

**A revision of the genus *Calectasia* (Calectasiaceae)
with eight new species described from south-west Western Australia**

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Abstract

Barrett, R.L. and Dixon, K.W. A revision of the genus *Calectasia* (Calectasiaceae) with eight new species described from south-west Western Australia. *Nuytsia* 13(3): 411-448 (2001). In this revision of the southern Australian genus *Calectasia* R. Br., eleven species are recognized. *Calectasia browneana* Keighery, K.W. Dixon & R.L. Barrett, *C. gracilis* Keighery, *C. hispida* R.L. Barrett & K.W. Dixon, *C. keigheryi* R.L. Barrett & K.W. Dixon, *C. narragara* R.L. Barrett & K.W. Dixon, *C. obtusa* R.L. Barrett & K.W. Dixon, *C. palustris* R.L. Barrett & K.W. Dixon, and *C. pignattiana* K.W. Dixon & R.L. Barrett, are described as new species from the south-west of Western Australia. A lectotype is selected for *C. grandiflora* Preiss and notes are made on the lectotype of *C. cyanea* R. Br. Keys, illustrations and distribution maps are provided for all taxa. Notes are made on the conservation status and ecology of the genus.

Introduction

Calectasia R. Br. is a genus endemic to southern Australia with eleven species recognized here. Ten are endemic to the south-west of Western Australia and *C. intermedia* is restricted to South Australia and Victoria. Three species have previously been named though Bentham (1878) and Anway (1969) recognized only *C. cyanea*. *C. grandiflora* and *C. intermedia* have since been reinstated with both George (1986) and Macfarlane (1987) suggesting that further research may result in the recognition of additional taxa. Given the paucity of specimens available to Bentham, his was a reasonable conclusion. Anway sampled widely, collecting many distinctive variants, several of which are here recognized as species. Anway took a broad view in defining only one species, with two varieties, based primarily on rhizome structure. Ironically, many species (including *C. cyanea*) are stilt-rooted (Pate *et al.* 1984, Pate & Dixon 1996), lacking a distinctly subterranean rhizome.

In recent years, an increase in the number of specimens supplemented by extensive field collections has enabled a reassessment of the reliability of identification of the rhizomatous status and other

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characters used by earlier authors. This paper draws attention to five taxa which are recognized as priority taxa for conservation, as well as one Gazetted Rare species, and a further variety which has a limited distribution, and provides information on the ecology of the genus.

Methods

Descriptions were made primarily from fresh material, supplemented with measurements from herbarium specimens to ensure the full range of variation was recorded. Illustrations were prepared from vouchered fresh material or herbarium specimens. All taxa have been seen in the field with the exception of *C. intermedia*.

Terminology where appropriate follows McCusker (1999). Bract measurements are taken from the four innermost bracts. Leaf lamina measurements were made only from branchlet leaves as stem leaves can be considerably larger and vary with stem age.

The main characters used to separate species were: presence or absence of a distinct underground rhizome; presence of stilt roots; vigour of basal sprouting; angle of mature leaves; leaf lamina shape and indumentum; bract structure and shape; perianth texture and coloration; anther shape, size and colour; staminal filament length.

All specimens held at BM, CANB, KPBG, PERTH, and UWA at July 1999 have been examined as well as substantial collections on loan from L and MEL. All specimens collected by J.C. Anway, previously cited as being held at UWA (Anway 1969), are now at PERTH and have been examined. Further collections were made from June to December 1999. A complete list of specimens examined is held at KPBG.

Maps were created using ArcView 3.0 using a combination of locality data sourced from examined herbarium vouchers, (Western Australian Herbarium 1999, MEL database) and field collections. All specimens examined with accurate locality data have been included in the distribution maps.

Notes on the genus

Ecology

Calectasia species occupy a variety of habitats, occasionally in seasonally swampy areas, usually low heath on sand over laterite or granite or in low woodland on sand. *C. browneana*, *C. hispida* and *C. narragara* are sympatric in kwongan vegetation near Badgingarra. *C. cyanea* is restricted to near-coastal heath on sand over laterite in the Albany region. *C. gracilis* and *C. obtusa* are sympatric in low kwongan near Cape Riche with *C. gracilis* flowering later than *C. obtusa*. *C. grandiflora* (type variant) and *C. narragara* are sympatric in several locations on the Swan Coastal plain, *C. grandiflora* flowering considerably later than *C. narragara*. *C. intermedia* occurs in woodland and heath in eastern Victoria and western South Australia. *C. keigheryi* occurs in kwongan in the Fitzgerald River National Park on the south coast of Western Australia. *C. palustris* is restricted to seasonally wet areas or swamplands in the Jurien-Coorow region. *C. pignattiana* is restricted to yellow sand lenses in the central wheatbelt.

The seeds are retained within the perianth, which is distributed by wind. Large quantities of fallen flowers have been observed deposited against surrounding plants. The perianth tube has a pungent apex with stiff hairs facing upwards which allows the tube to penetrate the sand with relative ease and subsequently minimise the risk of disturbance. The perianth lobes sit at 90° to the tube, regulating the depth at which the seed is buried. This strategy is similar to *Calytrix* (Myrtaceae) where the persistent calyces similarly behave as buoyancy devices for dispersing and positioning the seed for soil burial (Craven 1987).

Calectasia species are commonly parasitised by *Cassytha* species (Lauraceae).

Pollination biology

Calectasia species are buzz-pollinated (G. Keighery pers. comm.) as in *Solanum* (Solanaceae) (Symon 1981), some species of which bear a superficial resemblance to *Calectasia*. Anway (1969) found that pollen was apparently shed prior to anthesis and records germinating pollen grains in unopened flowers, concluding that *Calectasia* is normally self-pollinated. Anway also states that style length is such as to be level with the anther pores, however most specimens examined had styles exceeding the anthers, with only a few specimens of *C. grandiflora* being at the same height as the anther pores. There is an erroneous report in Brown *et al.* (1997) based on Woldendorp (1996) that pollination by the Honey Possum (*Tarsipes rostratus*) had been observed. *Calectasia* plants are not strong enough to support the weight of a Honey Possum and have no nectar to attract such a pollinator.

Close resemblance of flowers of *C. grandiflora* to those of *Thelymitra variegata* (Lindl.) F. Muell. (Orchidaceae) which has a regular 'star-shaped' perianth with an iridescent sheen and variegated markings with a bright yellow column apex (Heberle 1999) may indicate a case of floral mimicry, which has been widely postulated for many other orchid groups in Western Australia (Jones 1988). *C. grandiflora* and *T. variegata* have a similar distribution and are often sympatric.

Cytology

Anway (1969) records $2n = 18$ for *C. gracilis*, the south coast variant of *C. grandiflora*, *C. intermedia* and *C. narragara* [all as *C. cyanea*]. Keighery (1984) records $2n = 36$ for the wheatbelt variant of *C. grandiflora* [as *C. cyanea*]. Voucher specimens are cited under individual species descriptions.

Conservation

C. pignattiana is Declared Rare Flora (Brown *et al.* (1998) as *C. arnoldii* ms.). This species is critically endangered with only one plant surviving at one site, and another population at the type locality has significantly declined in numbers from several hundred in 1995 to less than 50 plants in 1999, most likely as a result of frequent burning of the site. *C. browneana*, *C. cyanea*, *C. obtusa* and *C. palustris* are recognized as priority species for conservation as they are known from few populations, are sensitive to fire and most populations occur outside reserves. *C. grandiflora* (type variant) has a very limited distribution on the Swan Coastal Plain. *C. keigheryi* is known only from three locations in the Fitzgerald River National Park. CALM and IUCN (1994) conservation categories are listed under each taxon. The remainder of the taxa are widespread and under no immediate threat. *C. browneana*, *C. cyanea*, *C. gracilis*, *C. obtusa*, *C. palustris* and *C. pignattiana* are all obligate seeders requiring careful fire management to ensure seed is produced between fire events.

Wills (1993, pers. comm.) studied the effects of dieback (*Phytophthora cinnamomi* Rands) on Dasypogonaceae *sens. lat.* in the Stirling Ranges and found that *Calectasia* plants were restricted in their growth, but not killed, while *Dasypogon bromeliifolius* R. Br. was killed. While no voucher specimens were collected, this study probably refers to *C. grandiflora* (south coast variant), the most common taxon in the Stirling Range. Further study should be made to determine the effects of *P. cinnamomi* on stilt-rooted species.

All stilt-rooted species are thought to be killed by fire. Hundreds of seedlings have been observed of *C. gracilis* (G. Keighery pers. comm.) and *C. pignattiana* (Brown *et al.* 1998) following fire, while all adult plants had been killed. It takes (2)3–5 or more years for these species to flower and presumably a substantially longer period to attain maximum reproductive potential, therefore fire frequency must be carefully controlled to ensure survival of the species.

Habit

Calectasia species are either obligate seeders (stilt-rooted species) or resprouters (rhizomatous species). All stilt-rooted species have epicormic buds above the soil surface while rhizomatous species have epicormic buds below the soil surface. Stilt-rooted species take two forms, obligate stiling species (*C. gracilis*, *C. obtusa*, *C. palustris* and *C. pignattiana*) and facultative stiling species (*C. browneana*, and *C. cyanea*). For obligate stiling species, stilt roots may not be observable above ground in the first three years of growth; however stilt roots subsequently form with a discernible absence of a distinct subterranean rhizome. Careful observation is required when collecting specimens as several collections described as rhizomatous were found to be stilt-rooted when re-collected. For facultative stiling species, specimens can appear to have rhizomatous habit as the stilt roots may not emerge above the soil/litter surface. The term 'stilt-rooted' is retained for these species as it is entirely variable within a population and prominently stiling specimens can usually be found.

Careful superficial excavation is required to determine the true nature of the root system. Very few collections include roots (root collection is discouraged for conservation reasons) making correct identification of some material difficult. *C. grandiflora*, *C. hispida*, *C. keigheryi* and *C. narragara* are tufting clonal resprouters with a distinct subterranean rhizome, all observed to resprout following fire. *C. intermedia* is distinctive in possessing a more extensive clonal ramification and subterranean rhizome. Seed set in these clonal species is very poor with few observations or records of seedlings in nature including after fire. This is despite claims that seedlings are 'not uncommon' (Gray 1969).

Elliot & Jones (1982) have recorded adventitious roots from the upper branches for *C. cyanea sens. lat.* and probably refer to the structures akin to stilt roots (Pate *et al.* 1984). Although it is unclear which species this refers to, the current study found prominent stilt root production from the upper branches only in the rare species *C. palustris* and *C. pignattiana*. Sand-binding roots as described by Pate & Dixon (1996) are recorded for the genus *Calectasia* for the first time, occurring in all species (Figure 1).

There are some examples of both seeder and resprouter morphotypes within species of monocots in other Australian plant families (Pate & Bell 1993, Pate & Dixon 1996, Pate *et al.* 1999), however the differences in growth form for *Calectasia* (with no intergrading specimens) are considered sufficient to use this character to distinguish between species in this genus.

The stilt habit is unique in the Dasypogonaceae *sens.* Clifford *et al.* (1998) with more prominent and larger stilt roots than most other stilt-rooted plants (e.g. Anthericaceae, Droseraceae, Styliidiaceae

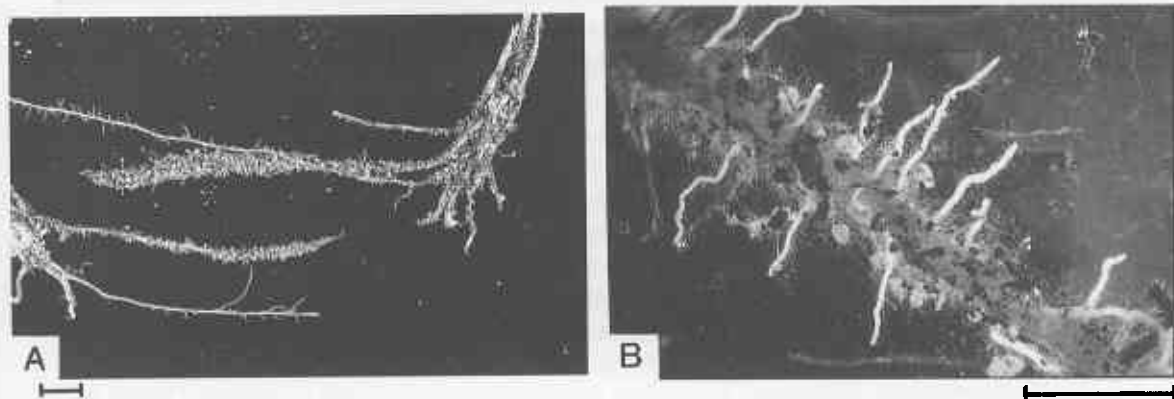


Figure 1. Sand-binding roots of *Calectasia narragara* (R.L. Barrett & K.W. Dixon 1306) A – sand bound to root; B – microphotograph of root hairs. Scale bars: A = 1 cm, B = 1 mm.

and western species of Laxmanniaceae). The stilt roots of *Calectasia* species are similar in size to *Romnaldia grallata* Henderson (Henderson 1981) [Laxmanniaceae sens. Angiosperm Phylogeny Group (1998)] and *Borya* species (Boryaceae), particularly the tropical species *B. subulata* C.A. Gardner.

Vegetative characters

Branched trichomes have been recorded for *Calectasia* by Fahn (1954), occurring on the margins of the leaf sheaths of all species. *C. palustris* has been observed with a profusion of marginal trichomes giving the sheath apex a woolly appearance. One specimen of *C. narragara* (C.L. Wilson 770) has leaf laminae with pilose marginal hairs, but was otherwise glabrous. Most specimens have scabrid hairs on the margin of the leaf lamina, absent in only *C. browneana*, *C. obtusa* and *C. pignattiana*. Dense pilose indumentum on the surfaces of the leaf lamina is found only in *C. browneana* and a dense hispid indumentum only in *C. hispida*. Scattered branched trichomes are found on the leaf lamina of *C. palustris* and occasionally on *C. grandiflora*. All other species have more or less glabrous leaf lamina surfaces.

C. pignattiana has a large internode length and reflexed leaf laminae. New season's growth (of all species) can have greater internode length and larger diameter stems than older plants, with new shoots of *C. cyanea* appearing like a robust variant of *C. pignattiana*.

Leaf, stem and root anatomy of *Calectasia* were first studied in detail by Fahn (1954) in a review of the anatomy of the family Xanthorrhoeaceae (sens. lat.) with further studies by Rudall & Chase (1996). Fahn studied two species of *Calectasia*, *C. grandiflora* [as *C. sp. nov.*] and *C. narragara* [as *C. cyanea*]. Rudall & Chase studied only *C. narragara* [as *C. cyanea*].

Floral characters

Perianth structure is recorded as either chartaceous (fading white) or thinly coriaceous (usually fading brown or red). Perianth fading is due to a combination of bleaching due to light and/or contact with water.

Anther pores are either terminal or just below the apex (facing inward). This character can be represented in either state for some species, however intermediate forms (gradation between terminal and sub-terminal) are not found. For most taxa anther pore position is fixed.

Relationships

Relationships within the genus require further research and no attempt is made to present a formal infrageneric classification. The following groupings have been derived using the number of characters shared between each species. The first group consists of *C. browneana*, *C. hispida* and *C. narragara* which all lack vestigial leaf laminae on their floral bracts. Group two comprises *C. cyanea*, *C. gracilis* and *C. pignattiana*, which are all stilt-rooting species with perianth lobes fading white. Group three comprises *C. grandiflora*, *C. palustris* and probably *C. obtusa*, which are large-flowered species with perianth lobes fading to red/brown. Group four includes *C. intermedia* and *C. keigheryi* which both have golden pilose hairs on the perianth tube; narrow perianth lobes not fading red/brown and relatively short staminal filaments. Group two is thought to be closest to group three, these groups to group four and group one most distant.

Taxonomy

Calectasiaceae Endl. in Fenzl & Endl., Gen. Pl. i: 132 (1836) [as *Calectasieae*].

Type: Calectasia R. Br.

Juncaceae subfam. *Calectasioideae* Meisn., Pl. Vasc. Gen.: Tab. Diagn. 406 (1842) [as *Calectasieae*].
– *Juncaceae* tribe *Calectasieae* Benth., Fl. Austral. 7: 93, 119 (1878).

A monogeneric family, comprising only *Calectasia*, closely allied to *Dasyogonaceae sens. Brummitt* (1992). The original publication of the family name has often been cited as 'Endl., Gen. Pl. viii: (1838)', however the name was first published in Endlicher (1836).

The family *Calectasiaceae* is recognized as distinct from *Dasyogonaceae* based on recent DNA evidence (Barthlott *et al.* in prep.). The Angiosperm Phylogeny Group (1998) included *Calectasiaceae* within *Dasyogonaceae*, placing the family in an unresolved position within the Commelinoid clade. Studies by Barthlott *et al.* (in prep.) resolve *Calectasiaceae* and *Dasyogonaceae* as sister families within the Arecales. The position of *Calectasia* has varied greatly in the past. Originally placed in *Juncaceae* (Brown 1810, Meisner 1842, Bentham 1878), then placed in its own family (Endlicher 1836), it has also been included in *Liliaceae* (Jessop & Toelken 1986), *Xanthorrhoeaceae* (Anway 1969, George 1986, Conn 1994, Mabberley 1997), *Dasyogonaceae* (Rudall & Chase 1996, Angiosperm Phylogeny Group 1998, Clifford *et al.* 1998), or accepted as *Calectasiaceae* (Dahlgren *et al.* 1985, Brummitt 1992, Takhtajan 1997, Watson & Dallwitz 1999, Barthlott *et al.* in prep.). In addition, *Calectasiaceae* is recognized in the National register of plant nomenclature for Australia (Chapman 1999).

Calectasia is unique in the *Dasyogonaceae sens. Clifford et al.* (1998) in many aspects, the most obvious features being solitary flowers with a chartaceous and persistent perianth. The persistence of the perianth and its apparent use for dispersal of the seeds is unknown in the remainder of this group and is an uncommon feature in the petaloid eumnocots. Stilt roots are not found in any other genera of the *Dasyogonaceae sens. Clifford et al.* (1998).

Calectasia R. Br., Prodr. 264 (1810).

Type: Calectasia cyanea R. Br.

Stilt-rooted or rhizomatous undershrubs with sand-binding roots. *Leaves* sessile; sheath closely appressed to stem, persistent. *Flowers* actinomorphic, bisexual, sessile, terminal, solitary. *Sepals and petals* undifferentiated, united in a tube in lower half, chartaceous or thinly coriaceous, blue or purple, fading white, or brown with red or russet markings. *Stamens* inserted at base of perianth lobes; anthers attached at base, linear, prominently exerted, yellow, usually turning red or brown with age, anther filaments sigmoidal to straight. *Ovary* 1-locular, superior; ovules 3. *Style* slender, exerted, exceeding stamens; stigma simple. *Fruit* indehiscent (anthocarpous), 1-seeded, falling with perianth. *Seed* oblong, with a membranous testa.

Distribution. Widespread in the south-west of Western Australia, from Kalbarri to Esperance with a disjunction to the eastern border of South Australia and western Victoria (Figure 2). The distributions of individual species are shown in Figure 3.

Etymology. From Greek – *calos* meaning beautiful and – *ectasia* meaning stretching out, in reference to the star-shaped perianth lobes (Sharr 1996).

Notes. This is a taxonomically isolated genus thought to be most closely related to *Dasypogon* (Dasypogonaceae). Often confused with *Calytrix* (Myrtaceae) due to the similar appearance of several species.

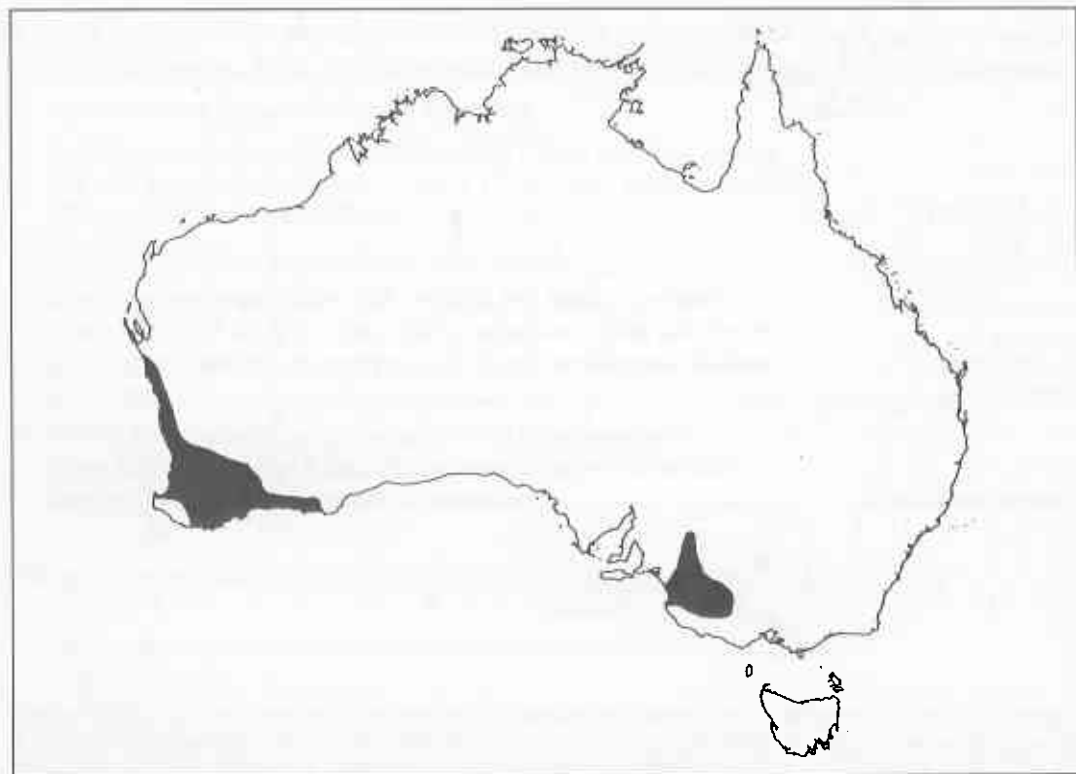


Figure 2. Distribution of the genus *Calectasia*.

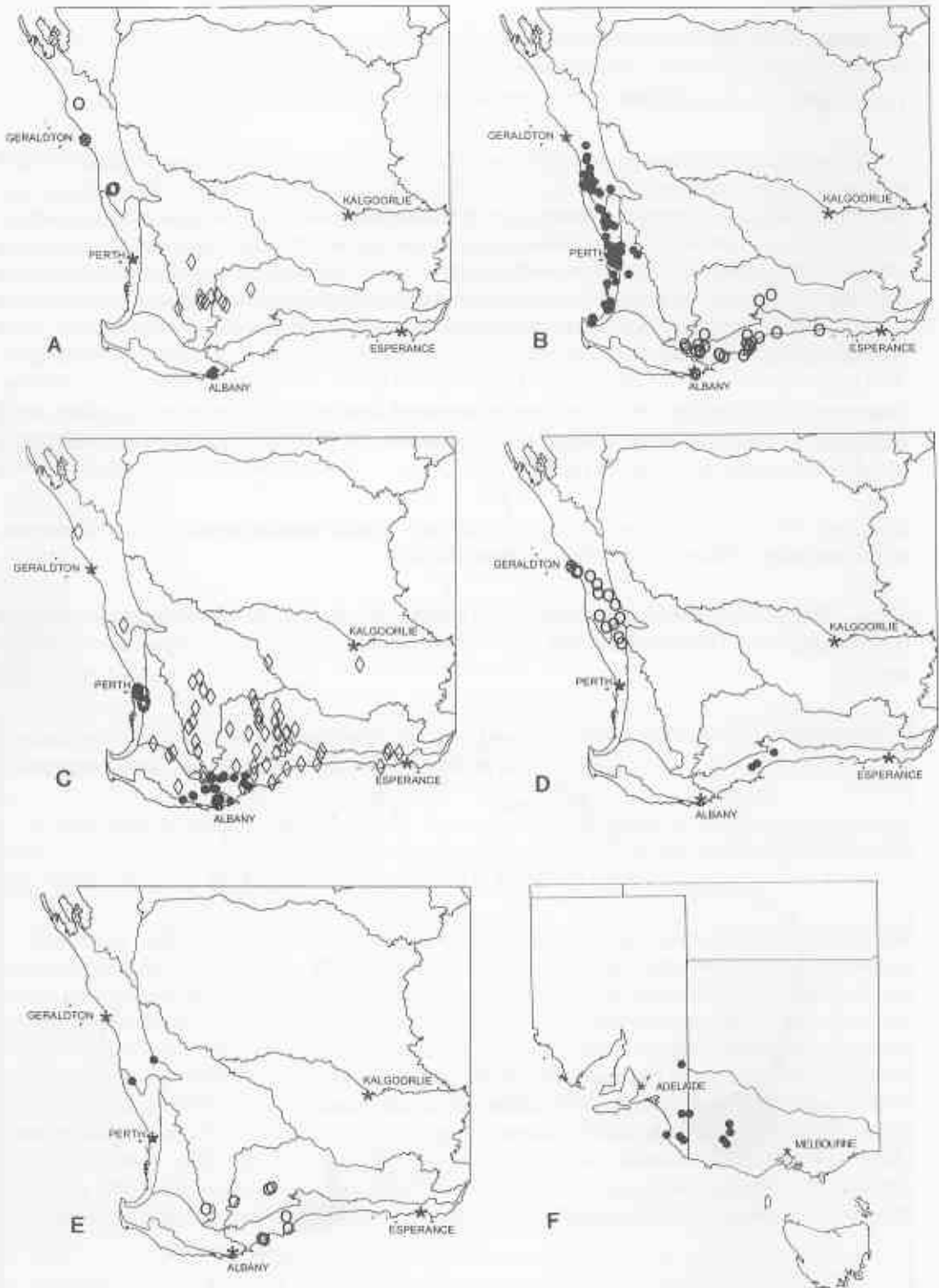


Figure 3. Species distribution A - *Calectasia browneana* o, *C. cyanea* ●, *C. pignattiana* ◇; B - *C. gracilis* o, *C. narragara* ●; C - *C. grandiflora* (type variant) o, (wheatbelt variant) ◆, (south coast variant) ◐; D - *C. hispida* o, *C. keigheryi* ●; E - *C. palustris* ●, *C. obtusa* o; F - *C. intermedia* ●. Western Australian maps show the phytogeographic regions of Beard (1980).

Key to *Calectasia* species

- 1: Plant not rhizomatous, usually with stilt roots 2
 1 Plant rhizomatous, never with stilt roots 7
 2: Leaf laminae reflexed (90°–140°), not overlapping (Quairading to Lake Grace) **C. pignattiana**
 2 Leaf laminae not reflexed (on mature branchlets) (0°–45°) 3
 3: Leaf lamina densely pilose; (Kalbarri to Eneabba) **C. browneana**
 3 Leaf lamina glabrous (margins often scabrous) 4
 4: Leaf lamina without mucro, apex obtuse to bluntly apiculate (Kojonup to Hopetoun) **C. obtusa**
 4 Leaf lamina with a pungent mucro over 0.2 mm long 5
 5: Leaf lamina 1.0–1.3 mm wide; staminal filaments 2.6–3.0 mm long; facultative stiling species (Albany region) **C. cyanea**
 5 Leaf lamina 0.4–0.7 mm wide; staminal filaments 1.0–2.2 mm long; obligate stiling species 6
 6: Slender; perianth tube 5.7–6.9 mm long, lobes 8.1–9.5 mm long; young leaves appressed (Stirling Range to Albany to Frank Hann National Park) **C. gracilis**
 6 Robust; perianth tube 9.9–10.1 mm long, lobes 10.2–12.2 mm long; young leaves rarely appressed (Cervantes to Coorow) **C. paustris**
 7: Leaf lamina hispid above (Kalbarri to Gillingarra) **C. hispida**
 7 Leaf lamina glabrous above (margin often scabrous) 8
 8: Rhizome long, decumbent (South Australia and Victoria) **C. intermedia**
 8 Rhizome short, compact (Western Australia) 9
 9: Anther apex caudate, base constricted with a short skirt (not turning red with age; perianth lobes 8.1–12.5 x 1.3–2.1 mm, thinly coriaceous) (Fitzgerald River National Park) **C. keigheryi**
 9 Anther apex obtuse to emarginate, base cordate 10
 10: Bracts brown-purple, often with vestigial leaf lamina; perianth lobes 11.9–21.5 x 2.0–4.7 mm, thinly coriaceous, aging pale brown and dark red; anthers not turning red with age (widespread, Kalbarri to Esperance) **C. grandiflora**
 10 Bracts white, papery, lacking vestigial leaf lamina; perianth lobes 8.7–12.6 x 2.0–3.0 mm, chartaceous, aging white; anthers turning red with age (Geraldton to Busselton) **C. narragara**

Calectasia browneana Keighery, K.W. Dixon & R.L. Barrett, *sp. nov.*

Calectasiae hispidae affinis sed foliis densi pilosis, rhizomate nullo differt.

Typus: 2.5 km east of Brand Highway on Coorow–Greenhead road, 30°03'06"S, 115°21'58"E, Western Australia, 3 July 1999, R.L. Barrett 1299 (*holo*: PERTH05542464; *iso*: AD, ALB, BM, CANB, K, KPBG, L, MEL, UWA).

Undershrub, stilt-rooted; rhizome absent. *Stems* to 60 cm, with many very short lateral branches. *Leaf lamina* 8.3–15.2 x 0.2–0.4 mm, with weakly barbed pilose hairs; apex cuspidate with a pungent mucro c. 0.25 mm long; sheath with weakly barbed pilose hairs. *Bracts* 11.1–11.4 x 2.0–3.1 mm, white, thin, apex acuminate, margins pilose. *Perianth*: tube 7.2–8.0 mm long, pilose in lower half; throat glabrous; lobes chartaceous, 8.8–10.5 x 2.6–3.0 mm, apex acuminate, pale blue-pink, fading, pilose on abaxial surface. *Staminal filaments* 2.1–2.9 mm long. *Anthers* 3.5–4.3 x 1.0–1.2 mm, apex incurved, yellow, turning orange-red with age, pores terminal or below apex. *Style* 9.3–10.1 mm long, exceeding anthers. *Seeds* not seen. (Figure 4)

Other specimens examined. WESTERN AUSTRALIA: 1.2 km S of intersection of Coorow–Greenhead road on Brand Highway, 50 m NW of rest area, 30°04' 11''S, 115°19' 52''E, 3 July 1999, R.L. Barrett 1300 (KPBG, PERTH); 3.3 km W of Brand Highway, on S side of Greenhead–Coorow road near fence, 30°04' 08''S, 115°17' 53''E, 1995, K.W. Dixon s.n. (KPBG, NSW, PERTH); E of Burry Rd, 6 Aug. 1986, A.S. George 16791 (PERTH); Champion Bay, [28°46' S, 114°38' E], 1873, C. Gray s.n. (MEL); 3 km W of Brand Highway, off Greenhead–Coorow road, 30 July 1995, M. Hislop s.n. (PERTH); 1.5 km S of Greenhead–Coorow road, on Brand Highway, on private property on W side of Highway, 30°04' 40''S, 115°19' 30''E, 29 June 1997, M. Hislop 786 (PERTH); Kalbarri National Park, 0.35 km N of Kalbarri–Ajana road on turnoff to Hawkes Head, 27°49' 10''S, 114°27' 46''E, 5 Aug. 1996, G.J. Keighery & N. Gibson 1922 (PERTH).

Distribution. South West Botanical Province. An uncommon species recorded mainly in the Coorow–Eneabba region, with a disjunct population near Kalbarri. (Figure 3A)

Habitat. White-grey sand over laterite in kwongan with emergent *Banksia attenuata* R. Br., *Eucalyptus todtiana* F. Muell. over *Adenanthos cygnorum* Diels, *Banksia candolleana* Meisn., *Calothamnus quadrifidus* R. Br., *Eremaea beaufortoides* Benth., *Grevillea shuttleworthiana* subsp. *canarina* Olde & Marriott, *Hypocalymma angustifolium* (Endl.) Schauer, *Scholtzia laxiflora* Benth. and *Stirlingia latifolia* (R. Br.) Steud., occasionally with *Kingia australis* R. Br.

Flowering period. June to August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. IUCN: VUD1. This species occurs in one large national park and in four roadside populations, two of which extend to private land. Further studies are urgently required to determine the fire response of this species.

Etymology. The specific epithet honours John and Judy Browne, owners of 'Breakaway', on whose property this species occurs and who have endeavoured to conserve high conservation value kwongan vegetation on their land.

Affinities. Closest to *C. hispida* and *C. narragara*, differing principally in the pilose leaf lamina and facultative stiling habit.

Notes. The common name of Browne's Tinsel Lily is suggested for this species. This is a facultative stiling species which may appear rhizomatous as soil often aggregates at the plant base forming a raised mound around the roots. It does not form a distinct subterranean rhizome and all shoots arise from above the soil surface. There is very minor storage of starch in the stem and in central pith of stilt roots suggesting that this species would not have sufficient reserves to resprout following fire. While its fire response has not been observed, this species is almost certainly killed by fire. The dense pilose indumentum on the leaf laminae is unique in the genus.

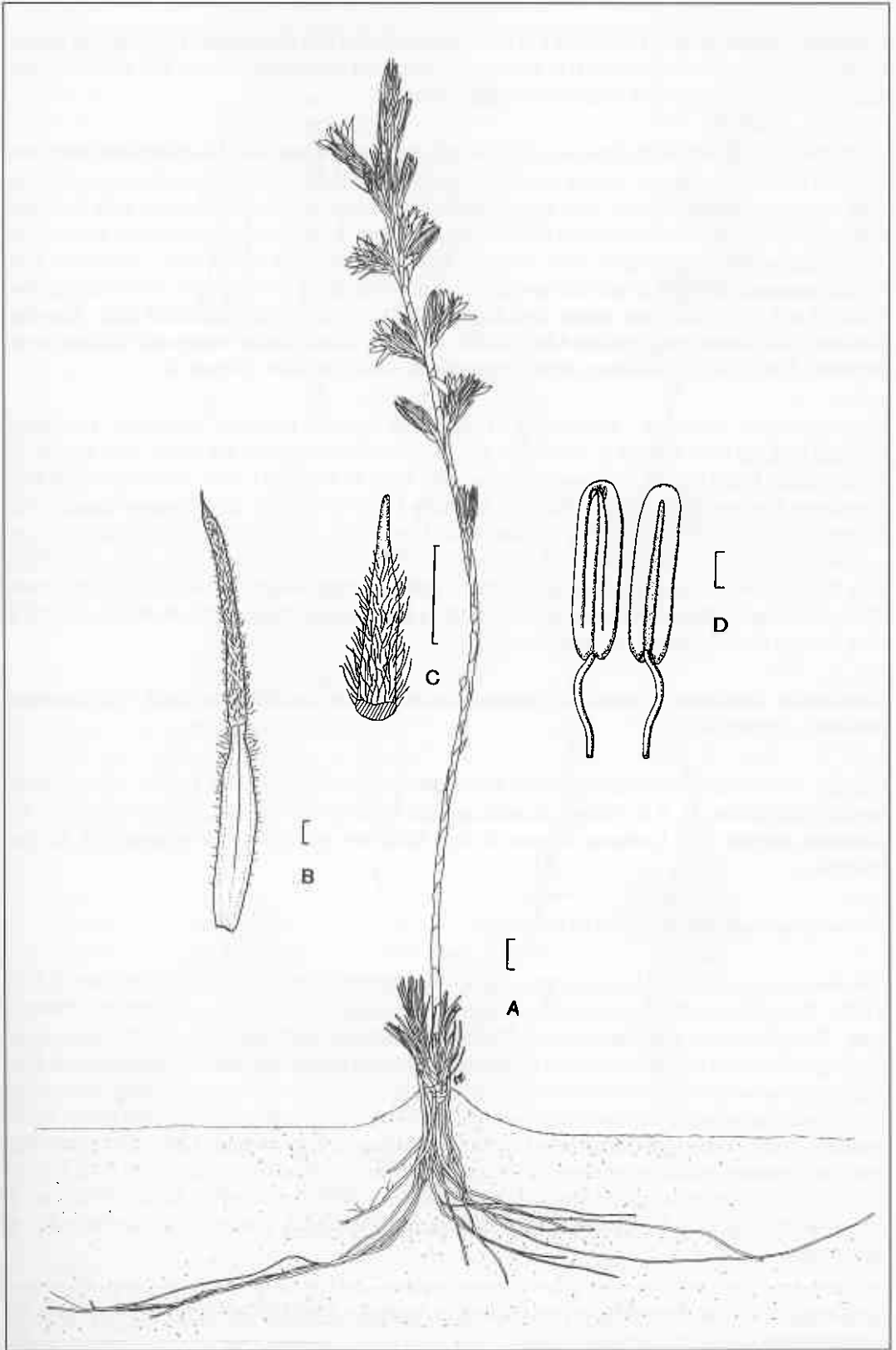


Figure 4. *Calectasia browneana* A - habit; B - leaf; C - leaf apex; D - anther (adaxial side L, abaxial side R). Scale bars: A = 1 cm, B-D = 1 mm. Drawn from R.L. Barrett 1299.

Calectasia cyanea R. Br., Prodr. 264 (1810). *Type*: Princess Royal Harbour, King George Sound, Western Australia, December 1801, *R. Brown s.n.* [No. 5778 added later] (*lecto*: BM 00593503 *vide* Anway (1969); *isolecto*: BM 000593504, MEL 247846).

Undershrub, usually with stilt roots; rhizome absent. *Stems* to 40 cm, with few short lateral branches, crowded at the apex. *Leaves*: lamina 6.5–13.2 x 1.0–1.3 mm, glabrous, margins scabrous, apex acute with a pungent mucro 0.5–0.7 mm long; sheath with sparse branched trichomes with branched trichomes on margin. *Bracts* 6.8–7.5 x 1.6–2.3 mm, light green to pale brown, lamina apex and margins with branched trichomes, apex with vestigial leaf lamina 2.5–3.1 x 0.5 mm. *Perianth*: tube 6.5–8.0 mm long, pilose in lower half–two thirds; throat with tangle of short hairs; lobes chartaceous, 8.3–11.2 x 2.1–3.3 mm, apex acute, dark blue, fading to white, pilose on abaxial side. *Staminal filaments* 2.6–3.0 mm long. *Anthers* 4.9–5.2 x 0.9–1.2 mm, yellow, turning orange-red with age, pores terminal. *Style* 9.5–(12) mm long, exceeding anthers. *Seeds* not seen. (Figure 5)

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: Torndirrup National Park, 25 Nov. 1999, *R.L. Barrett, N. Bluethgen & K. Reifnath* 1376 (ALB, BM, CANB, K, KPBG, MEL, PERTH, UWA); Torndirrup National Park, 26 July 1991, *C.A. Hortin* 2/6 (PERTH); Torndirrup National Park, 1 Oct. 1986, *G.J. Keighery* 11733 (PERTH); King George Sound, 1836, *A. Macleays s.n.* (PERTH); Torndirrup National Park, 7 Aug. 1988, *P. Morris* Sp10TN1 (PERTH); Cape ... [?West Cape Howe], mid 1800's, *A.F. Oldfield s.n.* (MEL); south-west Australia, *Anon. s.n.* (MEL); King George Sound, 1 Aug. 1884, *Anon.* 47 (MEL); [?King George Sound], *Anon.* 1016 (ex Herb. Paris) (BM); King George Sound, 1880, *W. Webb s.n.* (MEL); King George Sound, 1888, *W. Webb s.n.* (MEL); King George Sound, 1891–2, *W. Webb s.n.* (MEL).

Distribution. Restricted to Torndirrup National Park and Albany region of the South West Botanical Province. (Figure 3A)

Habitat. Yellow sand over laterite in low heath with *Adenanthos cuneatus* Labill., *Allocasuarina humilis* (Otto & Dietr.) L.A.S. Johnson, *Banksia grandis* Willd. (dwarf variant), *Hakea prostrata* R. Br., *Jacksonia horrida* DC., *Lysinema ciliatum* R. Br., *Melaleuca* sp., *Petrophile squamata* R. Br. and Poaceae sp.

Flowering period. (July) August to December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. IUCN: VUD1. This species is only known from a small area from King George Sound and Torndirrup National Park. The only mature population seen (in Torndirrup National Park) consisted of only five tussocks totalling c. 30 ramets (where new shoots are produced from the base of the stem which may detach from the parent plant with time, the new shoot first producing its own stilt roots). Approximately 50 seedlings were found in an adjacent area burnt four years previously where all adult plants had been killed. These seedlings were c. 3 years old though only 3–6 cm tall. They require monitoring to determine percentage surviving to maturity and age of reproductive maturity. Many old collections give only King George Sound as the collection location. Much of this area has now been developed as the site of the City of Albany and for agriculture. Further surveys are urgently required to determine the current extent of this species.

Etymology. The specific epithet is from the Latin – *cyaneus*, meaning dark blue, in reference to the flower colour.

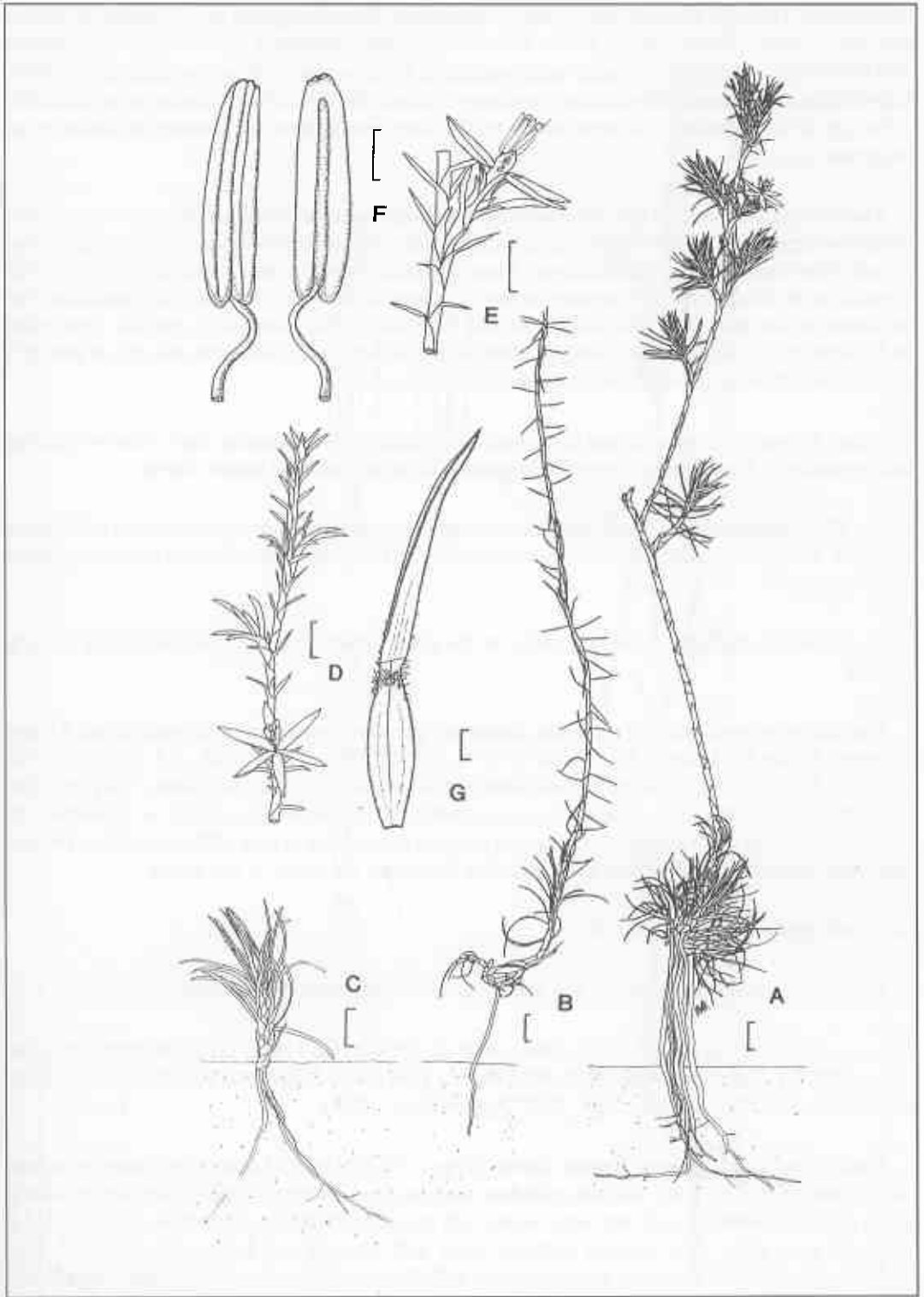


Figure 5. *Calectasia cyanea* A,B - habit; C - seedling (3 yrs); D - young branchlet; E - flower; F - anther (adaxial side L, abaxial side R); G - leaf. Scale bars: A-E = 1 cm, F, G = 1 mm. Drawn from R.L. Barrett et al. 1376.

Typification. Two type sheets at BM contain 12 specimens, representing two taxa collected by several botanists. Anway (1969) selected Robert Brown's collection 'Bennett's No. 5778' as the lectotype (BM 00593503). This sheet includes eight specimens, which appear to show two different variants. Examination of specimens in the field at Torndirrup National Park found this variation to be an artefact of the age of the branches. All eight pieces on this sheet are accepted as forming the lectotype as designated by Anway.

The second sheet contains four specimens representing four separate collections and two taxa. The central specimen (BM 000593504) is the only element that can be considered part of the original type set and is here regarded as an isolectotype. A second specimen of *C. cyanea* (BM 000593507) is not regarded as an isolectotype as it appears to have not been collected by Brown. The remaining two specimens on the same sheet (BM 000593505 and BM 000593506) belong to *C. gracilis*. Specimens on the sheet MEL 247846 match the type sheet well and there is no indication that this is part of a separate collection so it should be regarded an isolectotype.

Affinities. Closest to *C. gracilis* and *C. pignattiana*, differing in its clumping habit (due to vigorous basal sprouting). It also differs from *C. pignattiana* in its non-reflexed mature leaves.

Notes. This species has previously been considered to be widespread in the south-west of Western Australia. Many publications include illustrations labelled *C. cyanea*, most of which are now regarded as *C. narragara*.

C. cyanea has the latest flowering period in the genus, predominantly from late spring to early summer.

The following specimen is of uncertain placement: gravel reserve corner Rockwell Rd and Albany Highway, 45 km N of Mount Barker, 34°16'57"S, 117°49'28"E, 7 Sep. 1986, *E.J. Croxford* 4592 (ALB *n.v.*, PERTH). This location has been searched twice without finding any plants. Only branches were collected and the rooting habit was not recorded. This specimen is similar in appearance to *C. cyanea* however it is well outside the known range of this species in very different habitat. Further specimens including rooting habit are required to determine the status of this taxon.

Calectasia gracilis* Keighery, *sp. nov.

Calectasiae pignattianae affinis sed habito parviore, foliis junioribus adpressis differt.

Typus: c. 7 km N of Cape Riche on Sandalwood Road, 34°34'52"S, 118°43'08"E, Western Australia, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1344 (*holo:* PERTH 05542448; *iso:* AD, ALB, BM, CANB, K, KPBG, L, MEL, NSW, PERTH 05542456, UWA).

Undershrub with stilt roots; rhizome absent. *Stems* to 30(45) cm, with many short lateral branches. *Leaves:* lamina 5.4–7.2 x 0.5–0.6 mm, glabrous, margins finely scabrous; apex acute-obtuse usually with a pungent mucro 0.2–0.5 mm long; sheath with branched trichomes on margin. *Bracts* 6.2–7.5 x 1.8–1.9 mm, white, thin, margins glabrous, apex with vestigial leaf lamina 1.6–1.8 x 0.5 mm. *Perianth:* tube 5.7–6.9 mm long, pilose in lower half; throat with tangle of short hairs, lobes thinly coriaceous, 8.1–9.5 x 2.0–2.8 mm, apex acuminate, blue, fading to pale blue, pilose on abaxial side. *Staminal filaments* 1.9–2.2 mm long. *Anthers* 5.0–5.4 x 1.2–1.4 mm, yellow, turning orange-red with age, pores below apex. *Style* 6.2–7.2 mm long, exceeding anthers. *Seeds* not seen. $2n = 18$ (Anway 257) *vide* Anway (1969). (Figure 6)

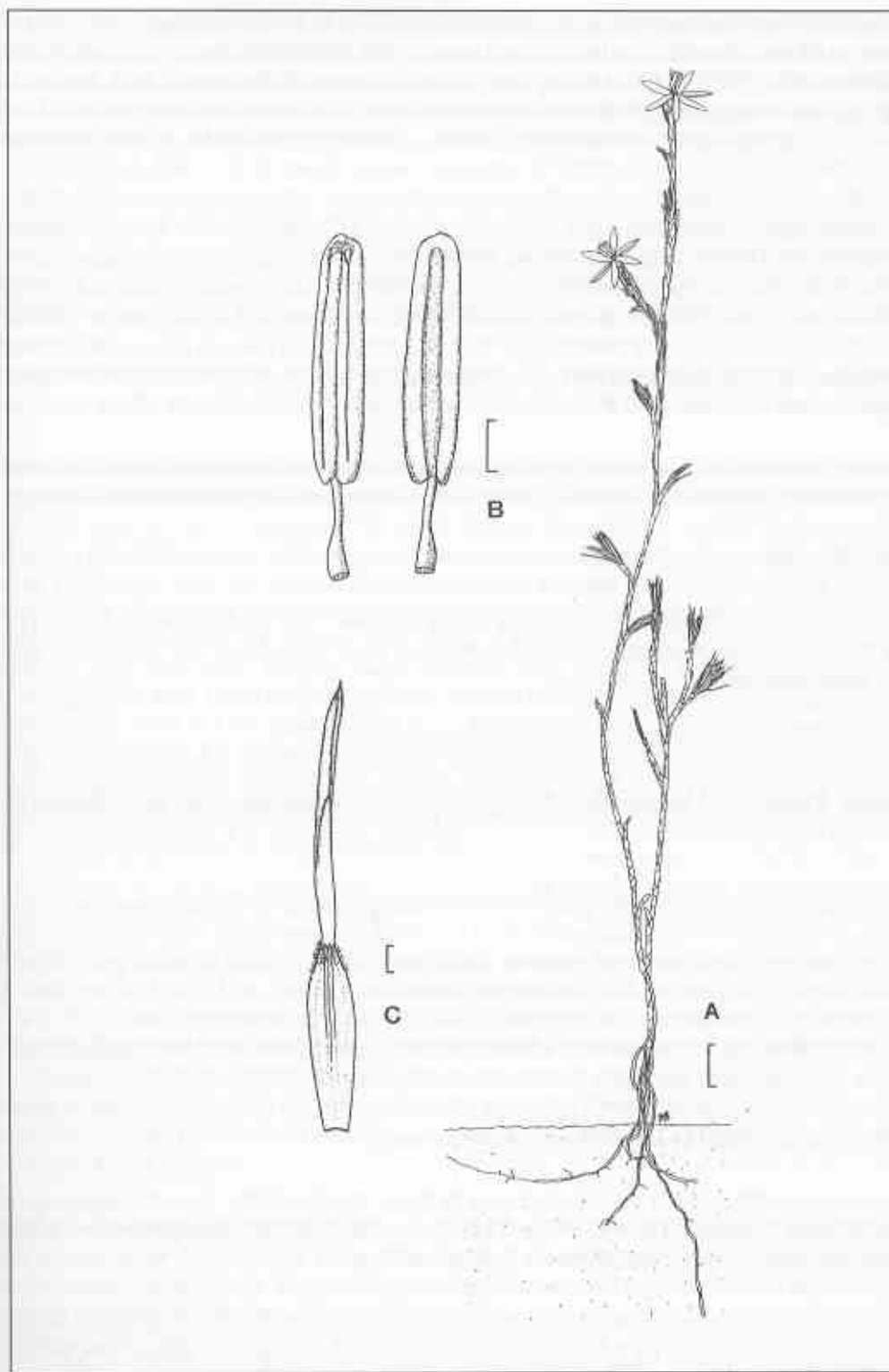


Figure 6. *Calectasia gracilis* A - habit; B - anther (adaxial side L, abaxial side R); C - leaf. Scale bars: A = 1 cm, B, C = 1 mm. Drawn from R.L. Barrett *et al.* 1343.

Selected specimens examined (12 of 36). WESTERN AUSTRALIA: 37 mile peg [c. 59.5 km] from Albany on Chester Pass Rd, 23 Aug. 1965, *J.C. Anway* 257 (PERTH); between road and Wellstead Roadhouse, 34°29'37"S, 118°36'18"E, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1343 (KPBG); King George Sound, ?*R. Brown* s.n. (ex [herb] Bauer) (BM); 4 km N of Hopetoun, 33°54'54"S, 120°08'25"E, 8 May 1996, *R. Davis* RD 687 (PERTH); 37 mile peg [59.5 km N], Albany-Borden road, 12 Aug. 1964, *A.S. George* 6397 (PERTH); Quaalup, Gairdner River, 28 Oct. 1965, *A.S. George* 6951 (PERTH); 6.5 km S of Salt River Rd on Red Gum Pass Rd, 24 Oct. 1993, *A.S. George* 17153 (PERTH); near Mount Bland, south Coast, 3 Oct. 1970, *B.R. Maslin* 1035 (PERTH); Blackwood River, 1883, *M. McHard*, s.n. (MEL); base of the Stirling Ranges, Oct. 1867, *F. Mueller* s.n. (MEL); 15.5 miles [25 km] W of Ongerup, 22 Aug. 1962, *K. Newbey* 355 (PERTH); 1.7 km S of Mt Gibbs, c. 34 km ENE of Lake King, 10 Aug. 1979, *K. Newbey* 5482 (PERTH); Bremer Bay, 1900, *J. Wellstead* s.n. (PERTH).

Distribution. From Albany and Stirling Range National Park east to Hopetoun with an early record apparently from the Blackwood River, South West Botanical Province. (Figure 3B)

Habitat. Quartzite sands, in mallee woodland or heath, often over laterite or granite. Recorded in association with *Banksia* sp., *Darwinia vestita* (Endl.) Benth. and *Eucalyptus redunca* Schauer.

Flowering period. May to October.

Conservation status. Scattered in the Stirling Range National Park, Fitzgerald River National Park, Cape Riche, and extending east to Frank Hann National Park. Uncommon, but widespread and not under immediate threat.

Etymology. The specific epithet – *gracilis* (Latin) means slender.

Affinities. Closest to *C. pignattiana* differing principally in having appressed rather than reflexed leaves and a smaller stature.

Notes. The common name of Graceful Tinsel Lily is suggested for this species.

There are two collections which appear to fit *C. gracilis*, however their locations are well outside the known range of any modern collections (Murchison's River, c. 1853, *J. Drummond* 446 (BM 000593505 (labelled only 'W. Australia'), MEL 2064143) & Greenough Flats, [1874], *C. Gray* s.n. (MEL 2064153)). It is uncertain whether these collections have been incorrectly labelled or whether *C. gracilis* may have once had a wider distribution including the northern kwongan.

This species is killed by fire (G. Keighery pers. comm.).

Calectasia grandiflora Preiss in J.G.C. Lehmann, Pl. Preiss. 2(1): 53 (1846). *Type:* Darling Range, near Perth, Western Australia, 1839, *L. Preiss* 1975 (*lecto:* MEL 247847, here designated; *isolecto:* L 0109478, MEL 247848, ?MEL 2064111 *p.p.* (see below)).

Undershrub without stilt roots, rhizome short, clonal. *Stems* to 65 cm, with many lateral branches. *Leaf lamina* 5.2–16.5 x 0.4–1.2 mm, glabrous or with branched trichomes on abaxial side, becoming glabrous, margins finely scabrous; apex acute with a pungent mucro 0.3–0.6 mm long; sheath with branched trichomes on margin, otherwise glabrous. *Bracts* papery-thickened with a pale brown apex, outer bracts brown to reddish brown, 9.6–11.2 x 1.3–2.4 mm, apex sometimes with vestigial leaf lamina

1.5–2.5 x 0.4–0.5 mm, margins pilose or with branched trichomes. *Perianth* tube 9.4–12.3 mm long, pilose in lower fifth to third; throat with tangle of short barbed hairs, lobes thinly coriaceous, 11.9–21.5 x 2.6–4.7 mm, apex acute to acuminate, blue, becoming red, pilose on abaxial side. *Staminal filaments* 2.7–4.2 mm long. *Anthers* 3.5–6.7 x 0.7–1.5 mm, yellow, not turning orange-red with age, pores terminal. *Style* 11.2–14.2 mm long, exceeding anthers. *Seeds* not seen. (Figures 7,8)

Specimens examined (type variant). WESTERN AUSTRALIA: Wilson Street in old dump area, Armadale, 32°09'29"S, 116°00'48"E, 14 Aug. 1965, *J.C. Anway* 224 (PERTH); Mundijong Rd, 1 km E of intersection with Kargotich Rd, 16 Dec. 1999, *R.L. Barrett & K.W. Dixon* 1379 (KPBG); Mundijong Rd, 200 m E of intersection with Kargotich Rd, 32°17'46"S, 115°57'21"E, 6 Nov. 1997, *R. Davis* 4461 (PERTH); 1 km N of Serpentine, 32°21'27"S, 115°58'23"E, 18 Sep. 1982, *G.J. Keighery* 5242 (PERTH); Brixton Rd [Street], Beckenham, 32°01'18"S, 115°58'00"E, 23 Sep. 1983, *G.J. Keighery* 6282 (CANB, K, PERTH); Swan River, 1850's, *W. Mylne s.n.* [7832] (MEL, PERTH); Around Perth, 1839, *J.A.L. Preiss* 1974B (MEL).

Selected specimens examined (south coast variant) (10 of 55). WESTERN AUSTRALIA: junction of Rocky Crossing Rd and Willying Rd, N of Albany, 35°03'S, 117°54'E, 30 Nov. 1965, *J.C. Anway* 253 (PERTH); slope of hill (N facing) on W side of Bremer Bay, 34°23'S, 119°23'E, 25 Aug. 1965, *J.C. Anway* 280 (PERTH); SW of Wellstead, 1.1 km W on Mettler Rd from Sandlewood Rd, 34°32'28"S, 118°38'12"E, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1348 (AD, BM, CANB, KPBG, L, MEL, PERTH, UWA); 0.8 km into Stirling Range National Park on Chester Pass Road, 34°28'06"S, 118°03'48"E, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1351 (ALB, K, KPBG, NSW, PERTH); Red Gum Pass, Stirling Range National Park, 34°22'S, 117°48'E, 15 Sep. 1965, *A.C. Beauglehole* ACB 12945 (CANB, PERTH); Hunton Rd, off Nanarup Rd, E of Albany, 34°56'S, 118°00'E, 1 Sep. 1984, *E.J. Croxford* 3593 (ALB n.v., PERTH); Mt Josephine, Stirling Ranges, 34°20'S, 117°43'E, 9 Oct. 1962, *A.R. Fairall* 485 (KPBG, PERTH); Surrey Downs Rd, Porongurup, 1 km S of rubbish dump, 1 Oct. 1999, *J. Hartley s.n.* (KPBG, PERTH); Mount Barker Hill, 34°39'S, 117°38'E, 1 Nov. 1995, *T.R. Lally* 850 (PERTH); Tick Flat, Two Peoples Bay Nature Reserve, 35°00'S, 118°11'E, 5 Oct. 1972, *G.T. Smith & L.A. Moore s.n.* (PERTH).

Selected specimens examined (wheatbelt variant) (8 of 76). WESTERN AUSTRALIA: sources of the Blackwood River, 1889, [*M. Cronin, s.n.*] (MEL); 2 km S of Mogumber, 31°10'S, 116°04'E, 26 Aug. 1979, *M. Fagg* 1039 (CANB); Rabbit-proof fence towards Starvation Boat Harbour, 33°54'S, 120°34'E, 15 Aug. 1965, *C.A. Gardner* 16152 (PERTH); 9 km E of Lake King along Rd to Kumarl, 34°04'14"S, 119°46'23"E, 13 Oct. 1991, *W. Greuter* 22786 (PERTH); 24 miles [38.5 km] from Kalbarri on track to gorge, 27°45'S, 114°20'E, 5 Sep. 1963, *A.R. Fairall* 1239 (KPBG); 20 km E of Lake Varley, 32°41'S, 119°35'E, 11 Oct. 1977, *G.J. Keighery* 1090 (KPBG, PERTH); Esperance Bay district, Neridup, c. 3 km NE of Howick Hill, in Location 251, 33°35'S, 122°44'E, 21 Sep. 1968, *A.E. Orchard* 1110 (AD n.v., PERTH); Charles Gardner Reserve, Tammin, 31°38'41"S, 117°28'54"E, 20 July 1993, *L. Sweedman* 2641 (KPBG).

Distribution. Widespread in the South West Botanical Province. The type variant is restricted to the Perth Region on the Swan Coastal Plain. The wheatbelt variant occurs from Dumbleyung north to Kalbarri and east to Esperance. The south coast variant occurs from Denmark, east to Fitzgerald River and north to the Stirling Ranges. (Figure 3C)

Habitat. On the Swan Coastal Plain, recorded as growing in swampy areas in low scrub-heath with *Calectasia narragara*, *Hakea prostrata*, *Philothea spicata* (A. Rich) Paul G. Wilson and *Viminaria*

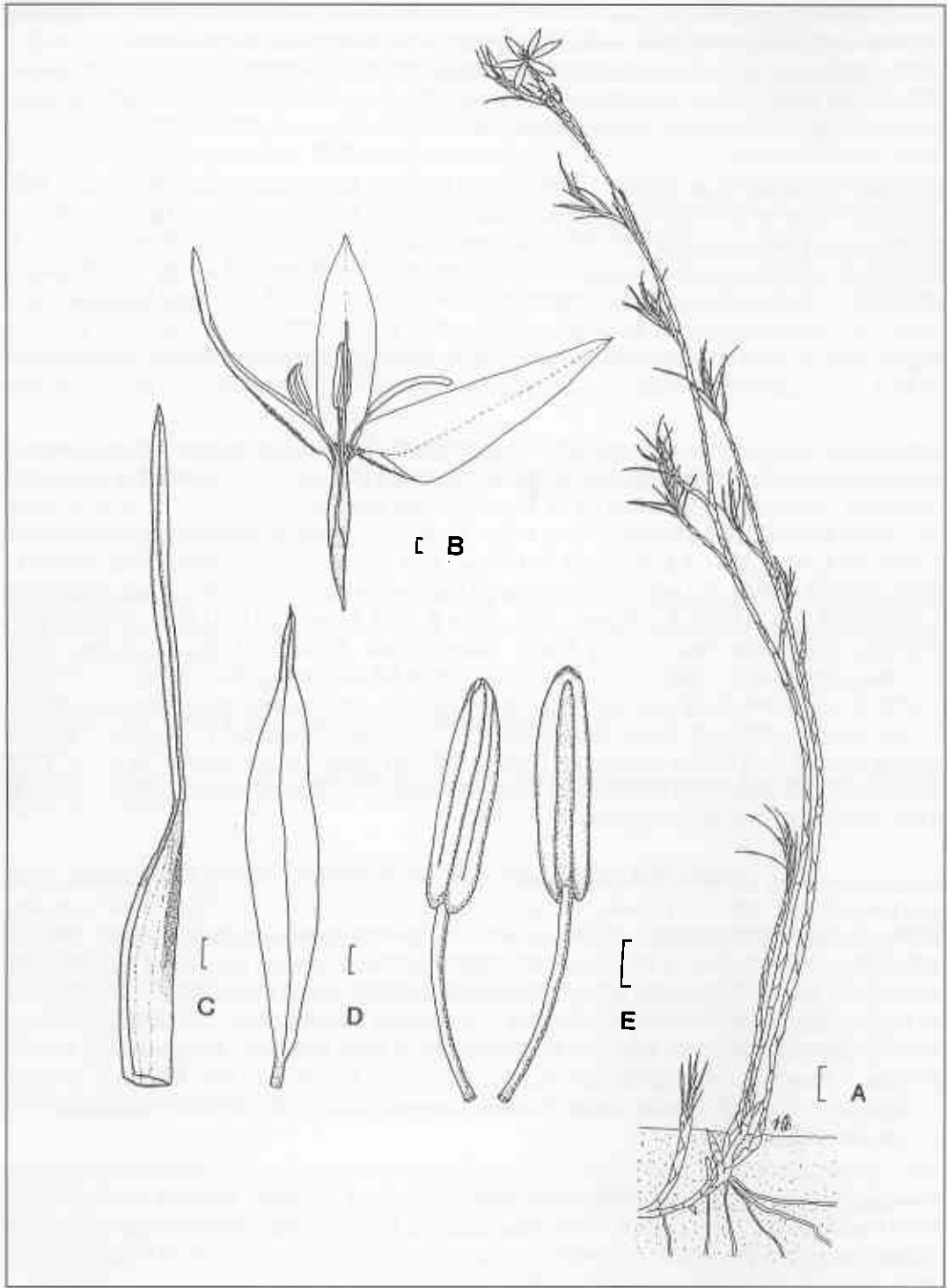


Figure 7. *Calectasia grandiflora* (type variant) A - habit; B - flower (cross-section); C - leaf; D - bract; E - anther (adaxial side L, abaxial side R). Scale bars: A = 1 cm, B-E = 1 mm. A drawn from *R.L. Barrett & K.W. Dixon* 1379, B-E from *G.J. Keighery* 6282.

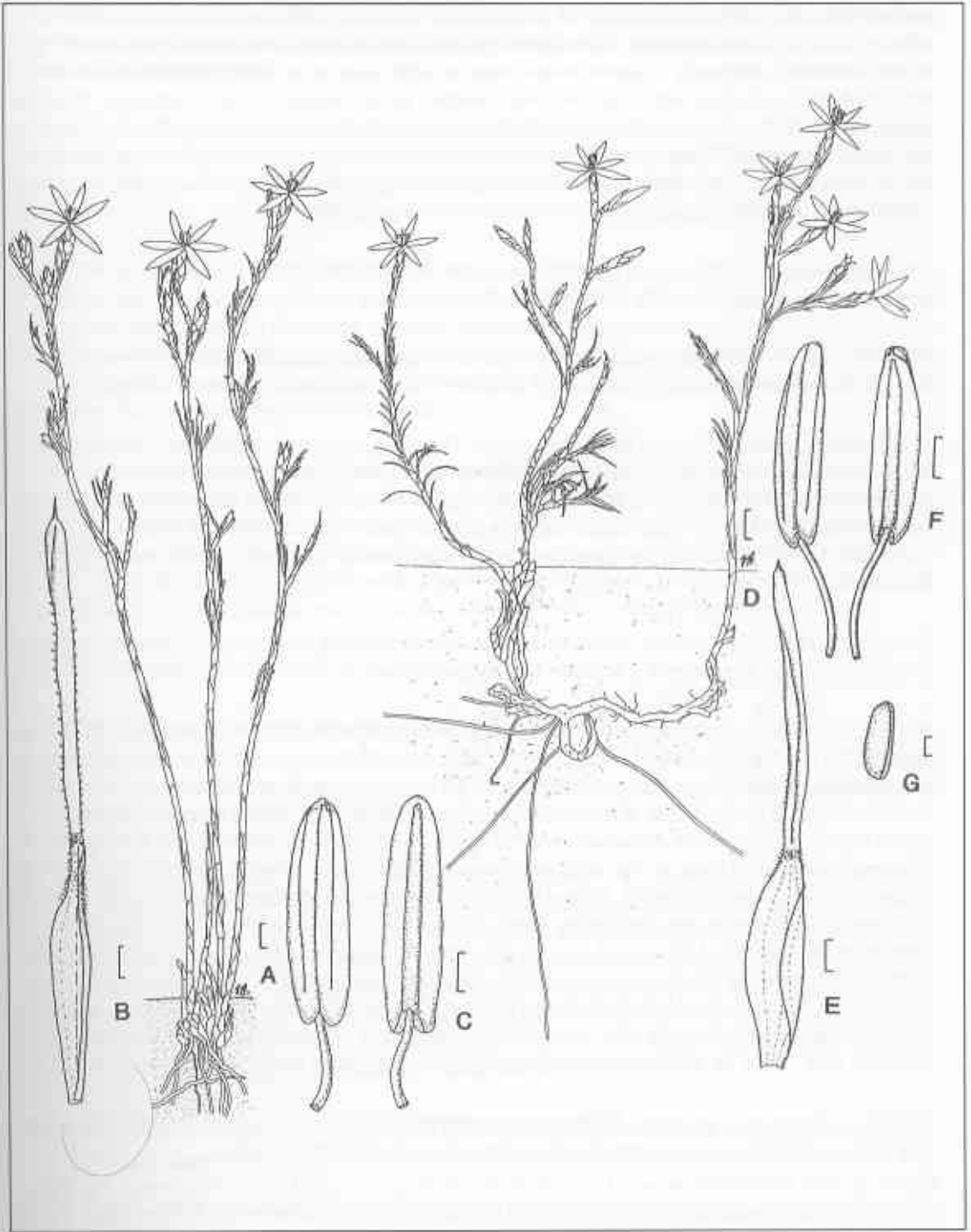


Figure 8. *Calectasia grandiflora* (wheatbelt variant) A - habit; B - leaf; C - anther (adaxial side L, abaxial side R); (south coast variant) D - habit; E - leaf; F - anther (adaxial side L, abaxial side R); G - pollen grain. Scale bars: A, D = 1 cm, B, C, E, F = 1 mm, G = 1 µm. A drawn from J. Drummond 779, MEL 2064044; B drawn from R.L. Barrett 1333 (KPBG); C drawn from M. Fagg 1039; D-G drawn from R.L. Barrett et al. 1351.

juncea (Schrader & Wendl.) Hoffsgg. In south coastal regions, in sparse woodland or heath on sand with *Agonis* sp., *Allocasuarina* sp., *Eucalyptus* spp., and *Kingia australis*, often near granite outcrops. In the wheatbelt, commonly in shrub mallee heath on white sand or in Eucalypt woodland on loam. Recorded in association with *Allocasuarina pinaster* (C.A. Gardner) L.A.S. Johnson, *Banksia sphaerocarpa* R. Br., *Beaufortia bracteosa* Diels, *B. micrantha* Schauer, *Callitris roei* (Endl.) F. Muell., *Calytrix leschenaultii* (Schauer) Benth., *Dryandra erythrocephala* C.A. Gardner, *Eremaea pauciflora* (Endl.) Druce, *Eucalyptus albida* Maiden & Blakely, *E. tetragona* (R. Br.) F. Muell., *Grevillea cagiana* McGillivray, *Melaleuca pungens* Schauer and *Petrophile ericifolia* R. Br.

Flowering period. (July) August to September in the Perth region, July to October in the wheatbelt and October to November south of the Stirling Ranges.

Cytology. $2n = 18$ for south coast variant (voucher: *J.C. Anway* 253) recorded by Anway (1969). $2n = 36$ for wheatbelt variant (voucher: *G.J. Keighery* 1090) recorded by Keighery (1984).

Conservation status. Not under immediate threat. The two non-typical variants are widespread and locally abundant. The typical variant is only known from swampy areas on the Swan Coastal Plain, mostly in reserves within the Perth Metropolitan Region. Further research is required to determine whether this taxon has a broader range than is indicated here. A specimen from Collie (*S. Saunders s.n.* [ACB 38495] (PERTH)) has tentatively been determined as the Type Variant pending further fieldwork.

Etymology. The specific epithet is from the Latin – *grandis* meaning great and – *floris* meaning flower in reference to the large flower size relative to *C. narragara*.

Typification. Three sheets have been found which belong to Preiss' original collection (L 0109478, MEL 247847 and MEL 247848). George (1986) cited the two MEL sheets as isotypes without referring to a holotype or specifying lectotype. MEL 247847 is in the best condition and bears a label with the number '1975' in Preiss' hand. It is here designated as lectotype. L 0109478 bears an identical label and is here considered to be an isolectotype. MEL 247848 bears a similar label in a different hand. The specimens match those on the other two sheets and it is also accepted as an isolectotype. None of the sheets bears any locality data. Preiss (1846) cites the collection location for Herb. Preiss No. 1975 as being in swampy areas near the Darling Range, Perth, 1839. There is another sheet (MEL 2064111) labelled as 'Herb. Preiss 1974' which is a mix of *C. grandiflora* and *C. narragara*. The top centre and bottom left specimens belong to *C. grandiflora* while the remainder are *C. narragara*. There are a further three duplicate sheets of 'Herb. Preiss 1974' at MEL, all of which are *C. narragara*. It is quite possible that the two elements of *C. grandiflora* were part of 'Herb. Preiss 1975' and mistakenly mounted with '1974' in which case they may be regarded as a third isolectotype.

Affinities. Closest to *C. palustris*, differing principally in having a short clumping rhizome rather than stilt roots and similar to *C. intermedia* which has a long decumbent rhizome.

Notes. Commonly called the Blue Tinsel Lily, it is suggested that it should be called the Large-flowered Tinsel Lily to distinguish it from *C. cyanea*. The specimen *Cronin s.n.* has only three perianth lobes per flower though it is otherwise normal.

Three variants appear to be recognizable based on habit and minor floral characters, however further research is required before formal recognition can be made. Polyploidy may have played a role in the

diversification of the *C. grandiflora* complex (G. Keighery pers. comm.). It is interesting to note that the limited cytological work conducted suggests that the south coast variant is diploid and the wheatbelt variant tetraploid.

The type variant occurs only on the Swan Coastal Plain (restricted to small reserves) and has a low clumping habit. The wheatbelt variant is very robust with a compact erect habit. The south coast variant is slender with a low semi-clumping habit, a 'looping' rhizome producing clones at short intervals and very narrow leaves. The wheatbelt variant has a broader, more rounded leaf lamina than the other two variants.

Habit and rhizome structure are the most easily recognizable differences but these are rarely adequately documented on herbarium vouchers and there is insufficient knowledge to determine the boundaries of variation and integration between variants. Plant age is a significant determinant of gross morphology (habit and leaf density), further confusing the situation. Resprouting from a rhizome following fire has been observed for all variants.

Chapman (1991) cites a name '*Calectasia grandiflora* Preiss ex Sonder, *Linnaea* 28: 222 (1856)' [1857]. Preiss (1846) is not cited after the name in the description given by Sonder (1857) although a citation is given for *C. cyanea*. No specimens are cited for *C. grandiflora*, and Chapman gives this name as '*nom. illeg.*' Preiss (1846) is cited in the generic description with direct reference to *C. grandiflora* and the later omission is seen as an oversight. There is no indication that Sonder intended to establish a new name and he was obviously aware of Preiss' earlier publication.

Calectasia hispida* R.L. Barrett & K.W. Dixon, *sp. nov.

Species insignis rhizomate breve et foliis hispidis.

Typus: 28.8 km N of Watheroo Rd on Coalara Rd, Watheroo National Park, Western Australia, 3 July 1999, R.L. Barrett 1295 (*holo*: PERTH 05542472; *iso*: BM, CANB, MEL).

Undershrub without stilt roots, rhizome short, clonal. *Stems* 9–45 cm, with many very short lateral branches. *Leaf lamina* 3.9–10.3 x 0.4–0.7 mm, hispid, margins scabrous; apex acuminate with a pungent mucro 0.4–0.7 mm long; sheath with branched trichomes on margin. *Bracts* 9.5–9.8 x 2.0–2.9 mm, white at base, thin, brown at apex, apex acuminate, margins glabrous. *Perianth tube* 6.8–9.0 mm long, pilose in lower half; throat glabrous, lobes chartaceous, 5.7–12.2 x 2.1–3.5 mm, apex acute, blue, fading to pale blue, pilose on abaxial side. *Staminal filaments* 2.7–3.9 mm long. *Anthers* 3.9–4.7 x 0.9–1.1 mm, apex incurved, yellow, turning orange-red with age, pores below apex-terminal. *Style* 9.0–10.0 mm long, exceeding anthers. *Seeds* not seen. (Figure 9)

Selected specimens examined (10 of 19). WESTERN AUSTRALIA: between road and railway, c. half way between Dongara and Mingenew on Geraldton [Brand] Highway, 29°13'S, 115°11'E, 21 July 1965, J.C. Anway 155 (PERTH); 1.2 km S of intersection of Coorow–Greenhead road on Brand Highway, 50 m NW of rest area, 30°04'11"S, 115°19'52"E, 3 July 1999, R.L. Barrett 1301 (PERTH); Melbourne Loc. 3555, 'Avena Vale', Boundary Rd, 12 km W of Koojan, on W side of property, 30°48'56"S, 115°53'44"S, 4 July 1999, R.L. Barrett 1305 (AD, ALB, BM, CANB, K, KPBG, MEL, NSW, PERTH, UWA); 10 miles [16 km] W of Three Springs, 18 Aug. 1968, J.S. Beard 167 (PERTH); Tomkins Rd, 16 km S from Mount Adams Rd intersection, 29°28'09"S, 115°17'42"E, 28 May 1997, R. Davis 3299 (PERTH); Murchison River, *s.d.*, J. Drummond 446 (MEL); 2 miles [3.2 km] along Burma Rd,

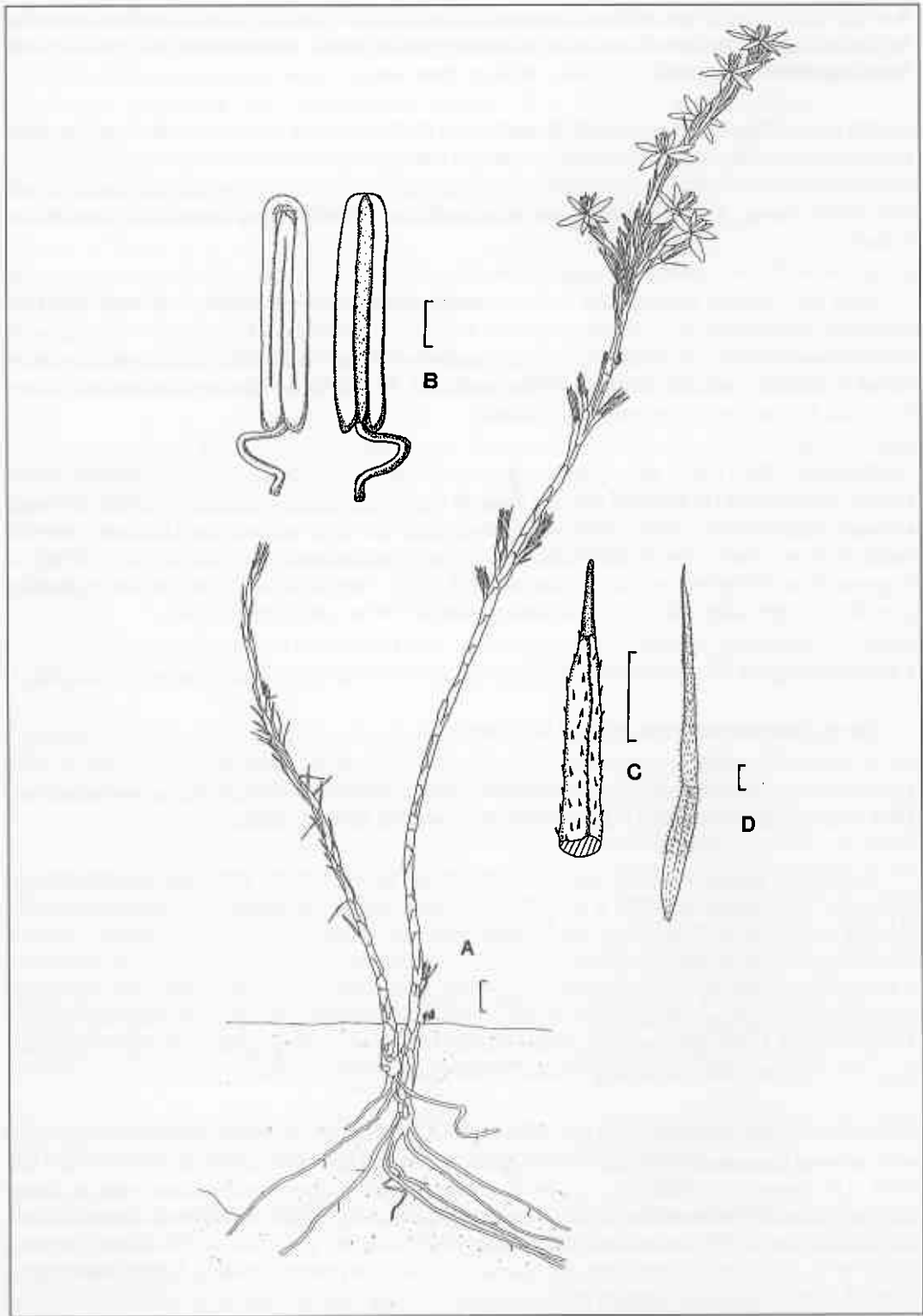


Figure 9. *Calectasia hispida* A - habit; B - anther (adaxial side L, abaxial side R); C - leaf apex; D - leaf. Scale bars: A = 1 cm, B-D = 1 mm. Drawn from R.L. Barrett 1305.

28°55'S, 114°45'E, 30 Aug. 1963, A.R. Fairall 1128 (KPBG); Greenough Flats, 1874, *C. Gray* s.n. (MEL); 10.3 km along Watheroo Rd from Watheroo, Watheroo National Park, 30°07'S, 115°52'E, 7 May 1984, G.J. Keighery 6856 (PERTH); Geraldton, 1889, H.A. Spalding s.n. (MEL).

Distribution. Relatively common between Gillingarra and Eneabba with an early collection from Kalbarri, in the South West Botanical Province. (Figure 3D)

Habitat. Usually in shallow white/grey sand over laterite on kwongan slopes, occasionally in deeper white sands on flats. Recorded in association with *Acacia pulchella* R. Br., *Banksia sphaerocarpa*, *Cyanostegia corifolia* Munir, *Dryandra lindleyana* Meisn., *Grevillea shuttleworthiana* subsp. *canarina* Olde & Marriott, *Hakea trifurcata* (Smith) R. Br., *Hibbertia huegellii* (Endl.) F. Muell., *Jacksonia restioides* Meisn., *Melaleuca* spp., *Pileanthus filifolius* Meisn., *Ricinocarpos glaucus* Endl., *Stachystemon brachyphyllus* Muell. Arg., *Stirlingia latifolia* (R. Br.) Steud., *Styloidium bulbiferum* Benth. and *Xanthorrhoea preissii* Endl.

Flowering period. May to September.

Conservation status. Not under threat. Common in Watheroo National Park and Alexander Morrison National Park.

Etymology. The specific epithet derived from the Latin – *hispidus*, referring to the hispid indumentum on the leaf lamina.

Affinities. Closest to *C. narragara* differing principally in the hispid leaf lamina and glabrous throat in the perianth.

Notes. The common name of Hispid Tinsel Lily is suggested for this species. Starch is found in the perennating buds also with substantial starch reserves scattered throughout the rhizome, often in multicellular lines. This species has been observed resprouting from a rhizome following fire.

Calectasia intermedia Sonder, *Linnaea* 28: 222 (1857). – *Calectasia cyanea* var. *intermedia* (Sonder) Anway, *Austral. J. Bot.* 17: 158 (1969). *Type:* between the Grampians and Victoria Range, Victoria, November 1853, F. Mueller (*holo:* MEL 247849).

Undershrub without stilt roots, rhizome decumbent, to 50 cm long, buried 7–10 cm deep. *Stems* to 65 cm, with many short lateral branches. *Leaves:* lamina 5.7–16.8 x 0.5–0.8 mm, glabrous, margins scabrous; apex acute with a pungent mucro 0.5–0.6 mm long; sheath with branched trichomes on margin and scattered on lamina. *Bracts* 12.3–13.5 x 2.2–2.8 mm, white at base, thin, brown at apex, pilose in upper third, margins glabrous, apex with vestigial leaf lamina 1.5–2.4 x 0.2–0.4 mm. *Perianth:* tube 10.5–11.6 mm long, golden pilose; throat with short scattered hairs, lobes chartaceous, 13.6–16.7 x 3.2–4.1 mm, apex acute, blue, not fading, pilose on abaxial side. *Staminal filaments* 1.2–1.4 mm long. *Anthers* 4.4–5.0 x 0.8–1.1 mm, yellow, turning yellow-brown, pores terminal. *Style* 7.8–8.5 mm long, exceeding anthers. *Seeds* not seen. $2n = 18$ (Anway 413) *vide* Anway (1969). (Figure 10)

Selected specimens examined (10 of 63). SOUTH AUSTRALIA: c. 18 miles [29 km] SW of Bool Lagoon, SW of Naracoorte, 13 Sep. 1965, J.C. Anway 369 (PERTH).

VICTORIA: junction of Roses Creek Rd and road from Zuinsteins to Halls Gap in the Grampians, 20 Sep. 1965, J.C. Anway 413 (PERTH); Portland, c. 3 miles [4.8 km] N of Greenwald, N side of Crawford

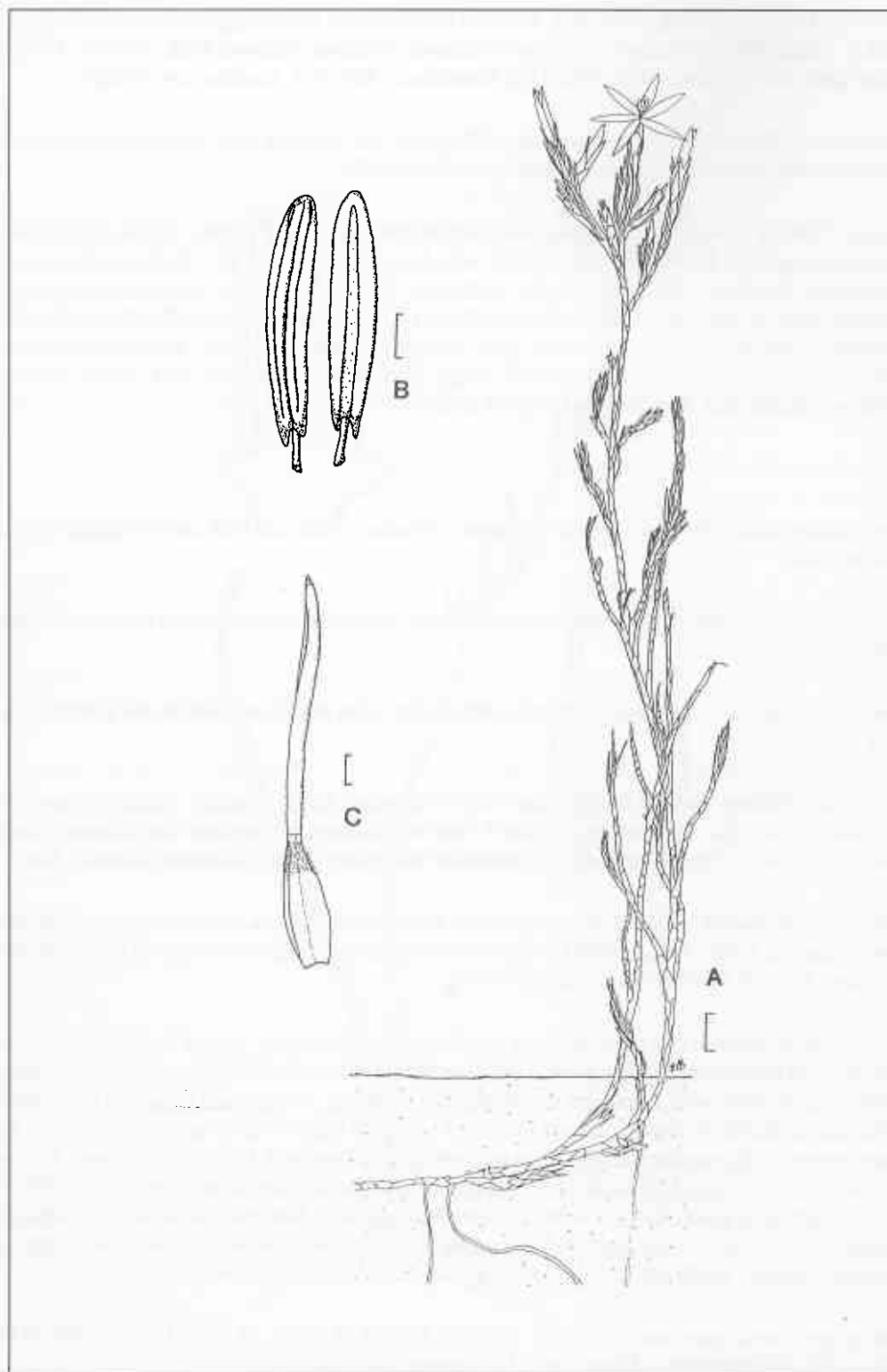


Figure 10. *Calectasia intermedia* A - habit; B - anther (adaxial side L, abaxial side R); C - leaf. Scale bars: A = 1 cm, B, C = 1 mm. A drawn from *unknown s.n.* (MEL 2064065); B, C drawn from *A.M. Lyne 484*.

River, 30 Oct. 1955, *A.C. Beauglehole & L. Aitken* ACB 19557 (PERTH); 0.5 miles [0.8 km] S of *Dicksonia* pocket of Little Moleside Creek, Lower Glenelg River, 9 Oct. 1965, *A.C. Beauglehole & J.C. Anway* 512 (PERTH); Grampians, Geerak track c. 0.5 km S of junction with Victoria Valley Rd, 37°24'S, 142°12'E, 22 Oct. 1978, *M.G. Corrick* 6105 (PERTH); "Little Desert", 5 miles [8 km] S of Kiata, Oct. 1965, *Hately & J.C. Anway* 511 (PERTH); The Grampians (Gariwerd) National Park, junction of Serra Rd and Henman Track, 37°20'56"S, 142°29'06"E, 6 Nov. 1991, *A.M. Lyne* 484 (CANB, HO n.v.); Grampians, on Siphon Rd, 0.5 km by road from Victoria Valley Airstrip, 37°11'24"S, 142°19'56"E, 30 Oct. 1998, *J. Mant & R. de Kok* 38 (CANB); Grampians, *Th. Müller* s.n. (L); towards Lake Bonney, 40 miles [64 km] from the coast, [34°13'S, 140°27'E], 1895, *F. Wehl*, s.n. (MEL).

Distribution. From Bordertown, eastern South Australia, east to the Grampians and Little Desert, southwestern Victoria. (Figure 3F)

Habitat. Open Eucalypt woodland on sandy soil in the Grampians, with *Acacia myrtifolia* (Sm.) Muhl. ex Willd., *Leptospermum myrtifolium* A. Cunn. ex DC., *Platylobium obtusangulum* Hook. and in heath in the Little Desert.

Flowering period. September to October.

Conservation status. Sporadic distribution due to clearing of habitat, apparently rare in sandy heaths in South Australia (Jessop & Toelken 1986) though this taxon is not considered to be at risk.

Etymology. The specific epithet is from the Latin – *intermedius*, coming between, referring to the apparent intermediate appearance of the species between *C. cyanea* and *C. grandiflora*.

Affinities. Thought to be closest to *C. keigheryi* and *C. grandiflora*, differing principally in having long decumbent rhizomes.

Notes. The common name of Eastern Tinsel Lily is suggested. Seeds apparently spindle-shaped, c. 5 mm long (Conn 1994):

Calectasia keigheryi R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae intermediae affinis sed antherae apice caudato, rhizomate brevi differt.

Typus: eastern edge of Fitzgerald River National Park [precise locality withheld], Western Australia, 11 January 1979, *B. Barnsley* 526 (*holo*: CANB 7900759).

Undershrub without stilt roots, rhizome short, clonal. **Stems** to 40 cm, with few short lateral branches. **Leaves:** lamina 6.8–12.3 x 0.5–0.8 mm, glabrous, margins finely scabrous; apex acute with a pungent mucro 0.5–0.9 mm long; sheath with branched trichomes on margin. **Bracts** 7.4–8.3 x 1.2–2.0 mm, straw-coloured, margins glabrous, apex with vestigial leaf lamina 1.0–1.8 x 0.7 mm. **Perianth:** tube 9.3–9.8 mm long, golden, white-golden pilose in lower third; throat glabrous, lobes thinly coriaceous, 8.1–12.5 x 1.3–2.1 mm, apex acuminate, blue, fading white, occasionally red, pilose on abaxial side. **Staminal filaments** 1.2–1.6 mm long. **Anthers** 4.5–5.7 x 0.8–0.9 mm, apex caudate, base constricted with a short skirt, yellow, not turning orange-red with age, pores terminal. **Style** 12.1–12.5 mm long, exceeding anthers. **Seeds** not seen. (Figure 11)

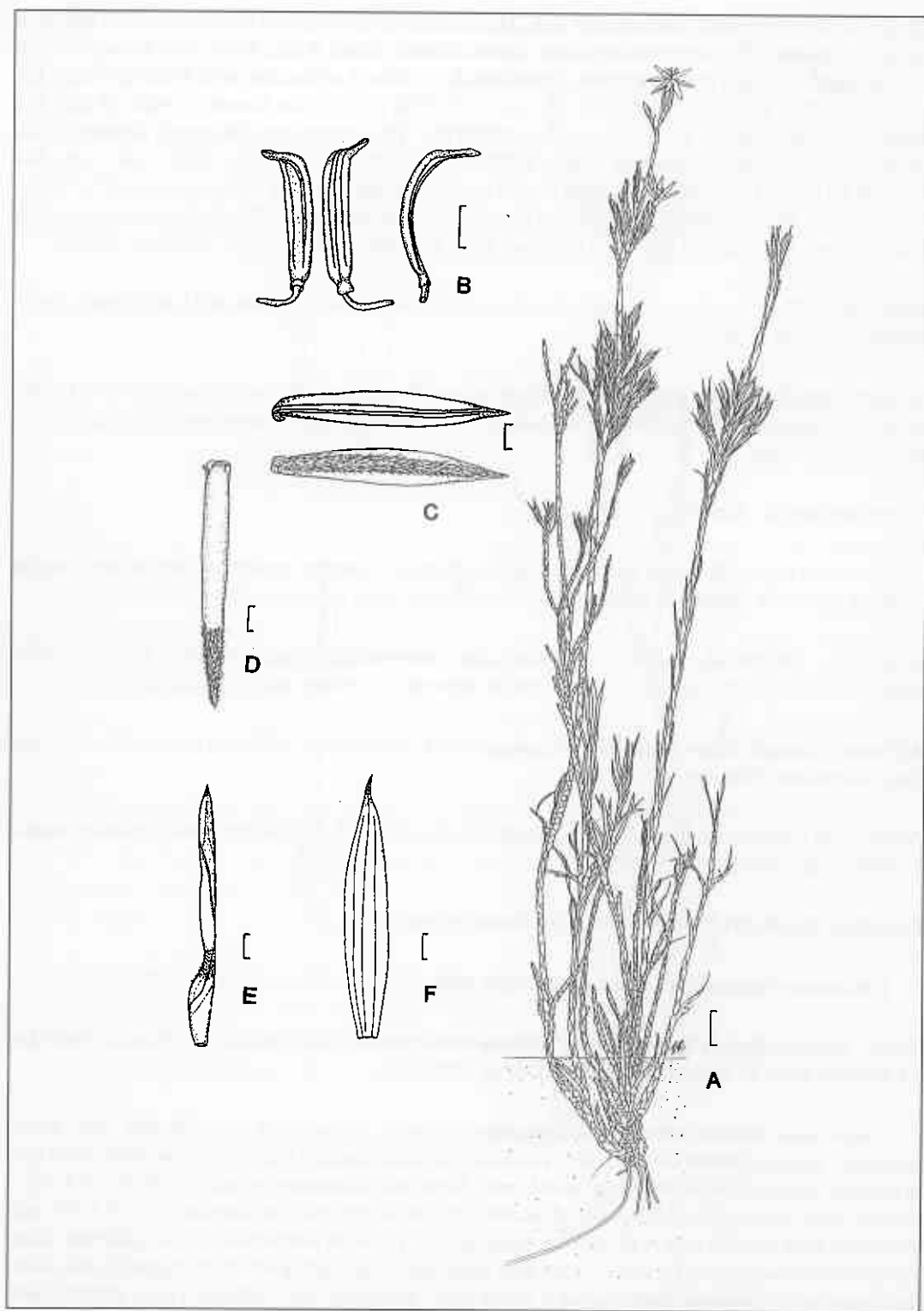


Figure 11. *Calectasia keigheryi* A - habit; B - anther (adaxial side T, abaxial side B, side view R); C - perianth lobes; (adaxial side T, abaxial side B); D - perianth tube; E - leaf; F - bract. Scale bars: A = 1 cm, B-F = 1 mm. Drawn from B. Barnsley 526.

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: near West Mount Barren, Sep. 1970, *T.E.H. Aplin* 3803 (PERTH); Near Mount Maxwell, 4 July 2000, *R.L. Barrett* 1384 (KPBG, MEL, PERTH, UWA); *loc. id.*, 19 July 1970, *K.R. Newbey* 3192 (ALB *n.v.*, photocopy PERTH).

Distribution. Known only from three locations in Fitzgerald River National Park, South West Botanical Province. (Figure 3D)

Habitat. In grey sand or shallow sandy loam over laterite, in low heath with *Banksia baueri* R. Br., *B. coccinea* R. Br., *Franklandia fucifolia* R. Br. and *Pimelea physodes* Hook.

Flowering period. July to September. Also recorded for January, but probably as the result of heavy summer rainfall.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. IUCN: VUD1. This species is known only from three locations in Fitzgerald River National Park. Collector's notes record abundance as occasional. Surveys are urgently required to determine distribution and abundance.

Etymology. The specific epithet honours botanist Greg Keighery who has made extensive contributions to the taxonomy, biology and conservation of the flora of Western Australia, including *Calectasia*.

Affinities. Closest to *C. intermedia*, differing in the shape of the anthers, a smaller perianth and compact rhizome. Similar in appearance to *C. gracilis*, a stilt-rooting species lacking a rhizome.

Notes. The common name of Keighery's Tinsel Lily is suggested for this species. *C. keigheryi* has been observed to resprout from its rhizome following fire.

This is a very distinctive species with an anther shape unique in the genus. Its small flowers and rhizomatous habit make it easy to differentiate from other species in the region. *C. keigheryi* has golden hairs on the base of the perianth tube, a character otherwise found only in *C. intermedia*.

Calectasia narragara R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae hispidae affinis sed foliis glabris differt.

Typus: Kings Park, near nature trail, 0.5 km W of Roe Memorial, 31°57'44"S, 115°49'59"E, Western Australia, 5 June 1999, *R.L. Barrett & K.W. Dixon* 1306 (*holo:* PERTH 05542618; *iso:* MEL).

Undershrub without stilt roots, rhizome short, clonal, roots clustered, wiry, sand binding. *Stems* to 50 cm, with many short lateral branches. *Leaves:* lamina 4.2–14.5 x 0.4–1.0 mm, glabrous, margins glabrous or scabrous (occasionally pilose), apex obtuse and with a pungent mucro 0.3–0.8 mm long; sheath with branched trichomes on margin. *Bracts* 10.7–12.2 x 1.4–2.1 mm, white at base, papery, brown median stripe in upper half, margins glabrous, apex without vestigial leaf lamina. *Perianth:* tube 8.9–10.2 mm long, pilose in lower half; throat glabrous, lobes chartaceous, 8.7–12.6 x 2.0–3.0 mm, apex acuminate, blue with bronze margins, fading to white, pilose on abaxial side. *Staminal filaments* 1.3–4.2 mm long. *Anthers* 5.1–8.3 x 0.6–1.3 mm, apex incurved, yellow, turning orange-red with age, pores below apex. *Style* 11.4–11.9 mm long, equal to or exceeding anthers. *Seeds* not seen. (Figure 12)

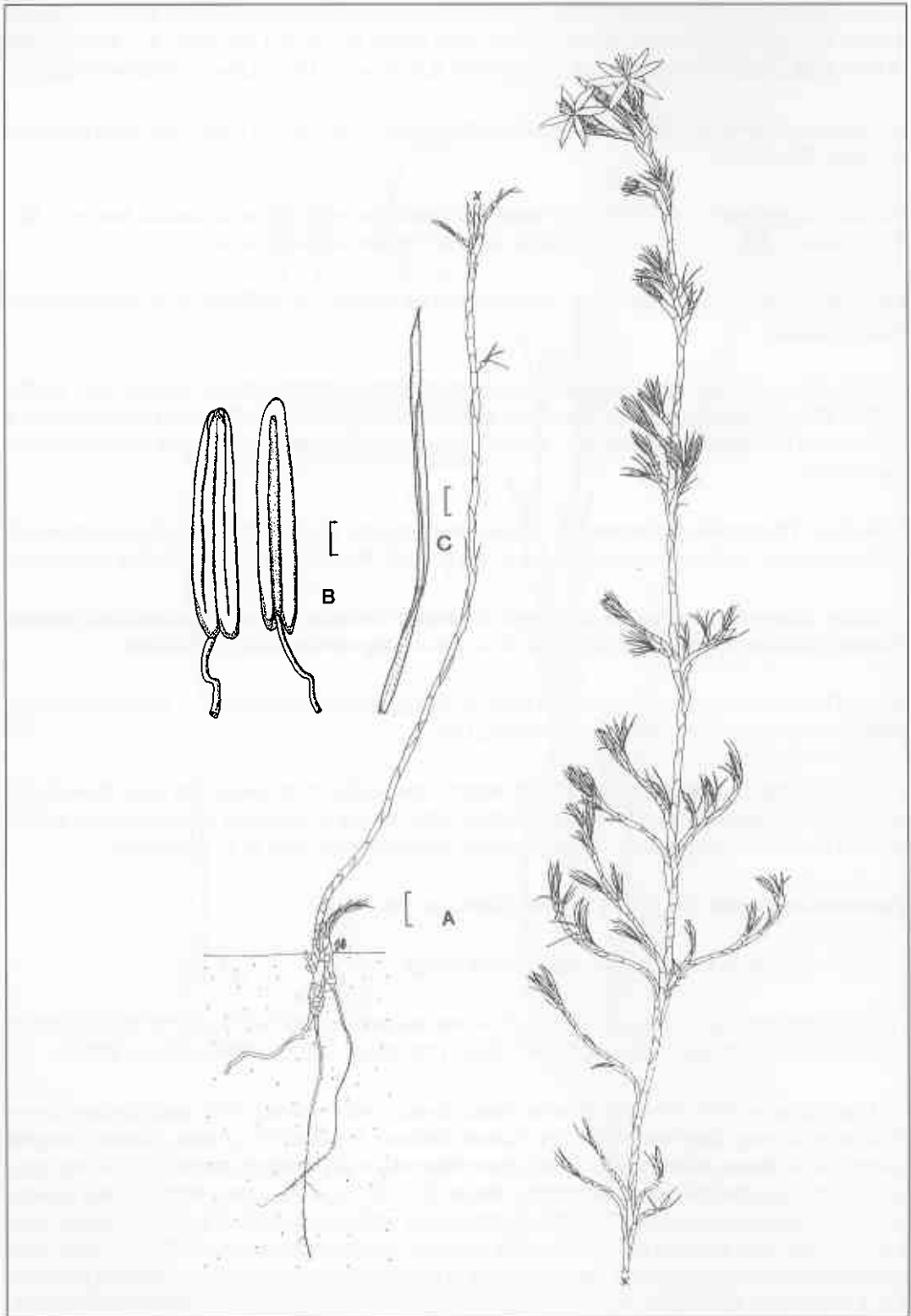


Figure 12. *Calectasia narragara* A - habit; B - anther (adaxial side L, abaxial side R); C - leaf. Scale bars: A = 1 cm, B, C = 1 mm. Drawn from R.L. Barrett & K.W. Dixon 1306.

Selected specimens examined (12 of 174). WESTERN AUSTRALIA: 13 miles [21 km] W of Watheroo on Badgingarra Rd, 20 feet from road, 30°18'S, 115°50'E, 18 July 1965, *J.C. Anway* 148 (PERTH); 6 miles E of Medina about 2 yards S of Highway, 32°14'S, 115°54'E, 5 Aug. 1965, *J.C. Anway* 206 (PERTH); Just off black top 5 miles W of North Dandalup on Mandalup Rd, 32°31'S, 115°53'E, 6 Aug. 1965, *J.C. Anway* 207 (PERTH); 1.7 miles S of Meelon, which is 7 miles SE of Pinjarra, 32°42'S, 115°56'E, 8 Aug. 1965, *J.C. Anway* 214 (PERTH); 1 mile E and 1 m S of Regan's Ford on Moore River on road to Mogumber, 30°59'S, 115°43'E, 12 Aug. 1965, *J.C. Anway* 217 (PERTH); 1.2 km S of intersection of Coorow Greenhead Rd on Brand Highway, 50 m NW of rest area, 30°04'11"S, 115°19'52"E, 3 July 1999, *R.L. Barrett* 1302 (PERTH); Port Augusta, near Geographe Bay, 1881, *D.R. Bunbury s.n.* (MEL); near Swan River, 1839, *J.A.L. Preiss* 1974 (MEL (4 sheets)); 39 km N of Cataby, Brand Highway N of Perth, 30°23'57"S, 115°32'59"E, 2 Sept. 1992, *P.J. Rudall* 37 (PERTH); 82.4 km N of Cataby, Brand Highway N of Perth, 30°04'19"S, 115°23'29"E, 2 Sept. 1992, *P.J. Rudall* 41 (PERTH); 3 km from Bolgart on Pitha Rd, 8 July 1999, *L. Sweedman & K.W. Dixon* 4952 (KPBG, PERTH); Gngangara, 31°47'S, 115°52'E, 25 June 1957, *C.L. Wilson* 770 (PERTH, UWA).

Distribution. Widespread within 80 km of the coast on the Swan Coastal Plain and Darling Scarp from Busselton north to Geraldton, in the South West Botanical Province. (Figure 3B)

Habitat. Occurring in a wide range of vegetation associations and habitats. In kwongan, recorded with *Allocasuarina humilis*, *Daviesia epiphyllum* Meisn., *Hakea conchifolia* Hook. and *Kingia australis*. In *Banksia attenuata*, *B. menziesii* R. Br. woodland with *Daviesia divaricata* Benth., *Eucalyptus todtiana* and *Hibbertia hypericoides* (DC.) Benth. In *Corymbia calophylla* (Lindl.) K.D. Hill & L.A.S. Johnson, *Eucalyptus marginata* Donn ex Sm. open woodland over *Acacia pulchella* R. Br., *Conostylis setigera* R. Br., *Hakea lissocarpha* R. Br., *Mesomelaena tetragona* (R. Br.) Benth. and *Xanthorrhoea preissii*. In *Allocasuarina* woodland, on white, grey or yellow sand, occasionally on laterite in shallow sand. Occasionally in swampy areas with *Calectasia grandiflora* and *Viminaria juncea*.

Flowering period. (February, March) June to September.

Cytology. $2n = 18$ (vouchers: *J.C. Anway* 206, 207, 214, 217), *fide* Anway (1969).

Conservation status. Common, not under threat.

Etymology. *Nar-rag-a-ra* is a composite Nyoongar Aboriginal name for a star (Bindon & Chadwick 1992), chosen for the common name of "Star of Bethlehem" which has often been applied to this species.

Affinities. Related to *C. hispida*, differing as stated under that species.

Notes. This species has been given the common name of "Star of Bethlehem" (often as *C. cyanea*). Starch is found scattered throughout the rhizome in multicellular lines and this species has been observed resprouting from the rhizome following fire.

Calectasia obtusa R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae gracilis affinis sed habito valido, antheris veteribus flavis differt.

Typus: Cape Riche, Western Australia, 24 August 1965, *J.C. Anway* 275 (*holo:* PERTH 01988727).

Undershrub with stilt roots 30–55 mm long; rhizome absent. *Stems* 8–50 cm, with several short lateral branches. *Leaves*: lamina 4.5–8.5 x 0.5–0.9 mm, often appressed to stem, glabrous, apex obtuse, mucro absent (rarely to 0.2 mm), margin with dendritic trichomes; leaf sheath almost glabrous-scattered with short dendritic trichomes, longer on margins. Apical lamina exceeding length of perianth tube by c. 1/2 their length. *Bracts* 9.3–10.9 x 1.3–1.6 mm, pale brown, thin, margins with dendritic trichomes, apex with vestigial leaf lamina 0.8–2.5 x 0.3–0.4 mm. *Perianth*: tube 7.7–8.8 mm long, pilose in lower third and upper one fifth; short tangled barbed hairs in throat, lobes thinly coriaceous, 10.6–13.1 x 3.2–3.5 mm, apex acuminate, margin blue, fading to pale blue, centre wine red, not fading, pilose on abaxial side. *Staminal filaments* 2.7–3.8 mm long. *Anthers* 4.0–4.7 x 1.2–1.3 mm, yellow, not turning orange-red with age, pores terminal. *Style* 9.5–10.8 mm long, exceeding anthers. *Seeds* not seen. (Figure 13)

Other specimens examined. WESTERN AUSTRALIA: c. 7 km N of Cape Riche on Sandalwood Road, 34°34'52"S, 118°43'08"E, 4 Oct. 1999, R.L. Barrett, K.W. Dixon & M.D. Barrett 1345 (AD, ALB, BM, CANB, KPBG, MEL, PERTH, UWA); Tieline Rd, between Parker and Moore Dam Roads, Gnowangerup, 33°56'S, 118°00'E, 17 Oct 1986, E.J. Croxford 4836 (PERTH); S of Twertup Dr., Fitzgerald River National Park, 34°00'S, 119°21'E, 11 July 1970, A.S. George s.n. (PERTH); Bungup North Rd & Newdegate Rd intersection, NW segment, N of drain & S of culvert, 33°17'20"S, 118°53'16"E, 17 Aug. 1995, M.S. Graham MSG 515 (PERTH); Beynon Rd, 30 m N of Magenta Rd, 33°14'40"S, 118°57'55"E, 17 Aug. 1995, M.S. Graham MSG 516 (KNG n.v., PERTH); Gairdner Swamp, 9.6 km NW of Quaalup, 34°12'S, 119°21'E, 20 July 1993, C.W. Hassell H 96 (UWA); Kwoberup [Kwobrup] Rd, 33°37'S, 117°58'E, 28 June 1966, F.W. Humphreys 3 (PERTH); Mission Rd, 20–30 km E of Kojonup, 33°49'05"S, 117°14'20"E, 14 Aug. 1997, C.M. Lewis 248 (PERTH); William River and W of the Blackwood River, s.d., Muir s.n. (MEL); Gordon Inlet Rd, 1 km N of junction between Gordon Inlet Rd and Gairdner River Rd, 34°19'S, 119°24'E, 6 Aug. 1974, G. Perry 187B (PERTH); ?Bremer River, 1884, W. Webb 24 p.p. (MEL).

Distribution. Scattered between Kojonup and Hopetoun, South West Botanical Province. (Figure 3E)

Habitat. In grey clay loam in open woodland with *Dryandra subpinnatifida* C.A. Gardner, *Eucalyptus wandoo* Blakely and *Melaleuca* sp. In low heath over laterite in near coastal areas with *Calectasia gracilis*, *Hakea* spp., *Lambertia* sp. and *Lysinema ciliatum*.

Flowering period. July to August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. While this species has a relatively wide distribution, it is only known from nine populations, two of which are on road verges, comprising two and twelve plants. A third population is recorded as 'several clumps, in open woodland'. Relatively common in the Cape Riche area. As it is a stilt plant relying on seed to recruit following fire, careful management is required to ensure the survival of this species. Further research is required to determine the growth rate of this species.

Etymology. The specific epithet is from the Latin – *obtusus*, referring to the obtuse apex on the leaf lamina.

Affinities. Probably closest to *C. gracilis*, differing in its robust habit and anthers remaining yellow with age. Similar also to *C. palustris*, which has prominently mucronate leaves and grows only in swampy areas of the northern kwongan.

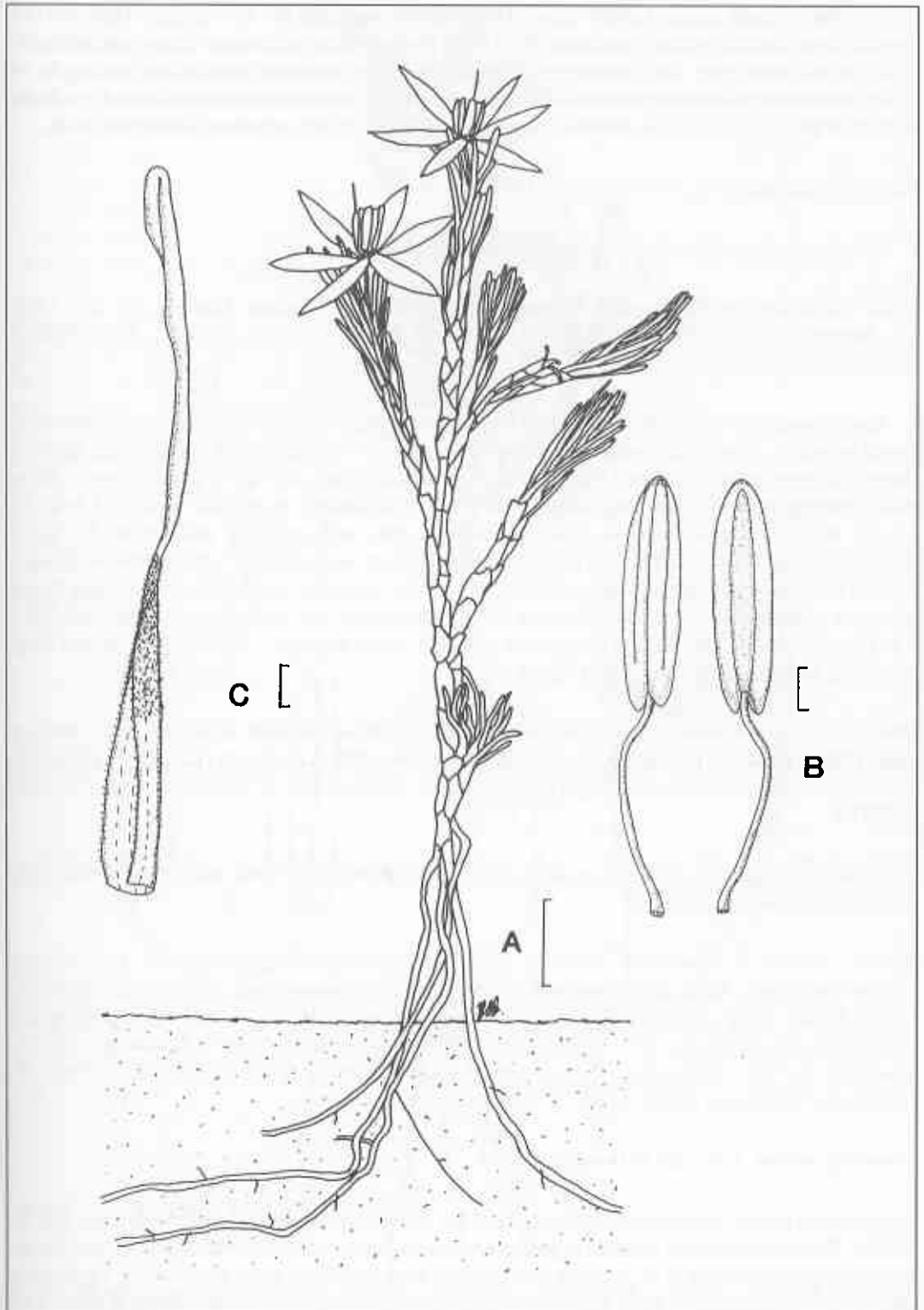


Figure 13. *Calectasia obtusa* A - habit; B - anther (adaxial side L, abaxial side R); C - leaf. Scale bars: A = 1 cm, B, C = 1 mm. Drawn from R.L. Barrett et al. 1345.

Notes. The common name of Blunt-leaved Tinsel Lily is suggested for this species. There are two growth forms for this species, specimens from Cape Riche and the south coast being predominantly 5–15 cm tall with very few branches and specimens from northern populations tending to be 15–35 cm tall with numerous branches. Complete integration has been found inland from Cape Riche with short plants occurring on skeletal stony soils and larger plants occasional in deeper sands.

Calectasia palustris R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae grandiflorae affinis sed rhizomate nullo differt.

Typus: south-west of Badgingarra [precise locality withheld], Western Australia, 30 July 1999, R.L. Barrett 1307 (*holo:* PERTH 05542413; *iso:* AD, ALB, BM, CANB, K, KPBG, L, MEL, PERTH 05542421, UWA).

Undershrub with stilt roots 40–110 mm long; rhizome absent. *Stems* to 70 cm, with many short lateral branches, occasionally with adventitious roots. *Leaves:* lamina 7–23 x 0.4–0.7 mm, glabrous above with short tufted trichomes below, margins scabrous at base, becoming glabrous; apex obtuse with a pungent mucro 0.2 mm long; sheath with branched trichomes on margins. *Bracts* 11.6–13.8 x 1.5–2.1 mm, creamy white, thin, margins glabrous, apex with vestigial leaf lamina 1.6–2.5 x 0.4–0.5 mm. *Perianth:* tube 9.9–10.1 mm long, pilose in lower half and upper eighth; throat with tangle of short hairs, lobes thinly coriaceous, 10.2–12.2 x 1.7–2.1 mm, apex acuminate, blue, fading to red, pilose on abaxial side. *Staminal filaments* 1.0–2.2 mm long, very dark blue. *Anthers* 4.7–5.8 x 0.8–1.1 mm, yellow, not turning orange-red with age, pores terminal. *Style* 10.6–12.0 mm long, exceeding anthers. *Seeds* not seen. (Figure 14)

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: type location, 3 July 1999, R.L. Barrett 1303 (KPBG); W of Coorow, 11 Dec. 1999, R.L. Barrett 1378 (KPBG, PERTH); *loc. cit.*, 8 Oct. 1992, E.A. Griffin 7165 (PERTH); *loc. cit.*, 23 Oct. 1992, S. Patrick & A. Brown SP 1389 (PERTH).

Distribution. Known only from two locations 70 km apart, between Cervantes and Coorow, South West Botanical Province. (Figure 3E)

Habitat. Grows in seasonally inundated (0–20 mm) swampland, growing with *Anigozanthos pulcherrimus* Hook., *Banksia ?micrantha* A.S. George, *Byblis gigantea* Lindl., *Calytrix* spp., *Grevillea preissii* Meisn. subsp. *preissii* and *Melaleuca systema* Craven in white sand at the type location, and in *Actinostrobos arenarius* C.A. Gardner scrub with *Banksia leptophylla* A.S. George, *Calytrix flavescens* A. Cunn., *Ecdeiocolea monostachya* F. Muell., *Eremaea beaufortioides* var. *microphylla* Hnatiuk and *Melaleuca seriata* Lindl., in grey sand west of Coorow.

Flowering period. Late July to October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. IUCN: VUD1. The type location is adjacent to a nature reserve however no plants were found in the reserve. No seedlings were found in an adjacent area that had been burnt two years previously. This area is classified as a Dieback Risk Area. Studies are urgently required to determine the effects of dieback on this species. The type population was surveyed in December 1999 and found to consist of c. 120 tussocks in a narrow strip of disturbed sand, mostly 5–10 m from the roadside. The population west

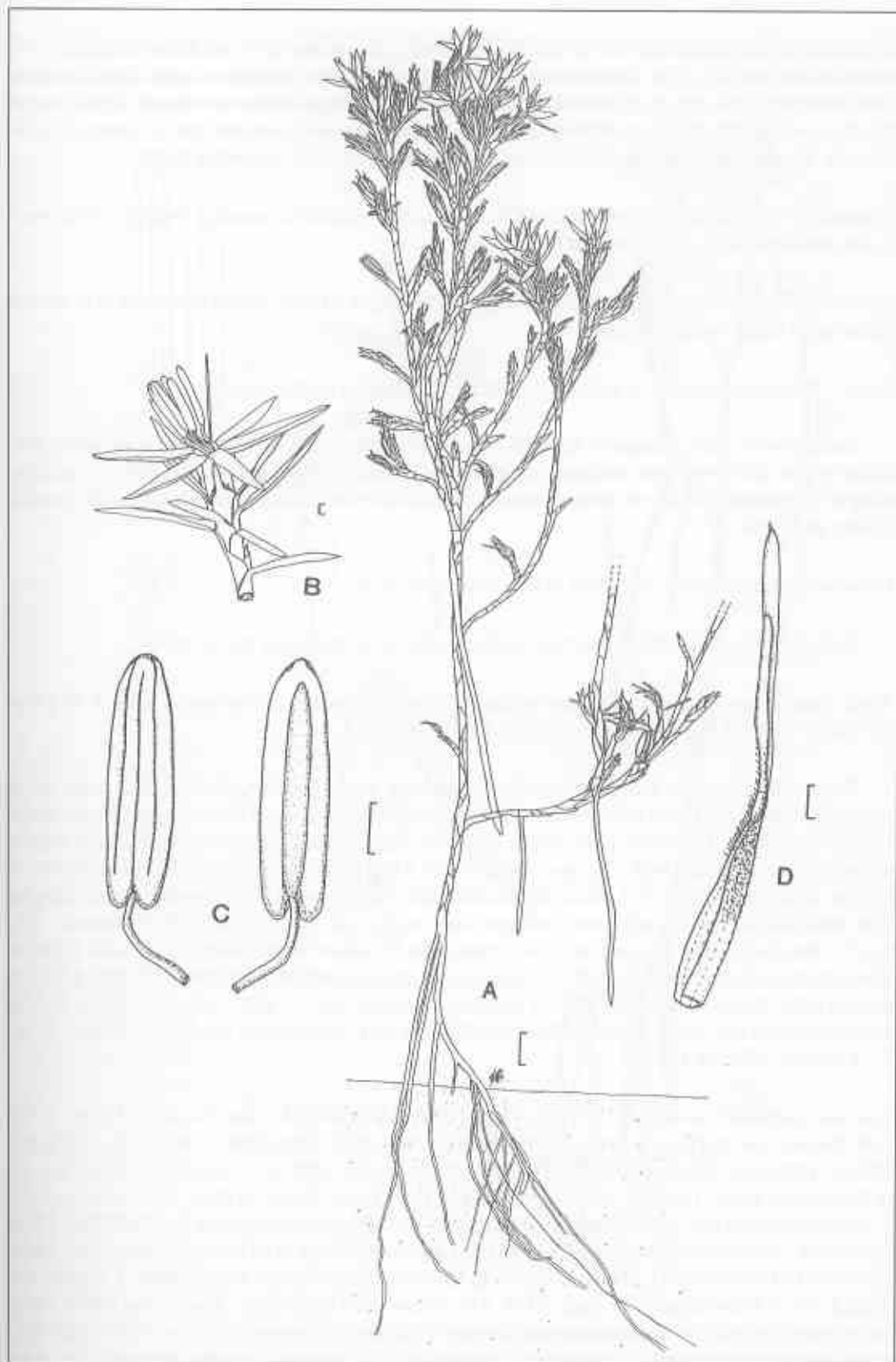


Figure 14. *Calectasia palustris* A - habit; B - flower; C - anther (adaxial side L, abaxial side R); D - leaf. Scale bars: A = 1 cm, B-D = 1 mm. Drawn from R.L. Barrett 1307.

of Coorow is in a nature reserve. It was also surveyed in December 1999 and found to consist of 72 tussocks in an area 10 x 15 m. Each tussock consists of 10–100 ramets. Numerous areas of similar habitat were searched in the vicinity of both locations, however no new populations were found. A third known location west of Coorow (not represented by any collections) was searched but no plants could be located. Further surveys of similar habitats are needed, particularly following fire.

Etymology. The specific epithet is derived from the Latin – *palustria*, meaning swampy, in reference to the unusual habitat preference for this species.

Affinities. Similar in appearance to *C. grandiflora* differing in its stilt-rooting habit, and to *C. obtusa*, differing as stated under that species.

Notes. The common name of Swamp Tinsel Lily is suggested for this species.

There is very minor storage of starch in outer pith of stilt roots and this species is expected to be killed by fire. Old specimens can form large tussocks (Coorow population up to 40 x 60 cm) consisting of up to 100 ramets. The age of these clumps is uncertain, however they are thought to be well in excess of fifty years old.

Calectasia pignattiana K.W. Dixon & R.L. Barrett, *sp. nov.*

Calectasiae cyanae affinis sed foliis reflexis, staminum filamentis brevis differt.

Typus: near Quairading [precise locality withheld], Western Australia, 20 September 1988, *K. W. Dixon* 861 (*holo:* PERTH 01730436; *iso:* AD, BM, CANB, MEL).

Rhizome absent, plant with stilt roots 10–60 mm long. *Stems* to 60 cm, slender, with many lateral branches, occasionally with adventitious stilt roots protruding from upper branches (to 150 mm long). *Leaves:* lamina 5.2–11.5 x 0.9–1.4(2.5) mm, glabrous, margins usually glabrous, occasionally slightly scabrous, apex acute and with a pungent mucro 0.4–0.7 mm long; sheath with branched trichomes on margin. *Bracts* 5.9–6.6 x 1.9–2.1 mm, white at base, thin, brown at apex, brown median stripe, margins with branched trichomes, apex with vestigial leaf lamina 1.6–2.1 x 0.2–0.3 mm. *Perianth:* tube 6.2–7.1 mm long, pilose in lower half and in three lines for entire length; short barbed hairs in throat, lobes chartaceous, 6.5–9.0(13) x 1.2–2.0 mm, apex acuminate, dark blue, eventually fading, pilose on abaxial side. *Staminal filaments* 1.1–2.2 mm long. *Anthers* 4.0–5.1 x 0.7–1.0 mm, yellow, turning orange-red with age, pores terminal. *Style* 8.9–9.6 mm long, prominently exceeding anthers. *Seeds* 2.7 x 0.5 mm. (Figure 15)

Selected specimens examined (14 of 22). WESTERN AUSTRALIA: near Toolibin, 28 Oct. 1992, *E.M. Bennett* 5646 (KPBG); near Quairading, 26 Sept. 1990, *R.M. Clifton* RMC2 (PERTH); S of Hyden, 19 Nov. 1991, *A.M. Coates* 3497 (PERTH); Near Lake Wagin, 1895, *M. Cronin s.n.* (MEL); Sources of Blackwood River, 1889, *M. Cronin s.n.* (MEL); N of Arthur River, 16 Nov. 1992, *V. Crowley & J. Smith s.n.* (PERTH); NE of Kukerin, 15 Oct. 1984, *E.J. Croxford* 3534 (ALB *n.v.*, PERTH); NE of Harrismith, 27 Oct. 1986, *E.J. Croxford* 5351 (ALB *n.v.*, PERTH); N of Dumbleyung, 3 Dec. 1992, *G. Durell* GD 18 (PERTH); Between the Swan River and King George Sound, 1881, *J. Forrest s.n.* (MEL); N of Dumbleyung, 27 Sept. 1975, *J.W. Green* 4411 (PERTH); Blackwood River, 1876, *Miss Hester s.n.* (MEL); N of Dumbleyung, 24 Aug. 1985, *G.J. Keighery & J.J. Alford* 1084 (PERTH); near Toolibin, 16 Dec. 1998, *G. Warren* SW 00106 (PERTH) [precise localities withheld].

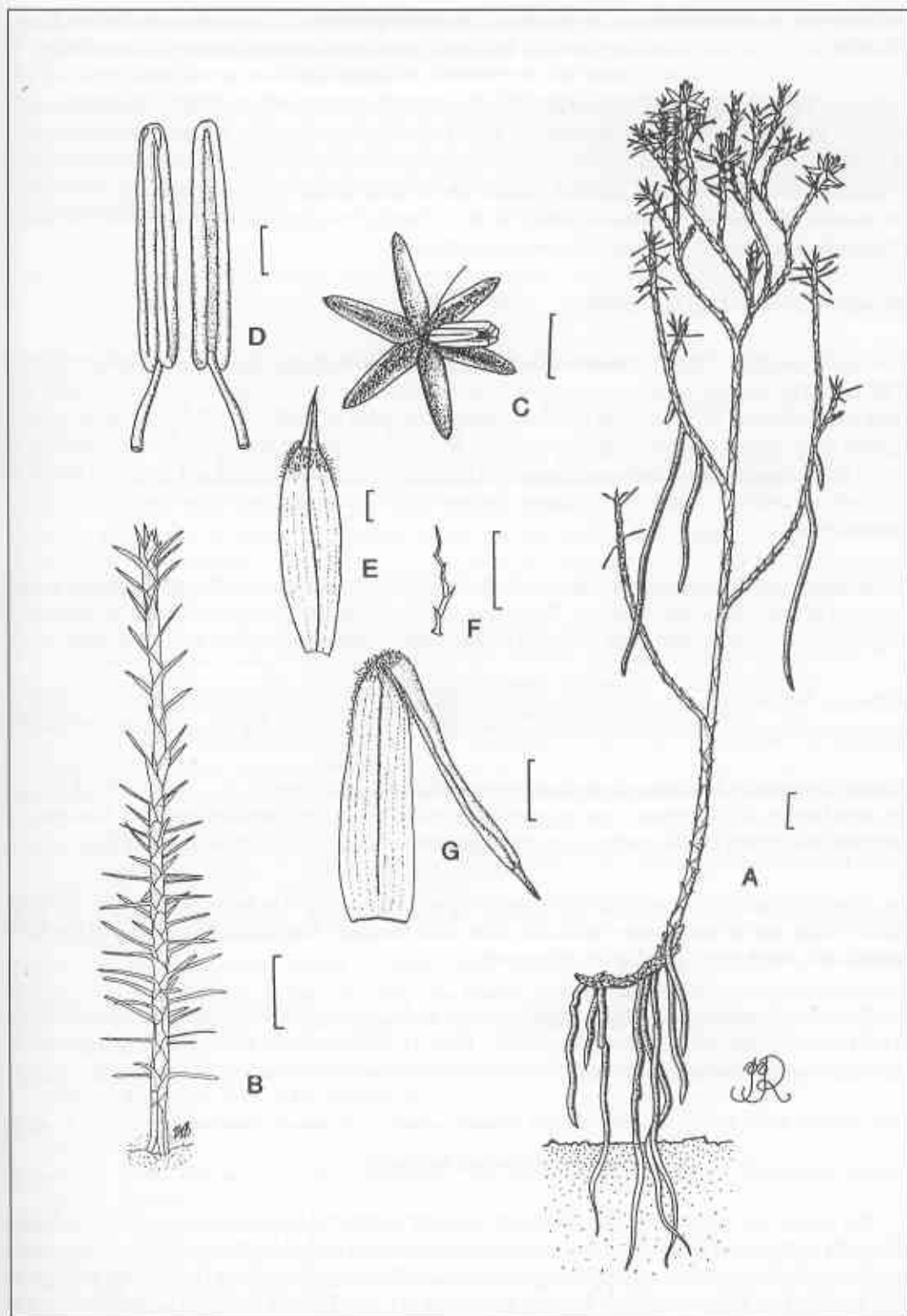


Figure 15. *Calectasia pignattiana* A - habit; B - seedling (3 yrs); C - flower; D - anther (adaxial side L, abaxial side R); E - bract; F - bract hair; G - leaf. Scale bars: A, B = 1 cm, C = 5 mm, D, E, G = 1 mm, F = 0.5 mm. Drawn from K.W. Dixon 861 (A & C drawn by J. Rainbird, B, D-G drawn by RLB).

Distribution. South West Botanical Province. Scattered populations occur between Arthur River, Dumbleyung, Lake Grace and Hyden with a disjunct population near Quairading. (Figure 3A)

Habitat. Yellow sand lenses, in kwongan dominated by Proteaceae. Recorded in association with *Acacia microbotrya* Benth., *Adenanthos* sp., *Allocasuarina humilis*, *Banksia sphaerocarpa*, *B. violacea* C.A. Gardner, *Calothamnus* sp., *Dryandra cuneata* R. Br., *Eremaea pauciflora*, *Hakea trifurcata*, *Kunzea preissiana* Schauer, *Lambertia ilicifolia* Hook., *Leptospermum* sp., *Melaleuca uncinata* R. Br., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl, *Pericalymma ellipticum* (Endl.) Schauer, *Petrophile longifolia* R. Br. and *Xanthorrhoea preissii*.

Flowering period. June to September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Declared Rare. IUCN: CRC2(a). Ten different locations are known, four of which are on road verges. One site consists of one plant only, a second of three plants while no plants were found at a third site. A fourth site is thought to have been cleared since the original collection was made. The type population near Quairading is under threat from frequent burning (this species is known to be killed by fire) and restricted extent of the preferred soil type. Surveys of all known sites are urgently required to ascertain the extent of current populations.

Etymology. The specific epithet honours Professors Erika and Alessandro Pignatti of Rome on the occasion of their seventieth birthdays. They have contributed greatly to our knowledge of south-west vegetation associations and have collected extensively, including many taxa new to science.

Affinities. Similar to *C. cyanea* and *C. gracilis* but differing as stated under those species. The laminae are also caducous earlier than other species, *K.W. Dixon* 861 (the type) being almost leafless at anthesis.

Notes. This species has been given the common name of Stilted Tinsel Lily. As six stilted species are now known, it is suggested that this species be called Pignatti's Star of Bethlehem. This species has previously been known under the manuscript name of *C. arnoldii* (Brown *et al.* 1998).

The collection *G. Warren* SW 00106 was described by the collector as being rhizomatous, possibly due to young plants not having visible stilt roots (only branches were collected). This site has been visited and plants were found to be stilt-rooted.

Two collections are doubtfully included here (S of Kulin, 28 Aug. 1995, *G. Durell* GD 102 (PERTH); S of Hyden, 20 Sep. 1999, *J. Wege* s.n. (KPBG, PERTH, UWA)). They differ in having larger, non-reflexed leaves and a larger perianth. Further research is required to determine their status.

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References

- Angiosperm Phylogeny Group (1998). An ordinal classification for the families of flowering plants. *Annals of the Missouri Botanic Garden* 85: 531–553.
- Anway, J.C. (1969). The evolution and taxonomy of *Calectasia cyanea* R. Br. (Xanthorrhoeaceae) in terms of its present-day variation and cytogenetics. *Australian Journal of Botany* 17: 147–159.
- Beard, J.S. (1980). A new phytogeographic map of Western Australia. *Western Australian Herbarium Research Notes* 3: 37–58. (Western Australian Herbarium, Department of Conservation and Land Management: Perth.)
- Bentham, G. (1878). "Flora Australiensis." Vol. 7, pp. 120–121. (Lowell Reeve: London.)
- Bindon, P. & Chadwick, R. (1992). "A Nyoongar wordlist from the South-West of Western Australia." (Western Australian Museum: Perth.)
- Brown, A., Thomson-Dans, C. & Marchant, N. (eds) (1998). "Western Australia's Threatened Flora." (Department of Conservation and Land Management: Perth.)
- Brown, E.M., Burbidge, A.H., Dell, J., Edinger, D., Hopper, S.D. & Wills, R.T. (1997). "Pollination in Western Australia: a database of animals visiting flowers" Handbook No. 15. (Western Australian Naturalists' Club: Perth.)
- Brown, R. (1810). "Prodromus Florae Novae Hollandiae et Insulae Van-Diemen." (Taylor: London.)
- Brummitt, R.K. (1992). "Vascular Plant Families and Genera." (Royal Botanic Gardens: Kew.)
- Chapman, A.D. (1991). "Australian Plant Name Index. A–C." Australian Flora and Fauna Series Number 12. (Australian Government Publishing Service: Canberra.)
- Chapman, A.D. (1999). Australian Plant Name Index (electronic version) – <http://www.anbg.gov.au/cpbr/databases/apni.html> (Accessed December 1999).
- Clifford, H.T., Keighery, G.J. & Conran, J.G. (1998). Dasygogonaceae. In: Kubitzki, K. (ed.) "The families and genera of vascular plants. Volume IV. Flowering plants. Monocotyledons. Alismatanaceae and Commelinaceae (except Gramineae)." pp. 190–194. (Springer-Verlag: Berlin.)
- Conn, B.J. (1994). Xanthorrhoeaceae. In: N.G. Walsh & T.J. Entwisle (eds) "Flora of Victoria." Vol. 2, pp. 720–734. (Inkata: Melbourne.)
- Craven, L.A. (1987). A taxonomic revision of *Calytrix* Labill. (Myrtaceae). *Brunonia* 10: 1–138.
- Dahlgren, R.M.T., Clifford, H.T. & Yeo, P.F. (1985). "The Families of the Monocotyledons." (Springer-Verlag: Berlin.)
- Elliot, W.R. & Jones, D.L. (1982). "Encyclopaedia of Australian plants suitable for cultivation." Vol. 2. (Lothian Publishing Company Pty Ltd: Melbourne.)
- Endlicher, S.L. (1836). Calectasiaceae. In: E. Fenzl & S.L. Endlicher. "Genera Plantarum secundum ordines naturales disposita" Part. 1, pp. 132. (Wein: Friedrich Beck.)
- Fahn, A. (1954). The anatomical structure of the Xanthorrhoeaceae Dumort. *Botanical Journal of the Linnean Society* 55: 158–184.
- George, A.S. (1986). *Calectasia*. In: "Flora of Australia." Vol. 46, pp. 170–171. (Australian Government Publishing Service: Canberra.)
- Gray, A. (1969). The Blue Tinsel Lily. *Australian Plants* 5: 233–234.
- Heberle, R.L. (1999). *Thelymitra variegata* (Lindl.) F.Muell. – "The Queen of Sheba". *The Orchadian* 13: 73–77.
- Henderson, R.J.F. (1981). *Romnaldia grallata*, a new species of the Xanthorrhoeaceae from Queensland. *Kew Bulletin* 37: 229–235.
- IUCN. (1994). IUCN Red list categories. (IUCN Species Survival Commission: Gland, Switzerland.)
- Jessop, J.P. (1986). Liliaceae In: Jessop, J.P. & Toelken, H.R. (eds) "Flora of South Australia. Part IV. Alismataceae – Orchidaceae." pp. 1742–1775. (The Flora and Fauna of South Australia Handbooks Committee: Adelaide.)

- Jones, D.L. (1988). "Native orchids of Australia." (Reed Books: Chatswood, New South Wales)
- Keighery, G.J. (1984). Chromosome numbers of Australian Liliaceae. *Feddes Repertorium* 95: 523-532.
- Mabberley, D.J. (1997). "The plant-book." 2nd edn. (Cambridge University Press: Cambridge.)
- Macfarlane, T.D. (1987). Dasyopogonaceae. In: Marchant, N.G. & Wheeler, J.R. (eds) "Flora of the Perth Region." Vol. 2, pp. 738-749. (Western Australian Department of Agriculture: Perth.)
- McCusker, A. (1999). Glossary. In: "Flora of Australia." 2nd edn. Vol. 1, pp. 585-636. (ABRS/CSIRO Publishing: Melbourne.)
- Meisner, C.F. (1842) "Plantarum Vascularium Genera Secundum Ordines Naturales Digesta, Eorumque Differentiae et affinitates Tabulis Diagnosticis Expositae." (Libraria Weidmannia: Lipsiae.)
- Pate, J.S. & Dixon, K.W. (1996). Convergence and divergence in the southwestern Australian flora in adaptations of roots to limited availability of water and nutrients, fire and heat stress. Chapter 23. In: Hopper, S.D., Chappill, J.A., Harvey, M.S. & George, A.S. (eds) "Gondwanan Heritage: Past, Present and Future of the Western Australian Biota." pp. 249-258. (Surrey Beatty and Sons: Chipping Norton.)
- Pate, J.S., Weber, G. & Dixon, K.W. (1984). Stilt plants - extraordinary growth form of the kwongan. In: Pate, J.S. & Beard, J.S. (eds) "Kwongan - Plant life of the sandplain." pp. 101-125. (University of Western Australia Press: Nedlands.)
- Pate, J.S., Meney, K.A., Dixon, K.W., Bell, T.L. & Hickman, E.J. (1999). Response of Restionaceae to fire. In: Pate, J.S. & Meney, K.A. (eds) "Australian Rushes. Biology, Identification and Conservation of Restionaceae and Allied Families." pp. 71-83. (University of Western Australia Press: Nedlands.)
- Preiss, J.A.L. (1846). Calectasieae. In: J.G.C. Lehmann (ed.) "Plantae Preissianae." Vol. 2(1), p. 53. (Hamburgi.)
- Rudall, P. & Chase, M.W. (1996). Systematics of Xanthorrhoeaceae *sensu lato*: evidence for polyphyly. *Telopea* 6: 629-647.
- Sharr, F.A. (1996). "Western Australian plant names and their meanings. A glossary." Enlarged edition. (University of Western Australia Press: Nedlands.)
- Sonder, O.W. ('Sept. 1856' [1857]). Calectasieae. *Linnaea* 28: 221-222.
- Symon, D.E. (1981). A revision of the genus *Solanum* in Australia. *Journal of the Adelaide Botanic Garden* 4: 1-367.
- Takhtajan, A. (1997). "Diversity and classification of flowering plants." (Columbia University Press: New York.)
- Western Australian Herbarium (1999). FloraBase - Information on the Western Australian flora. Department of Conservation and Land Management. <http://www.calm.wa.gov.au/science/florabase.html> (Accessed December 1999).
- Watson, L. & Dallwitz, M.J. (1992 onwards). "The Families of Flowering Plants: Descriptions, Illustrations, Identification, and Information Retrieval." Version: 19 August 1999. <http://biodiversity.uno.edu/delta/> (Accessed December 1999).
- Woldendorp, G. (1996). Undergraduate project, Murdoch University, Perth.