondary veins tipped by excurrent, pungent spines 1-5 mm long; reticulate venation evident, edge veins conspicuous; upper surface glabrous; lower surface white-sericeous to tomentose; margin shortly recurved to flat; texture coriaceous. *Conflorescence* axillary or terminal, pedunculate, simple or few-branched; unit conflorescence 1-3 cm long, globose, open, development acropetal; peduncles and floral rachises glabrous or almost so; floral bracts ± 2 mm long, ovate to lanceolate, ciliate, rarely persistent to anthesis. *Flowers* white with brown limb, glabrous; pedicels 7-12 mm long; torus 0.5-1 mm across, straight to slightly oblique at 30°; nectary scarcely evident; *perianth* 3.5-5.5

mm long, 0.7-0.8 mm wide, white, actinomorphic, oblong-obovoid below the limb, a few trichomes sometimes at the base inside; limb 1.5 mm wide, brown, globose to subovoid, the segments ribbed; *pistil* 2.5-5.8 mm long; stipe 1-2.5 mm long, flexuose; ovary globose; style white, constricted immediately above the ovary, the zone of constriction 0.1-0.3 mm long, then dilated, the dilation globose to cylindrical, 0.5-1 mm wide; pollen-presenter conical, its base 0.6-1 mm wide, straight, broader than the style. *Fruits* 9-12 mm long, 5 mm wide, 5 mm deep, ± perpendicular to the stipe on curved pedicels, oblong-ellipsoidal, smooth; style shortly persistent; pericarp 0.5 mm thick throughout. *Seed* 5.5-6 mm long, 2.5 mm wide, elliptic with a membranaceous border on the inner face, otherwise smooth.

Selected specimens (5 examined). WESTERN AUSTRALIA: Arrino, *Speck s.n.*, 23 Sep. 1953 (PERTH); 20 km from Three Springs on road to Eneabba, *McGillivray* 3307 & *George*, 11 June 1976 (NSW, PERTH); 9 km N of Watheroo, *Woolcock* G26, 15 Aug. 1985 (PERTH).

Distribution. Western Australia, from Arrino to Watheroo.

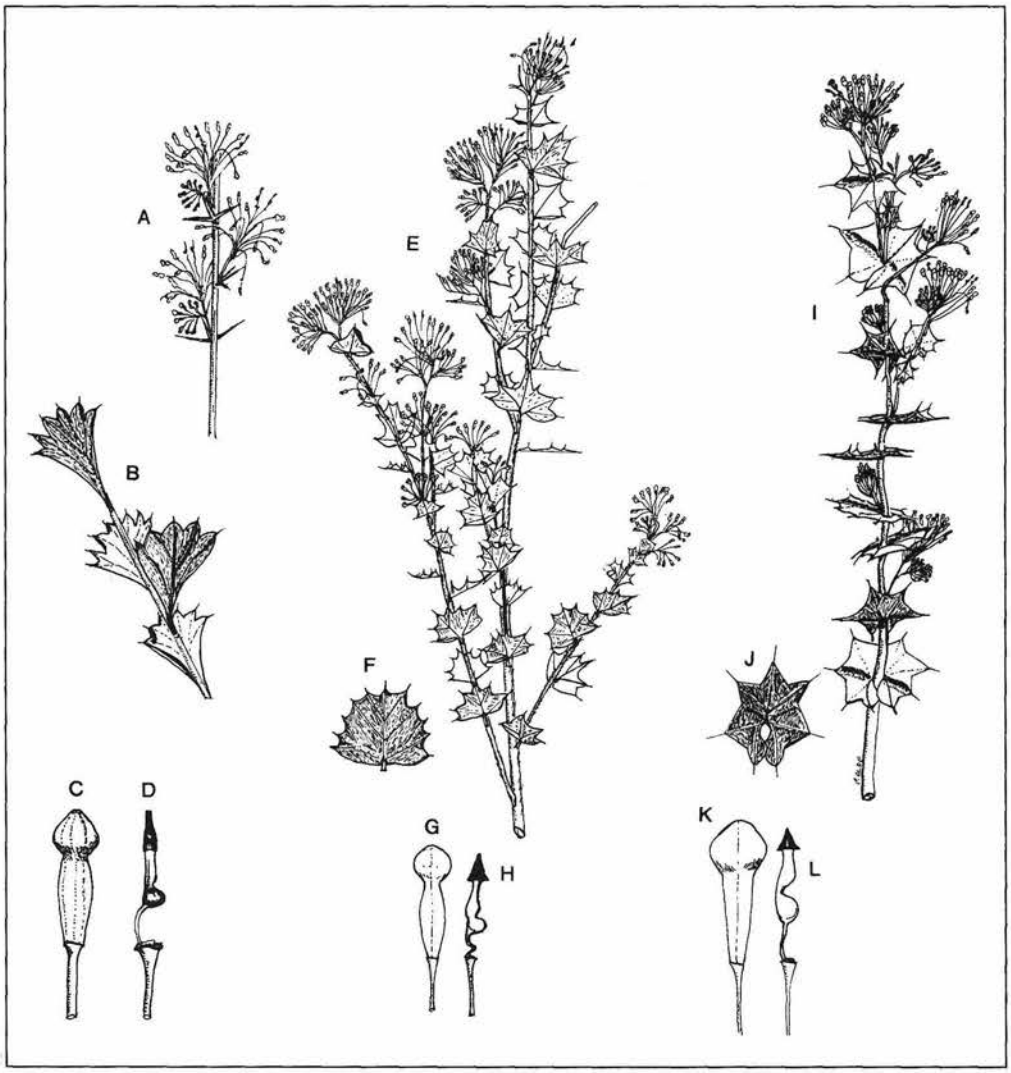

Figure 4. *G. acrobotrya* A - floral branch, B - basal leaves, C - perianth, D - pistil. *G. uniformis* E - habit, F - leaf, G - perianth, H - pistil. *G. adpressa* I - habit, J - leaf, K - perianth, L - pistil.

Habitat and ecology. Yellow sand-heath or brown gravelly loam. Flowers are insect-pollinated. Plants regenerate from seed after fire.

Flowering period. Winter-early Spring.

Conservation status. Not endangered.

Affinities. G. adpressa is most closely related to *G. amplexans* F. Muell.,*G. phanerophleba* Diels, *G. vestita* (Endl.) Meissn. and *G. acrobotrya* Meissn., the last prior to this paper comprising two subspecies, subsp. *acrobotrya* and subsp. *uniformis* McGillivray (McGillivary 1986). Both *G. vestita* and *G. acrobotrya* also have smooth fruits. Both *G. amplexans* and *G. adpressa* are distinguished by amplexicaul leaves which have the lamina clearly exposed on the undersurface and the basal leaf lobes strongly retrorse.

Discussion. McGillivray (1993: 175-176) recognises two forms of *G. amplexans*, the glaucous form and the hairy-leaved form, (the latter more or less conspecific with our *G. adpressa*), and notes the possibility of a third. Field research shows that the two recognised forms *sensu* McGillivray are represented in morphologically consistent populations that occur in an irregular, geographic replacement pattern throughout the range. We consider, following additional studies of all specimens at PERTH and our own, that two species should be recognised. The only attribute distinguishing the two populations is the presence or absence of indumentum on the leaf undersurface, although a tendency to robustness was observed in the habit of *G. amplexans* (the glaucous form *sensu* McGillivray). In a transect over 60 km along Watheroo Rd between Brand Highway and Midlands Rd, every population was physically searched and examined. At no time did we find mixed populations. However the distributions overlap continuously over their range and the probability of reproductive isolation in sympatry is very high. Species rank is therefore considered more appropriate. We were unable to ascertain any underlying association which might attach to one species occupying any particular habitat, although populations of one or the other tended to predominate over geographic areas.

Grevillea amplexans has a glabrous leaf undersurface and usually has glabrous and sometimes glaucous branchlets, although a number of specimens from the Watheroo area have hairy branchlets. Plants of *G. amplexans* from the southern part of the distribution tend to have smaller leaves, similar in size to *G. adpressa.*

Grevillea adpressa has a hairy leaf undersurface and hairy branchlets. Study of the specimens at PERTH and our own showed that nectary prominence and degree of leaf margin recurvature varies randomly between and within the species, although most specimens of *G. amplexans* have flat leaf margins and prominent nectaries while those of *G. adpressa* have shortly recurved leaf margins and obscure nectaries as observed by McGillivray (McGillivray 1993: 176). Trichomes on the inner perianth surface at the base were also observed on some specimens of *G. adpressa.*

Etymology. Latin *adpressus* - appressed, in reference to the indumentum on the leaf undersurface.

5. Grevillea uniformis (McGillivray) P. Olde & N. Marriott stat. nov. (Figure 4)

Basionym: Grevillea acrobotrya subsp. *uniforma* McGillivray (1986) in New Names in Grevillea :1. (Note- orthographic error).

Shrub 1.5-1.8 m tall, 1.5-3 m wide; branchlets tomentose or, rarely (*Olde* 91/97) glabrous, elongate, virgate. *Leaves* 0.5-2 cm long, 0.8-3 cm wide, sessile to very shortly petiolate, ovate to obovate with venation craspedodromous, the lateral veins tipped by spines 1-1.5 mm long; reticulate venation faintly evident, edge veins prominent; upper surface glabrous or sparsely sericeous; lower surface white-sericeous to tomentose; margin dentate, shortly recurved; leaf base truncate to spreading, sometimes cuneate; texture stiffly papyraceous. *Conflorescence* axillary or terminal, subsessile or shortly pedunculate, simple or few-branched; unit conflorescence 1-1.5 cm long, globose, open, development acropetal; peduncle sericeous; ultimate floral rachis 10-20 mm long, glabrous; bracts 0.5 mm long, 0.5 mm wide, ovate, glabrous, ciliate, caducous. *Flowers* white with dark-brown to reddish-brown limb, glabrous; pedicel 5-9 mm long, glabrous; torus 0.5-1 mm wide, straight to slightly oblique; nectary obscure; *perianth* 2.5-3 mm long, 0.5 mm wide, actinomorphic, cylindrical, glabrous; limb 1.2 mm wide, globose, erect; *pistil* 2.5-3.5 mm long, glabrous; stipe 1.5 mm long, flexuose; ovary globose; style 1.5 mm long, constricted above the ovary, the zone of constriction 0.1 mm long, then slightly dilated, the dilation 0.3-0.4 mm wide, terminated by a conical pollen-presenter 0.6-0.7 mm long, 0.3-0.4 mm wide at the base, the base broader than the style. Fruits 8-10 mm long, 6-8 mm wide, perpendicular to the stipe on curved pedicels, oblong-ellipsoidal, smooth; pericarp 0.6 mm thick at the suture. Seeds 7-8.5 mm long, 3-4 mm wide, elliptic with a membranaceous border on the inner face, otherwise smooth.

Selected specimens (5 examined). WESTERN AUSTRALIA: Cockleshell Gully, *Olde* 86/611, 24 Sep. 1986 (NSW); 8 km SW of Mt Lesueur, 8.8 km along track from Cockleshell Gully (Padbury) to main Jurien Rd, *B.G. Briggs* 6369, 26 Sep. 1976 (NSW, PERTH); Pen Rd, 2 km N of Road to Greenhead, SW of Eneabba, *Olde* 91/97, 15 Sep. 1991 (NSW, PERTH); North of Mt Lesueur, *Olde* 91/258, 6 Oct. 1991 (NSW).

Distribution. Western Australia, from south-west of Eneabba to Jurien, east to Mt Lesueur.

Habitat and ecology. Grows in exposed sandstone outcrops in crevices, beside creek lines in grey sand over brown loam, sand over laterite in low open heath, yellow sand-heath.

Flowering period. Late Winter-Spring.

Discussion. During the course of our study of the variation within *G. amplexans*, specimens of closely related species were also studied. These studies showed that *G. acrobotrya* subsp. *uniformis* McGillivray was as closely related to *G. amplexans sens. lat.* as to *G. acrobotrya sens. strict.* and that the degree of sharing of features suggested to us that species ranking is more appropriate for this taxon (see also *G. adpressa*). *G. acrobotrya sens. str.* is thus seen as unique in Section *Manglesia sensu* Bentham for its dimorphic leaves (obovate-cuneate at the base, tripartite on the floral branches), for its scarcely dilated style with a scarcely evident zone of constriction above the ovary and for its fusiform style-end. The basal leaves of *G. acrobotrya* are more clearly obovate-cuneate whereas those of *G. uniformis* are usually ovate with patent to spreading bases.

In its pistil length and stylar dilation, *G. uniformis* more closely approaches *G. acrobotrya* although there is overlap with *G. adpressa* in pistil length. However, most specimens of *G. uniformis* have a more conspicuously dilated style above an obvious though minute zone of constriction. Most significantly though, through its conical style-end with its base broader than the style, it is closer to *G. adpressa*. In addition, it shares with *G. adpressa* an obscure nectary and uniform foliage; its leaves have similar venation prominence and degree of marginal curvature and a similar indumentum on the undersurface. In fact, *G. uniformis* is so close visually to *G. adpressa* that they can scarcely be

separated without close inspection of the leaves. Indeed, some specimens of *G. uniformis*, including *Briggs* 6369, *Olde* 91/97, also have occasional leaves with retrorse basal leaf lobes (*cf.* consistently retrorse in *G. adpressa*). *G. uniformis* is clearly intermediate between *G. acrobotrya* and *G. adpressa* and therefore, in our opinion, deserves recognition at the ranking proposed.

Conservation status. A code of CALM Priority Three is recommended.

6. Grevillea synapheae R. Brown in Prodr. Flor. Nov. Holl. Suppl. 1: Prot. Nov. 23, (1830)

Typus: (n.v.) fide McGillivray 1993: Swan River, *Fraser*, 1827 (BM excluding the specimen at the lower right of the sheet).

Anadenia gracilis Lindl. (1840) in Edwards' Bot. Reg. App. Swan River Colony: xxxi n. 144. *Type (n.v.):* Swan River. *Drummond*, 1839 (CGE).

Grevillea flexuosa var. *pauciloba* Benth. (1870) in Fl. Austral. 5: 480, 'Var. ?*pauciloba*'. *Lectotype* (McGillivray 1993: 443): Darling Range, W. Aust., *Oldfield* (lecto: K *(n.v.)*; isolecto: K *(n.v.)*, MEL 74817, MEL 74818).

A lignotuberous shrub, variable in habit from prostrate and sprawling to open and erect to c. 1.5 m; branchlets ± glabrous or sparsely tomentose. *Leaves* 4-18 cm long, 1-6 cm wide, ascending to spreading, sessile, usually obovate-cuneate in broad outline, extremely variable even on the same shrub, from simple and entire to trifid to (bi-)pinnatifid, sometimes the primary division almost pinnatisect with pinnatifid to (rarely) subpinnatisect secondary lobes; rachis straight to slightly flexuous; primary lobes (0)3-7, ascending, rarely (Mt Misery) patent to retrorse; ultimate lobes 10-25 mm long, linear to broad-triangular, mostly terminated by a brittle excurrent spine; upper surface glabrous, occasionally glaucous, midvein and lateral veins visible, sometimes obscure; lower surface glabrous or sparsely sericeous, punctate, midvein and lateral veins prominent. *Conflorescence* erect, pedunculate, sometimes markedly so, terminal or axillary, simple or branched; unit conflorescence cylindrical, dense, with development basipetal, enclosed within or conspicuously exceeding the foliage; peduncles 0.8-3.5 cm long, glabrous, angular; floral rachises glabrous or sericeous or sparsely so; floral bracts 0.3-1.2 mm long, ovate-cymbiform to obovate or linear, glabrous or sparsely hairy, usually ciliate, patent, caducous or persistent beyond anthesis. *Flowers* creamy-yellow: pedicels 1.5-2.5 mm long, glabrous or with scattered hairs, the apex expanded with 4 sub-opposite lobes c. 0.1 mm long; torus ± 0.5 mm across, straight; nectary absent or minutely pulvinate; *perianth* 2.5-3 mm long, 0.7 mm wide, oblong-cylindrical, strongly curled in bud, glabrous outside, mealy to papillose inside; tepals persistent, separating markedly on the dorsal side and reflexing to expose the inner surface at anthesis; limb revolute, spheroidal to subcubic, prominently carinate; *pistil* 4.5-5.5 mm long, glabrous; stipe 0.6-1 mm long; ovary subglobose; style strongly retrorse to sigmoid after anthesis; pollen-presenter ± straight, broadly conical with faint to obscure basal rim. *Fruit* 8-13 mm long, 7-9 mm wide, erect to oblique, sometimes persistent, ovoid, ellipsoid to obovoid, glabrous, rugulose; style persistent, shrivelled; pericarp ± 1 mm thick. *Seed* 6-7 mm long, 4-4.5 mm wide, obovate, rugulose; outer face slightly convex; inner face with a raised, central elliptic section, channelled near the border, all encircled by a waxy, excurrent wing.

Affinities. Key 2 on page 260 is provided to facilitate separation of all members of this group.

Discussion. McGillivray (1993: 163) asserts that "the apparent two-state nature of the delapsus of floral bracts...may prove to be associated with other features". Our research, which involves the

physical inspection of all populations seen in the range over four flowering seasons, plus an examination of all specimens at PERTH and NSW, shows that two subspecies are clearly justified. However, the partition of the species along these lines is to some extent artificial in that both subspecies exhibit internal variation that is, to some extent, population-based but insufficiently discontinuous on the characters examined to warrant more formal recognition. This variation is here treated informally but further separations may be warranted following research using new character states and modern methods of analysis.

Key to subspecies of *Grevillea synapheae*

1 Floral bracts deciduous before anthesis; leaves papyraceous the margin flat or shortly recurved; unit conflorescence 1-2 cm long ..... subsp. *synapheae*

1* Floral bracts persistent at and sometimes beyond anthesis; leaves coriaceous the margin strongly recurved to revolute; unit conflorescence 2-6 cm long ..... subsp. *pachyphylla*

Grevillea synapheae subsp. **synapheae** (Figure 5)

Grevillea synapheae var. *latiloba* Meissn. in Lehmann (Ed.) Pl. Preiss. 2: 259 (1848). *Neotype* (McGillivray 1993: 443): *Drummond* Coll. II n. 313 in hb. Shuttl. 11 Oct. 53. (*Type:* NY- specimen at right of sheet; iso: A,G,LD, LE, MEL- 2 sheets, NSW, P-2 sheets).

Branchlets rounded to sharply angular; leaves papyraceous or firmly so, the margin flat or shortly recurved; floral bracts caducous, usually before the buds are 1 mm long; unit conflorescence 1-2(3) cm long, usually borne within the foliage; pistil 4-5 mm long; stipe c. 1 mm long.

Selected specimens (90 examined). WESTERN AUSTRALIA: 33 mi. from Perth towards Brookton on Brookton Highway, *Phillips* (CBG022086), 6 Oct. 1962 (CBG, NSW); Mt Dale Rd, *Demarz* 6406, 8 Dec. 1976 (PERTH); Berry Reserve, Stoneville, *Olde* 91/76, 12 Sep. 1991 (NSW); Ridge Hill Rd., Helena Valley, *Olde* 86/272, 6 Sep. 1986 (NSW); Mundaring Weir, *Olde* 86/280, 6 Sep. 1986 (NSW); Canning Dam, *Went* 14, 2 Sep. 1962 (PERTH); Glenn Forest, *Sonster* 498, 8 Sep. 1946 (NSW); Parkerville, *Diels & Pritzel*, Aug. 1901 (PERTH); Smith's Mill, *Morrison,* 9 Aug. 1898 (PERTH); *Drummond* 313, Coll II, (NSW); Drummond's Track, S of New Norcia, *Gardner* 8675, 1 Oct. 1947 (PERTH); Gt Northern Highway, S of New Norcia, just S of Mogumber turn-off, *Strid* 20644, 20 Sep. 1982 (NSW); 16 mi. N of Bindoon, *R.V. Smith* 66/126, 30 Aug. 1966 (AD, MEL, NSW, PERTH); Wooroloo, *Koch,* Sep. 1906 (PERTH); 22 km S of Toodyay, *Olde* 86/843, 11 Oct. 1986 (NSW); Swan View, *Fitzgerald,* Sep. 1901 NSW 129248); 6.2 km S of Mogumber turn-off on Gt Northern Highway, *Olde* 86/317, 10 Sep. 1986 (NSW); 79 m.p. Geraldton Highway (1 km N of Mogumber), *McCrum* 61, 5 Sep. 1957 (PERTH); N edge of Mt Misery, W of Dandaragan, *Hopper* 6333, Feb. 1988 (PERTH); Mt Misery, *Olde* 91/82, 14 Sep. 1991 (NSW).

Distribution. Western Australia, from near Narrogin to New Norcia, with a small population on Mt Misery in the Irwin District.

Habitat and ecology. Grows in lateritic loam in *Eucalyptus* woodland. Resprouts from lignotuber after fire with some regeneration from seed. Pollination is by insects.

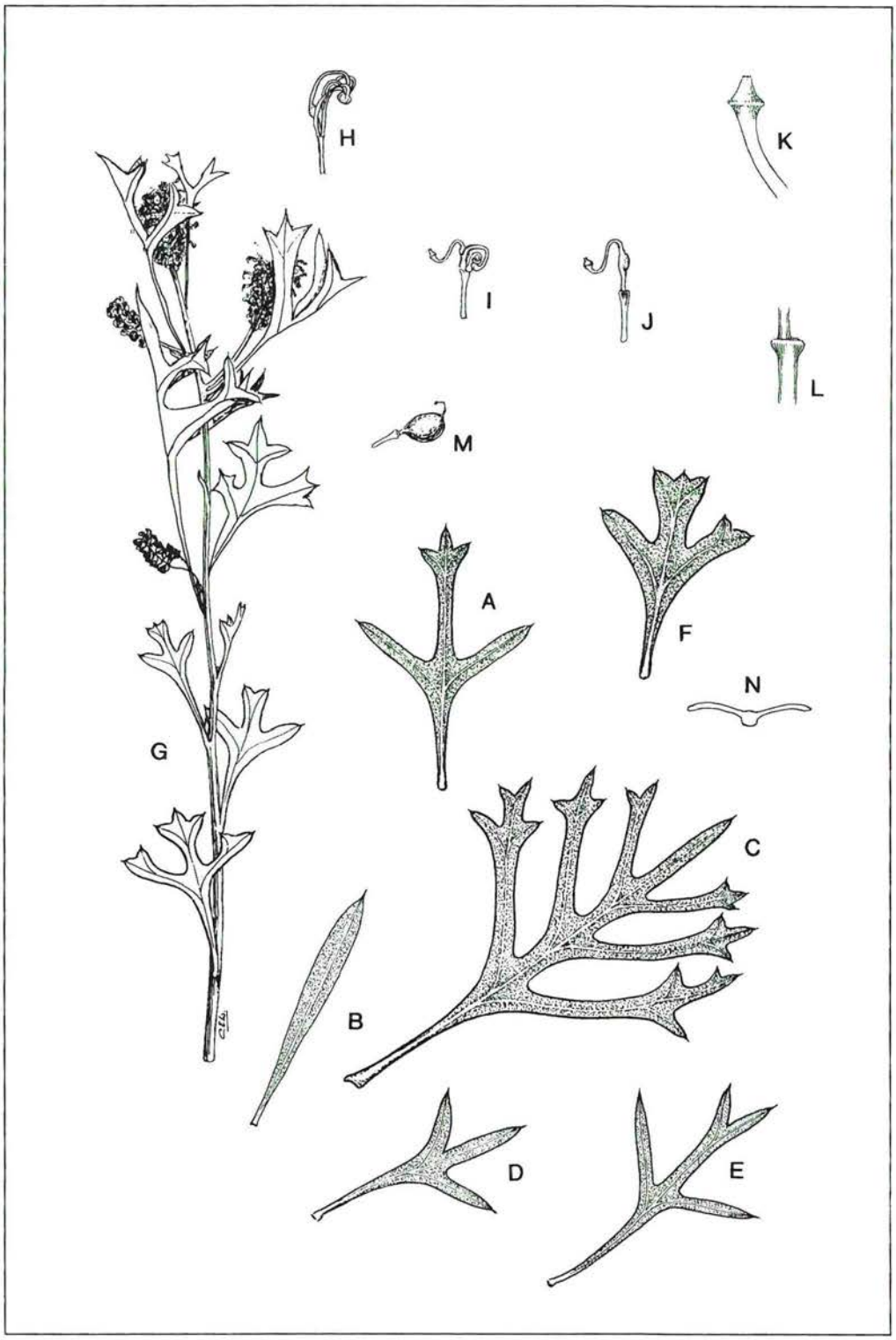

Figure 5. *G. synapheae* subsp. *synapheae* A-F - leaf shapes, G - habit, H, I - perianth, J - pistil, K - style-end, L - torus, M - fruit, N - leaf in cross-section.

Flowering period. Late Winter-Spring.

Fruiting period. Spring-early Summer.

Typification. Only the isotype of var. *latiloba* at NSW has been seen.

Conservation status. Not rare or endangered overall. However, at least two forms may need monitoring.

Discussion. Within subsp. *synapheae* there are at least three elements. The typical form occurs in the Darling Range in the Perth region extending south almost to Williams. It is a prostrate to diffuse shrub with unit conflorescences 1-2(2.8) cm long, mostly enclosed within the foliage and with relatively thin, round to slightly angular branchlets. McGillivray (1993: 163) has also observed that "at the southern end of the species' range, some specimens e.g. *Phillips* CBG 021636, 022086, have longer pedicels and looser inflorescences than other collections of *G. synapheae*". These populations warrant further study. There appears to be no conservation imperative with regard to this form.

The second element included in subsp. *synapheae,* here termed the broad-leaved form, are plants from the Bindoon to Mogumber area. At first we had the impression that these plants belonged with our subsp. *pachyphylla.* They share a similar, erect habit (sometimes to 1.5 m), stout, sharply angular branchlets, apically toothed obovate-cuneate to bipinnatifid leaves and longer unit conflorescences (c. 2 cm long), which sometimes conspicuously exceed the foliage. The leaves also dry to a whitish-green colour. However, the leaves are firmly papyraceous with scarcely recurved margins and the floral bracts are not persistent. Accordingly they have been placed in subsp. *synapheae.* Meissner's var. *latiloba* (*Drummond* 313, Coll. II) is from this population. Future studies aimed at more accurate delimitation of this population may be worthwhile. There may be some conservation risk to this form.

The third element, here termed the Mt Misery form, is a geographically disjunct population from Mt Misery, near Dandaragan, in the Irwin District (*Hopper* 6333, *Olde* 91/82). This population has leaves with the primary lobes almost pinnatisect with pinnatifid secondary lobes. However, some specimens e.g. *Olde* 86/843 and *Fitzgerald* (NSW129248), closely approach the leaf type and preclude any formal separations at least until further sampling is conducted. There is also some approach of this element to *G. flexuosa* Meissn. through its slightly flexuous leaf rachis and patent to retrorse leaf lobes. However, it differs in its fewer leaf lobes and smaller fruits. We understand that this population is conserved but, as its distribution is so restricted and its taxonomy unresolved, investigation of its conservation status is considered worthwhile.

Grevillea synapheae subsp. **pachyphylla** P. Olde & N. Marriott subsp. nov. (Figure 6)

A subspecie typica bracteis florum persistentibus, foliis coriaceis cum marginibus forte recurvato vel revoluto differt.

Type: Western Australia: Brand Highway, 8 km S of Half Way Mill Roadhouse, *P. Olde* 91/87, 14 Sep. 1991 (holo: PERTH; iso: NSW).

Differs from the type in its persistent floral bracts, its coriaceous leaves with strongly recurved to revolute margins.

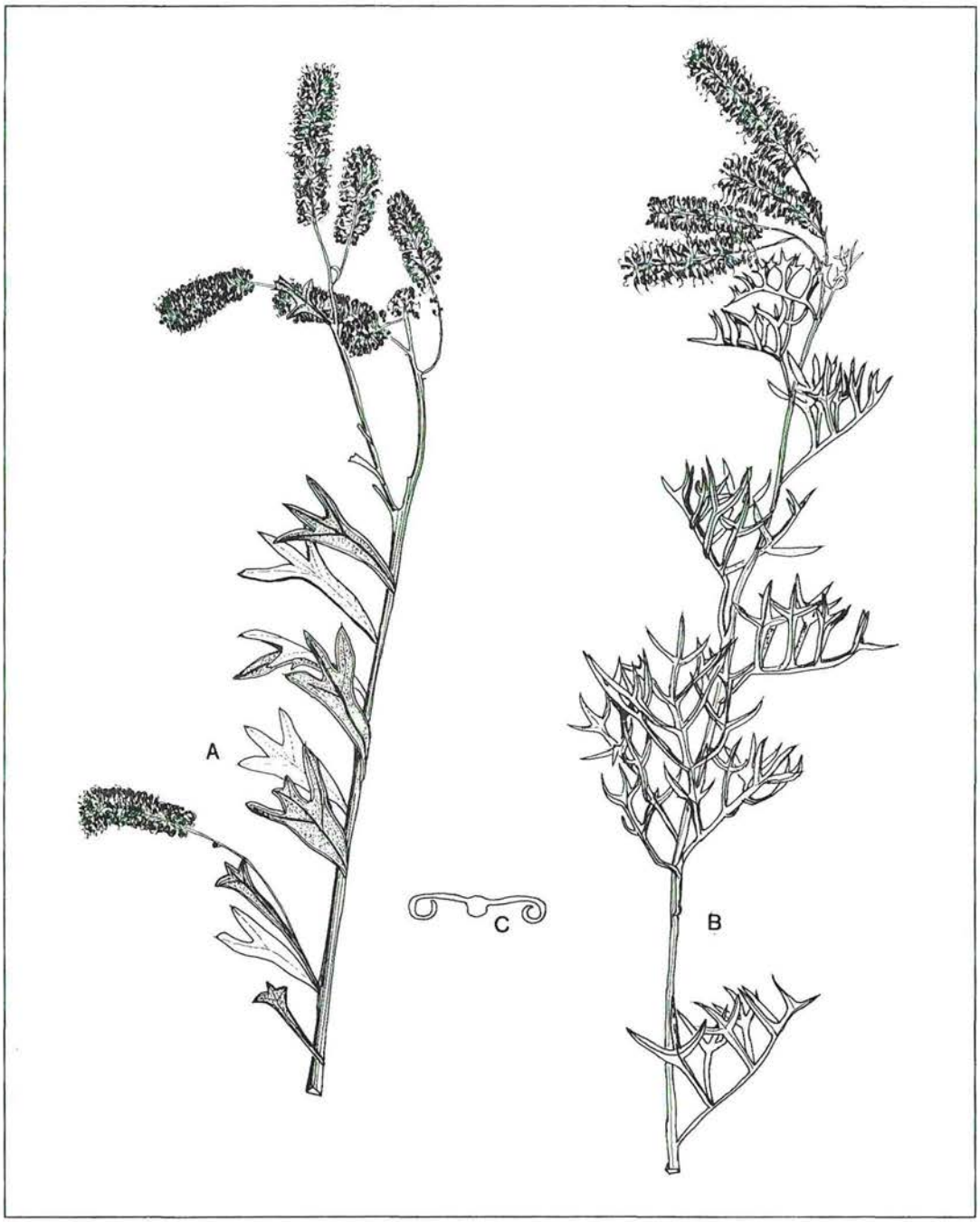

Figure 6. *G. synapheae* subsp. *pachyphylla* A - typical form, B - Minyolo form, C - leaf in cross-section.

Shrub 50 cm to 1 m high; branchlets stout, angular, usually sharply so; leaves trifid to obovate-cuneate with apical toothing, sometimes pinnatifid with ascending lobes, sometimes bipinnatisect, sometimes simple, elliptic, coriaceous, the margin strongly recurved to revolute; conflorescences branched, exceeding the foliage; unit conflorescence 2-4(6) cm long; floral bracts persistent at or beyond anthesis; pistil 4.5-5 mm long; stipe 1 mm long.

Selected specimens (42 examined). WESTERN AUSTRALIA: Irwin District; Hills S from Three Springs, *Gardner* 9052, 23 Aug. 1948 (PERTH); 10 miles NE of Cockleshell Gully, *Anway* 151, 18 July 1965 (PERTH); 5 km N on Erindoon Rd, south of Eneabba, *Olde* 91/99, 15 Sep. 1991 (NSW, PERTH); Bibby Rd, Cervantes, 5 km from Highway, *Woolcock* G33, 16 Aug. 1985 (NSW); 18 mi. E of Jurien Bay, *Beard* 7885, 19 Sep. 1976 (NSW, PERTH); 15 mi. NNW Dinner Hill, *Newbey* 2297, 31 Aug. 1965 (PERTH); 5 miles W of Jurien Bay turnoff, *Cranfield* 249, 20 July 1978 (PERTH); 0.5 km E of Badgingarra, *McGillivray* 3283 & *George*, 10 June 1976 (NSW, PERTH); 1 km S of Minyolo Brook, *Pieronii* 90/4, 20 Sep. 1990 (NSW, PERTH); Mullering Rd, Cataby, *Olde* 91/86, 14 Sep. 1991 (NSW); Minyolo Rd, W of Dandaragan, *Griffin* 5060, 11 Sep. 1988 (PERTH); "Dunearn" NW of Dandaragan, *Griffin* 4912, 11 Aug. 1988 (PERTH).

Distribution. Western Australia, from near Cataby to Eneabba, usually within c. 70 km of the coast.

Habitat and ecology. Grows in open heath usually at or near the top of rises in strongly laterised loam or sandy loam over laterite. Regenerates from lignotuber and/or seed after fire.

Flowering period. As for subsp. *synapheae.*

Discussion. In addition to the features listed in the diagnosis, most plants of subsp. *pachyphylla* also usually have have an erect few-branched, ?non-lignotuberous habit with 1 to 3 branches from the base, branched conflorescences 2-4 cm long that clearly exceed the leaves, stout, sharply angular branchlets and obovate-cuneate leaves with apical toothing. Dried specimens of this subspecies sometimes have a whitish appearance. The specimen *Cranfield* 249 (NSW, PERTH) has only one persistent floral bract, but is placed with subsp. *pachyphylla* because of foliar features that more closely conform with this subspecies. Subsp. *pachyphylla* occurs in the Irwin District and is found from c. Eneabba to Cataby, possibly extending to around New Norcia.

A few specimens from south of New Norcia e.g. *Gardner* 8675 (PERTH), *Strid* 20644 (NSW), have some conflorescences with persistent bracts and some without. These specimens are intermediate between subsp. *synapheae* (broad-leaved form) and subsp. *pachyphylla* but are placed with subsp. *synapheae* because of their papyraceous leaves and flat margins. Further field study of these specimens may show sympatric occurrence and that specific rank is more appropriate for subsp. *pachyphylla.* However, on the character states that we have examined, we did not feel there was sufficient discontinuity to warrant this ranking.

Some collections from the Badgingarra-Dandaragan area (*Griffin* 4912, *Olde* 91/86, *McGillivray* 3282 & *George, Anway* 151) have a lignotuberous habit with numerous branches from the base, branched conflorescences borne conspicuously beyond the foliage with leaves subtending the conflorescence much-reduced in size (*cf. G. muelleri* Benth.). Unit conflorescences are up to 6 cm long and leaves are sometimes deeply divided to subpinnatisect (*Pieronii* 90/4, *Olde* 88/95) with secondary sect division and ultimate lobes narrow-linear to narrow-triangular, c. 2-3 mm wide and with a slightly flexuous rachis. In addition, they have a shorter pollen-presenter with a slight basal collar. These plants, which are c. 30 cm tall, spreading 1-2 m wide, grow sympatrically with more typical plants of subsp. *pachyphylla.* At first, we had the impression that these plants formed part of a separate taxon and indeed they might. However, the differences are not sufficiently clear to warrant separate ranking at this stage and they are here treated informally as the Minyolo form of subsp. *pachyphylla.* The specimen *Anway* 151 (PERTH 02439115) has unit conflorescences c. 6 cm long with apically toothed, obovate-cuneate leaves and cannot be clearly assigned to either form.

Conservation status. Not rare or endangered except that the Minyolo form requires assessment.

Etymology. From the Greek *pachys* - thick and *phyllon* - a leaf.

KEY 2

Key to species related to *Grevillea synapheae*

1 Floral rachis 1 or more cm long
2 Unit conflorescence loose; flowers pink ..... *G. leptobotrys*
2* Unit conflorescence dense; flowers creamy-white
3 Pollen-presenter lacking a basal collar
4 Fruits ovoid with apical attenuation, ± 20 mm long; leaf rachis conspicuously flexuous; basal leaves mostly with >10 retrorse to patent primary lobes ..... *G. flexuosa*
4* Fruits ellipsoid to obovoid with obtuse apex, 8-13 mm long; leaf rachis straight or scarcely flexuous; basal leaves either dentate or mostly with 7 or less ascending, primary lobes ..... *G. synapheae*
3* Pollen-presenter with a conspicuous basal collar
5 Leaves dentate ..... *G. monticola*
5* Leaves divaricately divided ..... *G. prominens*
1* Leaf rachis 0.5 or less cm long
6 Conflorescence umbelliform, extending ± regularly along the whole branchlet; leaves on the floral branches usually not reduced in size ..... *G. trifida*
6* Conflorescence globose, crowded in the upper axils; leaves on the floral branches usually much reduced in size or linear ..... *G. muelleri*

7. Grevillea flexuosa (Lindl.) Meissn. (1845) in Lehmann's Pl. Preiss.1: 553 (1845). *Anadenia flexuosa* Lindl. (1840) in Edwards' Bot. Reg. App. Swan River Colony: xxxi n. 142. (Figure 7)

Grevillea flexuosa var. *pauciloba* Benth. in Flor. Aust. 5: 480 (1870) is a synonym of *G. synapheae* R. Br. subsp. *synapheae*

Typus: Swan River. *Drummond,* 1839 (holo: CGE; iso: LE, MEL, NSW, P, PERTH). Only the isotypes at NSW and PERTH have been seen.

An irregular, few-branched, ± glabrous shrub to 1.5 m,; branchlets sharply angular, glabrous. *Leaves* 5-10 cm long, 5-7 cm wide on the floral branches, 15-26 cm long, 10-16 cm wide at the base, spreading to patent, sessile but appearing petiolate, subpinnatisect; rachis markedly flexuous; primary lobes 7-18, patent to retrorse, usually distant, pinnatifid with up to 5 secondary lobes, sometimes tertiary -fid lobing evident; ultimate lobes 0.5-3 cm long, 5-10 mm wide, broad- to narrow-triangular, terminated by scarcely pungent, excurrent spines 2 mm long; upper surface glabrous, the midvein and lateral veins evident; lower surface glabrous, glaucous, the midvein and lateral prominently raised; margin shortly recurved. *Conflorescence* erect, conspicuously pedunculate, terminal or axillary in the upper axils, clearly exceeding the foliage, usually branched; unit conflorescence 3.5-6.5 cm long,

1 cm wide, cylindrical, very condensed with development basipetal; peduncle sharply angular, glabrous; floral rachis glabrous; floral bracts 0.7 mm long, ovate, glabrous with ciliate margins, caducous. *Flowers* creamy-yellow, glabrous: pedicels 2-2.2 mm long; torus c. 0.5 mm wide, straight, expanded at its apex into 4 obtuse, subopposite lobes c. 0.2 mm long; nectary absent; *perianth* 3.5 mm long, 0.5 mm wide, creamy-white, oblong-cylindrical, strongly recurved, papillose on the inside; limb revolute, spheroidal, the segments carinate; tepals persistent, reflexing to reveal inner surface at anthesis; *pistil* 5-8.5 mm long; stipe 0.5-1.2 mm long; ovary globose; style creamy-white, retrorse to sigmoid after anthesis, terminated by a scarcely expanded style-end; pollen-presenter ± straight, conical with base round to oblong-elliptic. *Fruits* 20 mm long, 10 mm wide, erect, ovoid to ovoid-ellipsoid with the apex attenuate, rugulose; style deciduous; pericarp 1.5-2 mm thick at the suture. *Seeds* (cult.) 9 mm long, 3 mm wide, oblong with acute apices; outer face convex, smooth, slightly crimped before the margin; inner face with a raised, central ridge, encircled by a broad channel; the margin recurved with a short, waxy wing prominent in the basal half.

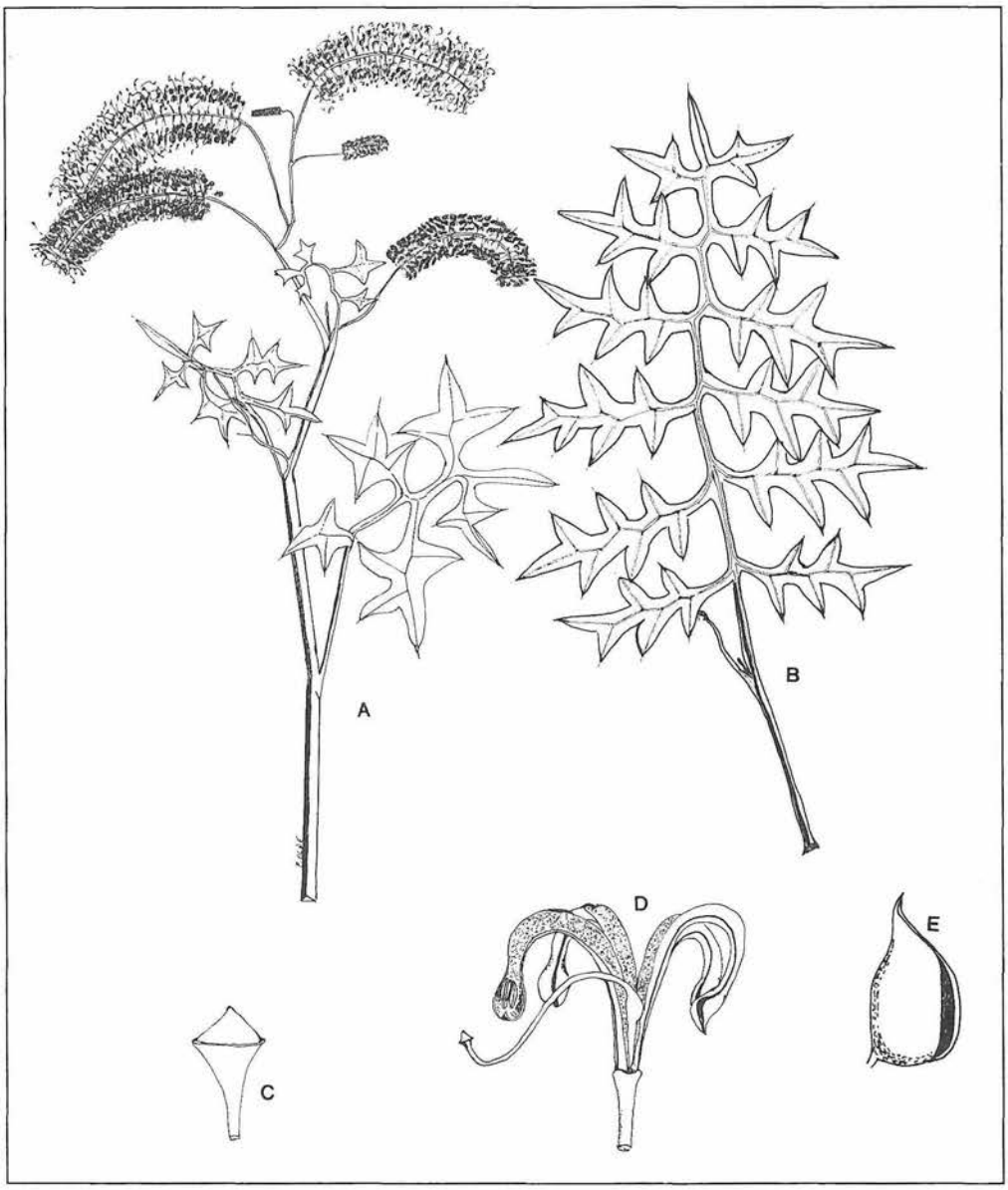

Figure 7. *G. flexuosa* A - flowering habit, B - leaf, C - style-end, D - flower, E - fruit.

Specimens examined (2). WESTERN AUSTRALIA: Berry Reserve, Stoneville, *Olde* 91/75, 12 Sep. 1991 (NSW); Swan River, *Drummond,* 1839 (PERTH).

Distribution. Western Australia, where confined to a few locations near Stoneville and Toodyay.

Habitat and ecology. Grows in granite sand among granite rocks in exposed platform vegetation or low heath. Fire response unknown. Pollination by insect.

Flowering time. Winter-early Spring.

Fruiting period. Late Spring.

Discussion. McGillivray(1993), having seen only the Type collection, has referred *G. flexuosa* (Lindl.) Meissn. to synonymy under *G. synapheae*. However, the species, rediscovered in 1985 by Mrs Gwen Abbott, although clearly and most closely related to *G. synapheae* is, in our opinion, quite distinct. It grows sympatrically with *G. synapheae* at Stoneville, in Berry Reserve and is, at this site, morphologically discontinuous and reproductively isolated. The diagnostic features which distinguish *G. flexuosa* are its ovoid to ovoid-ellipsoid fruits (c. 20 mm long) with an attenuated apex and a thicker pericarp (c. 1.5 mm thick) and its much longer basal leaves (up to 26 cm long) bearing a conspicuously flexuous rachis with 7-18 distant, patent to retrorse primary lobes. *G. synapheae* sometimes approaches *G. flexuosa* in its foliar morphology but is readily distinguished by its obovoid fruits which are <13 mm long with the apex obtuse and the pericarp <1 mm thick, its smaller basal leaves (mostly <10 cm long) with a mostly straight to scarcely flexuous rachis and with 3-7 relatively close, ascending primary lobes.

Additionally, in the area of its sympatric occurrence with *G. synapheae, G. flexuosa* is a robust, non-lignotuberous shrub 1.5-2 m high with angular branchlets and unit conflorescences up to 6 cm long borne clear of the foliage and with pistils 8-8.5 mm long, whereas *G. synapheae* is a low, lignotuberous subshrub to 10 cm with rounded branchlets and conflorescences c. 1 cm long borne within the foliage and pistils c. 5 mm long. The Type of *G. flexuosa* at NSW has shorter pistils (c. 5 mm long) and conflorescences enclosed within the foliage and differs from the Stoneville populations in this respect. A full key to the group is provided (Key 2, see page 260).

Conservation status. A conservation code of Priority Two is recommended but *G. flexuosa* does occur in a known reserve. The current code of Priority Four (Hopper *et al.* 1990: 114) does not reflect more recent collections of this species.

8. Grevillea prominens P. Olde & N. Marriott sp. nov. (Figure 8)

Affinis *G. trifidae* sed conflorescentiis longioribus subsecundis, pedunculis longioribus, pedicellis plerumque brevioribus (1.8-3 mm longis) differt.

Typus: Western Australia: corner of Victor Mount Rd and Harvey-Quindanning Rd, near Harvey, *P. Olde* 91/237, 26 Sep. 1991 (holo: NSW; iso: PERTH).

Aff. *Grevillea trifida* but differs in its longer, subsecund conflorescences, its longer peduncles and shorter pedicels.

An open shrub 0.5-1.2 m high, 0.3-1 m wide; branchlets angular, glabrous. *Leaves* 3-4.5 cm long, ascending, sessile, but appearing petiolate, mostly biternate, sometimes bipinnate; primary lobes 3-5, usually with secondary division, the secondary lobes sometimes with tertiary -fid division, sometimes the primary apical lobe undivided; ultimate lobes 4-22 mm long, 0.6-2 mm wide, linear to narrow-triangular, pungent; upper surface glabrous, smooth, angularly concave or grooved along the midvein, the venation otherwise obscure; lower surface exposed, glabrous with prominent midvein and lateral veins; margin smoothly revolute. *Conflorescence* erect, pedunculate, terminal, usually branched; unit conflorescence 1-3 cm long, secund, sometimes becoming subcylindrical at length, quite condensed, development basipetal, usually exceeding the foliage; primary peduncles 0.5-2 cm long, secondary peduncles 1-2 cm long, glabrous; floral rachises glabrous; floral bracts not seen. *Flowers* creamy-white, glabrous: pedicels 1.8-3 mm long, the apex not expanded into sub-opposite lobes; torus c.0.5 mm across, ± straight; nectary not seen; *perianth* 4.5 mm long, creamy-white, oblong-cylindrical, strongly curled; limb revolute, subglobose, firmly cohering at anthesis, the segments carinate; tepals separating and reflexing to reveal the inner surface at anthesis; *pistil* 4.5-5.5 mm long, glabrous; stipe 0.5-0.7 mm long; ovary c. 0.8 mm long, globose; style creamy-white, retrorse to sigmoid after anthesis; pollen-presenter conical, its base 0.8 mm wide, round, collared, wider than the style. *Fruit* 8.5-10 mm long, 6-6.5 mm wide, perpendicular to the pedicels, obovoid, smooth; style deciduous; pericarp 0.5-0.9 mm thick. *Seed* not seen.

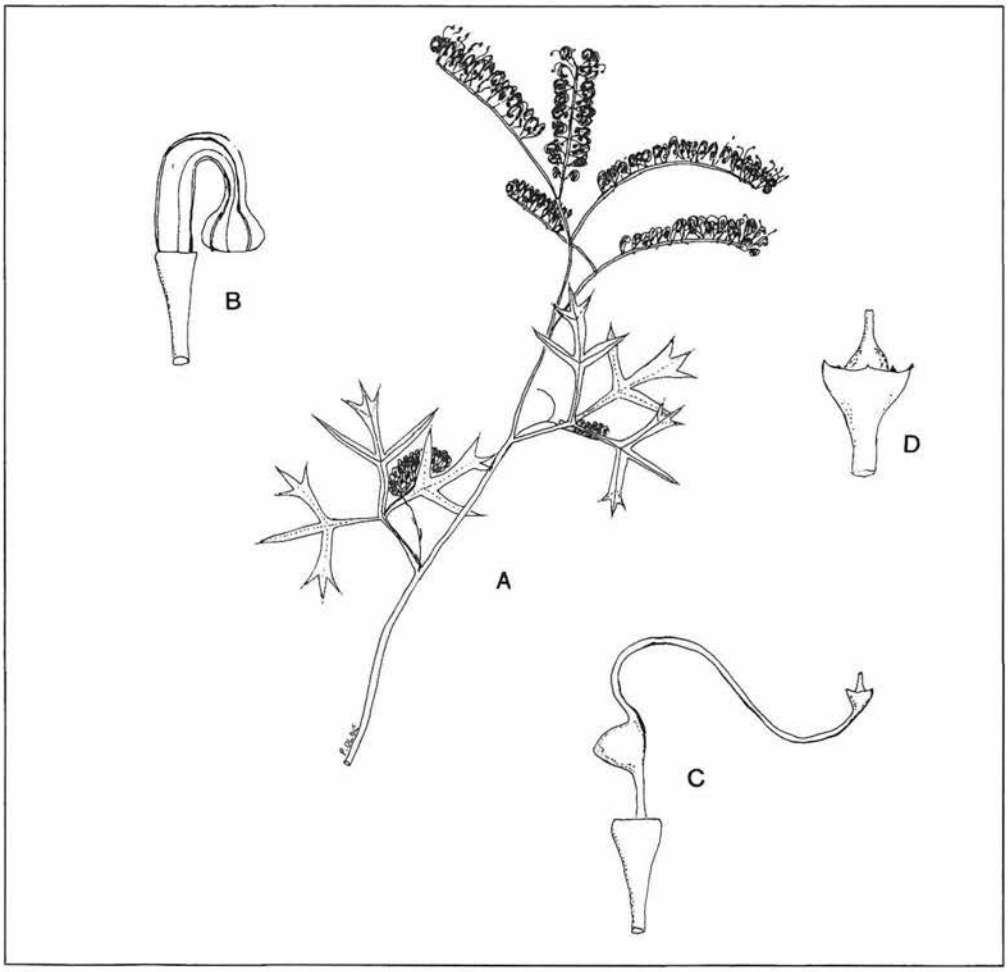

Figure 8. *G. prominens* A - habit, B - perianth, C - pistil, D - style-end.

Selected specimens (8 examined). WESTERN AUSTRALIA: Mount William, *Gilbert* 139, 1842 (NSW); Mount William near Wagerup, *van der Moezel* 7, 5 Sep. 1979 (NSW, PERTH); Hoffmans Mill, NE of Harvey, *R.F. Williams*, 16 Sep. 1932 (CANB); 11.8 km N of Collie towards Tallanalla, *Canning* CBG 065483, 2 Oct. 1968 (CBG, NSW, PERTH).

Distribution. Western Australia, where known from only a few collections in the Harvey area.

Habitat and ecology. Grows along creek lines in Jarrah forest in gravelly loam. No pollinators were seen to visit the flowers but the species is almost certainly insect-pollinated. Fire effects are unknown. The collared pollen-presenter of this species seems to permit an unusually large pollen-deposit to be stacked around the pollen-presenter and would thus appear to act as a facilitator of increased fertilisation.

Flowering period. Late Winter-Spring.

Fruiting period. Late Spring-Summer.

Affinities. McGillivray (1993: 164) has included our *G. prominens* in *G. trifida* as the long-inflorescence form, noting that plants "show remarkable differences from all other material of *G. trifida* in the shape of the inflorescences". Reasons are there advanced for retaining it as an informal entity in *G. trifida*, among them its divaricately divided leaves and collared pollen-presenter. There is also a perceived close relationship with *G. synapheae* through a shared pattern of leaf and inflorescence structure.

Discussion. Examination of these arguments do not convince. The conflorescence structure of *G. prominens* is not subcylindrical as stated but secund. Hence the discontinuity from *G. synapheae* which has dense cylindrical conflorescences is apparent. Further, not all populations of *G. trifida sensu* McGillivray have divaricate leaves (e.g. *G. trifida sens. str.*) while a collared pollen-presenter is found in *G. monticola* Meissn. It therefore becomes a matter of considerable argument as to what are the closest affinities of *G. prominens*. Secund conflorescences are a shared feature with *G. monticola* Meissn. which has, in addition, conflorescences of similar length and prominence. No populations of *G. trifida* have secund conflorescences. Further, as well as the discontinuities evident in its conflorescence length, structure and prominence in relation to *G. trifida* (see Table 2), the flowers of *G. prominens* have pedicels shorter (1.8-2.5(3) mm long). We would therefore assert that sufficient grounds are present to withdraw *G. prominens* from *G. trifida sensu* McGillivray. Our position in relation to other elements of *G. trifida sensu* McGillivray is currently being assessed, although we shall continue recognition of *G. muelleri* Benth. at specific rank (*G. trifida* Stirling Range form *sensu* McGillivray).

Conservation status. A code of CALM Priority Three is recommended.

Etymology. Latin *prominens* - prominent, in reference to the longer, more conspicuously pedunculate conflorescences.

TABLE 2

	G. prominens	**G. trifida**
Pedicels	1.5-2.5(3)mm long	3-7 mm long
Primary peduncles	0.5-2 cm long	0-0.5 cm long
Unit conflorescence	secund beyond the foliage	umbelliform/globose within the foliage
Floral rachis	1-3 cm long	0.2-0.5 cm long
Pistil	4.5-5.5 mm long	5-7.5 mm long

9. Grevillea thyrsoides Meissn. in Hooker's Journ. Bot. Kew Gard. Misc. 7: 77 (1855)

Typus: From the protologue:"Common between Dundaragan and Smith River". *Lectotype:* (McGillivray 1993: 445): Interior North of Swan River. A. 1850-51. *legit Drummond*, Coll. VI. No. 183 (lecto: NY; isolecto: CGE, FI, G-DC, K, LD, MEL, P, PERTH). Only the isolectotype at PERTH has been seen.

A low, mounding, lignotuberous shrub to 70 cm high, spreading 1-2 m.; branchlets rounded to slightly angular, openly villous. *Leaves* 2.5-11.5 cm long, ascending, shortly petiolate, subpinnatisect, secund; leaf rachis straight or recurved, sometimes strongly so near the apex; leaf lobes 9-65 mm long, 1-1.5 mm wide, linear, the lower lobes often strongly introrse on dried specimens, the apex scarcely pungent to uncinate; upper surface granulate, loosely villous, sometimes with intermixed glandular hairs, midvein evident; margins angularly revolute; lower surface bisulcate, the lamina almost obscured by the margin, villous in the grooves, the midvein prominent. *Conflorescence* erect on trailing peduncles, terminal, branched; unit conflorescences 2.5-25 cm long, conico-secund, dense, the flowers at the proximal end usually becoming shrivelled and dying before anthesis of those at the distal end; peduncles tomentose to glandular-villous; floral rachis glandular-villous; floral bracts 3.5-7.5 mm long, ovate-acuminate, glabrous to sparsely villous outside, the margins usually ciliate, persistent to anthesis. *Flowers:* pedicels 1.3-4 mm long, villous; torus ± 1.5 mm across, oblique; nectary U-shaped, smooth; *perianth* 7-8 mm long, 3 mm wide, whitish-pink, ovoid-sigmoid, dilated at the base, villous and longitudinally ribbed outside, glabrous inside, persistent to fruiting; limb green, revolute, globular; *pistil* 24-33 mm long; stipe 1-2.8 mm long, sparsely villous; ovary densely appressed-villous; style pink, gently curved, introrse after anthesis, pilose-villous, dilating gradually into the style-end; pollen-presenter oblique, convex, ovate to almost round. *Fruit* 14-18 mm long, 8 mm wide, oblique, ellipsoidal to obovoidal, somewhat compressed, tomentose; style persistent; pericarp c. ± 0.5 mm thick. *Seeds* 9-10 mm long, 3.5 mm wide, elliptic with a laterally recurved apical elaiasome c. 2 mm long, outer face convex, smooth; inner face smooth, concave; margin recurved, bordered by a waxy wing c. 1 mm wide.

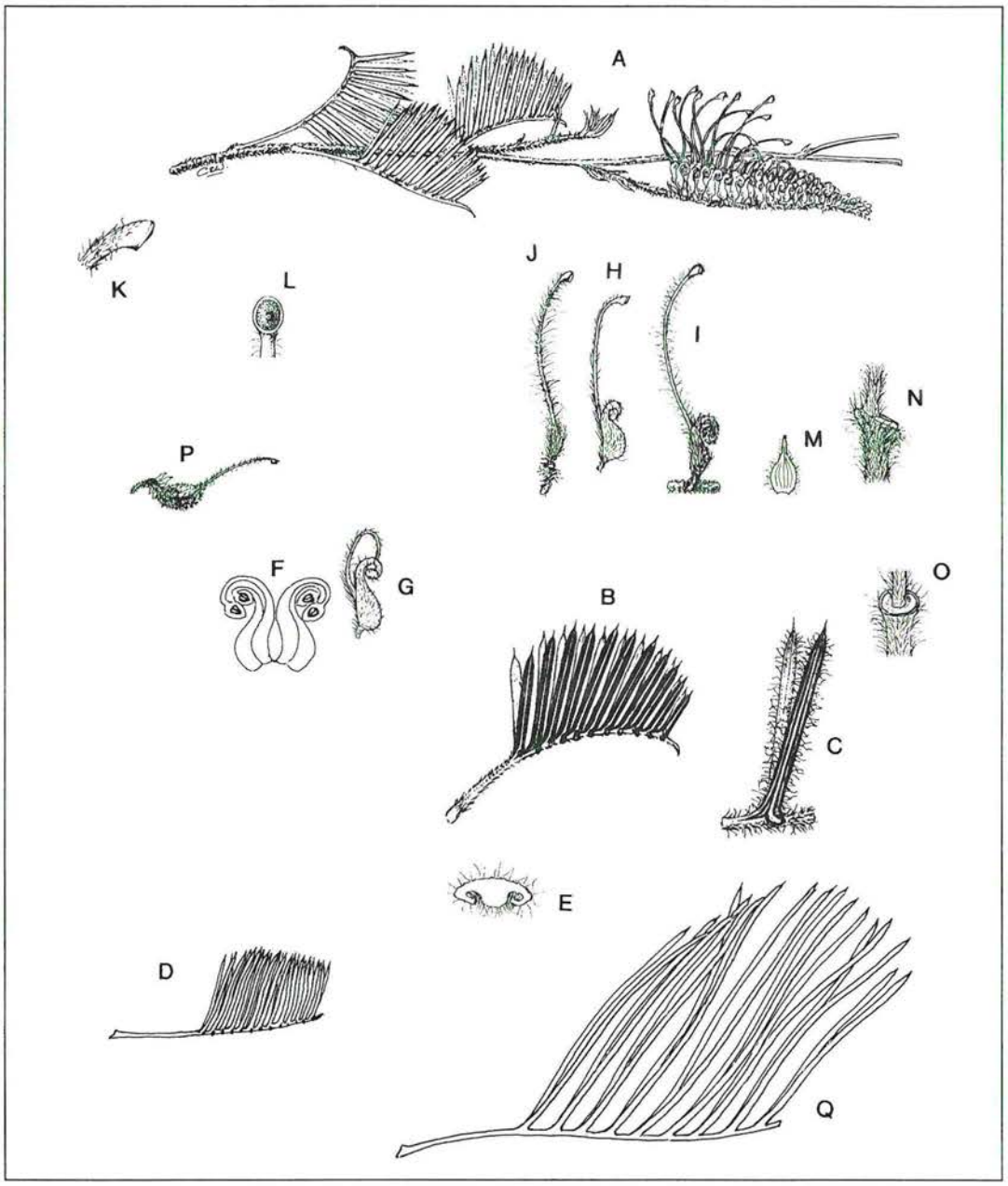

Figure 9. *G. thyrsoides* subsp. *pustulata* A - habit, B-D - leaves, E - leaf in cross-section, F - inner perianth surface, G-I - flowers, J - pistil, K - style-end, L - pollen-presenter, M - floral bract, N, O - torus/nectary, P - fruit. *G. thyrsoides* subsp. *thyrsoides* Q- leaf.

Affinities. G. thyrsoides appears to be quite remote from other related species. Visually, its affinities are with *G. dryandroides* C.A. Gardner which differs in its elongate-conical pollen-presenter.

Discussion. McGillivray (1993: 100) distinguishes two forms on the basis of leaf and bract characteristics. We have examined this species in the field and all specimens at PERTH and NSW, including specimens cited by McGillivray (*Gardner* 9017, *Gardner* 9297, *Drummond* VI. 183). The two forms *sensu* McGillivray, termed respectively the longer-leaved form and the shorter-leaved

form, are visually distinct, in that the leaves, leaf lobes, inflorescences and floral bracts of the former entity are, with very few exceptions, longer than those of the latter entity. In addition, the leaf lobes of the longer-leaved form are usually spreading (*cf.* closely aligned in the shorter-leaved form).

There is morphological discontinuity between the forms in the leaf length on all but one or two leaves, but in addition, through the development of a pimple-like protuberance at the base between the midvein and anterior margin on the undersurface of each leaf lobe of specimens of the shorter-leaved form, there is a further, very obvious discontinuity. The protuberance is completely absent from all but three specimens of the longer-leaved form. Our examination of these specimens, cited above and by McGillivray (1993), showed that the development of this protuberance on leaves otherwise clearly assignable to the longer-leaved form because of the other features which all conformed to be exceedingly obscure, was developed on only a few proximal lobes of a few leaves and could not on any account cause confusion when used in combination with the other distinguishing features. Given further that the two populations defined by this unusual morphological feature are geographically and (geologically E. Griffin pers. comm.) disjunct and that there is both a conservation imperative with respect to both of them and a high horticultural usage and that, as well, there is no confusion about the entity to which all specimens can be assigned, we submit that subspecific rank for the two entities is both reasonable and warranted. Accordingly, two subspecies, subsp. *thyrsoides* and subsp. *pustulata* P. Olde & N. Marriott are here recognised.

Key to subspecies of *Grevillea thyrsoides*

1 Most leaves > 5 cm long; leaf lobes lacking a prominent basal pimple-like protuberance on the undersurface ..... subsp. *thyrsoides*

1* Most leaves < 5 cm long; leaf lobes bearing a prominent basal pimple-like protuberance on the undersurface ..... subsp. *pustulata*

Grevillea thyrsoides subsp. **thyrsoides** (Figure 9)

Leaves (3) 5.5-11.5 cm long; lobes 15-65 mm long, straight to irregularly curved, closely aligned to spreading, the terminal lobe 1-16 mm long; unit conflorescence 5-25 cm long; floral bracts 4.6-7.4 mm long.

Selected specimens (20 examined). WESTERN AUSTRALIA: 14.6 mi. along Jurien Bay Rd from Dandaragan, *George* 230, 13 Dec. 1958 (PERTH); 5 km S of Cataby, *Keighery* 10273, 10 July 1988 (PERTH); "Dunearn", NW of Dandaragan, *Griffin* 4921, 28 Sep. 1988 (PERTH); 21.5 km from Badgingarra on road to Dandaragan, *Olde* 86/913, 17 Oct. 1986 (NSW); Source of the Hill River, *Gardner* 9017, 23 Aug. 1948 (PERTH).

Distribution. Western Australia, where confined to an area between Badginarra and Jurien Bay.

Habitat and ecology. Grows in gravelly or sandy loam in mallee shrubland. Pollinator unknown, presumably nectarivorous birds. Regeneration is from seed and lignotuber.

Flowering period. All year with a peak in Spring.

Fruiting period. Fruiting specimens have been collected in late Spring.

Conservation status. A code of CALM Priority Three is recommended. Most extant populations occur in degraded roadside habitats.

Grevillea thyrsoides subsp. **pustulata** P. Olde & N. Marriott subsp. nov. (Figure 9)

A subspecie typica foliis brevioribus (pro parte maxime minus quam 5 cm longis) cum lobis brevioribus approximatioribusque unisquisque basi in pagina infera pustulam gerentibus, bracteis florum saepe brevioribus differt.

Typus: Western Australia: 12 mi. S of Marchagee, *M. Tindale* 1275, 27 Mar. 1970 (holo: PERTH; iso: NSW).

Differs from the type in its shorter leaves (mostly less than 5 cm long) with shorter, more closely aligned lobes each bearing at its base on the undersurface a pimple, and in its often shorter floral bracts.

Leaves 2.5-4 (6) cm long; lobes 9-32 mm long, straight and closely aligned, bearing a terminal lobe 2-3 mm long; unit conflorescence 2.5-11 cm long; floral bracts 2-5.3 mm long.

Selected specimens (23 examined). WESTERN AUSTRALIA: 13.2 km N of Watheroo on Midlands Rd, *Hopper* 1644, 29 July 1980 (PERTH); Coorow, *E. Salisbury s.n.,* 10 Aug. 1949 (PERTH); 54 km N of Moora, *Olde* 86/920, 17 Oct. 1986 (NSW); *pr.* Watheroo, *Gardner* 1935, 23 Sep. 1926 (PERTH).

Distribution. Western Australia, where confined to an area between Coorow and Watheroo.

Habitat and ecology. As for subsp. *thyrsoides.*

Flowering period. All year.

Conservation status. Subsp. *pustulata* has a limited distribution and is confined to an area which has been largely cleared. It survives mainly in unreserved road verges. A conservation code of CALM Priority One is recommended.

Etymology. Latin *pustula* - a pimple, in reference to the pimple-like protuberance at the base of the leaf lobes.

10. Grevillea dryandroides C.A. Gardner in J. & Proc. Roy. Soc. W.A. 19: 81 (1934). (Figure 10)

Lectotypus (McGillivray 1993: 415): Ballidu, in yellow sandy loam, with *Synaphea polymorpha, Ecdeiocolea etc., C.A. Gardner* 2711, 22 Sep. 1931 (lecto: PERTH - with rubber stamp "TYPE" and 'TYPE SPECIMEN' sticker; isolecto: K *(n.v.)*, PERTH).

Tufty, root-suckering shrub 10-50 cm high with leafless peduncles trailing up to 1 m from the foliage; branchlets angular, villous. *Leaves* 5-20 cm long, ascending, shortly petiolate, subpinnatisect, secund; leaf rachis straight, incurved or recurved; leaf lobes 5-35 mm long, 1.2-2.5 mm wide, linear, closely aligned, the apex uncinate; upper surface glabrous to villous, the midvein evident; margin angularly to smoothly refracted; lower surface bisulcate, the lamina obscured or almost so by the margin, villous in the grooves, the midvein prominent. *Conflorescence* erect on trailing peduncles, terminal, usually branched, sometimes simple; unit conflorescence 3-10 cm long, conico- to oblong-

secund, dense; peduncles sparsely to densely sericeous to appressed-villous; floral rachis sericeous; floral bracts 1-2 mm long, ovate-acuminate, some usually persistent at anthesis. *Flowers:* pedicels 1-2 mm long, sericeous; torus 1-1.5 mm across, oblique to almost straight; *perianth* 6-8 mm long, pink to purplish-red, ovoid-sigmoid, sericeous to tomentose outside, glabrous inside; limb green, revolute, ellipsoid; *pistil* 17-23 mm long; stipe 0.5-1.5 mm long; ovary appressed-villous; style red, straight, sparsely villous becoming glabrous near the style-end; pollen-presenter straight, erect,

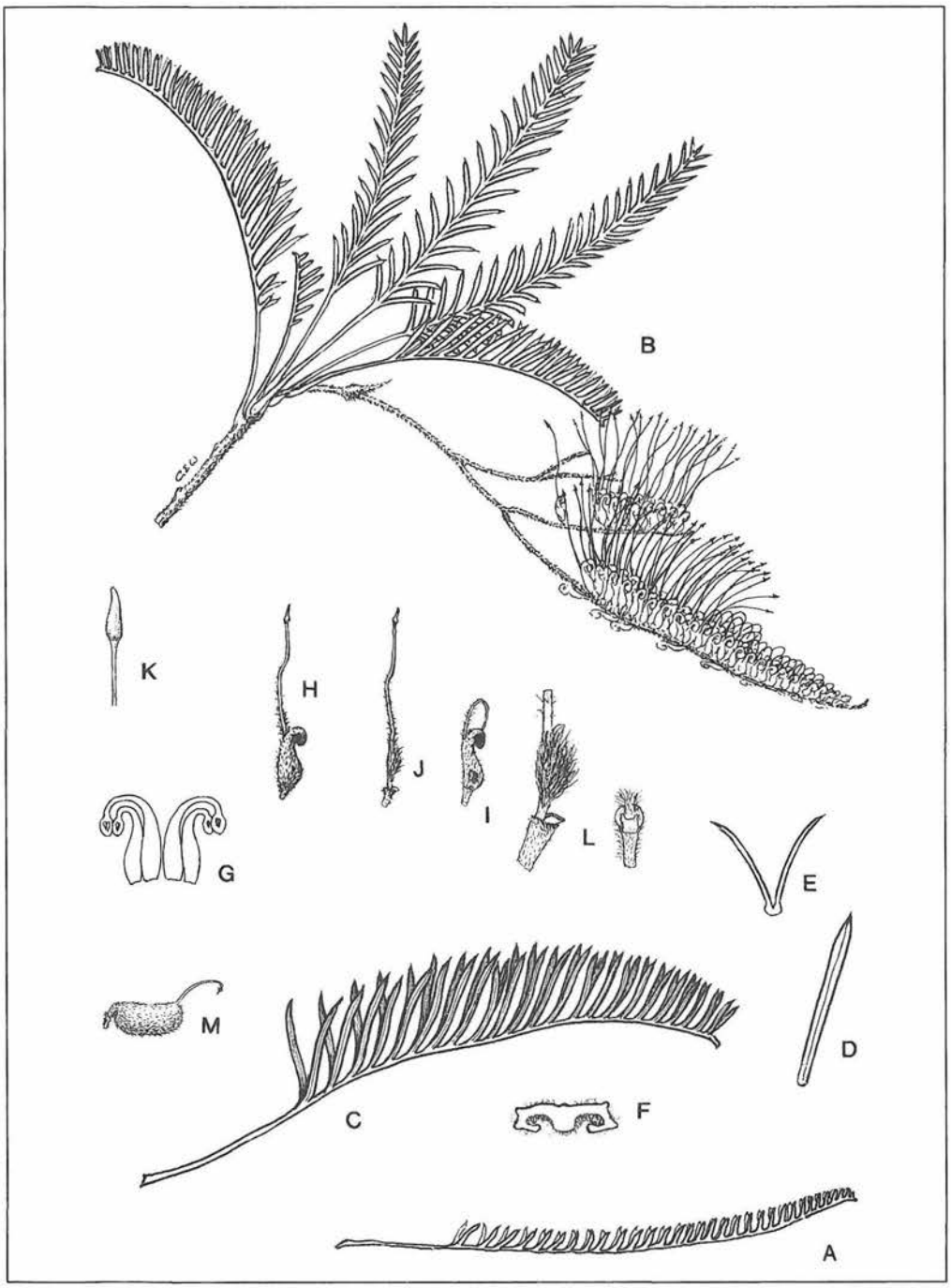

Figure 10. A - *G. dryandroides* subsp. *dryandroides* leaf. *G. dryandroides* subsp. *hirsuta* B - habit, C-E - leaves, F - leaf in cross-section, G - inner perianth surface, H, I - perianth, J - pistil, K - style-end, L - nectary/ovary, M - fruit.

very narrowly elongate-conical, the base slightly bulbous. *Fruits* 14-16.5 mm long, 8.5 mm wide, oblique, oblong to ellipsoid; pericarp 0.5 mm thick throughout. *Seed* 7 mm long, 2.5 mm wide, oblong-ellipsoid; outer face convex, rugulose; inner face flat, channelled around the margin; margin recurved with a papery or waxy border.

Discussion. Two subspecies are here recognised based on the persistence of foliar indumentum, leaf lobe length, conflorescence and pistil length.

Key to subspecies of *Grevillea dryandroides*

1 Most leaf lobes <10 mm long, glabrescent; pistil 17 mm long; ovarian stipe <1 mm long ..... subsp. *dryandroides*

1* Most leaf lobes >12 mm long, persistently hairy; pistil 19-23 mm long; ovarian stipe 1-1.5 mm long ..... subsp. *hirsuta*

Grevillea dryandroides subsp. **dryandroides**

A lightly root-suckering shrub 10-50 cm high, usually forming colonies of <5 plants or scattered singly among the vegetation; leaves dull, yellow-green; leaf rachis glabrous; leaf lobes 5-10(15) mm long, glabrescent; unit conflorescence 3-4 cm long, oblong-secund; pedicels 1-1.5 mm long; torus oblique at c. 30°; perianth 6-7 mm long; pistil 17 mm long; ovarian stipe 0.5-0.7 mm long.

Selected specimens (8 examined). WESTERN AUSTRALIA: 1 km S of Ballidu, *Olde* 86/850, 12 Oct. 1986 (NSW); Ballidu, *Gardner,* 10 Feb. 1940 (PERTH); 2.2 km N of Ballidu, *S. Patrick* 255, 20 May 1986 (PERTH); Between Pithara and Wongan Hills, *Blackall* B791, 26 Sep. 1931 (PERTH); 27 mi. from Wubin towards Wongan Hills, *Canning,* 13 Sep. 1968 (CBG, NSW).

Distribution. Western Australia where confined to a small area near Ballidu.

Habitat and ecology. Grows in sandy clay loam in heath. Pollinator unknown, probably ground-hopping, nectarivorous birds. The flowers are attended by numerous 'meat-ants'.

Flowering period. Winter-Summer.

Notes. The Type specimen has mostly hairy leaves with a few older leaf lobes starting to shed hairs. The same has been observed on cultivated plants with shedding of hairs becoming apparent only after some months. It is presumed that the Type was collected from a plant in vigorous growth as it otherwise complies with the features observed for this subspecies at the Type locality, including shorter leaf lobes, pistils and conflorescences and shorter ovarian stipe.

Conservation status. A code of CALM Priority One is recommended.

Grevillea dryandroides subsp. **hirsuta** P. Olde & N. Marriott subsp. nov.

Ab subsp. *dryandroides* foliorum lobis cum indumento persistenti longioribus, conflorescentiis pistillisque longioribus distinguitur.

Typus: Western Australia: 2.6 km N of Cadoux, *J. Briggs* 645, 25 Sep. 1980 (holo: PERTH; iso: CBG, NSW).

Distinguished from subsp. *dryandroides* in its longer leaf lobes with a persistent indumentum and in its longer conflorescences and pistils.

Tufty, vigorously root-suckering shrub 10-30 cm high, usually forming colonies in excess of 50 clones; leaves grey; rachis appressed-villous; leaf lobes (8)12-35 mm long, persistently hirsute, the hairs crisped; unit conflorescence 5.5-10 cm long, conico-secund; pedicels 1.5-2 mm long; perianth 7-8 mm long; pistil 19-23 mm long; ovarian stipe 1-1.5 mm long.

Selected specimens (11 examined). WESTERN AUSTRALIA: 2-3 km N of Cadoux, *Olde* 86/874, 14 Oct. 1986 (NSW); Baandee Rd, N of Cadoux, *R. Gibbons*, Oct. 1964 (PERTH); 15 km N of Yardingalong, *Cranfield* 4834, 27 Oct. 1983 (PERTH); Hindmarsh Nature Reserve, 16 km SSE Dowerin, *A.P. Brown* 284, 1 June 1986 (PERTH); Durrakoppinen Nature Reserve, N of Kellerberrin, *Olde* 91/67, 11 Sep. 1991 (NSW); Cnr Gill & Creek Rds, NW of Corrigin, *Olde* 88/ 55, 6 Oct. 1988 (NSW); 30 km S Quairaiding, (5 km S of Lake Mears), *J. Taylor* 913, *M. Crisp & R. Jackson,* 27 Sep. 1979 (AD, CBG, NSW, PERTH); near wheatbin, 6.6 km N of Lomos, W of Corrigin, *George* 12915, 30 Oct. 1974 (PERTH).

Distribution. Western Australia, between Cadoux and Corrigin.

Habitat and ecology. Grows in yellow sand-heath, sometimes with *Eucalyptus* or *Banksia.*

Conservation status. A code of CALM Priority Two is recommended. This subspecies is more common than subsp. *dryandroides* but has nonetheless suffered severely from the loss of habitat due to agricultural clearing.

Etymology. Latin *hirsutus* - hairy, in reference to the persistent leaf indumentum.

11. Grevillea crowleyi P. Olde & N. Marriott sp. nov. (Figure 11)

Affinis *Grevilleae callianthae* Makinson et Olde, sed foliorum lobis angustioribus approximatioribusque, conflorescentiis plerumque brevioribus (2-5 cm longis), pedunculis brevioribus (2.5-4 mm longis), secus stylum biramosis trichomis supra ovarium 5-10 mm extensis, florum bracteis minoribus, trichomis biramosis in fructibus adultis persistentibus differt.

Typus: Western Australia: North-east of Darkan, near Dardadine [precise locality withheld], *P. Olde* 91/234, 26 September 1991 (holo: PERTH; iso: CANB, NSW).

Aff. *G. calliantha* Makinson & Olde, but differs in its narrower and more closely aligned leaf lobes, in its generally shorter conflorescences (2-5 cm long), in its shorter peduncles (2.5-4 mm long), in hairs extending 5-10 mm along the style above the ovary, in its smaller floral bracts and in persistent two-armed trichomes on the fruits.

Shrub 0.5-1.5 m high, dense and spreading up to 1.5 m wide when young, becoming spindly with leaves crowded on the upper branchlets when older; bark grey, rough; branchlets round, occasionally

angular, tomentose to pubescent, striation lacking. *Leaves* (2)3-7 cm long, grey to grey-green, ascending, subsessile but appearing petiolate (distance from leaf base to first lobe 10-20 mm) subpinnatisect; leaf lobes 3-7 per leaf, (4)10-42 mm long, 0.8 mm wide, narrow-linear, dipleural to dorsiventral, basal lobes longest; lobe apex acute, scarcely pungent with a straight to slightly uncinate spine 0.8 mm long; upper surface white tomentose to pubescent when young, becoming ± glabrous with age and either smooth or with 2 longitudinal sulci beside a scarcely evident midvein; lower surface bisulcate, the lamina enclosed by the margin, the grooves packed with white or black, wavy trichomes, the midvein prominent; margin smoothly or angularly revolute; venation obscure except the midvein on the undersurface; texture firmly chartaceous. *Conflorescence* 2-5 cm long, erect or occasionally decurved, subsessile to shortly pedunculate, terminal, secund, dense, simple but sometimes appearing branched with peduncles arising terminally on successive subterminal branchlets, scarcely exceeding the foliage, development acropetal; peduncle 2.5-4 mm long, bracteate (bracts 3-4.5 mm long) lanate; floral rachis 1.2-1.5 mm thick at the base, villous to sublanate; floral bracts 2 mm long, 1-1.2 mm wide, ovate-acuminate, ascending to spreading, persistent, imbricate in bud, villous to tomentose throughout, glabrous at the base inside. *Flowers:* pedicel 1.5-2.5 mm long, villous; torus 1.2-1.5 mm across, straight to oblique at 30°, projecting further on the ventral side; nectary linguiform, slightly lipped at the apex, patent, spreading ± 1 mm from the stipe and exceeding the torus 0.2-0.5 mm, margin entire; *perianth* 7-8 mm long, 2-3 mm wide at the base, grey, obliquely ovoid, tomentose outside, the indumentum consisting mostly of white biramous trichomes mixed with a few red, glabrous inside; limb 1.8 mm long, 2 mm wide, villous, revolute, globose to spheroidal; dorsal tepals 12 mm long, 2 mm wide; *pistil* (23)34-38 mm long; stipe 0.2-0.5 mm long, villous, inserted on the dorsal rim of the torus; ovary subsessile, villous with mixed red and white trichomes; style maroon-black to red, gently incurved, biramous trichomes extending (3)5-10 mm along the style above the ovary, otherwise glabrous; style-end gradually dilated c. 1 mm from the end; pollen-presenter 1 mm long, 0.8 mm wide, 0.5 mm high, convex to subconic, ± round, oblique at c. 45°; stigma distally off-centre. *Fruit* 13-16 mm long, 6-9 mm wide, 8-9.5 mm deep, erect or reflexed on straight or incurved pedicels, oblong-ellipsoidal with recurved apiculum, slightly compressed laterally, tomentose with mixed biramous and glandular trichomes, conspicuous red or brownish blotches or striping evident caused by the trichome cell colour; style persistent; pericarp c. 0.3 mm thick throughout. *Seeds* 12 mm long, 5 mm wide, 2 mm deep, oblong-elliptic; outer face convex, smooth with a prominent submarginal ridge all round; margin undulate, entire, paler than the central area; inner face concave with conspicuous, gill-like fluting radiating c. 2 mm from the margin all round towards a central, more open base 6 mm long, 1.5 mm wide.

Selected specimen (15 examined). WESTERN AUSTRALIA: North-east of Darkan. *V. Crowley s.n.*, 5 November 1990 (NSW).

Distribution. Western Australia, confined to the Type location where only 10 plants remain. Most are found in a disturbed gravel pit. Two were found in nearby undisturbed bushland.

Habitat and ecology. Grows in *Eucalyptus wandoo* forest in heavily laterised loam in association with *Allocasuarina* sp., *Glischrocaryon aureum, Baeckea crispiflora, Grevillea leptobotrys, Synaphea* sp., *Calothamnus* sp. The area contains about 75 different species. Pollination is probably by birds. Regeneration is from seed only.

Flowering period. August-November.

Fruiting period. November-December.

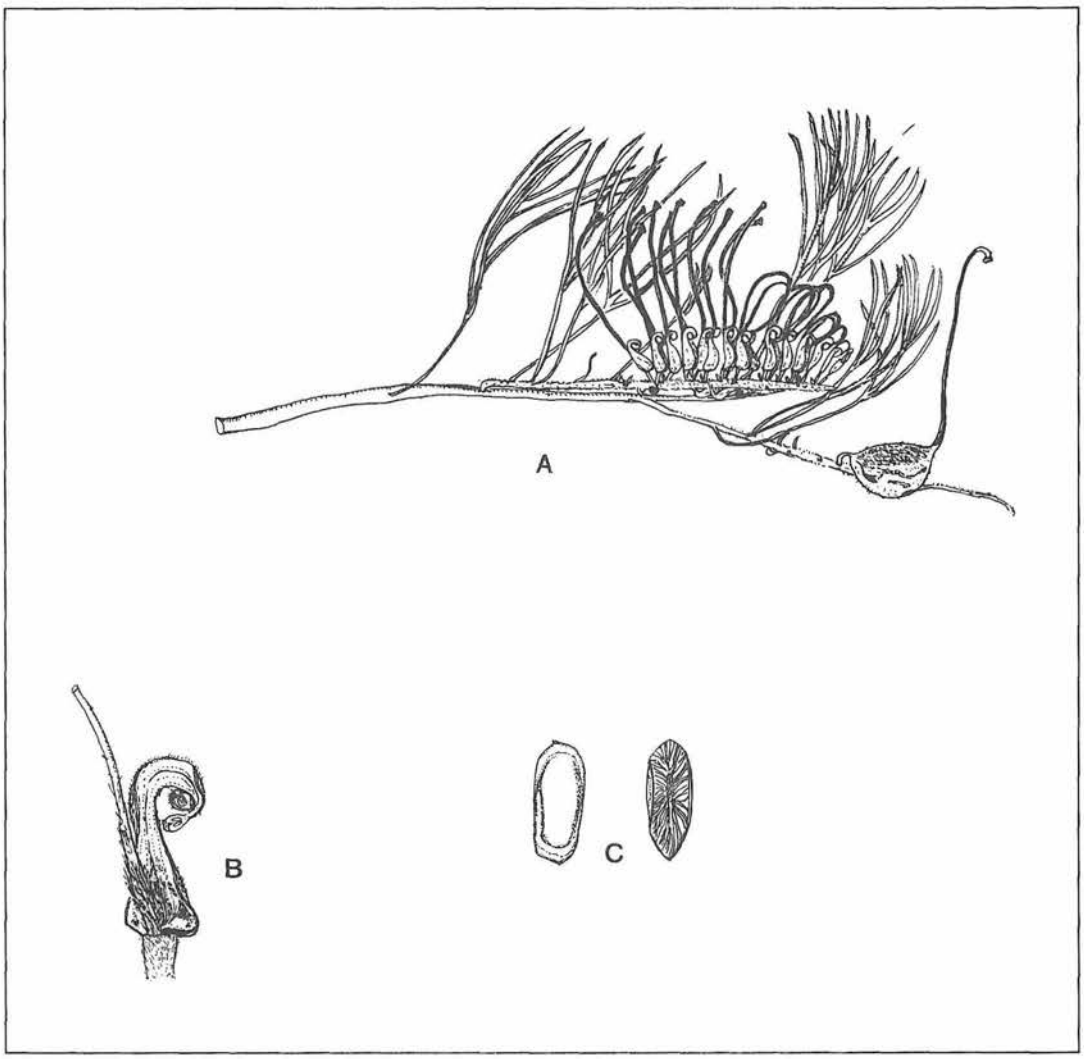

Figure 11. *G. crowleyi* A - habit, B - perianth and pistil, C - seed.

Affinities. Grevillea crowleyi is most closely related to *Grevillea calliantha* and *G. hookeriana,* the latter differing in its shorter pistils (19-21.5 mm long) and in its glabrous style. The differences from *G. calliantha* are listed in Table 3 on page 274.

Conservation status. A code of CALM Priority One is recommended. We understand that the Type locality is currently being considered as a nature reserve. Direct intervention as a conservation initiative is recommended both by *ex-situ* propagation by horticulturists and *in-situ* protection.

Etymology. The epithet honours Mrs Valma Crowley (1937-), amateur naturalist, of Darkan, W.A. who, with her friend Mrs Janice Smith (1933-), also of Darkan, discovered the new species in a gravel pit while bushwalking near her home. Mrs Crowley first drew our attention to this species and forwarded specimens from each plant. The ongoing concern of the two co-discoverers for its conservation has enabled this species to be preserved in its natural habitat.

TABLE 3

	G. calliantha	G. crowleyi
Leaf lobes	>1 mm wide	<1 mm wide
orientation	spreading	closely aligned.
Peduncle	5-15 mm long	2.5-4 mm long
Conflorescence	5-7 cm long	2-5 cm long
Floral bracts	2.2-2.9 mm long	2 mm long
Stylar indumentum		
biramous trichomes	1-3 mm above ovary	3-10 mm above ovary
glandular trichomes	sometimes present	absent
Fruit indumentum	densely glandular	sparsely glandular
Habitat	open heath	*Euc. wandoo* forest
Soil	white sand over laterite	laterised brown loam

12. Grevillea coccinea Meissner in Hooker's Journ. Bot. Kew Gard. Misc. 7: 76 (1855), and, Meissner in Lehmann [ed.], Pl. Preiss. 1: 545 (1845) sub *Grevillea concinna* R.Br. (Figure 12)

Lectotypus (n.v.) (*fide* McGillivray 1993: 411): "In calculosis confragosis 7 mill. a monte Manypeak 1, Tjilberup", *Preiss* 711, 22 Nov. 1840 (lecto: NY - specimen at right of sheet overlain by lectotype determinavit slip; isolecto: B, G, G-DC, HBG, LE, MEL 47032, NY, P - 2 sheets).

G. hewardiana Meissn. in Candolle, Prodr. 14: 366 (1856); lectotype (McGillivray 1993: 411): SW Australia, *Drummond* 404 (lecto: K; isolecto BM, CGE, FI, G, LE, MEL, P, TCD).

G. concinna var. *racemosa* Benth. in Fl. Austral. 5: 432 (1870); *lectotype (n.v.)* (*fide* McGillivray 1993: 411): SW Australia, *Drummond* 404 (lecto: K; isolecto: BM, CGE, FI, G, K, LE, MEL, P, TCD).

A spreading, mid-dense shrub; branchlets terete to slightly angular. *Leaves* crowded, shortly petiolate, simple; apex acute to obtuse-mucronate, pungent; upper surface smoothly or angularly convex to flat, usually with 3-5 longitudinal veins, glabrous with minute pitting to sericeous or sparsely so, the hairs often with a sparkling sheen; margin entire, angularly to vertically refracted about an edge-vein; midvein and edge-veins evident to prominent on the upper surface, the midvein prominent below. *Conflorescence* 2.5-6.5 cm long, erect, shortly pedunculate, terminal, secund, simple, scarcely to not exceeding the leaves; peduncles sericeous to pubescent; floral rachises angular, sericeous to tomentose; floral bracts 2.4-4.8 mm long, narrow-triangular with attenuate to subulate apex, sericeous to tomentose, caducous. *Flowers:* pedicels 1.3-2.1 mm long, sericeous to tomentose; torus ± straight, oblong; nectary oblong to thickly U-shaped, entire or lipped; *perianth* greenish-cream to brown, ovoid, glabrous inside; limb revolute, globular to spheroidal; *pistil* 19-23.5 mm long; stipe 0.6-1.6 mm long, villous, partly adnate within the torus; ovary villous; style red, glabrous, papillose or wrinkled on the ventral side, retrorse soon after anthesis, dilating c. 1 mm before the unguiform style-end; pollen-presenter straight or slightly oblique, oblong-elliptic to ± round, flat to convex,

umbonate. *Fruit* 10.5-16 mm long, 5.5-8 mm wide, erect on incurved pedicels, faintly ridged, ovoid, tomentose to pubescent with red-brown striping; style persistent, fragile; pericarp 0.5-1 mm thick. *Seed* 10 mm long, 3 mm wide, elliptic; outer face convex, smooth with a flange-like border, shortly winged at each end; inner face channelled about the margin with an elliptic concave centre; margin recurved.

Affinities. G. coccinea is closely related to a number of species including *G. concinna* and *G. cagiana*. *G. concinna* differs primarily in its deflexed inflorescences. *G. cagiana* differs in having its leaves divided with the undersurface enclosed by the margin.

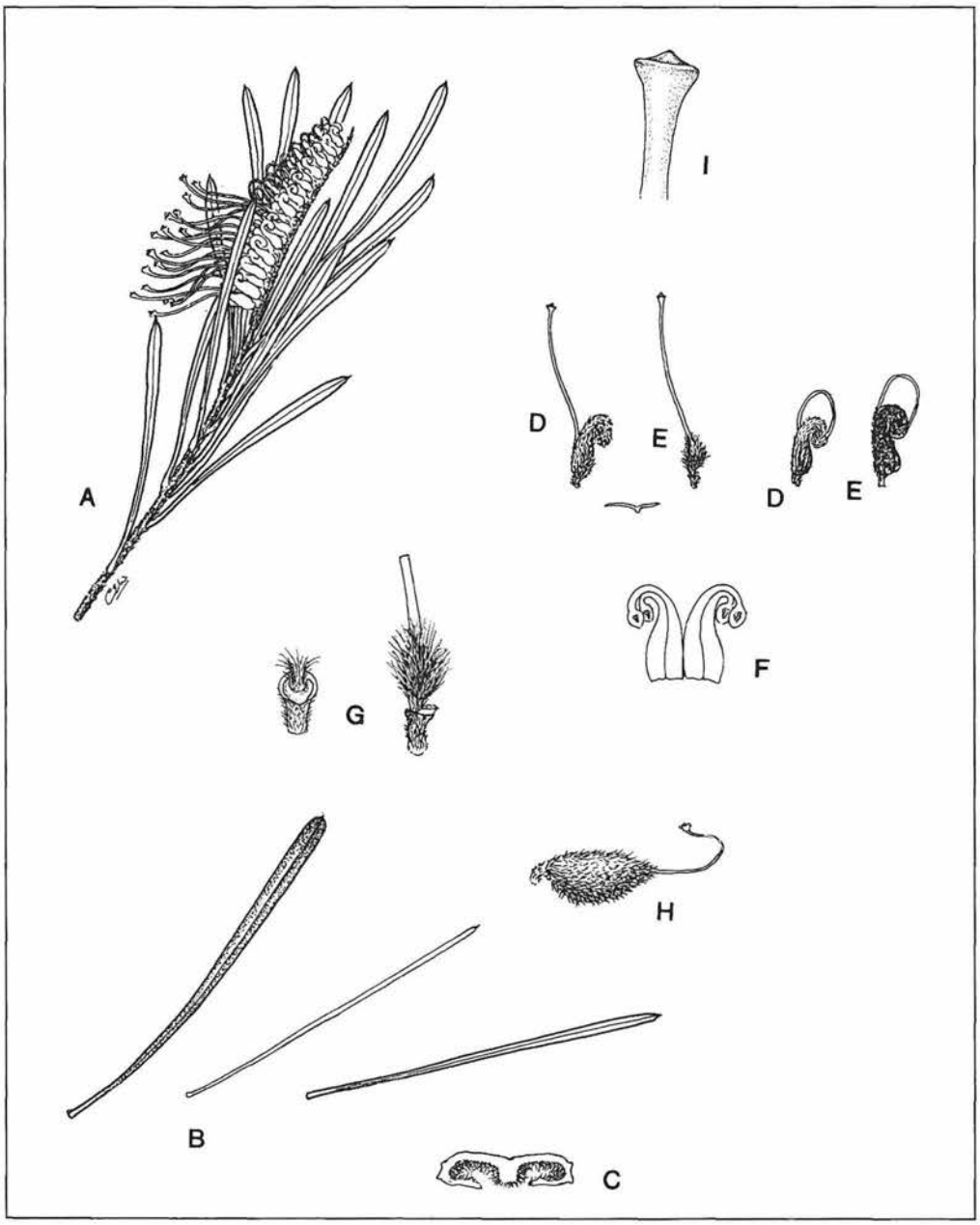

Figure 12. *G. coccinea* A - habit, B - leaf variation, C - leaf in cross-section, D - perianth (subsp. *coccinea*), E - perianth/pistil (subsp. *lanata*), F - inner perianth surface, G - nectary/ovary, H - fruit, I - style end.

Discussion. McGillivray (1993: 74) informally recognises three forms in *G. coccinea.* We have conducted extensive field research and herbarium study into this species and conclude that at least one of them, "the woolly-flowered form", should be recognised formally. The taxon is represented in collections by two specimens and is both visually distinctive and morphologically discontinuous from other forms of *G. coccinea* in the characteristics outlined by McGillivray. In addition, both specimens of this form have an exceedingly short ovarian stipe (0.4-0.5 mm long). Further it is geophysically confined to two mountainous areas from which collections of other forms are not known.

Key to subspecies of *Grevillea coccinea*

1 Perianth 2-3 mm wide, outer surface sericeous to tomentose; torus <1.5 mm wide; ovarian stipe > 0.5 mm long ..... subsp. *coccinea*

1* Perianth 3-3.5 mm wide, outer surface lanate; torus 1.6 mm wide; ovarian stipe <0.5 mm long ..... subsp. *lanata*

Grevillea coccinea subsp. **coccinea**

A shrub 1-3 m high; leaves 2.5-12.5 cm long, 1-3(4.5) mm wide; torus 1-1.5 mm wide; floral bracts 2.4-4.8 mm long; perianth 8 mm long, 2-3 mm wide, sericeous to tomentose; pistil 19-23 mm long; stipe (0.5)0.7-1.6 mm long.

Selected specimens (55 examined). WESTERN AUSTRALIA: 5 km S along Hamersley Drive from West River Rd, WNW of Hopetoun, *Olde* 86/1126, 10 Nov. 1986 (NSW); 20 miles S of Jerramungup, *Filson* 9142, 2 Oct. 1966 (PERTH); 3 km E of Pallinup River on Hassell Hway, *Olde* 86/1088, 7 Nov. 1986 (NSW); Fitzgerald River NP, Junction of Hamersley Dr. & Telegraph Rd, *J. Fox* 86/074, 3 Jan. 1986 (NSW); East Mt Barren, *Phillips*, 31 Oct. 1962 (NSW); 4 km N of Hopetoun on Ravensthorpe Rd, *Rodd* 5105 & *McCarthy*, 20 Nov. 1985 (NSW, PERTH); 30 km S of Reynolds Hill on road S from Jerramungup, *McGillivray* 3508 & *George*, 25 June 1976 (NSW); 80 mi. from Albany towards Jerramungup, *Wrigley*, 26 Oct 1968 (CANB, NSW); Nr Whoogarup Range, *George* 1928, 2 Dec. 1960 (PERTH); 51 miles Many Peak Rd, Sth Stirlings, *Lullfitz* L3502, 19 Aug. 1964 (PERTH); Elverdton, *Woolcock* G121, 30 Sep. 1985 (NSW); Ravensthorpe, *Andrews,* Oct. 1903 (NSW); Mt Short, N of Ravensthorpe, *Bennett* 2478, 1 Sep. 1968 (NSW, PERTH); 5 mi. from Ravensthorpe, *Wrigley*, 27 Oct. 1968 (PERTH); 16 km S of Ravensthorpe, *Demarz* 135, 24 May 1968 (PERTH); Nr Hopetoun, *Andrews,* Oct. 1903 (PERTH).

Distribution. Western Australia, widespread south from the Ravensthorpe Range to the coast and west towards Mount Manypeak.

Habitat and ecology. Grey sand over loam in heath, sometimes in granitic loam, or dense lateritic loam. Honeyeaters have been observed frequenting the flowers. Regenerates from seed after fire.

Flowering period. All year, peaking in Spring.

Conservation status. Not endangered.

Grevillea coccinea subsp. **lanata** P. Olde & N. Marriott subsp. nov.

A subspecie typico perianthio latiore (3-3.5 mm lato) extus lanato, toro parum latiore (1.6 mm lato) ovarii stipite plerumque breviore (0.4-0.5 mm longo) differt.

Typus: Western Australia: Middle Mt Barren Reserve 24048. 119° 41'E, 34°03'S, *A.S. George* 10104, 16 July 1970 (PERTH).

Differs from the type in its broader perianth (3-3.5 mm wide) with a woolly outer surface, in its slightly longer torus (1.6 mm long across) and in its generally shorter ovarian stipe (0.4-0.5 mm long).

Shrub 1.3 m high. Leaves 8-12 cm long, 1.8-2.5 mm wide; unit conflorescence 3.5-5 cm long; torus 1.6 mm wide; floral bracts 6 mm long; perianth 8-10 mm long, 3-3.5 mm wide, creamy-pink, sublanate; pistil 20 mm long; stipe 0.4-0.5 mm long.

Specimen examined. WESTERN AUSTRALIA: Thumb Peak, *George* 7126, 31 Oct. 1965 (PERTH).

Distribution. Western Australia, where confined to Fitzgerald River National Park.

Habitat and ecology. Recorded from submontane habitats in quartzitic soils in heath. Pollination is probably by nectarivorous birds.

Flowering period. Flowers recorded in July and October.

Conservation status. The subspecies is contained in two specific areas of Fitzgerald River National Park. Although the specimen base is small, the area is difficult of access and poorly collected. Accordingly, the subspecies may be more common than is indicated. A code of CALM Priority Three is recommended.

Etymology. Latin *lanatus* - woolly, in reference to the outer perianth indumentum.

13. Grevillea pilosa A.S. George (1966) in W.A. Nat. 10: 32

Replaced synonym: *G. rufa* C.A. Gardner in Journ. & Proc. Roy. Soc. W.A. 27: 168 (1942) *nomen illeg. non* (Warb.) Sleumer (1939).

Lectotypus (McGillivray 1993: 434): gravelly rises. Pallarup Rocks. Low woody diffuse shrub. fls. dark red, woolly. *C. A. Gardner*, September 1930 (lecto: PERTH; isolecto PERTH).

A spreading, dense shrub 0.5-2 m high with down-arching branches; branchlets round, villous to silky-tomentose with intermixed glandular hairs, often secund. *Leaves* 2-5.5 cm long, 1-6 cm wide, ascending to retrorse, shortly petiolate, obovate-cuneate to ovate-oblong, the base narrowly cuneate to spreading; rachis straight; upper surface minutely glandular-pubescent, extending even onto the marginal spines, sometimes with scattered biramous trichomes, sometimes also glaucous; lower surface sericeous; margin flat or shortly recurved, dentate to triangular-lobed, the apices pungent; venation craspedodromous, the midvein and lateral veins flat or slightly raised on the upper surface, prominently raised below, the lateral veins terminated by excurrent spines 1-2 mm long, less

prominent lateral veins terminated at the margin with conspicuous tertiary reticulum. *Conflorescence* erect to decurved, usually terminal, sometimes axillary, pedunculate, simple or few-branched; unit confloresence 3-4(10) cm long, secund-globose, development basipetal; peduncles and floral rachises tomentose to villous; floral bracts 3-6 mm long, ovate-acuminate, sericeous to villous outside, caducous. *Flowers:* pedicels 8-16 mm long, villous, slender; torus 2.5-4.5 mm across, oblique, cupuliform; nectary lining the inside of the torus, scarcely evident above the rim; *perianth* 7-15 mm long, 2.5-3 mm wide, oblong, slightly dilated at the base, glandular-pubescent outside with mixed biramous trichomes; limb revolute, globose, densely villous, the segments not visible, coherent after anthesis; *pistil* 20-27 mm long, hairy; stipe c. 3 mm long, adnate for c. 2 mm to the inner face of the torus, refracted perpendicular to the torus at the toral rim and rising c. 1 mm; ovary densely spreading-villous; style villous, terminated by a clavate style-end; pollen-presenter very oblique to lateral, obovate, convex, the stigma distally off-centre. *Fruit* ± 12 mm long, 8 mm wide, erect, subglobose to oblong-ellipsoid, glandular-villous but the hairs soon deciduous; style persistent; pericarp 0.5-1 mm thick. *Seed* 7.5-8.5 mm long, 3.5 mm wide, compressed-ellipsoid to obovoid; outer face convex, smooth, mottled; inner face with a raised, elliptic ridge in the middle, otherwise flat; margin recurved, narrowly winged all round, the wing drawn to a short, oblique apical point extending 0.5 mm beyond the testa.

Affinities. Grevillea pilosa is most closely related to *G. dissecta* and *G. insignis.* See Key 3 on page 282.

Discussion. G. pilosa currently comprises two subspecies, subsp. *pilosa* and subsp. *dissecta* McGillivray (McGillivray 1986: 12). From our observations in the field, of herbarium specimens and of the group generally, it is our view that subsp. *dissecta* should be recognised at specific rank and that *G. pilosa* should be further divided into two subspecies, subsp. *pilosa* and subsp. *redacta* P. Olde & N. Marriott. Subsp. *dissecta* McGillivray differs very greatly from subsp. *pilosa* in its leaf indumentum and structure, although floristically it is very close to our *G. pilosa* subsp. *redacta.* The minute glandular indumentum on the upper leaf surface is a distinctive character for *G. pilosa,* shared only by one other related species, *G. asteriscosa* Diels. *G. pilosa sens. str.* has a straight leaf rachis with the lamina exposed on the undersurface, reticulate venation evident, a mixed indumentum of glandular and biramous trichomes on the branchlets and a villous floral rachis and pedicels. *G. dissecta*, on the other hand, has divaricately bipinnatisect leaves with the upper surface glabrous and the undersurface enclosed with only the midvein of the leaf and lobes evident, a sericeous to almost glabrous floral rachis and pedicels. The perianth has a sparser and more closely appressed indumentum and slightly different torus than our subsp. *redacta* and differs markedly from the larger, more densely villous flowers of subsp. *pilosa.* Although we have not seen them growing closely together, the distribution of *G. dissecta* overlaps that of our *G. pilosa* subsp. *redacta.* However, it is much more widely distributed than that subspecies.

Key to subspecies of *Grevillea pilosa*

1 Perianth 3.5-6.5 mm wide, limb 3-4 mm wide, densely villous; most leaves >2 cm wide with base cuneate to truncate and margins with shallow sinuses; flowers either pale pink or red ..... subsp. *pilosa*

1* Perianth 2.5-3 mm wide, limb 2.5-3 mm wide, villous; most leaves much reduced either <15 mm wide and with attenuate-cuneate leaf bases or c. 2 cm wide and the margins deeply dissected; flowers rose-pink ..... subsp. *redacta*

Grevillea pilosa subsp. **pilosa** (Figure 13)

Branchlets glandular-villous; leaves 1.5-6 cm wide, oblong, obovate or round, the base cuneate, spreading to truncate, margins sometimes sinuate, rarely entire, usually with 3-11 spine-tipped, triangular teeth with shallow sinuses; peduncle glandular-villous; torus 3-4.5 mm across; perianth 10-15 mm long, 3.5-6.5 mm wide, pale pink or red, moderately to densely hairy outside with red or brown hairs, the limb 3.5-4 mm wide, conspicuously and densely villous; pistil 21-27 mm long; stipe 2-3 mm long; style red with red or rusty hairs.

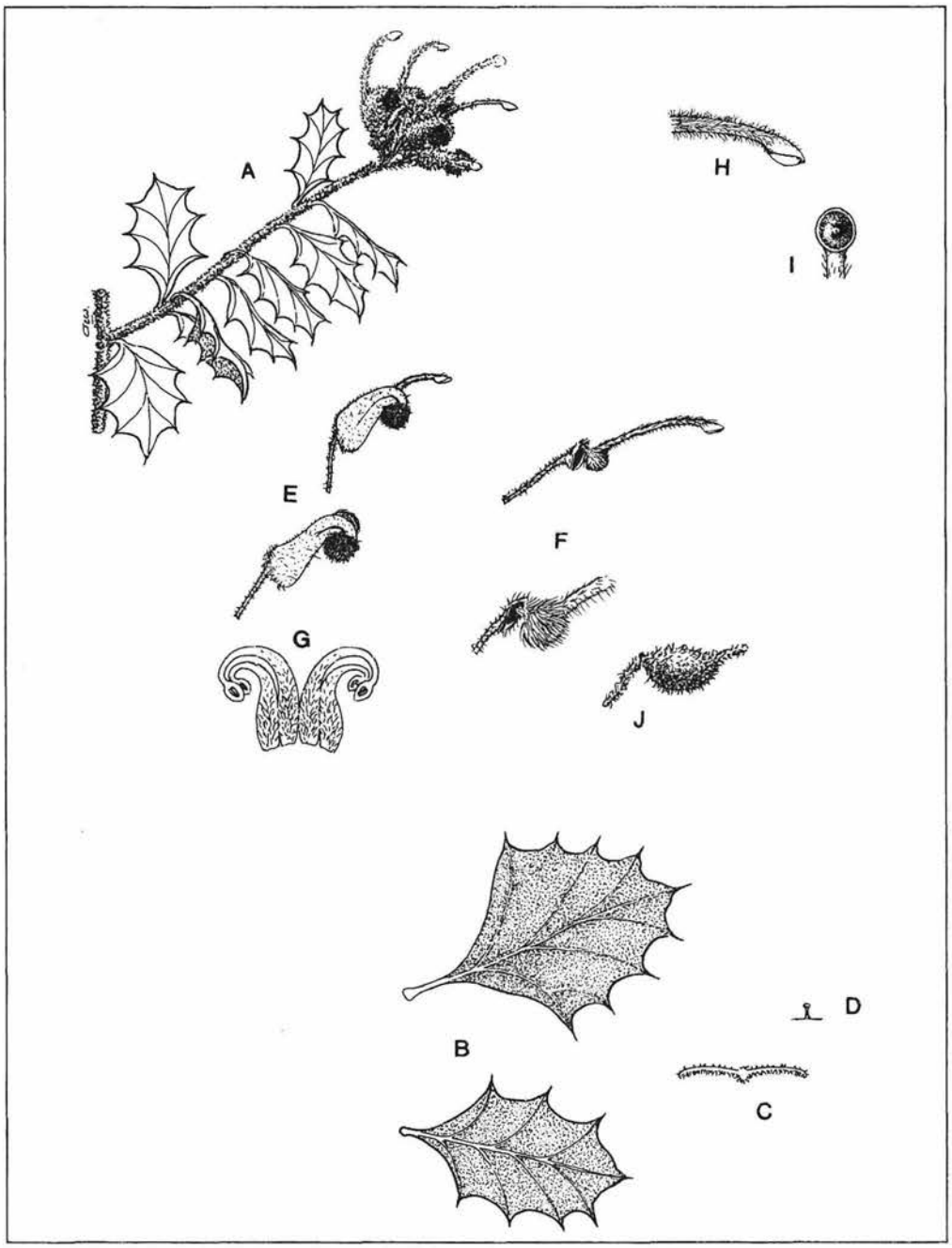

Figure 13. *G. pilosa* subsp. *pilosa* A - habit, B - leaf forms, C - leaf in cross-section, D - glandular hairs on upper leaf surface, E - perianth, F - pistil/ovary, G - inner perianth surface, H - style-end, I - pollen-presenter, J - fruit.

Selected specimens (36 examined). WESTERN AUSTRALIA: Near Pallarup, next to Mt Short, *Gardner* 14812, *s.d.* (PERTH); 18.5 km E of Newdegate PO, *McGillivray* 3561 & *George,* 27 June 1976 (NSW); 13 mi. from Lake King, *Wrigley,* 7 Nov. 1968 (NSW); Lake King Rd, 26 km N of Highway, *Ballingall* 2057, 29 Sep. 1985 (PERTH); 130 km W of Daniell, *Kuchel* 1810, 15 Sep. 1964 (PERTH); Towards Diggers Rocks, *Gardner,* 9 Dec. 1964 (PERTH).

Distribution. Western Australia, between Newdegate-Lake King-Ravensthorpe area.

Habitat and ecology. Grows in sand over laterite or in laterised loam in mallee scrub. Pollination is by nectarivorous birds. Fire response unknown.

Flowering period. Winter-Spring

Conservation status. Not endangered.

Grevillea pilosa subsp. **redacta** P. Olde & N. Marriott subsp. nov. (Figure 14)

A subspecie typica, foliis minoribus, redactis, perianthio cum trichomatis paucioribus extus minore differt.

Typus: Western Australia: Lake Cronin, 13 km septentrionalum versus ..., *C.A. Gardner* 15915, 10 Dec. 1964 (PERTH).

Differs from the type in its smaller, reduced leaves and in its smaller perianth with fewer hairs on the outer surface.

Branchlets tomentose, usually mixed with a few glandular trichomes; leaves (0.3)1-2(2.5) cm wide, obovate either with bases attenuated and margins either entire or with 3-5 pungent teeth with shallow sinuses or with base narrowly cuneate and margin deeply dissected into 5-12 linear to narrow-triangular, spine-tipped lobes usually with deep sinuses; peduncle tomentose; torus 2.5 mm across; perianth 7-8 mm long, 2.5-3 mm wide, rose-pink with white or cream hairs, sparsely moderately hairy outside, the hairs white or pale brown, the limb 2.5-3 mm wide, dull-brown, villous; pistil 20-21 mm long; stipe 1-2 mm long; style pinkish-red with white hairs.

Selected specimens (12 examined). WESTERN AUSTRALIA: 11.4 km N of Crossroads near Lake Cronin on road to Mt Holland, *Olde* 86/782, 5 Oct. 1986 (NSW); 5 mi. N of Mt Holland, *A.R. Main s.n.,* Dec. 1964 (PERTH); Mt Holland, *Beard* 3870, 28 Aug. 1964 (PERTH); Holt's Rock, *C. Davies* 110, December 1962 (PERTH).

Distribution. Western Australia, where confined to a small area from just north of Lake Cronin to Mt Holland.

Habitat and ecology. Grows on gravelly rises in brown loam in dense shrubland. Fire effects unknown. Pollination by nectarivorous birds.

Flowering period. Spring.

Conservation status. A code of CALM Priority Two is recommended. Subsp. *redacta* is known from only a few populations, at least one of which contains few plants. The area is poorly surveyed and populations in greater numbers may be present.

Etymology. Latin *redactus* - reduced, in reference to the smaller perianth, reduced leaf size and sparser perianth indumentum.

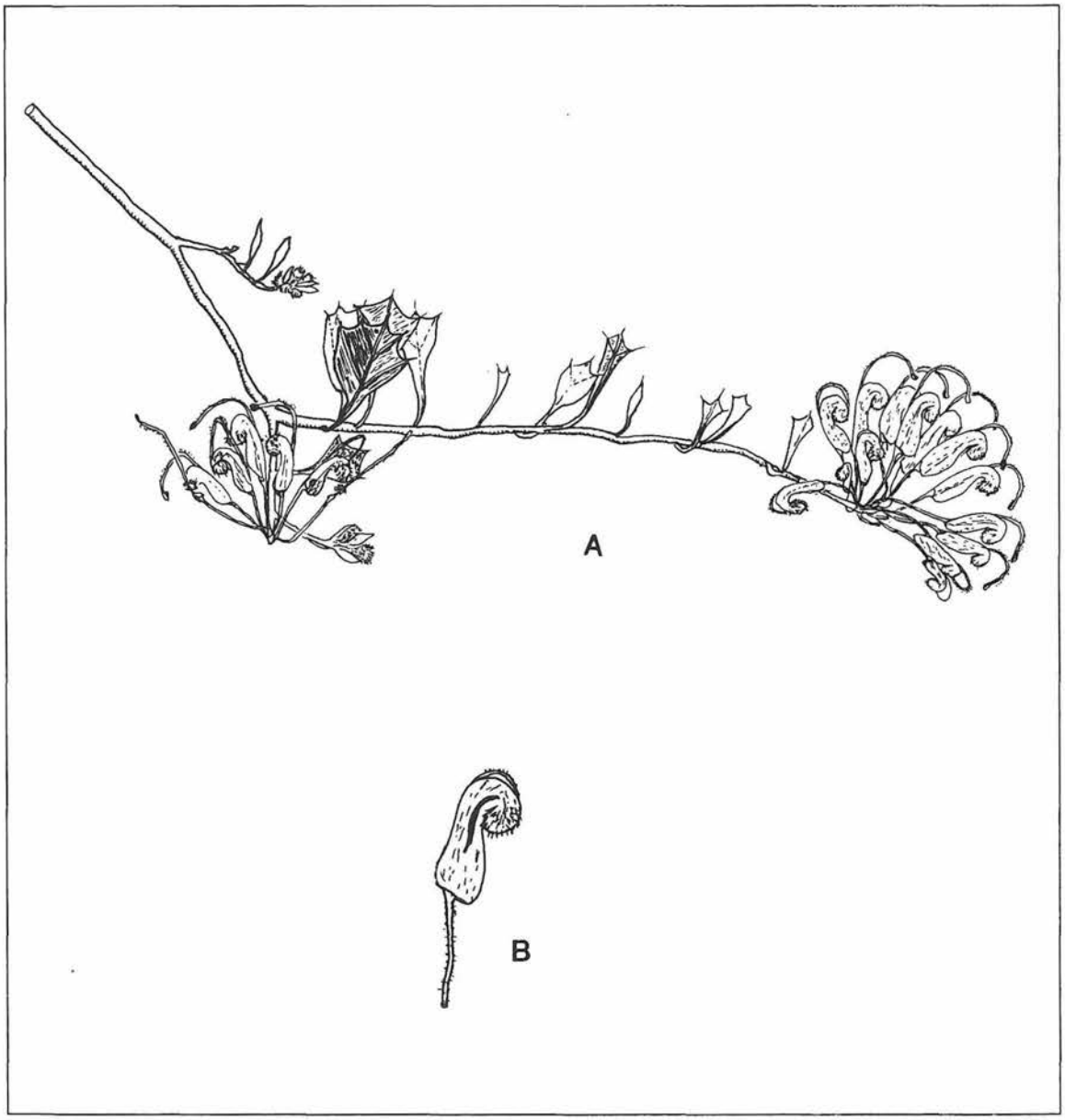

Figure 14. *G. pilsoa* subsp. *redacta* A - habit, B - perianth.

KEY 3

Key to species related to *Grevillea pilosa*

1 Unit conflorescence 1-3 flowered
2 Perianth limb glabrous ..... *G. involucrata*
2* Perianth limb hairy ..... *G. fulgens*
1* Unit conflorescence 4 or more flowered
3 Most leaves either entire, or if divided, then lobes >3.5 cm long
4 Undersurface of leaves or leaf lobes not enclosed by the margin ..... *G. longistyla*
4* Undersurface of leaves or leaf lobes enclosed by the margin
5 Ovarian stipe >3 mm long; leaves blue-green ..... *G. erectiloba*
5 Ovarian stipe <2 mm long; leaves green ..... *G. johnsonii*
3 Most leaves either toothed or divided; lobes <2 cm long
6 Leaves divaricately and deeply twice-divided; leaf undersurface concealed, except for the midvein, by the revolute margin
7 Outer perianth surface hairy ..... *G. dissecta*
7* Outer perianth surface glabrous
8 Style glabrous ..... *G. georgeana*
8* Style hairy ..... *G. wilsonii*
6* Leaves toothed or with entire primary lobes, not divaricately twice-divided; leaf undersurface not concealed by the revolute margin
9 Upper leaf surface glabrous ..... *G. insignis*
9* Upper leaf surface glandular-pubescent
10 Leaves sessile ..... *G. asteriscosa*
10*Leaves shortly petiolate ..... *G. pilosa*

14. Grevillea dissecta (McGillivray) Olde & Marriott stat. nov. (Figure 15)

Basionym: Grevillea pilosa subsp. *dissecta* McGillivray in New Names in Grevillea: 12 (1986).

Typus: Western Australia: Lake Barker Area. *W.H. Butler*, 13 Feb. 1973 (PERTH - specimen at lower right of sheet).

A low, rounded, prickly shrub to c. 1 m high with arching branchlets; branchlets round, sericeous. *Leaves* 1-2 cm long, 2-4 cm wide, spreading, ± sessile, divaricately subpinnatisect, sometimes simple, linear; rachis recurved; primary leaf lobes (2)3-7, the lower lobes usually bi- or trisect; ultimate lobes 7-15 mm long, 1-1.5 mm wide, narrow-linear to subulate, pungent; upper surface glabrous, glaucous, sometimes sericeous between the lowermost lobes and the axis of attachment, the midvein evident to slightly raised; lower surface bisulcate, sericeous in the grooves, midvein raised above the lamina but recessed below the level of the margin; margin angularly revolute, enclosing the undersurface except the midvein. *Conflorescence* erect to decurved, pedunculate, terminal, simple or few-branched; unit conflorescence 0.5-2 cm long, secund-umbelliform; peduncle sericeous, subtended by leaf-like bracts; floral rachises sericeous to almost glabrous, development basipetal; floral bracts 3-5 mm long, ovate-acuminate, glabrous or with scattered appressed hairs outside, the margins ciliate, caducous. *Flowers:* pedicels 10-15 mm long, glabrous or sparsely pilose, villous at the base of the

torus, slender; torus 3.5-4 mm across, 2-2.2 mm broad, oblique, cupuliform; nectary spreading over and lining the inner surface of the torus, scarcely evident above the rim; *perianth* 8-9 mm long, 3.5 mm wide, rose-pink, oblong, slightly dilated at the base, sparsely villous with mixed glandular and biramous trichomes outside, bearded inside about the level of the ovary; limb 2.5-3 mm wide, creamy-white, revolute, spheroidal, the segments slightly impressed at the margin, sparsely villous; *pistil* 18-20 mm long; stipe 2 mm long, dorsally villous, ventrally glabrous, adnate within the torus over the basal 1.5 mm, refracted at right angles to the torus at the rim and rising 0.5 mm above; ovary densely villous; style pinkish-red, villous, terminated by a clavate style-end; pollen-presenter very oblique to lateral, convex, the stigma prominent, distally off-centre. *Fruit* 10-12 mm long, 7.5 mm wide, erect, globose to ellipsoid, sparsely hairy; style persistent; pericarp ± 0.5 mm thick. *Seed* 7 mm long, 3 mm wide, ellipsoid, narrowly winged all round; outer face convex, smooth; inner face with a raised, oblong-elliptic centre surrounded by a narrow, marginal, waxy channel.

Specimens examined (4). WESTERN AUSTRALIA: 54 km N of Lake Cronin, *Olde* 86/786, 5 Oct. 1986 (NSW); 32.5 km N of Lake Cronin, *Olde* 86/785, 5 Oct. 1986 (NSW); site M, Mt Holland area, *W. Martinick & K. Tinley* 3 (PERTH).

Discussion. See under *G. pilosa.*

Distribution. Western Australia, between Moorine Rock and Lake Barker and south to Mt Holland area.

Ecology and habitat. Grows in low mallee scrub or heath in sand over laterite or in heavily laterised brown loam. Regeneration is from seed after disturbance. Probable pollinator nectarivorous birds.

Flowering period. Spring-Summer.

Conservation status. A code of CALM PriorityThree is recommended. Much of the presumed habitat remains uncleared and contains few public roads. However, there may be an immediate threat from mining.

15. Grevillea insignis Kippist ex Meissner in Hooker's J. Bot. Kew Gard. Misc. 7: 76 (1855).

Typus: Swan R., *J. Drummond* Ser. 5, Supp., No. 12 (holo: K, NY; iso: K, MEL, NSW, P, TCD). Only the isotype at NSW has been seen.

A shrub 2-5 m high, 3-5 m wide; branchlets rounded, glabrous, sometimes glaucous. *Leaves* 3-9 cm long, 2-4 cm wide, spreading, shortly petiolate, oblong to obovate, the base truncate to cuneate; rachis straight to recurved; upper and lower surfaces similar to slightly discolorous, glabrous, sometimes glaucous; margin flat or shortly recurved, sinuate, dentate to shallow-lobed; venation craspedodromous, more prominent on the undersurface, the most prominent lateral veins terminated by excurrent spines 1-2 mm long, the less prominent terminated at the margin, conspicuous tertiary reticulum evident. *Conflorescence* erect to decurved, pedunculate, terminal on short axillary branchlets, simple or few-branched; unit conflorescences 2.5-3 cm long, secund-globose to shortly cylindrical, development basipetal; peduncles and floral rachises glabrous, sometimes with scattered, appressed hairs when very young; floral bracts 1.8-2.5 mm long, linear to triangular, tomentose to glabrous except for persistent apical and marginal hairs, caducous. *Flowers:* pedicels 5-10 mm long, glabrous, slender; torus 1.5-3 mm across, oblique; nectary patelliform to annular, overlying the torus and slightly raised above the toral rim, fundibular at the base of the stipe; *perianth* 8-9 mm long, 3-5

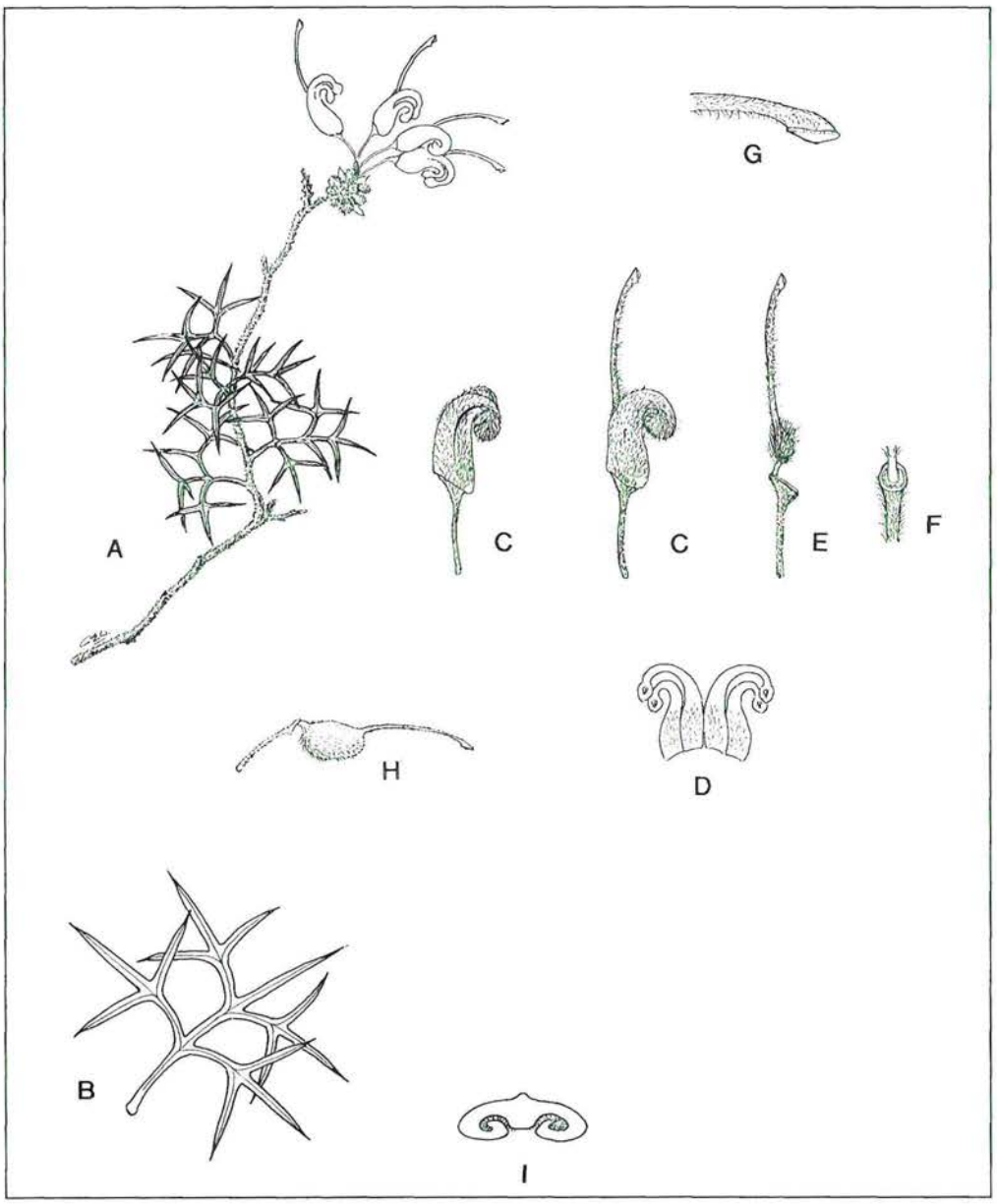

Figure 15. *G. dissecta* A - habit, B - leaf, C - perianth, D - inner perianth surface, E - pistil, F - nectary, G - style-end, H - fruit, I - leaf lobe in cross-section.

mm wide, cream to creamy-pink ageing pink, oblong, dilated at the base, narrowed towards the throat, glabrous and shiny outside, pilose inside about the level of the ovary and slightly above on the dorsal tepals; limb revolute, spheroidal, the segments impressed at their margin; *pistil* 11-20 mm long, hairy; stipe 1.2-2.5 mm long, dorsally villous, ventrally glabrous, inserted perpendicular to the torus on the dorsal margin; ovary densely villous; style reddish-pink, straight, glabrous in the distal half, terminated by a clavate style-end; pollen-presenter lateral, oblong to round, flat with inconspicuous stigma. *Fruit* 10-13 mm long, 9 mm wide, erect, subglobose to oblong-ellipsoid, villous soon glabrous and glaucous; style persistent; pericarp 1.5-2 mm thick. *Seed* 8-9 mm long, 4 mm wide, oblong-ellipsoid; outer face convex, smooth; inner face flat; margin shortly winged with an oblique apical attenuation.

Affinities. Grevillea insignis belongs to a group of species for which a key (Key 3) is provided on page 282. Although most species of this group have the stipe inserted perpendicular to the oblique torus, in *G. georgeana* McGillivray and *G. erectiloba* F. Muell. the insertion appears to be secondarily lateral.

Discussion. Grevillea insignis is here divided into two geographically disjunct subspecies approximately 200 km apart. Subsp. *elliotii* P. Olde & N. Marriott differs from subsp. *insignis* in its non-glaucous branchlets, its usually shorter, less visibly glaucous leaves which are also usually more deeply dissected and generally have the base cuneate.

Key to subspecies of *Grevillea insignis*

1 Branchlets glaucous; most leaves with the base truncate to spreading and the sinuses shallow-arcuate ..... subsp. *insignis*

1* Branchlets not glaucous; most leaves with the base cuneate and the sinuses arcuate ..... subsp. *elliotii*

Grevillea insignis subsp. **insignis** (Figure 16)

A spreading shrub; branchlets white or pinkish, glabrous, glaucous; leaves 3-9 cm long, bluish-grey, slightly discolorous, rigidly coriaceous, the base usually truncate to spreading, sometimes cuneate, margins dentate with sinuses shallow-arcuate to linear; pistils 15-20 mm long.

Selected specimens (45 examined). WESTERN AUSTRALIA: *J. Drummond,* Coll. 5 Suppl. 12, 1849 (*Type*!) (MEL, NSW); 25 km NW of Lake Grace, *Woolcock,* 2 Sep. 1985 (NSW); 19 km W of Quairading on York Rd, *K. Hill* 2974, 30 Aug. 1988 (NSW, PERTH); 5 mi. E of Kukerin, *Phillips,* 29 Oct. 1962 (NSW); Tarin Rock Siding, *Wrigley*, 9 Nov. 1968 (NSW); Narrogin, towards Lake Grace, *D. Clyne,* Oct. 1969 (NSW); Avon district, 20 km SE of Cunderdin on Youndegin Hill, *Crisp* 6198, *Taylor & Jackson,* 27 Sep. 1979 (NSW, PERTH); 4.5 km N of Nyabing, *McGillivray* 3528 & *George*, 26 June 1976 (NSW, PERTH); 22 mi. E of York, *George* 224, 19 Aug. 1958 (PERTH); 6 km N of Balkuling, *Beard* 8100, 13 Oct. 1977 (PERTH).

Distribution. Western Australia, where originally widespread in the central and southern wheatbelt regions around Tarin Rock, Nyabing and Tammin.

Flowering period. Winter-Summer.

Habitat and ecology. Grows in very well-drained, dry sites in sand over laterite, or in rocky lateritic hills, usually associated with low heath to thick scrub.

Conservation status. A code of Priority Four is recommended.

Grevillea insignis subsp. **elliotii** P. Olde & N. Marriott subsp. nov. (Figure 16)

A subspecie typica ramulis non glaucis, foliis saepe minoribus (3-4 cm longis) cum marginibus profundiore incisis, basi plerumque cuneatis differt.

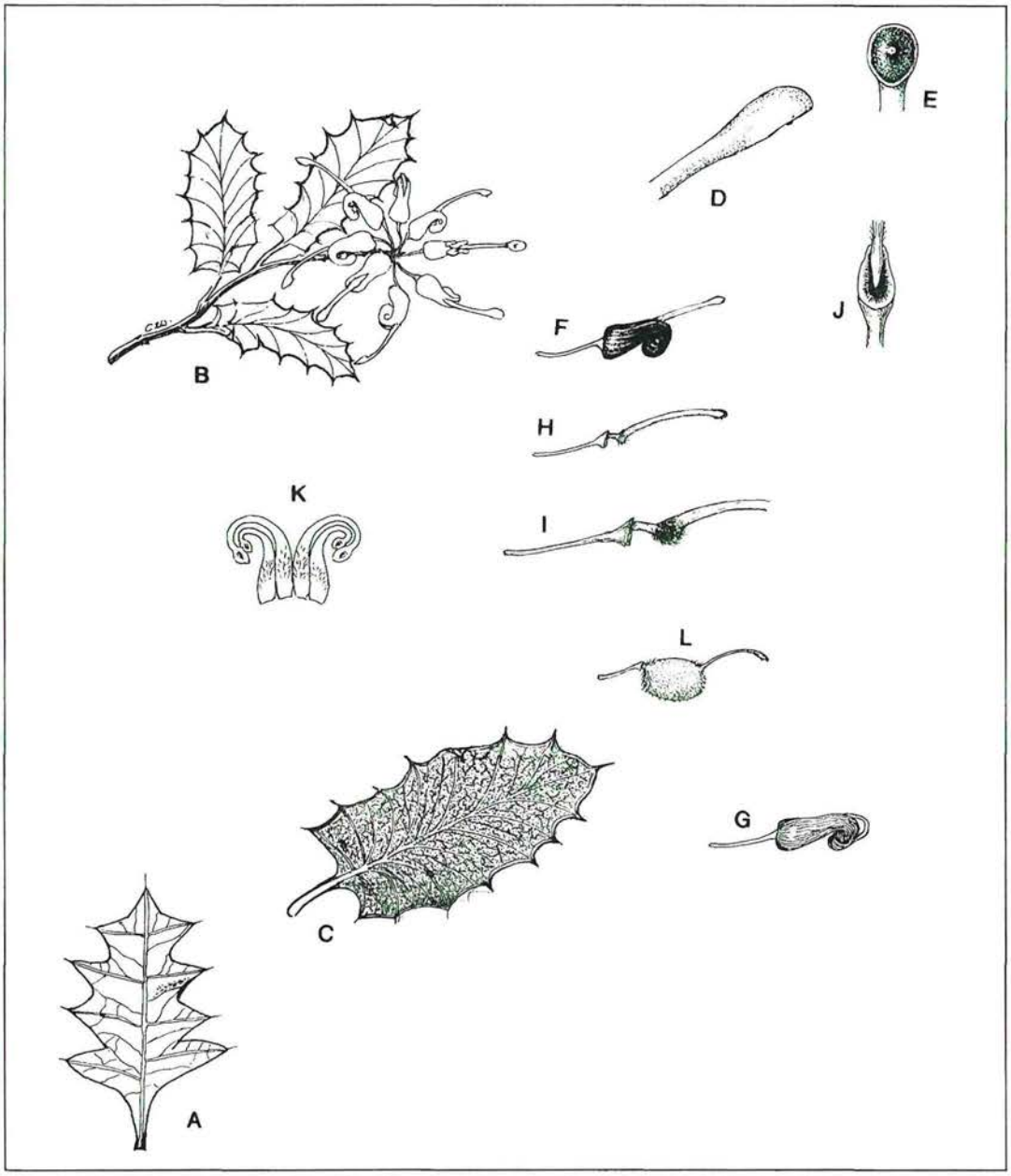

Figure 16. *G. insignis* subsp. *elliotii* A - leaf. *G. insignis* subsp. *insignis* B - habit, C - leaf, D - style end, E - pollen-presenter, F, G - perianth, H, I - pistil, J - nectary, K - inner perianth surface, L - fruit.

Typus: Western Australia: Diggers Rocks, 31.5 km E of Varley, *P. Olde* 86/757, 4 October 1986 (holo: NSW; iso: CANB, PERTH).

Differs from the Type in its non-glaucous branchlets, its leaves usually smaller (3-4 cm long) and more deeply divided, with their bases usually cuneate.

A bushy shrub; branchlets glabrous, non-glaucous; leaves 3-4(6) cm long, green, ovate to oblong, discolorous, firmly chartaceous to coriaceous, subglaucous to non-glaucous, the base usually cuneate or narrowly so, sometimes spreading, the marginal sinuses strongly arcuate; pistils 11-17 mm long.

Selected specimens (6 examined). WESTERN AUSTRALIA: Hatters Hill, c. 41 km NE of Lake King, *Newbey* 6551, Nov. 1979 (PERTH); South Ironcap, *Olde* 92/252, 10 Oct. 1992 (NSW); Middle Ironcap, SE of Hyden, *Keighery* 893, 12 Oct. 1976 (PERTH).

Distribution. Western Australia, confined to laterite outcrops between Hatters Hill and Middle Ironcap.

Habitat and ecology. Grows in very well-drained, dry sites in densely laterised loam in eucalypt woodland or medium scrub. Usually confined to hilltops or rises. Regeneration is from seed after fire. Probable pollinator: nectarivorous bird.

Flowering period. Winter-Summer.

Conservation status. A code of CALM Priority Three is suggested. The distribution of this subspecies is fairly restricted although it is not presently at risk. The area is presently undergoing intensive mining development and may require some protection in the long-term.

Etymology. The epithet honours W. Rodger Elliot (1941-), horticulturist, nurseryman, author on the Australian flora who first drew our attention to this taxon.

16. Grevillea haplantha F. Muell. ex Benth. (1870) in Fl. Aust. 5: 451.

Lectotypus (McGillivray 1993: 419): "W.A.", *Drummond* (MEL 64510). *Syntype (n.v.):* "E. Mt. Barren, W. Aust., *Maxwell* (K)". The Drummond collection is without locality or date. McGillivray (1993: *l.c.*) states that the syntype is a specimen of *G. disjuncta* F. Muell.

An erect or spreading, rounded, dense shrub 1 m tall, 1-1.5 m wide; branchlets angular to rounded, sericeous. *Leaves* 3-8 cm long, 1-1.5 mm wide, ascending to erect, sessile, simple, linear, relatively stiff and leathery; apex pungent; upper surface minutely granulose, sericeous, longitudinally ribbed, midvein not evident; margin entire, angularly revolute; lower surface bisulcate, silky, midvein sometimes recessed below the margin. *Conflorescence* axillary or cauline, shortly pedunculate (peduncles c. 1 mm long) or sessile, usually simple, often solitary or 2-4(6) flowered in umbel-like clusters; floral rachis c. 1 mm long, villous; floral bracts 0.7-1 mm long, ovate, villous outside, persistent to anthesis. *Flowers:* pedicels 5-9 mm long, villous; torus 2-2.5 mm across, oblique; nectary V-shaped, scarcely evident above the toral rim, entire; *perianth* 6-7 mm long, 3 mm wide, dilated at the base, oblong, conspicuously narrowed at the throat, ribbed, villous outside, bearded inside; limb conspicuous, revolute, densely villous, coherent after anthesis; *pistil* 18-25 mm long, hairy; ovary densely villous, sessile or almost so; style gently curved to straight; pollen-presenter lateral, obovate, convex; stigma distally off-centre. *Fruit* 10-13 mm long, 5 mm wide, erect, ellipsoidal, prominently ribbed, spreading-villous; style persistent; pericarp ± 0.5 mm thick. *Seed* 8-10 mm long, 2.5 mm wide, oblong-elliptic with an apical wing 1.5 mm long, minutely pubescent; outer face convex; inner face flat; margin strongly revolute on one side, shortly recurved on the other.

Affinities. G. haplantha is most closely related to *G. disjuncta* F. Muell. and *G. dolichopoda* (McGillivray) P. Olde & N. Marriott both of which differ in the enclosure of the whole undersurface of their leaves by the margin.

Closely related species are treated in Key 4 on page 291.

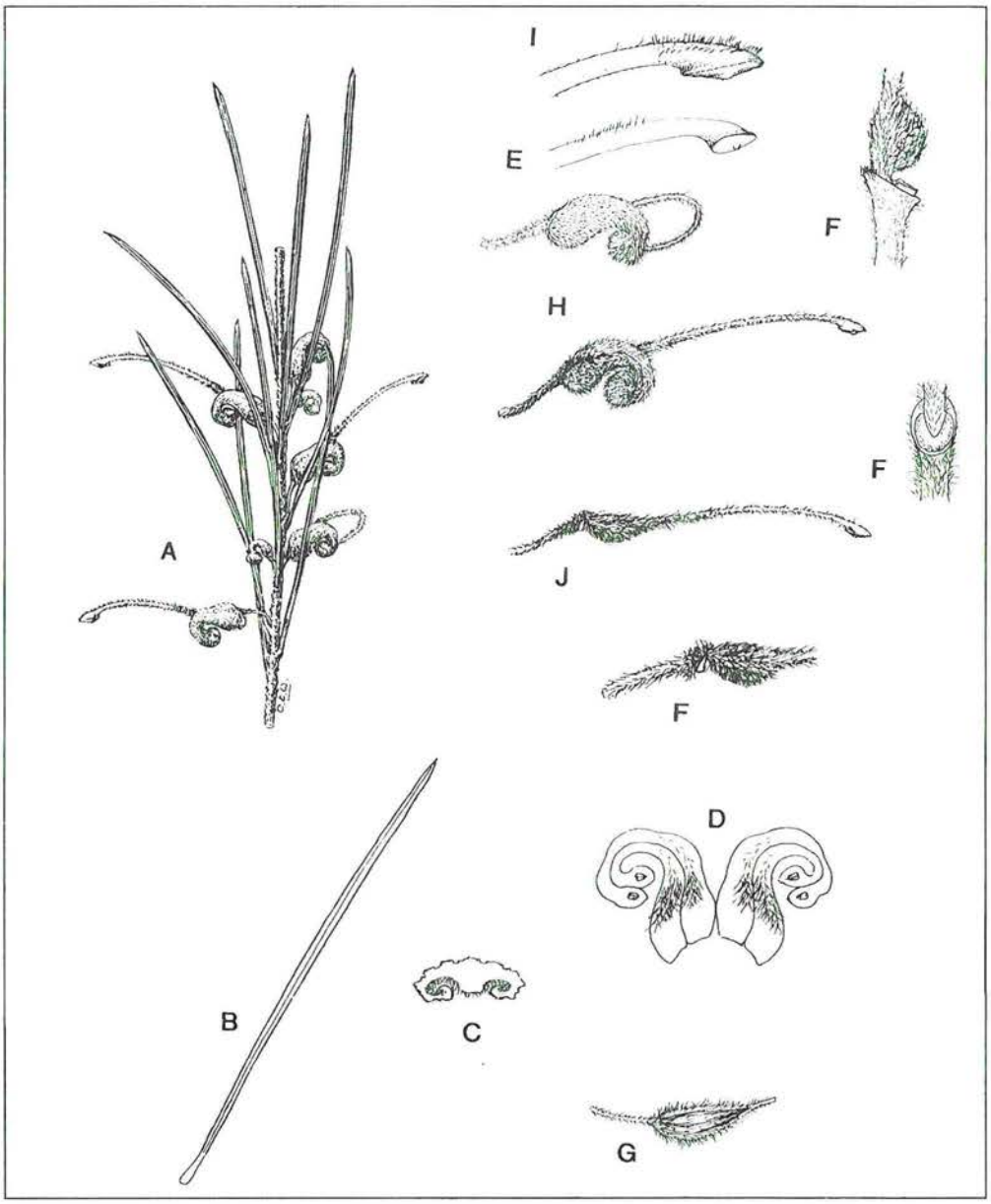

Figure 17. *G. haplantha* subsp. *recedens* A - habit, B - leaf, C - leaf in cross-section, D - inner perianth surface, E - style-end, F - ovary/nectary, G - fruit. *G. haplantha* subsp. *haplantha* H - flowers, I - style-end, J - pistil.

Discussion. McGillivray (1993: 300-301) informally recognises two entities in *G. haplantha*, the Coolgardie District Race and the Avon District Race, and has provided distinguishing features which he considered "did not provide an adequate basis for recognition of subspecific taxa at a formal level". While we appreciate that this is a question of judgement and argument as to what degree of discontinuity is required in the recognition of subspecies, we would submit that, in addition to the features noted by McGillivray, the following give an adequate basis for recognition of two subspecies, with our subsp. *recedens* equivalent to the Avon District Race *sensu* McGillivray. The recognition of two subspecies creates an entirely different conservation imperative with respect to subsp. *recedens* which is known from only two recent collections.

Our subsp. *recedens* has been known in cultivation for very many years, mainly in Victoria, where it was frequently misidentified as *G. disjuncta.* It differs from subsp. *haplantha* in its lower, more divaricately branched habit with flowers of a different colour and more concealed within the shrub. Further an examination of the style-end on all specimens at PERTH and NSW showed that for plants referable to our subsp. *recedens*, the apical 2-3 mm was either totally devoid of hairs or they were much reduced in size and that in using this observation rather than presence or absence of indumentum provides the necessary discontinuity. When in combination with features such as shorter pedicels and pistils, flower colour and habit differences, two geographically and climatically disjunct, formally described subspecies are warranted.

Accordingly two subspecies are here recognised, subsp. *haplantha* and subsp. *recedens*.

Key to subspecies of *Grevillea haplantha*

1 Stylar indumentum extending onto the back of the pollen-presenter, the hairs ± uniform in size throughout; pedicels 7-9 mm long; pistil (22)24-25 mm long ..... subsp. *haplantha*

1* Stylar indumentum either lacking in the apical 2-3 mm or the hairs much reduced in size; pedicels 5-7 mm long; pistils 18-20(22) mm long ..... subsp. *recedens*

Grevillea haplantha subsp. **haplantha** F. Muell. (Figure 17)

Shrub 1.5-2 m high, 3 m wide; branchlets erect and ± straight, bearing prominent axillary flowers; perianth dull pink with cream limb, the indumentum consisting of white hairs; pedicel 7-9 mm long; pistil (21)24-25 mm long; stipe c. 1 mm long; style villous over its entire length.

Selected specimens (40 examined). WESTERN AUSTRALIA: Comet Vale, *Jutson* 121, Dec. 1916 (NSW); Bet. Callion and Musson Soak, W of Goongarrie, *Beard* 6251, 10 Sep. 1970; Bungalbin Hill, 50 km N of Koolyanobbing, *Olde* 86/190, 2 Sep. 1986 (NSW); 4 km W of Bullabulling, *Olde* 91/12, 6 Sep. 1991 (NSW); 95 mi. N Norseman, *Phillips*, 7 Nov. 1962; 28 mi. S of Coolgardie, *Beauglehole* 13297b, 21 Sep. 1965; 95 km SSW of Coolgardie, 20 km ESE Diamond Rock, *Taylor* 613, *Crisp & Jackson,* 19 Sep. 1979 (CBG7908421, NSW, PERTH); Woolangie, *Cough* 139, 19 Sep. 1963 (PERTH); 6 km NW Scorpion Rock, Walling Rock Station, *Cranfield* 7449, 14 Sep. 1988 (PERTH); 12 km SSE Duri, *Newbey* 6093, 24 Sep. 1979 (PERTH); Queen Victoria Rock, 30 mi. S of Coolgardie, *Filson* 8890, 16 Sep. 1966 (PERTH); Between Dedari and Gilgai, *Gardner* 13495, 7 Sep. 1961 (PERTH).

Distribution. Western Australia, in the Coolgardie area where it extends from north of Koolyanobbing to west of Goongarrie up to 50 km south of Coolgardie.

Habitat and ecology. Grows in heathland or mallee shrubland, sometimes in tall shrubland in gravelly loam, sometimes in dense laterite. Appears to be killed by fire and is seed regenerative. Pollination is by nectarivorous birds.

Flowering period. Winter-Spring.

Conservation status. Not presently endangered.

Notes. The specimen *Taylor* 613 *et al.* from 95 km south-south-west of Coolgardie differs from others of subsp. *haplantha* in having a shorter pistil (21 mm) with a sparse indumentum in the distal half of the style. However, it retains a strip of long hairs onto the back of the pollen-presenter and is accordingly placed with subsp. *haplantha.*

Grevillea haplantha subsp. **recedens** P. Olde & N. Marriott subsp. nov. (Figure 17)

A subspecie typica, habitu humiliore, apice styli aut glabro aut sparsim puberulo, pistillis pedicellisque plerumque brevioribus differt.

Typus: Western Australia; Near Manmanning [precise locality withheld], *B.H. Smith* 658, 6 July 1986 (holo: NSW; iso: CBG, HO, PERTH).

Differs from the type in its lower habit, the style-end either glabrous or sparsely and minutely hairy and in its usually shorter pistils and pedicels.

Shrub 0.6-1 m tall, 1 m wide; branchlets divaricate, bearing flowers concealed mostly within the bush; perianth red throughout and usually with a rusty indumentum; pedicel 5-7 mm long; pistil 18-20(22) mm long; stipe c. 0.5 mm long; style villous becoming glabrous or sparsely and minutely pubescent in the apical 2-3 mm.

Selected specimens (16). WESTERN AUSTRALIA: Cowcowing, *Koch* 1904 (NSW93154); Cunderdin, *Fitzgerald,* Aug. 1903 (NSW); 3 km directly SE of Manmanning, *McGillivray* 3419 & *George,* 17 June 1976 (NSW); Manmanning Rd, 3.7 km from Dowerin-Kalannie Rd, *Olde* 86/898, 16 Oct. 1986 (NSW); Kodjkodjin Nature Reserve, *Mattiske* HLA 38, 22 Sep. 1986 (PERTH); Cunderdin, *Fitzgerald,* Aug. 1903 (PERTH); Yorkrakine, *Gardner,* 30 Aug. 1920 (PERTH); 13 mi. E of Ballidu, *Royce* 1262, 13 Sep. 1946 (PERTH); Nr Merredin, *Gardner* 728, 30 Aug. 1920 (PERTH).

Distribution. Western Australia where it occurs in the Avon district from Mollerin to near Ballidu, extending south to Cunderdin and Merredin.

Habitat and ecology. Occurs in heavy clay loams often with a strong lateritic association in open shrubland or woodland. This subspecies is killed by fire and is seed regenerative. Pollination is by nectarivorous birds.

Flowering period. Winter-Spring.

Conservation status. A code of CALM Priority One is recommended. Subsp. *recedens* has only been collected a few times in recent years, mainly from near Manmanning and there only in degraded verges. However, the collection from Kodjkodjin Nature Reserve is encouraging. This subspecies is considered to be at risk, but a survey of the known populations is necessary to confirm this.

Etymology. Latin *recedere* to recede, an allusion to the receding hairs on the style-end.

KEY 4

Key to species closely related to *Grevillea haplantha*

1 Leaf undersurface either two-grooved or the lamina exposed beside the midvein
 2 Ovarian stipe >2 mm long ..... *G. extorris*
 2* Ovarian stipe <2 mm long ..... *G. haplantha*
1* Leaf undersurface single-grooved
 3 Leaves with a granular surface ..... *G. dolichopoda*
 3* Leaves smooth and ridged ..... *G. disjuncta*

17. Grevillea dolichopoda (McGillivray) P. Olde & N. Marriott stat. nov. (Figure 18)

Basionym: *G. disjuncta* subsp. *dolichopoda* McGillivray (1986) in New Names in Grevillea: 5.

Typus: Western Australia: "c. 21 km by road N of Ongerup." *D.J. McGillivray* 3521 & *A.S. George*, 26 June 1976 (NSW).

A low, divaricately-branched subshrub; branchlets rounded, sericeous to tomentose to villous, usually secund. *Leaves* (1)2-5(7) cm long, 1-2.5 mm wide, erect to spreading, sessile, simple, linear to ± terete, stiff; apex weakly pungent to obtuse-mucronate; upper surface glabrous, scabrous to granulate, sometimes the granules subdued (Newdegate area), sometimes with faint longitudinal ridges, otherwise midvein obscure; margin entire, smoothly or angularly revolute; lower surface usually unisulcate, obscured by the revolution of the margin, rarely (*Olde* 86/1125) exposed, sericeous with prominent midvein. *Conflorescence* axillary or cauline, 2-4-flowered, often from old peduncles (peduncles absent to c. 1 mm long); floral rachis c. 1 mm long, villous; floral bracts 0.5-0.9 mm long, narrow-triangular, tomentose outside, persistent at anthesis. *Flowers:* pedicels 5-9 mm long, sparsely sericeous; torus 2-3 mm across, oblique; nectary very conspicuous, V-shaped, toothed at the ends, the walls rising 0.5-0.8 mm above the torus; *perianth* 5-7 mm long, 2.2-3 mm wide, dull red, oblong with basal dilation, much narrowed and elongate-patent at the throat, sparsely sericeous to almost glabrous outside, densely bearded inside; limb rusty-orange, tomentose, revolute, spheroidal, distant from the perianth, cohering after anthesis; *pistil* 23-24 mm long; stipe 0.5-1 mm long, inserted on the dorsal rim of the torus; ovary densely villous; style red, villous at the base, sparsely hairy to glabrous near the apex; pollen-presenter lateral, round to oblong, convex. *Fruit* 12 mm long, 5-6 mm wide, erect, ovoid, sparsely villous; style persistent; pericarp c. 0.3 mm thick. *Seed* 7-8 mm long, 2-3 mm wide, oblong-elliptic with a short apical wing, sparsely pubescent; margin strongly revolute.

Selected specimens (32 examined). WESTERN AUSTRALIA: Ravensthorpe Range, *Bennett* 2306, 29 Aug. 1968 (NSW, PERTH); Bottle Rock, *George* 9892, 30 June 1970 (NSW); Dunn Rock Nature Reserve, *Atkins* 1730, 7 Oct. 1984 (NSW, PERTH); 1 km W of Needilup, *McGillivray* 3512 & *George*, 26 June 1976 (NSW, PERTH); 13 km W of Ravensthorpe, *Woolcock* G231, 1 Oct. 1985 (NSW); Cnr Lake Bryde Rd & Grant William Rd, SSW of Newdegate, *Olde* 86/724, 2 Oct. 1986 (NSW); 18 km S of Lake King, *Woolcock* G84b, 1 Oct. 1985 (NSW); 5 km E of Kebaringup, *Woolcock* G79a, 3 Sep. 1985 (NSW).

Distribution. Western Australia, very widespread in two disjunct localities, between Nyabing and Gairdner River and in the Newdegate-Ravensthorpe-Hopetoun area.

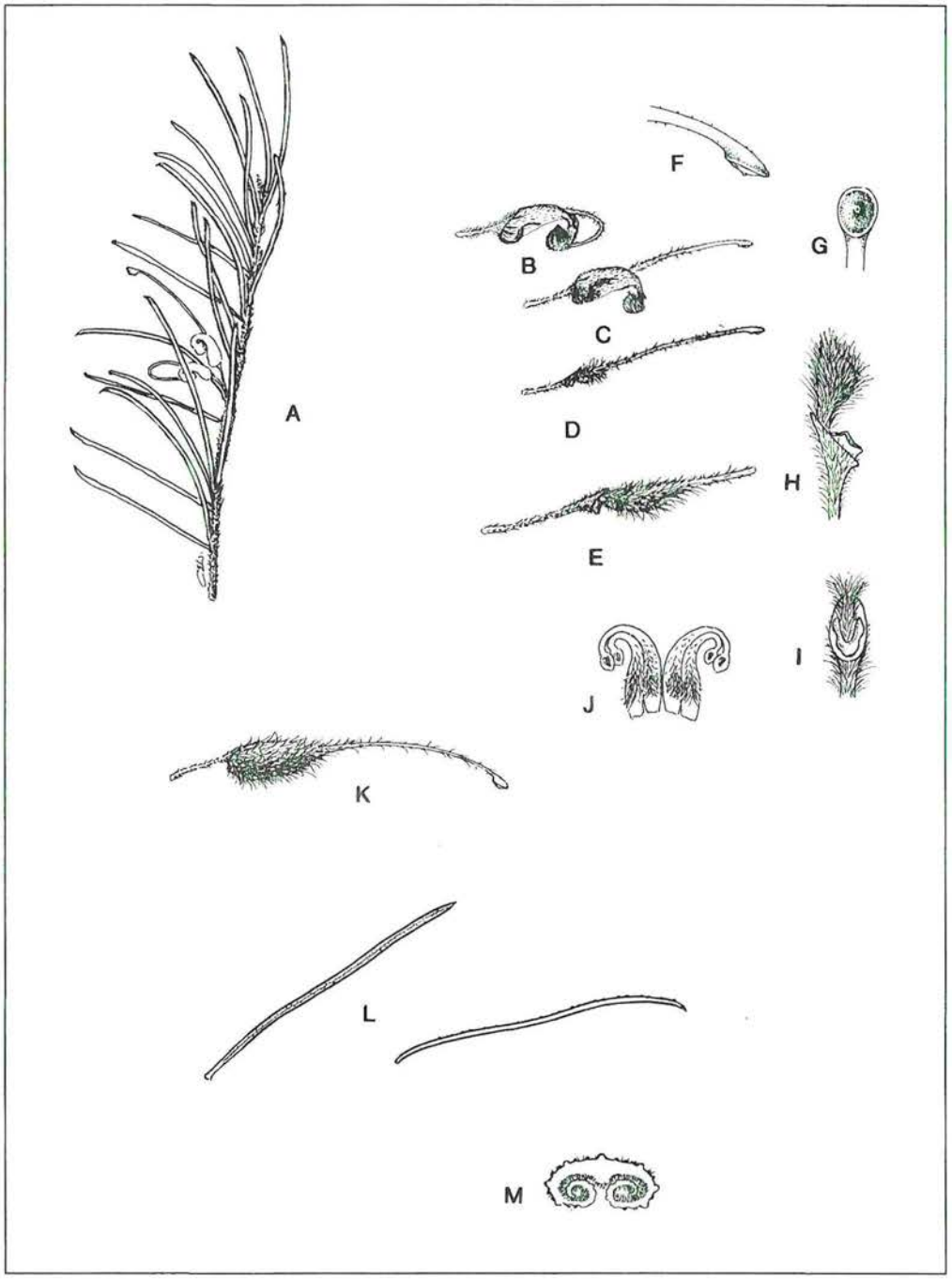

Figure 18. *G. dolichopoda* A - habit, B, C - perianth/flower, D, E - pistil, F - style-end, G - pollen-presenter, H, I - ovary/nectary, J - inner perianth surface, K - fruit, L - leaves, M - leaf in cross-section.

Habitat and ecology. Found in open, low mallee shrubland and low, sandy heathland often over laterite, on quartzite ridges, occasionally in clay near granite outcrops and in granitic loam. Regenerates from seed after fire. Pollination by birds.

Flowering period. Autumn-Spring.

Affinities. *G. haplantha* and *G. disjuncta* are most closely related. *G. haplantha* differs in its more densely hairy outer perianth surface and in its leaf margin revolute but not enclosing the midvein. *G. disjuncta* differs in its smooth, ridged leaves.

Discussion. From our observations in the field and our studies of herbarium specimens, the two currently recognised subspecies of *G. disjuncta* F. Muell., subsp. *disjuncta* and subsp. *dolichopoda* McGillivray, should be recognised at specific rank, being, in our opinion, as distinct from each other as they are from *G. haplantha*. McGillivray (1993: 301-303) apparently sees *G. disjuncta sens. lat.* as genetically labile, divides it into two subspecies one of which (subsp. *dolichopoda*) has two forms (rough-leaved form - 'roughly' corresponding to our proposed *G. dolichopoda sens. str.* and smooth-leaved form - a form showing affinity to both subspecies). Plants distributed over a substantial distance (around Newdegate) are unassigned to either subspecies, being somewhat intermediate between the two taxa.

In our arrangement, *G. disjuncta* is more narrowly defined by its smooth, longitudinally ribbed leaves, usually symmetrically crowded around the branchlets. Most collections of *G. disjuncta* also have more robust flowers than those of *G. dolichopoda*. *G. dolichopoda* is defined by its scabrous to granular leaves, usually on secund branchlets. Most collections of *G. dolichopoda* have an elongate torus 2-3 mm long and longer leaves than *G. disjuncta*, but there is some variability in this feature especially on plants from the Newdegate area, treated as unassigned elements of *G. disjuncta* by McGillivray (McGillivray 1993: 302). They are here regarded as *G. dolichoda* because of their granular leaves. Plants assigned as the smooth-leaf form of *G. disjuncta* subsp. *dolichopoda* (McGillivray *l.c.*) are here treated as a long-leaf form of *G. disjuncta* because their smooth, ridged leaves are conformant with that taxon. Bentham cited a specimen of this population as a syntype of *G. haplantha,* which demonstrates the close relationship of all three species. Although the elongation of the torus appears to be significant and more consistent in *G. dolichopoda,* its reduction in plants around Newdegate suggests this is not so.

The broad-species concept of a genetically labile *G. disjuncta sensu* McGillivray is not ruled out as empirically wrong but is, in our opinion, a less acceptable classification at this stage because of the lack of verifiable data, the unassigned populations around Newdegate and the *ad-hoc* assignation of the smooth-leaf form. A classification in which all taxa are assigned through their leaf morphology seems more acceptable.

Conservation status. Not endangered.

18. Grevillea pythara P. Olde & N. Marriott sp. nov. (Figure 19)

Fruticulus rhizomatosus, villosus, plerumque 6-30 cm altus. Folia simplicia, convexa, linearia vel peranguste elliptica, conferta, 7-16 mm longa, 1.5-4 mm lata cum nervatura obscura, marginibus revolutis, apice minute mucronulata retrocurvataque. Conflorescentiae simplices, terminales, sessiles cum 4-8 floribus. Torus obliquisissimus. Perianthium zygomorphum, rubrum, in pedicello sparse villoso 6-7 mm longo gestum, ad basim dilatatum, extus sparse tomentosum intus dense barbatum cum limbo revoluto, globoso, caeruleo, ad anthesim firme coherenti. Antherae steriles, deformes. Pistillum sparse villosum; stipes 7.5 mm longus stylo crassior; ovarium inconspicuum, dense villosum; praebitor pollinis lateralis, plus minusve planus. Follicula seminaque non visa.

Typus: Western Australia: near Pithara [precise locality withheld], *P. Olde* 92/173, 29 Sep. 1992 (holo: PERTH; iso: NSW).

A root-suckering shrub 6-30 cm high; branchlets rounded, villous. *Leaves* 7-16 mm long, 1.5-4 mm wide, simple, villous, linear to narrow-elliptic or sometimes obovate, strongly convex, crowded, sessile, slightly discolorous; venation obscure, the midvein sometimes evident on the undersurface; margin strongly recurved to revolute, entire, sometimes enclosing the undersurface; apex obtuse-mucronate, slightly retrorse. *Conflorescence* erect, terminal, sessile, 4-8 flowered, secund; floral rachis c. 3 mm long, villous; floral bracts 3 mm long, 1 mm wide, subtriangular to linear, villous outside, sometimes persistent to anthesis. *Flowers:* pedicels 6-7 mm long, villous; torus 3.5-4 mm across, lateral to very oblique at 80-85°; nectary prominent, long U-shaped; *perianth* 10 mm long, 5 mm wide, red, blue around the dorsal tepal margins in the vicinity of the limb, strongly zygomorphic, ± oblong, ventrally dilated at the base, sparsely tomentose outside, bearded inside below the level of the ovary and above the somewhat chambered dilation, the hairs strongly reflexed and concentrated mainly on the ventral tepals, glabrous to sparsely villous elsewhere; limb 2 mm long, 3.5 mm wide, revolute, subglobose to spheroidal, firmly cohering at and beyond anthesis; dorsal tepals flared open below the limb before anthesis; anthers misshapen, without pollen; *pistil* 20-22 mm long; stipe 7.5 mm long, adnate to the torus at the base, noticeably thicker than the style, sparsely villous with spreading hairs; ovary relatively inconspicuous, densely villous; style red, curved, pubescent; pollen-presenter 2.5 mm long, 1.8 mm wide, lateral, flat, obovate; stigma distally off-centre. *Fruits* and *seeds* not seen.

Specimens examined. Only specimens forming the type collection have been seen, although one of us (Olde) has studied the species in the field.

Distribution. Western Australia. Confined to the Type locality where it occurs in two small, populations containing upwards of c. 100 individuals separated by only a few hundred metres. The two populations are most likely reproducing from a single parent rootstock.

Habitat and ecology. Grows in gravelly sand in a weedy road verge with *Dampiera* spp. The verge has been partially disturbed. Reproduction is most probably only from root-sucker as no fruits have been seen. Misshapen anthers on the few flowers examined contained no pollen and no pollen has been found on pollen-presenters.

Flowering period. May-October but possibly all year.

Affinities. Grevillea pythara appears to have no close relatives although *Grevillea singuliflora* F. Muell. or *Grevillea glossadenia* McGillivray may be remotely related. The locality of these species is some 3000 km away and the similarities are more likely a process of parallel convergence than recent common ancestry. The possibility of a relationship with species related to *G. saccata* Benth. is not excluded.

Conservation status. A code of CALM Priority One is recommended. This species is seriously endangered by low numbers and weed domination of its habitat. Active conservation measures are recommended using both *in-situ* bush regeneration (weeding), horticultural *ex-situ* intervention and road-verge controls. Propagation should be relatively simple using small root-suckers which are advancing onto the roadside.

Etymology. The epithet acknowledges the request of the discoverer of the species, Ms Jan Wellburn, that it be named after her father's farm "Pythara", along one boundary of which this species grows. The epithet *pythara* is used as a noun in apposition, not adjectivally.

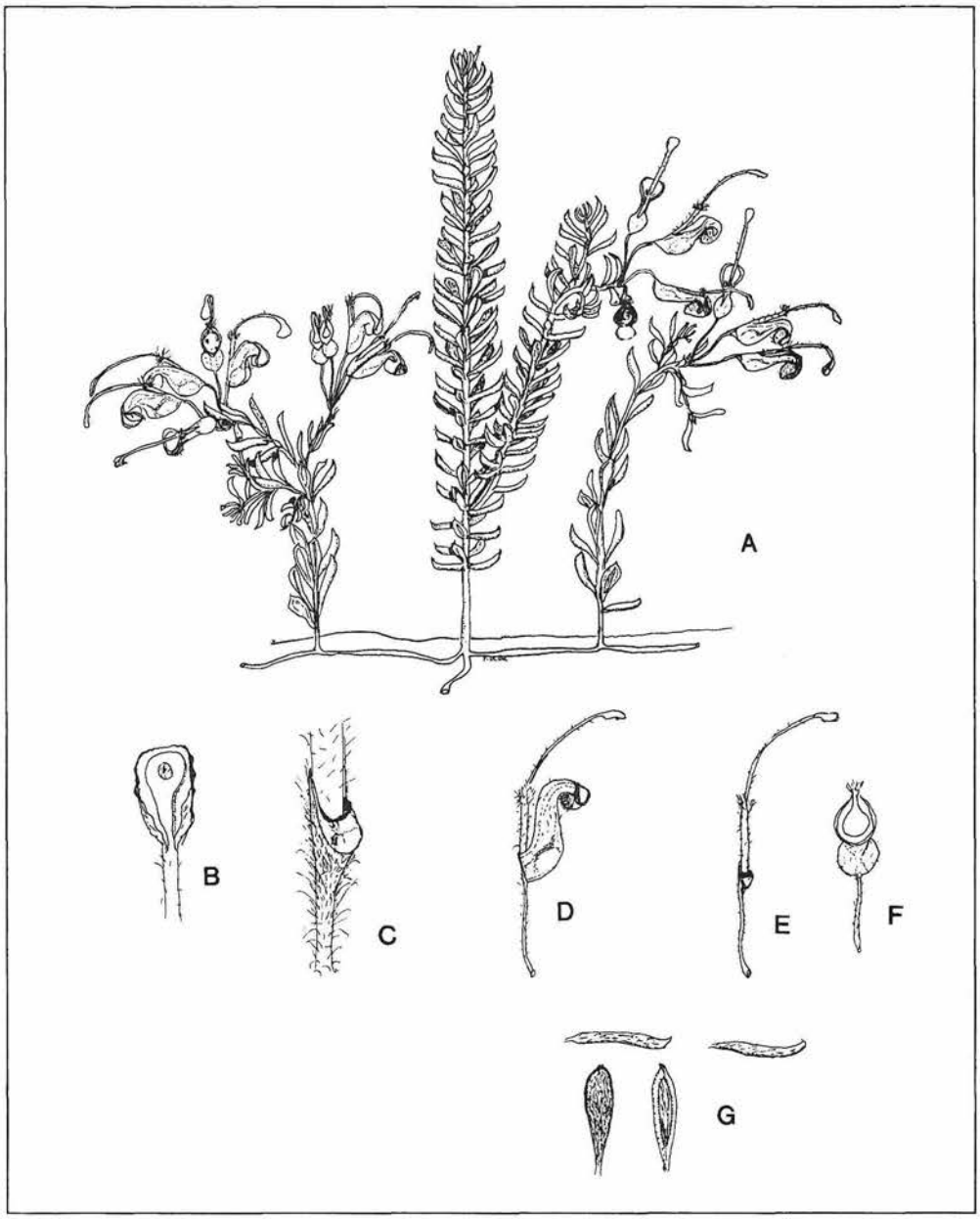

Figure 19. *G. pythara* A - habit, B - style-end, C - nectary, D - flower, E - pistil, F - perianth, G - leaves.

19. Grevillea althoferi P. Olde & N. Marriott sp. nov. (Figure 20)

Affinis *Grevilleae rudi* Meissn., sed ab illa foliis pro parte maxima pinnatipartitis cum primis lobis distantibus pinnatifidisque, conflorescentiis laxioribus folia aut vix aut haud excedentibus, perianthio longiore latioreque aut dense papilloso aut breviter barbato intus distinguitur.

Typus: Western Australia: near Eneabba, *P.M. Olde* 91/102, 15 September 1991 [precise locality withheld], (holo: NSW; iso: PERTH).

Aff. G. rudis but is distinguished from that species by its mostly pinnatipartite leaves with the primary lobes distant and pinnatifid, its looser conflorescences either not or scarcely exceeding the leaves, in its perianth both longer and wider and either densely papillose or shortly bearded on the inner surface.

Juveniles: young leaves and branchlets bearing a caducous, dense indumentum of mixed spreading biramous and glandular trichomes. *Adults:* compact, rounded shrubs 0.3-0.5 m high, 0.5-1 m wide; branches flexuose, ascending to spreading, dense to the ground; branchlets round, scabrous to sparsely hirsute. *Leaves* 3-7.5 cm long, 1-5 cm wide, including petioles 1-5 cm long, bluish-green, tangled, persistent after death, secund, ascending to erect, usually pinnatipartite, rarely (confined to foliage at the base of the plant) simple, pinnatifid, obovate-cuneate with 3-4 apical teeth, sometimes with secondary lobing of the apical lobe, sometimes leaves subtending the peduncles simple and entire, 1.8-2.4 cm long, 0.1-0.2 cm wide, linear, often fasciculate near the base of the conflorescence, sessile, usually curved, pungent; primary leaf lobes 3-7 per leaf, 2-2.5 cm long, 1-3 cm wide, obovate-cuneate, distant, cuspidate, apically 3(4)-fid; the ultimate secondary lobes broadly triangular, pungent, the apical lobe often linear, occasionally the secondary lobes bifid; upper and lower surfaces similar, scabrous to sparsely hirsute, concolorous; venation prominent, more conspicuous on the undersurface, mixed craspedodromous with prominent reticulum; margin flat, coincident with a conspicuous, rounded, scabrous vein; texture firmly chartaceous to coriaceous. *Conflorescence* terminal, usually simple, rarely 1-3 branched, erect, sessile, scarcely or not exceeding the foliage; unit conflorescence 2-5 cm long, 1.5 cm wide, cylindrical, loose, development acropetal; floral rachis 1.5 mm wide at the base, arising from a leaf-opposed rosette of bracts, villous; floral bracts 6-7 mm long, 1.5 mm wide, narrowly triangular with apex acuminate, villous outside with mixed biramous and glandular trichomes, glabrous inside, caducous. *Flowers:* pedicel 2-3 mm long, villous, patent; torus $\pm$ 1 mm across, straight; nectary not evident; *perianth* 5-6 mm long, 1.5-1.8 mm wide, actinomorphic, reddish when young, ageing dull creamy-yellow, oblong below the limb, villous outside with a mixed indumentum of biramous and glandular trichomes; tepals cohering to anthesis, becoming free and rolling down at anthesis, exposing an inner surface either densely papillose or bearing short papilloid trichomes; limb 1.5-2 mm long, 1.5-2 mm wide, erect, densely villous, subglobose; *pistil* 6-6.5 mm long; stipe scarcely evident; ovary sessile, densely villous with spreading to erect, straight trichomes; style creamy-yellow, kinked or folded above the ovary, glandular-pubescent on the lower filiform portion, papillose on the upper third where continuously dilated to c. 0.4 mm wide below the broadly expanded style-end; pollen-presenter c. 0.8 mm long, 0.6-0.7 mm wide at its base, straight, conico-cylindrical with cupuliform apex. *Fruits* not seen.

Specimens examined (3). WESTERN AUSTRALIA: Allied Eneabba Leases, south of Eneabba, *Griffin* 1454, 2 Nov. 1978 (PERTH 01418319); *Griffin* 1448 (PERTH 01418327) from same area.

Distribution. Western Australia: restricted to a single known extant population south of Eneabba. Two other specimens (at PERTH) have been seen from sites now known to have been destroyed by sandmining.

Habitat and ecology. Occurs in low heath dominated by *Grevillea integrifolia* subsp. nov., *Grevillea shuttleworthiana* and *Eucalyptus* sp. aff. *tetragona* in grey sand with laterite. Pollinators not seen. Regeneration is from lignotuber or root-sucker.

Flowering period. September-October.

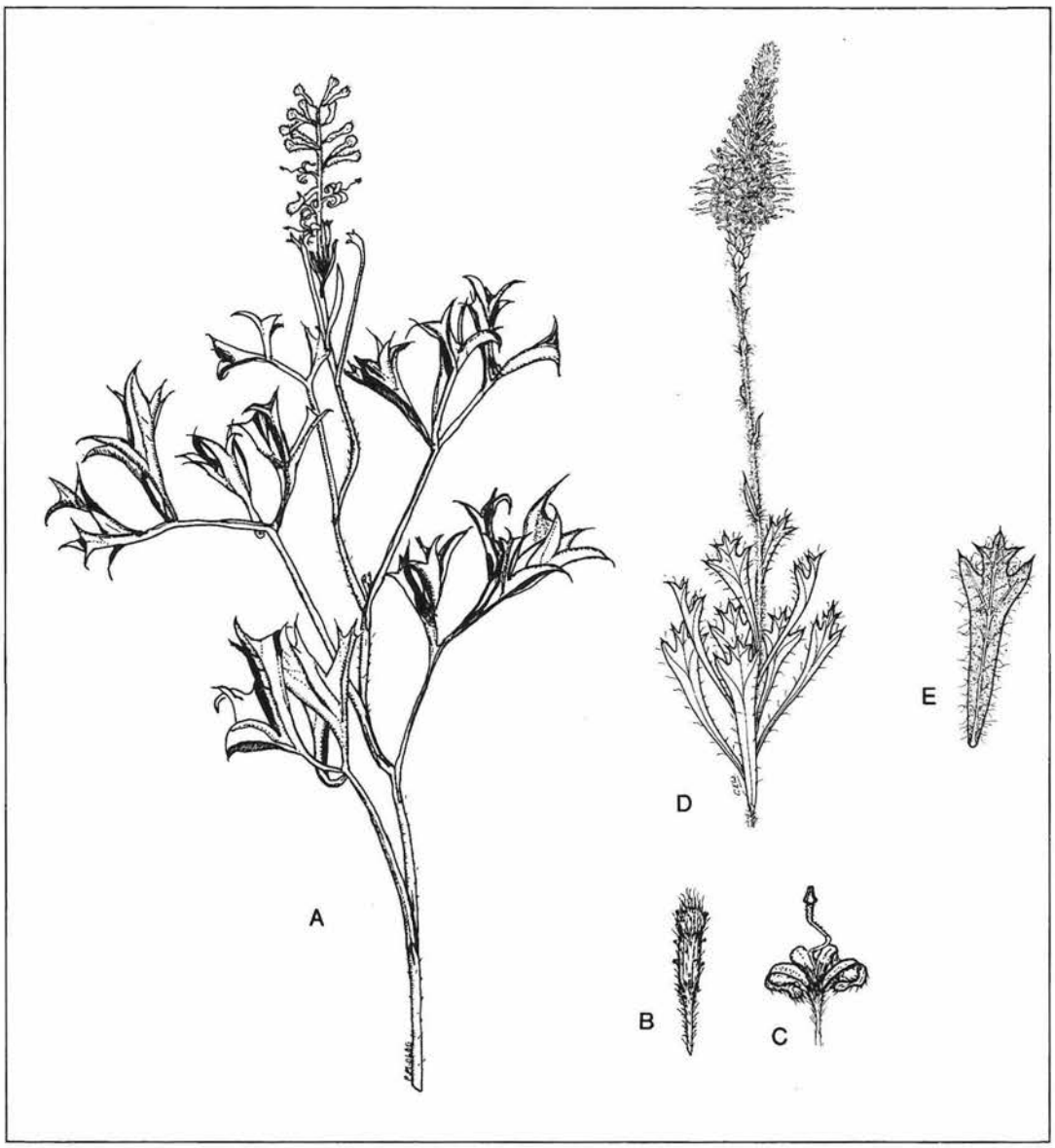

Figure 20. *G. althoferi* A - habit, B - perianth, C - flower. *G. rudis* D - habit, E - leaf.

Conservation status. A code of CALM Priority One is recommended. This species is only known from one extant population, growing on a road verge beside the entrance to a paddock gate where some plants have already suffered damage.

Affinities. Grevillea althoferi is closely related to four other species (see Key 5 on page 298) some members of which have a complex inflorescence morphology (McGillivray 1993: 375). All have the following features in common; perianth actinomorphic; nectary absent; ovary hairy; style conspicuously folded above the ovary, the lower filiform section glandular-pubescent, the upper half dilated gradually upwards and papillose; pollen-presenter erect, conical or conico-cylindrical. Of these, it is closest to *Grevillea rudis* which differs in its pinnatifid, obovate-cuneate leaves, mostly lacking secondary division, its denser inflorescences borne on peduncles far above the basal foliage, in its

perianth shorter and narrower (3-4 mm long, 0.7 mm wide) and in its perianth glabrous and smooth inside. In addition, the indumentum on the leaves and branchlets is more conspicuous, with trichomes both longer and more densely distributed.

Etymology. The epithet honours the naturalist and former curator of Burrendong Arboretum, near Wellington, NSW, Peter McDowell Althofer (1918-1991) and his wife and former assistant, Hazel J. Althofer (nee Johnston), O.A.M. (1920-), for the inspiration and encouragement provided to the authors by their deep love of the Australian flora.

KEY 5

Key to species closely related to *Grevillea althoferi*

1 Leaf lobes terete ..... *G. stenostachya*

1* Leaf lobes not terete

2 Ovary sessile, villous

3 Most leaves pinnatifid (rarely bipinnatifid), usually obovate-cuneate with apical toothing or lobes; perianth 3-4 mm long, smooth and glabrous on the inside ..... *G. rudis*

3* Most leaves pinnatisect with 3-7 distant, secondarily divided lobes; perianth 5-6 mm long, papillose or hairy on the inside ..... *G. althoferi*

2* Ovary stipitate, glandular-pubescent

4 Pedicel <2 mm long; ovarian stipe <1 mm long; floral bracts caducous ..... *G. pulchella*

4* Pedicel >2 mm long; ovarian stipe usually >1 mm long; floral bracts persistent ..... *G. tenuiflora*

20. Grevillea superba P. Olde & N. Marriott sp. nov. (Figure 21)

Affinis *Grevilleae plurijugae* F. Muell., sed lobis foliorum plerumque latioribus (usque ad 2.2 mm latis) patentioribusque aut bi- aut tripartitis aut pinnatis infernis, subtus costa ultra marginem haud exserta, pedunculis pro parte maxima fruticis verticem excedentibus, pistillis plerumque longioribus (40-47 mm longis), differt.

Typus: Western Australia: Norwood Rd, east of Scaddan, *P. Olde* 91/332, 13 October 1991 (holo: NSW; iso: PERTH).

Aff. *Grevillea plurijuga* F. Muell. but differs in its leaf lobes which are usually broader (up to 1.5 mm wide) more spreading with the lower lobes either bi- or tripartite or pinnate, in the midvein on the lower surface level with the margin, in its peduncles which usually exceed the top of the shrub and in its usually longer pistils (40-47 mm long).

Robust, non-lignotuberous shrub 2-3 m high, 2 m wide with emergent floral branches up to 1 m above the shrub; branchlets rounded, tomentose. *Leaves* 2-7 cm long, secund, sessile or almost so, simple when subtending the conflorescence, otherwise subpinnatisect; rachis usually recurved,

sometimes straight; primary leaf lobes 9-17 per leaf, (1)3-6 mm apart, 5-20 mm long, 1-2.2 mm wide, linear, pungent, the lower lobes bi- to pinnatisect; upper surface glabrous or almost so, smooth or with faint longitudinal grooves, the midvein obscure to faintly evident; lower surface bisulcate, the midvein level with or scarcely prominent above the lamina, glabrous or with scattered appressed biramous trichomes; margin smoothly to angularly revolute, enclosing the undersurface; texture coriaceous. *Conflorescence* usually carried on emergent floral branches above the shrub, sometimes also on short, peduncles at the apex of leafy branchlets, terminal, usually 5-10 branched, sometimes simple; unit conflorescence 4-6 cm long, cylindrical, lax, development basipetal; peduncles tomentose, persistent and becoming glabrous with age; floral rachis 1.5 mm wide at the base, tomentose; floral bracts 1-1.2 mm long, 1 mm wide, ovate, tomentose outside, glabrous inside, caducous. *Flowers:* pedicels 7-10 mm long, ascending to spreading, tomentose; torus 2 mm wide, trapezoid-undulate, slightly cupuliform, reverse oblique at 10-30°; nectary subpatelliform to linguiform, the margin undulate to toothed; *perianth* 7-10 mm long, 2.5-4 mm wide at the base, whitish over olive green ageing creamish-pink to pink or reddish-pink, oblong below the curve, slightly dilated at the base, strongly revolute in the apical half, densely glandular-pubescent with a few closely appressed biramous trichomes intermingled outside, pilose inside over most of the surface, glabrous above the curve; limb 2 mm long, 3 mm wide, spheroidal-subcubic, the segments slightly ribbed; *pistil* (38)40-47 mm long, glabrous; stipe 2-2.2 mm long; ovary rugose with two ventral oncogynous protuberances; style cream or pink with red style-end, gently curved, dilated in the apical 2 mm; pollen-presenter 2.5 mm long, 1.6-1.8 mm wide, lateral, flat to convex, obovate. *Fruits* 17 mm long, 15 mm wide, 9-10 mm deep, erect, obovoidal to subglobose, rugose with two prominent swellings on the upper ventral surface; style persistent, fragile; pericarp 2-3 mm thick at the suture. *Seeds* (*Olde* 86/1189) 10 mm long, 5 mm wide, 2 mm deep, 2 per fruit, oblong-ellipsoidal, outer surface convex, smooth, inner face convex encircled by a wrinkled, membranaceous wing c. 1 mm wide.

Selected specimens (30 examined). WESTERN AUSTRALIA: 5 km W of Grasspatch on Grasspatch Rd, *Olde* 91/330, 13 October 1991 (NSW); 2 km N of Grasspatch, *C. & D. Woolcock* 126, 3 October 1985 (NSW); Mt Burdett Rd, near Mt Burdett, *Olde* 86/1189, 13 November 1986 (NSW); N of Mt Ridley, *Aplin* 4006, 15 Oct. 1970 (PERTH); 2.4 km SSE of Mt Ney Rd on Kau Rock Rd, *Nunn* 144, 20 Sep. 1985 (PERTH); N of Scaddan, *A. Ashby* 2779, 2 Dec. 1969 (PERTH).

Distribution. Western Australia: extending north to south between Grasspatch and Scaddan east through the Wittenoom Hills to Mt Ney and west a few km from Scaddan. The area is now widely cleared and the full extent of the original distribution is uncertain.

Habitat and ecology. Grows in *Eucalyptus* shrubland in white sand over pale-brown, calcareous loam. Nectarivorous birds were seen probing the flowers. *G. superba* appears to be short-lived but regenerates from seed after fire.

Flowering period. October to December.

Affinities. Grevillea superba is most closely related to species placed by Bentham in his Sect. 1 *Eugrevillea* Series 1 *Leiogyne*, a diverse group, of which only some are closely related. The closely related species, for which Key 6 is provided on page 302, may be described as having inflorescences with basipetal development; a glabrous, stipitate, ovary with strongly developed oncogynous protuberances on the ventral side; a mostly reverse-oblique torus; a zygomorphic, oblong perianth; a prominently exserted style with lateral pollen-presenter.

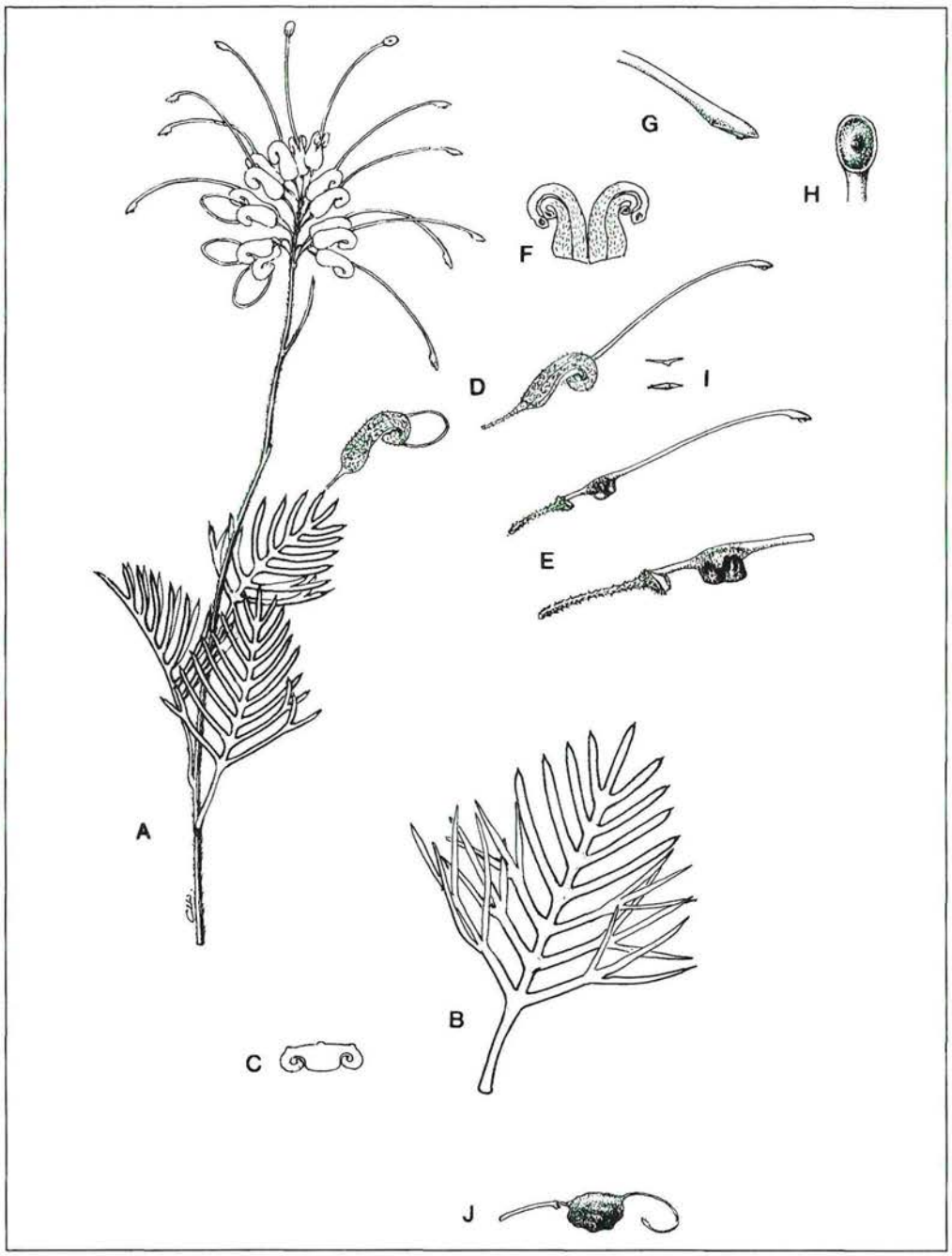

Figure 21. *G. superba* A - habit, B - leaf, C - leaf lobe in cross-section, D - perianth, E - pistil/ovary, F - inner perianth surface, G - style-end, H - pollen-presenter, I - hair types on perianth, J - fruit.

Discussion. Plants referable to our *Grevillea superba* have been included by McGillivray (1993) in *G. plurijuga* F. Muell. a species to which, like *G. pectinata*, it is undoubtedly very closely related. The photograph (McGillivray 1993: 241) is of our *G. superba. G. plurijuga* differs in its round, dome-shaped, lignotuberous habit, its inflorescences mostly either within the shrub on decurved peduncles or at the base of the bush where erect on prostrate peduncles around the perimeter of the plant (persistent peduncles not exceeding the top of the bush); its leaf lobes 0.8-1.2 mm wide, closely

aligned, trigonous and with the basal lobes undivided; its shorter pistils (35-38(40) mm long). Continuity is observed in that occasional leaves on some specimens of *G. plurijuga sens. str.* have bipartite division of the lowermost lobe. We have also seen a few plants of *G. plurijuga sens. str.* south west of Mt Ragged (e.g. *Olde* 91/04 [NSW]) with occasional peduncles exceeding the top of the bush. However, these plants were always accompanied by other features unifying them with *G. plurijuga* (*viz.* trigonous leaf lobes, short pistils, most flowering at the base of the plant). (Figure 22)

An argument could be mounted that *G. superba* is better included in a conceptually broad *G. plurijuga*, a species thus seen as genetically labile, expressing itself in different circumstances in different ways. However, this highly speculative view must be balanced against the field situation of sympatric occurrence. We would argue that the two entities are distinct and show a level of internal morphological consistency and degree of discontinuity from each other similar to other accepted separations (e.g. *G. wittweri* - *G. tetragonoloba*) and that separation at specific rank is warranted (see Table 4 on page 303). However, we cannot confidently argue full reproductive isolation as there are a number of hybrids (albeit of uncertain parentage but putatively either between these two species or as relicts through a former distribution of *G. pectinata*) in the Scaddan area. The hybrids are restricted, from our observation, to disturbed roadside situations.

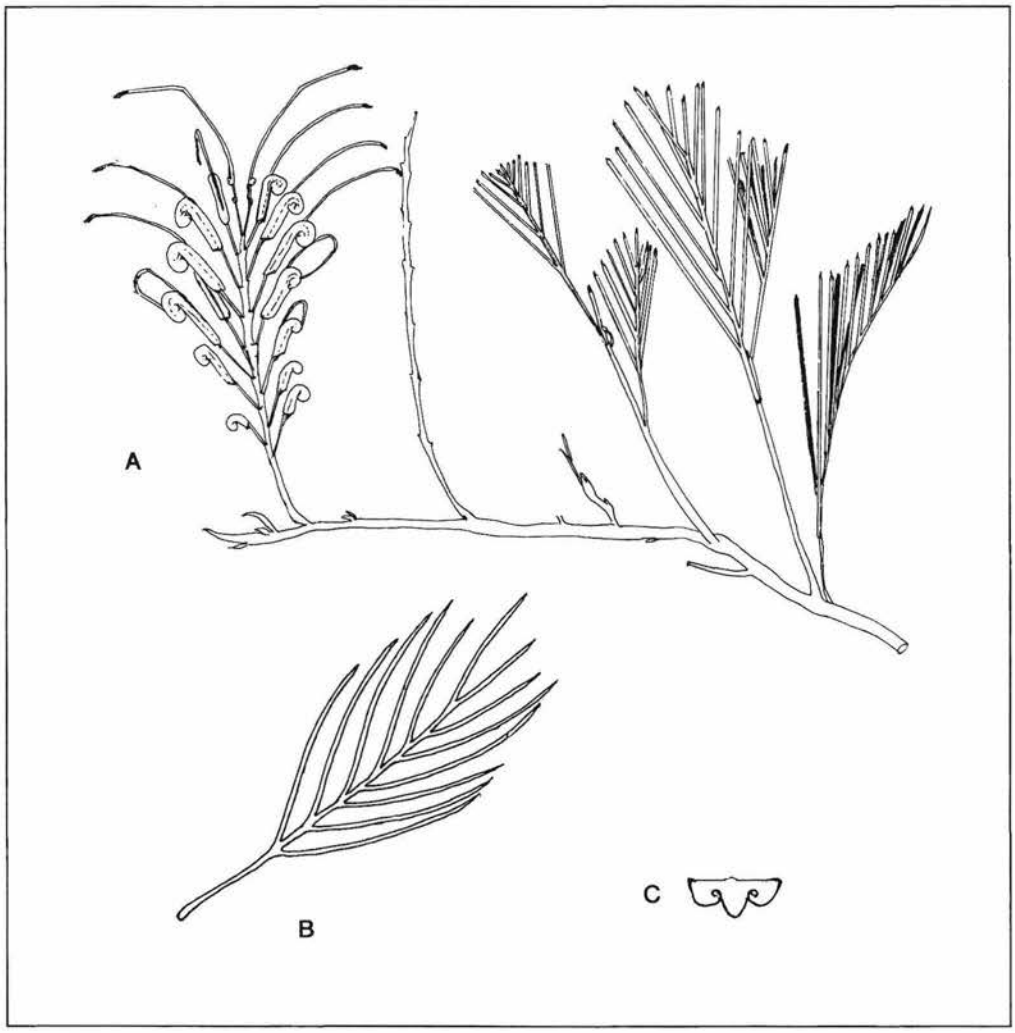

Figure 22. *G. plurijuga* A - habit, B - leaf, C - leaf lobe in cross-section.

Conservation status. A code of CALM Priority Three is recommended. *G. superba* is contained in Truslove Nature Reserve. However, many of the plants still extant in roadside verges around Scaddan appeared to be dying in October 1992 and the conservation imperative for this species may be greater than our recommendation.

Etymology. Latin *superbus* - proud, in reference to the flowers standing proud of the shrub.

KEY 6

Key to some species related to *G. plurijuga* and *G. superba*

Pistils >25 mm long

1 All leaves simple and >5 cm long ..... *G. oncogyne*

1* Some or all leaves either divided or simple and <4 cm long

2 Some or all leaves pinnate, (sometimes the lower lobes with secondary division)

3 Most floral rachises <0.5 cm long; inflorescences decurved ..... *G. pectinata*

3* Most floral rachises >0.5 cm long; inflorescences erect

4 Most leaves with <10 lobes; inflorescences mostly on short peduncles and borne within the leaves ..... *G. oncogyne*

4* Most leaves with >10 lobes; inflorescences on long peduncles exceeding the leaves

5 Leaf lobes trigonous; peduncles decurved within or trailing at the base of the plant; pistils 35-38(40) mm long ..... *G. plurijuga*

5* Leaf lobes with the midvein on the undersurface c. level with the subtending lamina; peduncles emergent above the top of the plant; pistils 40-47 mm long ..... *G. superba*

2* Leaves not pinnate

6 Leaves divaricately lobed

7 Leaf lobes c. 1 mm wide; leaf margins smoothly rounded; leaves sometimes with secondary division; inflorescences usually pedunculate and branched ..... *G. newbeyi*

7* Leaf lobes 1.5-3 mm wide; leaf margins angularly refracted; leaves with primary division only; inflorescences usually sessile or almost so and unbranched ..... *G. tripartita*

6* Leaves not divaricately lobed

8 Pistils >45 mm long; inflorescences subsessile ..... *G. macrostylis*

8* Pistils <40 mm long; inflorescences pedunculate ..... *G. pectinata*

TABLE 4

	G. superba	**G. plurijuga**
Habit	erect	dome-shaped
Lignotuberous	no	yes
Flowering habit:		
peduncles emergent above	usual	rare
peduncles at ground level	never	usual
Leaf lobes	1-2.2 mm wide	0.7-1.2 mm wide
	oblong in cross-section	trigonous
	spreading	closely aligned
Secondary division	usual	very rare
Pistil length	35-38(40)mm	(38)40-47 mm

Acknowledgements

We wish to pay special thanks to the late Collin Woolcock who provided numerous illustrations for use and the Directors of the following institutions for providing access to their collections: NSW, PERTH. We deeply appreciate comments on the introductory section of this paper by Dr L.A.S. Johnson, Ken Hill and Gwen Harden. Don McGillivray also gave information and made available a manuscript of his revision of the genus *Grevillea*, from which some typification details of previously named species were drawn. Alex George critically read an earlier draft of the manuscript.

This research was funded by a grant from the Society for Growing Australian Plants (NSW) Limited and by the Sutherland and Menai Groups of the same Society.

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INDEX

CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora - Extant Taxa (= Threatened Flora = Endangered + Vulnerable)

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

X: Declared Rare Flora - Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

1: Priority One - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four - Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Publication date of Nuytsia Volume 9 Number 1: 11 June 1993

Notes for Authors

The aim of **Nuytsia** is to publish original papers on systematic botany with preference given to papers relating to the flora of Western Australia. Descriptions and keys using manuscript or phrase names will not generally be accepted. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

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Title. Should include the family name of genera or species treated, but not authorities. New taxa should be named if not numerous. The geographic area of study should be given where appropriate.

Abstract. The paragraph (or paragraphs) should be indented and commence with bibliographic information. New taxa, combinations and names should be listed. The major contents of the paper should be summarised but no additional material given.

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Species treatments. Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly used headings are shown below. Recommended headings which are italicised below, should be left-justified, followed by text on the same line.

(1) Taxon name, synonymy (if any) and type details (for previously published taxa).
(2) Latin (for new taxa - indented).
(3) *Typus:* (for new taxa - not indented).
(4) English description (indented).
(5) *Other specimens examined* or *Selected specimens examined* as appropriate.
(6) *Distribution.*
(7) *Habitat.*
(8) *Flowering period.*
(9) *Fruiting period.*
(10) *Typification* (discussion).
(11) *Affinities* or *Relationships.*
(12) *Discussion* or *Comments* or *Notes.*
(13) *Conservation status.* (Department of Conservation and Land Management conservation codes for rare and threatened (Declared Rare Flora) WA taxa are given in each issue).
(14) *Etymology.*

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Synonymy. The desired format is that used by P.G. Wilson, Nuytsia 4: 135-262.

Standard abbreviations. It is suggested that where possible the following standards be followed.

(1) Author abbreviations - Brummitt, R.K. & Powell, C.E. (1992). Authors of Plant Names. (Royal Botanic Gardens: Kew.)

(2) Book titles in literature citations - Stafleu, F.A. & Cowan, R.S. (1976-83). Taxonomic Literature. Edn 2. (I.A.P.T.: Utrecht) (but with capital initial letters.) - Green, J.W. (1985). Census of the Vascular Plants of Western Australia. Edn 2. Pp. 20-24. (Department of Agriculture: Perth.)

(3) Journal titles in literature citations and reference lists - Lawrence, G.H.M. *et al.* (1968). B-P-H (Botanico-Periodicum-Huntianum). - Green *loc. cit.*

Figures. Numbers should follow a single sequence including maps.

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