

Four new species of *Astroloma* (Ericaceae: Styphelioideae: Styphelieae) from Western Australia

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Abstract

Hislop, M., Wilson, A.J.G. & Puente-Lelièvre, C. Four new species of *Astroloma* (Ericaceae: Styphelioideae: Styphelieae) from Western Australia. *Nuytsia* 23: 23–42 (2013). Four new species of *Astroloma* R.Br. s. str. (*A. acervatum* Hislop & A.J.G. Wilson, *A. chloranthum* Hislop & A.J.G. Wilson, *A. inopinatum* Hislop and *A. oblongifolium* A.J.G. Wilson & Hislop) are described, illustrated and mapped. The current taxonomic status of *Astroloma* is discussed in the light of significant changes that are pending in the *Styphelia* clade to which the genus belongs. A key to members of *Astroloma* s. str. with pale yellow, cream and/or green flowers is provided.

Introduction

The current circumscription of the small Australian genus *Astroloma* R.Br. is largely unchanged from that used by Bentham in *Flora Australiensis* (1868). Bentham's treatment represented an expansion of Brown's (1810) original generic concept to include taxa first described in *Stenanthera* R.Br. (*Astroloma pinifolium* (R.Br.) Benth. and *Astroloma conostephioides* (Sond.) Benth.) and *Stomarrhena* DC. (*Astroloma xerophyllum* (DC.) Sond.). He also accepted two other morphologically anomalous species, *A. stomarrhena* Sond. and *A. baxteri* DC. In the last 25 years a growing body of research (Powell *et al.* 1987; Powell *et al.* 1997; Streiber 1999; Quinn *et al.* 2003; Puente-Lelièvre *et al.* unpublished) has provided strong evidence that as so constituted the genus is polyphyletic. A molecular study of relationships across the tribe *Styphelieae* Bartl. by Quinn *et al.* (2003) utilized DNA sequence data from two plastid regions, *matK* gene and the *atpB-rbcL* intergenic spacer. Cladistic analyses of the combined data from these two regions yielded a phylogenetic tree that showed species currently assigned to *Astroloma* grouping in five different areas of the tree. Three of these groupings, including the *Astroloma* s. str. subclade, were nested within a larger clade (referred to as the *Styphelia* clade) which also included species of *Styphelia* Sm., *Coleanthera* Stschegl., *Croninia* J.M. Powell and the majority of *Leucopogon* R.Br. segregate taxa (i.e. excluding *Leucopogon* s. str. which is outside of the *Styphelia* clade). The level of support for these potential generic groupings was mixed but at least for the *Astroloma* s. str. subclade it was relatively weak. Other relationships within this clade were also inadequately resolved and the need for further research was recognised before any final decisions could be taken regarding the potential splitting of *Astroloma* and the other two polyphyletic genera, *Styphelia* and *Leucopogon*. The third author is currently finalising a PhD project with the primary aim

of resolving these phylogenetic relationships and delimiting generic boundaries in this taxonomically complex clade. Molecular phylogenies have been estimated based on four chloroplast (*atpB-rbcL*, *matK*, *rbcL* and *trnH-psbA*) and one nuclear (ITS) loci. The new study has largely confirmed and strengthened the topology obtained by Quinn *et al.* (2003) as it pertained to the various elements of *Astroloma*. The overall taxonomic implications of the latest research are challenging and will be discussed in a forthcoming paper (Puente-Lelièvre *et al.* unpublished). A final decision has yet to be made regarding the most appropriate generic framework to reflect the complex patterns of morphological and genetic diversity contained within the *Styphelia* clade. A conservative approach would potentially see all members of the clade, including *Astroloma s. str.*, subsumed into a greatly expanded *Styphelia*, although it is more likely that *Astroloma* will be retained with a reduced circumscription. In the latest analyses of the combined molecular data (Puente-Lelièvre *et al.* unpublished) the *Astroloma s. str.* clade is consistently supported.

From a morphological perspective *Astroloma s. str.* is well-defined and can be recognised by the following character combination: corolla various shades of red, pink or orange, or pale yellow, cream and/or green (never white); corolla tube usually with a whorl of hairs close to the base on the inner surface; corolla lobes erect basally and spreading or recurved in the upper one quarter to one third, usually bitextured, with the distal one third to one half of the lobes abruptly smoother and paler than the basal portion; filaments flattened (linear in section) or occasionally compressed (narrowly elliptic in section); anthers partially included within the tube. Of these characters the bitextured corolla lobes represents a synapomorphy for the genus (it is only absent from *A. macrocalyx* Sond.).

Based both on their morphology and position in the phylogenetic tree the new species described below are members of *Astroloma s. str.* Although, as outlined above, the taxonomic status of the members of this clade may change, they are published here under *Astroloma* rather than *Styphelia* for reasons of convenience. The genus is a long-accepted one and, at least when circumscribed to include only members of *Astroloma s. str.*, has morphological and molecular integrity. If ongoing research does ultimately conclude that *Astroloma* is better recognised as a subgenus under *Styphelia* then new combinations can be made for these four species at the same time as for the several other taxa in *Astroloma* for which names are currently lacking under *Styphelia*. The specific epithets used here are not occupied in *Styphelia*.

The majority of species in *Astroloma s. str.* have corollas which are shades of red, pink or orange, but six species have pale yellow, cream or green corollas. Three of these six are formally described in this paper. They had all been previously identified as *A. pallidum* R.Br. which remains a widespread and variable species even after the segregation of the new taxa. The other species described here, *A. inopinatum*, is red-flowered. A key to the yellow, cream or green-flowered taxa in *Astroloma* is provided below, as all known taxa in this group are now described. The taxonomy of those species with red, pink or orange coloured flowers is still incomplete and it would therefore be premature to include a key to those at this stage.

Methods

This study was based on examination of dried specimens housed at PERTH together with extensive field observations of the genus, including the four new species described below.

Foliar measurements were taken from dried specimens. Leaf thickness was measured at the midrib, half way along the lamina. Observations of leaf venation were made from mature leaves only. Across the

tribe *Styphelieae* generally it is common for young leaves to show prominently raised venation on the abaxial surface which is much less evident, if at all, at maturity. Similarly, the first leaves produced at the beginning of a growth flush should be ignored. The lowest of these are clearly bract-like, but there is a morphological transition across several nodes before the form of the mature leaves is reached.

Inflorescence length is measured from the insertion point in a leaf axil to the tip of the bud rudiment. Floral measurements were taken from re-hydrated flowers. The recurved corolla lobes were straightened prior to measuring. Sepal width was measured in natural posture, i.e. they were not flattened out. This method was preferred because their curvature can be so extreme that they are liable to either split or become pleated when attempts are made to flatten them.

Taxonomy

Key to species of *Astroloma s. str.* with pale yellow, cream and/or green flowers

1. Leaves convex adaxially, the margins recurved to revolute; sepal margins manifestly ciliate at least in the upper half, with hairs to 0.7 mm long (northern Darling Range in the Bindoon–New Norcia area and Geraldton Sandplains between Cataby and Eneabba) **A. oblongifolium**
- 1: Leaves concave adaxially, the margins never recurved; sepal margins eciliate or minutely ciliolate in *A. tectum* and *A. macrocalyx*
 2. Longest leaves usually at least 20 mm long, but if less, then the widest leaves at least 6 mm wide; staminal filaments compressed only (i.e. narrowly elliptic in section)
 3. Leaves very narrowly ovate, widest leaves to *c.* 4 mm wide; sepals longer than the corolla tube, >13 mm long (mostly on the Swan Coastal Plain Darling Range from Regans Ford to the Perth region with scattered occurrences inland as far south as the Katanning area)..... **A. macrocalyx**
 - 3: Leaves elliptic or narrowly elliptic, widest leaves at least 6 mm wide; sepals shorter than corolla tube, 7–10 mm long (near-south-coast localities between Albany and Cape Arid and inland as far as the Stirling Range and Mt Ragged) **A. tectum**
 - 2: Longest leaves to *c.* 20 mm long and widest to *c.* 5 mm wide; staminal filaments manifestly flattened (i.e. linear in section)
 4. Corolla bright green throughout; leaves narrowly obovate to obovate, \pm abruptly contracted towards the apical mucro (restricted distribution in the south-eastern wheatbelt between Newdegate and Pingrup) **A. chloranthum**
 - 4: Corolla mostly cream or very pale yellow, the tube sometimes greenish cream in the lower half; leaves elliptic to narrowly obovate-elliptic, gently tapering towards the apical mucro
 5. Plants with a fire-sensitive rootstock, prostrate and mat-forming, or becoming raised and mounded in the centre, but always tapering toward a well-defined margin at soil level; aspect bright green; mature leaf margins conspicuously pale and hyaline; sepal mucro to 0.15 mm long (eastern Darling Range and adjacent parts of the western wheatbelt)..... **A. acervatum**
 - 5: Plants with a fire-resistant rootstock, of irregular form, \pm erect, but usually low and spreading, not prostrate or mat-forming, nor tapering to a well-defined margin at soil level; aspect glaucous; mature leaf margins not pale and hyaline; sepal mucro >0.20 mm long (widespread in the wetter parts of south-western Australia from Mt Lesueur in the north to the Wellstead area, east of Albany) **A. pallidum**

Descriptions

Astroloma acervatum Hislop & A.J.G. Wilson, *sp. nov.*

A. pallido affinis sed caudice non-ligno-tuberoso, habito denso rotundato, foliis viridibus non glaucis, marginibus hyalinis, et mucronibus sepalii brevioribus.

Typus: Lower Hotham Road, 3.9 km north of Harvey–Quindanning Road, north-west of Quindanning, Western Australia, 14 September 2010, *M. Hislop* 4077 (*holo*: PERTH 08253692; *iso*: CANB, NSW).

Astroloma sp. Tutanning (A.S. George 7779), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed March 2012].

Very dense *shrubs*, prostrate and mat-forming, but the centre often becoming raised and mounded with age, to 15 cm high and at least 120 cm wide, from a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of \pm patent, straight or variously curled hairs to 0.6 mm long, but usually shorter. *Leaves* antrorse, usually steeply so, narrowly obovate-elliptic, 10–17 mm long, 1.8–3.3 mm wide; apex long-mucronate, pungent, the mucro 0.9–1.5 mm long; base attenuate; petiole rather indistinct, creamy yellow or greenish yellow, *c.* 0.5–1.0 mm long, glabrous or with a few hairs on the adaxial surface and margins; lamina 0.25–0.35 mm thick, concave adaxially, longitudinal axis \pm straight, gently incurved or gently recurved; surfaces distinctly discoloured; adaxial surface shiny, glabrous, or sparsely hairy towards the base, venation either not evident, or 1–3 sunken lines sometimes visible, mostly in the lower half; abaxial surface paler, shiny, glabrous, with 3–5 rather conspicuous, white, flat or raised, primary veins, and significant secondary development, the midrib no more prominent than the others; margins of mature leaves conspicuously pale and hyaline, coarsely ciliolate with stiff, antrorse hairs (26–56 along each margin), 0.05–0.25 mm long. *Inflorescences* erect; axis 2.5–3.6 mm long, single-flowered. *Fertile bract* broadly elliptic, \pm orbicular to transversely elliptic, 1.6–2.4 mm long, 1.7–2.4 mm wide, subtended by 8–12 variously shaped, smaller sterile bracts. *Bracteoles* ovate to elliptic, 2.3–3.4 mm long, 2.1–2.5 mm wide, obtuse, mucronate, the mucro 0.05–0.20 mm long, abaxial surface glabrous, straw-coloured, occasionally flushed pink towards the apex, multi-veined and striate, becoming scarious towards the margins; adaxial surface glabrous; margins glabrous. *Sepals* narrowly ovate, 5.0–6.7 mm long, 2.1–2.5 mm wide, obtuse, mucronulate, the mucro 0.05–0.15 mm long; abaxial surface glabrous, mostly straw-coloured, but sometimes greenish towards the base and/or flushed pink towards the apex, conspicuously striate with 11–15 raised veins, becoming scarious towards the margins; adaxial surface glabrous except for a discrete patch of hairs close to the base, at least on the inner sepals; margins glabrous. *Corolla tube* cream towards the apex, becoming greenish cream in the lower half, cylindrical, or very narrowly campanulate, much exceeding the sepals, 10.4–14.5 mm long, 2.8–3.6 mm wide, internal surface with a \pm continuous whorl of dense hairs in the lower half (2.8–4.5 mm above the base), the hairs 0.9–1.5 mm long and issuing from unmodified tissue, hairs also scattered in the tube above the tufts, especially towards the throat. *Corolla lobes* erect in the lower 2/3–3/4, recurved above, cream, always shorter than the tube (ratio = 0.33–0.50:1), 3.6–6.0 mm long, 1.5–2.2 mm wide at base; the indumentum of the central portion of the internal surface 0.8–1.4 mm long; glabrous tips 0.20–0.35 mm long. *Anthers* partially exerted from the tube (by 3/4–7/8 of their length), 2.0–2.5 mm long, apex deeply emarginate. *Filaments* flat, 1.0–1.5 mm long, 0.3–0.7 mm wide, attached *c.* 3/4 above anther base. *Nectary* annular 0.6–1.0 mm long, irregularly lobed for up to 1/4 of length. *Ovary* ovoid to ellipsoid, 1.1–1.4 mm long, 1.0–1.3 mm wide. *Style* 13.4–18.4 mm long, scabrous in the upper half. *Fruit* ellipsoid to \pm globose, 5.5–8.0 mm long, 5.0–7.0 mm wide, much longer than the calyx, the surface deeply rugose when dry. (Figures 1, 2)

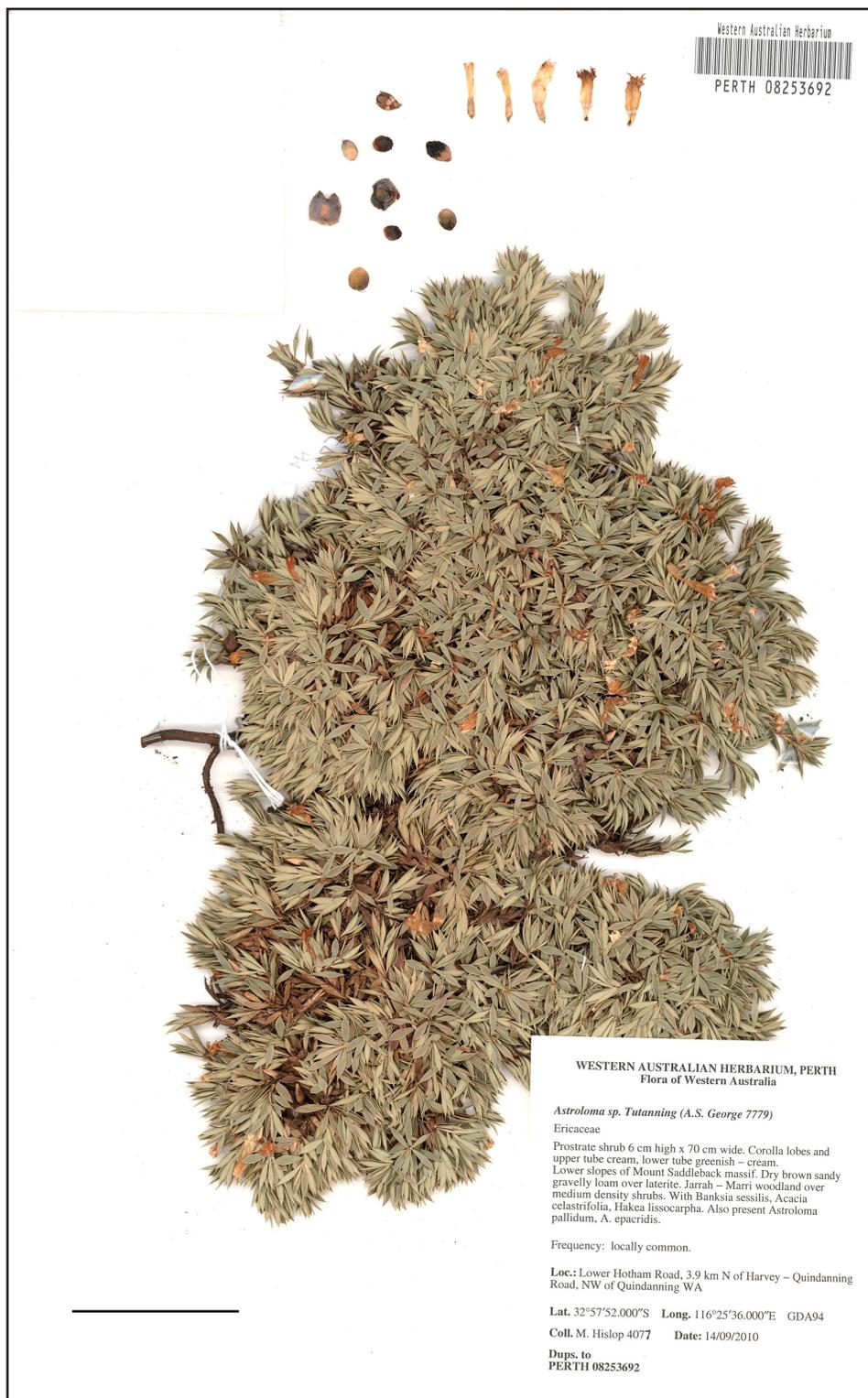
Figure 1. Scan of holotype of *Astroloma acervatum* (PERTH 08253692). Scale = 5 cm.



Figure 2. *Astroloma acervatum*. A – habit; B – leaves and flowers (F. & J. Hort 3660). Photographs by J. Hort.

Other specimens examined. Ricks Rd 6.3 km E of North Bannister–Wandering Rd, N of Wandering, 21 Aug. 2010, *M. Hislop* 4044 (CANB, MEL, PERTH); Lupton Conservation Park, E boundary firebreak adjacent to Woods Loop, W of Brookton, 23 Aug. 2010, *M. Hislop* 4049 (PERTH); Brookton Highway Nature Reserve, perimeter firebreak, E of Coles Rd, W of Brookton, 23 Aug. 2010, *M. Hislop* 4050 (CANB, NSW, PERTH); Bannister–Marradong Rd, 3.2 km N of Robins Rd, S of Boddington, 4 Sep. 2010, *M. Hislop* 4051 (PERTH); W boundary of Mooradung Nature Reserve, 600 m S of Lucev Rd, SE of Boddington, 4 Sep. 2010, *M. Hislop* 4052 (CANB, PERTH); site 233. [Private property], off W end of Pike Rd, W of Brookton, 30 Sep. 2008, *M. Hislop* & *M. Griffiths* WW 233-36 (PERTH); site 235. [Private property], W side of Hillcroft Rd between Dale Rd South and Groves Rd, W of Brookton, 1 Oct. 2008, *M. Hislop* & *M. Griffiths* WW 235-33 (PERTH); site 237. [Private property], S of Edison Mill Rd between Dobaderry and Rogers Rd, W of Beverley, 3 Oct. 2008, *M. Hislop* & *M. Griffiths* WW 237-44 (PERTH); site 232. [Private property], E side of Bicker Rd, opposite intersection with Tutanning Rd, E of Pingelly, 25 Sep. 2008, *M. Hislop* & *H. Mills* WW 232-34 (PERTH); Wearne State Forest, Wandering, Ricks Rd, 4.2 km E from South Rd, and then the track N for 50 m, 28 Aug. 2010, F. & J. Hort 3660 (CANB, NSW, PERTH); Fox’s Lair, Narrogin, 15 Sep. 1992, *J.P. Pigott* JPP 1504 (PERTH); Wearne Rd, 15.8 km E from Albany Highway [E of North Bannister], 2 July 2010, *C. Puente-Lelièvre*, *M. Hislop* & *E.A. Brown* CPL 36 (NSW, PERTH).

Distribution and habitat. A regional endemic restricted to the eastern Darling Range and adjacent parts of the western wheatbelt from west of Beverley to the Narrogin area and as far east as Tutanning Nature Reserve, east of Pingelly (Figure 3). *Astroloma acervatum* mainly occurs high in the landscape in sandy loam soils over laterite and in association with woodlands dominated by *Eucalyptus accedens*, *E. marginata*, *E. wandoo* and *E. astringens*. It favours open sites where there is limited competition from other shrubs.

Phenology. The main flowering period is between July and September, although sporadic flowering apparently occurs at other times of the year, probably depending on available moisture. Fruit appears to be retained on the plants for many months. It is likely to be present for much of the year but with a peak between October and March.

Etymology. From the Latin *acervatus* (mounded or heaped), a reference to the distinctive growth habit of the species.

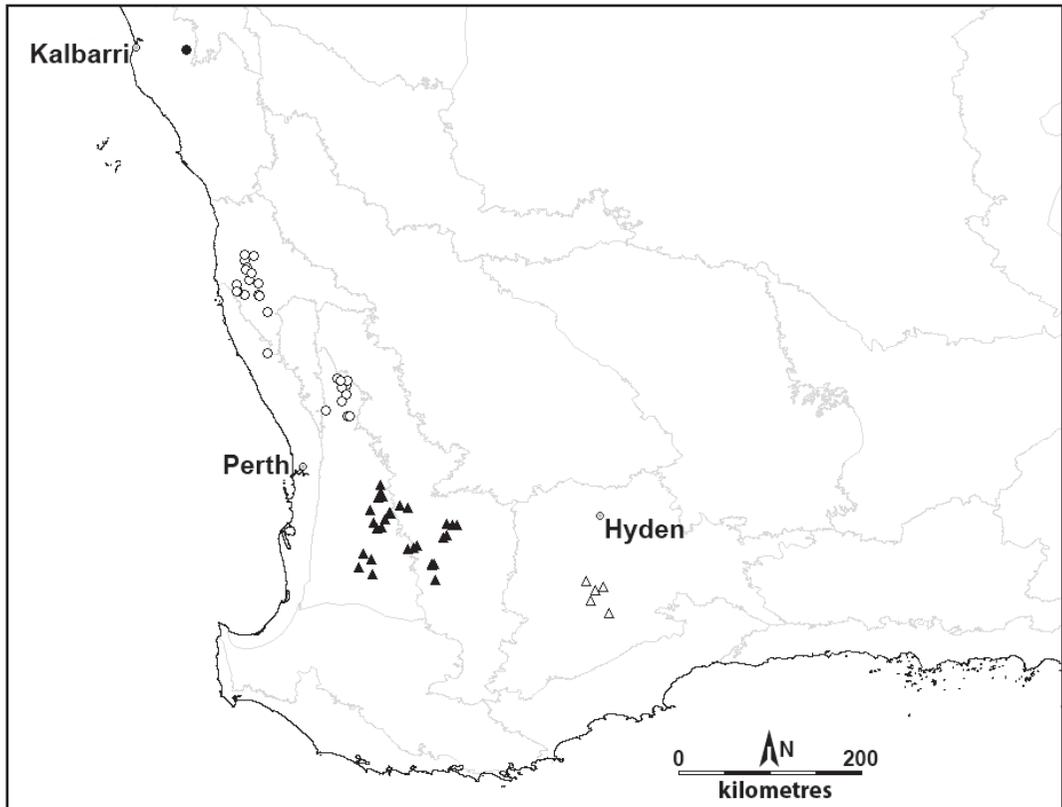


Figure 3. Distribution of *Astroloma acervatum* (closed triangle), *A. inopinatum* (closed circle), *A. oblongifolium* (open circle) and *A. viridis* (open triangle) in Western Australia.

Conservation status. Although the distribution of *A. acervatum* is not extensive, it is known to occur in a number of Nature Reserves and National Parks and its preferred habitat is common across the species' range. No conservation coding is recommended here.

Affinities. Collections of this species have hitherto mostly been assigned to *Astroloma pallidum*, which shares similar-coloured flowers and a low growth habit (Figure 4). The two are often sympatric in the same habitat across the range of *A. acervatum*, although there is no evidence of hybridisation between them.

In addition to the characters used in the key above there are a couple of other less clear-cut, but still useful, differences between the two. Relative to the leaves of *A. acervatum*, those of *A. pallidum* generally have fewer (frequently <25 per margin), but longer (often >0.25 mm long), marginal hairs. Whereas the abaxial sepal surfaces are always glabrous in *A. acervatum*, they are often shortly hairy in *A. pallidum*.

Although the two species produce flowers over many months of the year, there is a significant difference in the detail of their flowering patterns. At sites where they co-occur, when *A. acervatum* is at peak flowering between mid-July and mid-September, plants of *A. pallidum* are either not flowering at all or have very few flowers present. Conversely between October and December when *A. pallidum* is in full flower, flowering plants of *A. acervatum* are scarce.



Figure 4. *Astroloma pallidum*. A – habit; B – leaves and flowers (M. Hislop 4099). Photographs by M. Hislop.

Sterile or fruiting plants could be mistaken for the red-flowered *A. compactum* R.Br. (Figure 5), another species which frequently co-occurs with *A. acervatum*. The former generally has a similar prostrate, mat-forming habit, but plants do not become mounded and the leaves are smaller, more obviously obovate (i.e. the widest part of the leaf is closer to the apex), and lack the characteristic pale margins of *A. acervatum*.

Immediately to the south of the known range of *A. acervatum*, there occurs a plant with the same hyaline leaf margins and a very similar habit to that species, but which differs in ways that are of potential taxonomic significance. Currently known only from very few collections from near Darkan (e.g. *M. Hislop* 4065) and Collie, it has pink flowers, apparently longer sepals and a generally taller habit, although still with the characteristically tapered and well-defined margins of typical *A. acervatum*. This entity is not included in the above description. Further collections and field observations are required in order to verify that these differences are consistent and whether taxonomic recognition is warranted.

Notes. The area of the eastern Darling Range and adjacent parts of the western wheatbelt to which *A. acervatum* is endemic is the richest in Western Australia for the genus *Astroloma*. In addition to the new species, and the already-mentioned *A. pallidum* and *A. compactum*, another four are known to occur here (i.e. *A. ciliatum* (Lind.) Druce, *A. drummondii* Sond., *A. epacridis* (DC.) Druce and *A. serratifolium* (DC.) Druce *s. str.*) and sometime as many as five species can be observed growing at the same site.

Although the drupes of all species of *Astroloma s. str.* have a significant mesocarp, those of *A. acervatum* are particularly well-developed and can be as much as 12 mm wide at maturity. At that stage they have a strong, sweet odour.



Figure 5. *Astroloma compactum*. Leaves and flowers (unvouchered). Photograph by J. Hort.

Astroloma chloranthum Hislop & A.J.G. Wilson, *sp. nov.*

A. compacto affinis sed floribus viridibus, habito humilis effuso (non prostrato), mucronibus folii longioribus, mucronibus bracteolii et sepalii brevioribus differt.

Typus: west of Newdegate [precise locality withheld for conservation reasons], Western Australia, 23 April 2006, *M. Hislop* 3584 (*holo*: PERTH 07524013; *iso*: CANB, NSW).

Very low, spreading *shrubs* to *c.* 10 cm high and 100 cm wide, multi-stemmed at ground level from a rootstock which is probably fire-tolerant. Young *branchlets* with a sparse indumentum of patent, straight hairs to *c.* 0.1 mm long. *Leaves* steeply antrorse, narrowly obovate to obovate, 7.8–13.5 mm long, 1.8–3.6 mm wide; apex long-mucronate, pungent, the mucro 1.4–2.0 mm long; base attenuate; petiole rather indistinct, yellowish green, to *c.* 0.8 mm long, glabrous or with a few hairs on the adaxial surface and margins; lamina 0.25–0.35 mm thick, concave adaxially, longitudinal axis gently incurved in the basal 1/3, the remainder either straight or gently recurved in the upper 1/3; surfaces discolorous; adaxial surface shiny, bright green, glabrous in the upper half, glabrous or sparsely hairy in the lower, venation not evident; abaxial surface much paler, matt, \pm glabrous, with 3–5 flat or slightly raised primary veins and significant secondary development, the midrib becoming wider and more prominent than the others towards the apex; margins of mature leaves not hyaline, or very narrowly so, coarsely ciliolate with short, stiff, antrorse hairs (24–42 along each margin), 0.5–0.15 mm long. *Inflorescences* erect; axis 1.2–2.4 mm long, single-flowered. *Fertile bract* broadly ovate to suborbicular, 1.3–2.2 mm long, 1.3–2.1 mm wide, closely subtended by 4–7 variously shaped, smaller sterile bracts. *Bracteoles* broadly elliptic to suborbicular, 1.7–2.3 mm long, 1.5–1.9 mm wide, obtuse, mucronulate, the mucro 0.05–0.10 mm long; abaxial surface glabrous, striate, pale green to straw-coloured, sometimes tinged pink towards the apex, narrowly scarious towards the margins; adaxial surface glabrous; margins glabrous. *Sepals* ovate or narrowly ovate, 4.0–4.8 mm long, 1.6–2.1 mm wide, obtuse, obscurely mucronulate, the mucro to 0.08 mm long; abaxial surface glabrous, pale green, tinged pink towards the apex, conspicuously striate with 9–11 raised veins, narrowly scarious towards the margins; adaxial surface glabrous except for a discrete patch of hairs close to the base; margins glabrous. *Corolla tube* green, cylindrical, or very narrowly campanulate, much exceeding the sepals, 6.6–10.1 mm long, 2.6–3.0 mm wide, internal surface with a \pm continuous whorl of dense hairs in the lower half (2.2–3.0 mm above the base), the hairs 0.8–1.1 mm long and issuing from unmodified tissue, glabrous elsewhere. *Corolla lobes* green, erect in the lower 2/3–3/4, recurved above, always shorter than the tube (ratio = 0.37–0.57:1), 3.4–4.0 mm long, 1.3–1.7 mm wide at base; indumentum of the central portion of the internal surface, 0.6–0.8 mm long, glabrous at the very base; glabrous tips 0.3–0.4 mm long. *Anthers* partially exerted from the tube (by 3/4–7/8 of their length), 1.8–2.2 mm long, apex deeply emarginate. *Filaments* flat, 0.8–1.2 mm long, 0.7–0.8 mm wide, attached *c.* 3/4 above anther base, tapering towards the apex, anther attachment at apex. *Nectary* annular, 0.4–0.6 mm long, entire or very shallowly and irregularly lobed. *Ovary* ellipsoid, 1.0–1.3 mm long, 0.8–1.0 mm wide. *Style* 10.0–13.2 mm long, shortly scabrous in the upper half. *Fruit* ellipsoid to \pm globose, 4.8–5.2 mm long, 3.9–4.8 mm wide, much longer than the calyx, the surface with a shallow, irregular reticulum. (Figure 6)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 24 June 2003, *A. Coates* AC 4664 (PERTH); 30 May 2010, *M. Hislop* 4019 (CANB, MEL, PERTH); 31 May 2010, *M. Hislop* 4022 (NSW, PERTH); 31 Oct. 2000, *R. Meissner* LB 52 (PERTH).

Distribution and habitat. *Astroloma chloranthum* appears to be restricted to a small area of the south-eastern wheatbelt between Newdegate and Pingrup (Figure 3). It usually occurs low in the landscape in sandy or sandy loam soils, probably with clay at depth, and is associated with mallee woodland where the understorey is typically dominated by various species of *Melaleuca*.



Figure 6. Scan of *Astroloma chloranthum* (PERTH 08213178). Scale = 5 cm.

Phenology. The onset of flowering is likely to be determined by soil moisture levels, but in average seasonal conditions peak flowering is probably between April and June, later if autumn rainfall has been light. Mature fruit has been collected in late June and could be expected to be present for much of the second half of the year.

Etymology. From the Greek *chloros* (green) and *anthos* (flower).

Conservation status. To be listed as Priority Two under DEC Conservation Codes for Western Australian Flora (M. Smith pers. comm.). Although all but one of the five known populations of this species are either in Nature Reserves or Water Reserves, the four observed by the author were small (<12 individuals) and very scattered. In addition dead plants were noted at each of the sites. The hotter summers and reduced rainfall that have been experienced in much of inland south-western Australia in recent decades are expected to be only a forerunner of more extreme conditions in the future (Watterson *et al.* 2007). This climatic scenario presumably represents an active threatening process for many plant species, but local endemics such as *A. chloranthum* would appear to be particularly vulnerable.

Affinities. Because of its similar leaf shape the species most likely to be confused with *A. chloranthum* is the widespread, red-flowered *A. compactum*. In addition to flower colour, *A. chloranthum* differs from that species in the following ways: has a low, spreading rather than strictly prostrate habit (but refer to next paragraph for a possible exception); a longer leaf mucro (1.4–2.0 mm compared to 0.6–1.4 mm in *A. compactum*); shorter bracteole and sepal mucros (0.05–0.10 mm and 0.02–0.08 mm respectively, as against 0.10–0.50 mm and 0.10–0.50 mm for *A. compactum*); corolla lobes which are glabrous at the base and with the inner corolla tube completely glabrous above the hair whorl, rather than the lobe bases having a sparse indumentum with a few hairs extending well into the throat of the corolla tube, which is the case for *A. compactum*. *Astroloma chloranthum* has a more inland distribution than *A. compactum*. On the basis of current knowledge the closest populations of the latter occur in the southern part of Lake Magenta Nature Reserve about 60–70 km south of the southernmost known population of *A. chloranthum*.

In aspects of its leaf morphology *A. compactum* is rather variable, and this variation has some geographical basis. Plants from the Darling Range (Figure 5), especially in the north, have narrower, more spatulate leaves which tend to have fewer and longer marginal hairs relative to those from the Great Southern district. A variant from the south coast (e.g. *J.M. Powell* 3313), which probably represents the type form, has glaucous or blue-green leaves which are more attenuate towards the apex and a corolla with somewhat denser hairs in the throat. Collecting notes suggest that, at least in some populations, this variant may have a low, ascending habit. In its foliar morphology *A. chloranthum* is most similar to those populations of *A. compactum* from the Great Southern district. DNA data; however, does not support any particularly close relationship between these two species (Punkte-Lelièvre *et al.* unpublished).

Notes. Outside of the genus *Acrotriche* R.Br., where green flowers are the norm, the only other Australian epacrids that have uniformly green corollas are *Styphelia viridis* Andrews and *Brachyloma scortechinii* F.Muell., both from New South Wales and southern Queensland. However, another locally endemic Western Australian species of *Astroloma*, *A. foliosum* Sond., has corolla lobes which are black in the basal half and bright green above. This is an important feature in distinguishing it from its close relative *A. ciliatum*, in which both the lobes and the tube are red. *Astroloma pinifolium* often has a multi-coloured corolla with combinations of yellow and green and/or red.

Astroloma inopinatum* Hislop, *sp. nov.

A. glaucescenti affinis sed habito grandiore, foliis rectis ellipticis (non linearibus convolutis) et floribus patentibus vel pendulis.

Typus: east of Kalbarri, Western Australia [precise locality withheld for conservation reasons], 24 July 2008, M. Hislop & G. Phelan MH 3778 (*holo*: PERTH 08056889; *iso*: CANB, NSW).

Astroloma sp. Galena (G. Phelan & A. Chant 9), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed March 2012].

Robust, spreading *shrubs* to 1.8 m high and 1.8 m wide, from a well-developed rootstock which is probably fire-tolerant. Young *branchlets* with a sparse to moderately dense indumentum of very short, patent hairs, *c.* 0.02 mm long. *Leaves* usually variably antrorse, but sometimes \pm patent, narrowly elliptic, 11–24 mm long, 1.9–3.6 mm wide; apex long-mucronate, pungent, the mucro 1.0–1.6 mm long; base attenuate; petiole moderately distinct, creamy yellow, 0.6–1.1 mm long, glabrous or with a few hairs on the adaxial surface; lamina 0.35–0.45 mm thick, concave adaxially, longitudinal axis \pm straight, or gently incurved; surfaces glaucous, \pm concolorous, or with the abaxial surface very slightly paler; adaxial surface matt or becoming shiny on older leaves though abrasion, glabrous throughout or sparsely hairy towards the base, venation not evident; abaxial surface matt, glabrous, with 5–7 conspicuous, white, slightly sunken, primary veins, the midrib no more prominent than the others; margins of mature leaves not hyaline or very narrowly so, \pm glabrous to very shortly and coarsely ciliate with hairs (>60 along each margin), to *c.* 0.02 mm long. *Inflorescences* widely spreading to slightly pendulous; axis 2.1–3.4 mm long, 1(2)-flowered, the surface usually exposed in the central portion above a basal cluster of sterile bracts. *Fertile bract* depressed-ovate, 1.2–1.4 mm long, 1.3–1.5 mm wide. *Bracteoles* suborbicular to depressed-ovate 1.6–2.0 mm long, 1.8–2.1 mm wide, obtuse, obscurely mucronulate, the mucro to 0.1 mm long; abaxial surface glabrous, striate, pale green to straw-coloured, sometimes flushed pink towards the apex, becoming scarious towards the margins; adaxial surface glabrous; margins glabrous. *Sepals* ovate or narrowly ovate, 3.3–4.0 mm long, 1.8–2.0 mm wide, obtuse, obscurely mucronulate, the mucro <0.08 mm long; abaxial surface glabrous, straw-coloured, tinged pink towards the apex, \pm striate with 7–9 veins, becoming scarious towards the margins; adaxial surface glabrous except for a small, obscure patch of hairs close to the base; margins glabrous. *Corolla tube* reddish pink, very narrowly campanulate, much exceeding the sepals, 6.5–7.5 mm long, 3.0–3.4 mm wide, internal surface with a \pm continuous whorl of dense hairs in the lower half (1.7–2.0 mm above the base), the hairs 1.0–1.7 mm long and issuing from and between 5 short, irregular projections, a few hairs also scattered in the upper half of the tube. *Corolla lobes* pink, erect in the lower 2/3–3/4, recurved above, always shorter than the tube (ratio = 0.60–0.66:1), 4.0–4.5 mm long, 1.8–2.0 mm wide at base; the indumentum of the central portion of the internal surface, 0.7–1.0 mm long; glabrous tips *c.* 0.4 mm long. *Anthers* partially exerted from tube (by *c.* 7/8 of their length), 1.8–2.0 mm long, apex deeply emarginate. *Filaments* flat, 1.2–1.5 mm long, 0.5–0.6 mm wide, attached *c.* 2/3 above anther base, the apex bilobed above the point of anther attachment. *Nectary* annular, 0.5–0.6 mm long, shallowly and irregularly lobed. *Ovary* ovoid, 1.3–1.4 mm long, 0.9–1.0 mm wide. *Style* 8.5–10.0 mm long, shortly scabrous throughout. *Immature fruit* ellipsoid or broadly ellipsoid, much longer than the calyx, the surface with a shallow, irregular reticulum. (Figures 7, 8)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 5 Aug. 2010, A. Chant 1072 (CANB, PERTH); 13 Feb. 2007, G. Phelan & A. Chant 9 (PERTH).



Figure 7. Scan of holotype of *Astroloma inopinatum* (PERTH 08056889). Scale = 5 cm.



Figure 8. *Astroloma inopinatum*. Leaves and flower (unvouchered). Photograph by E.A. Brown.

Distribution and habitat. Known from a decomposed granite breakaway north of the Murchison River, east of Kalbarri National Park (Figure 3), growing in rocky, brown loam. The associated vegetation is open shrubland dominated by *Acacia acuminata*, *A. tetragonophylla*, *Hakea recurva*, *Dodonaea inaequifolia* and *Eremophila clarkei*.

Phenology. As with most early-flowering epacrids, especially those from the drier parts of southwestern Australia, flowering is, in large part, governed by the rainfall pattern through the preceding summer–early autumn period. In the Kalbarri area rainfall is particularly variable during that time of year and flowering might be expected any time between March and July. Mature fruit is likely to be present for much of the second half of the year.

Etymology. The epithet is from the Latin *inopinatus* (unexpected), a reference to the atypically large growth habit for a member of this genus, and to the collection site, which represents an unusual habitat for members of the *Styphelioideae* generally in Western Australia.

Conservation status. Currently known only from a single, small population on an active pastoral lease. Listed by Smith (2012) as Priority One under DEC Conservation Codes for Western Australian Flora, under the phrase name *Astroloma* sp. Galena (G. Phelan & A. Chant 9).

Affinities. The combination of large growth habit and glaucous, narrowly elliptic, concave leaves, together with the relatively small, spreading pink flowers make this a particularly distinctive species. Potential close allies within the genus are not apparent. *Astroloma glaucescens* Sond. bears some superficial resemblance, in that it also has narrow, glaucous leaves which lack the stout, marginal hairs characteristic of many members of the genus. However, it is readily separated by its much smaller stature, twisted, linear leaves and erect, orange-red flowers.

Notes. The above description of the flowers is based on limited material. The two fertile specimens examined are essentially in fruit, although the type does have a few flowers at or just post anthesis. The fruit are at various stages of development but some appear close to maturity. Because of the uncertainty measurements were not given in the formal description, but the largest fruits on *A. Chant* 1072 are 5–6 mm long by 4–5 mm wide.

Astroloma inopinatum is one of the largest species in the genus, reaching a height of at least 1.8 m.

Astroloma oblongifolium A.J.G. Wilson & Hislop, *sp. nov.*

A. pallido affinis sed marginibus foliorum recurvis vel revolutis, marginibus sepalorum ciliatis differt.

Typus: South Eneabba Nature Reserve, Beros Road 1.8 km from Brand Highway, Western Australia, 11 April 2010, *M. Hislop* 3999 (*holo:* PERTH 08270988; *iso:* CANB, NSW, MEL).

Astroloma sp. Cataby (E.A. Griffin 1022), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed March 2012].

Open or straggling *shrubs*, sprawling to erect, to 30 cm high, resprouting after fire from a stout rootstock. Young *branchlets* with a dense indumentum of translucent white hairs *c.* 0.1 mm long, patent or reflexed up to 45°. *Leaves* crowded near branchlet apices, steeply antrorse to antrorse-appressed, narrowly oblong-elliptic to narrowly obovate, 5–18 mm long, 2–4 mm wide; apex long-mucronate, pungent, the mucro 0.5–1 mm long; base cuneate; petiole ± distinct, grading into lamina, greenish yellow, 0.5–1.5 mm long, glabrous or very sparsely hairy; lamina 0.30–0.45 mm thick, convex adaxially, longitudinal axis ± straight; surfaces discoloured; adaxial surface dull grey-green, ± glaucous, glabrous or hairy with a sparse to moderately dense indumentum of variously orientated hairs to *c.* 0.3 mm long, venation not visible; abaxial surface paler, with sparse to moderately dense, minute, patent hairs to 0.05 mm long or sometimes glabrous, with 5–9 slightly raised primary veins and midrib no more prominent than the others; margins recurved to almost revolute, either eciliate or with sparse to dense, irregularly spaced cilia up to 0.5 mm long. *Inflorescences* erect; axis 2.0–3.5 (–6) mm long, single-flowered (one 2-flowered inflorescence seen), flattened portion of axis above the flower and bud-rudiment very reduced, usually completely concealed by subtending bracts. *Fertile bract* broadly to depressed-ovate, 1.6–2 mm long, 1.8–2.1 mm wide, subtended by 8–14 variously shaped, smaller sterile bracts. *Bracteoles* broadly ovate, 2.6–4.5 mm long, 2.5–3.5 mm wide, obtuse to subacute, mucronate, the mucro 0.3–0.4 mm long; abaxial surface cream-yellow in upper half, cream-green towards base, striate, variably hairy, ranging from sparse, appressed hairs in upper half to dense, patent hairs over entire surface or between the veins only; adaxial surface glabrous; margins scarious, ciliate. *Sepals* ovate to obovate, 5.5–10.5 mm long, 2.6–3.7 mm wide, subacute or acute, mucronate, the mucro to 0.5 mm long; abaxial surface hairy with a sparse to dense indumentum of ± erect hairs between the veins, pale yellow, conspicuously striate with 11–15 veins; adaxial surface glabrous except for a tuft

of sparse, appressed hairs near the base; margins scarious, ciliate throughout, or at least in the upper half, with hairs to *c.* 0.7 mm long. *Corolla tube* pale yellow throughout, cylindrical or very narrowly campanulate, from a little shorter than, to a little longer than the sepals, 6.0–9.5 mm long, 2.3–3.5 mm wide, internal surface with a \pm continuous whorl of dense hairs in the lower half (1.5–2.0 mm above the base), the hairs 1.5–2.0 mm long, issuing from slightly thickened underlying tissue, glabrous above and then with hairs in the throat. *Corolla lobes* pale yellow, erect in the lower 2/3–3/4, recurved above, always shorter than the tube, although sometimes barely (ratio = 0.64–0.94:1), 4.5–8.0 mm long, 1.5–2.0 mm wide at base; the indumentum of the central portion of the internal surface 1–2 mm long; glabrous tips 0.5–1.5 mm long. *Anthers* exerted from the tube for most of their length, 1.8–2.8 mm long; apex emarginate. *Filaments* flat, 1.0–2.5 mm long, 0.5–1.0 mm wide, attached 1/2–3/4 above the anther base, the apex truncate to bilobed above the point of anther attachment. *Nectary* annular, 0.50–0.75 mm deep, margin entire or lobed for up to 1/2 of length. *Ovary* ovoid to ellipsoid, bluntly 5-angled, 0.9–1.5(–2.0) mm long, 0.8–1.4 mm wide. *Style* 8.5–12 mm long, minutely scabrous in upper half. *Fruit* ellipsoid, *c.* 5.5–6.5 mm long and 3–4 mm wide (but refer comment under notes below), slightly longer than the calyx, the surface with a shallow, irregular reticulum. (Figure 9)

Other specimens examined. site 2, 11.5 km S of Cachionalgo Hill, off Bindoon–Dewars Pool Rd, 7 Nov. 1996, M.G. Allen 194 (PERTH); site 4, off Trig Rd – (E of), 22 km SSE of Bindoon, 18 Nov. 1996, M.G. Allen 1164 (PERTH); 8 miles [*c.* 12.9 km] W of Calingiri, 24 Apr. 1959, T.E.H. Aplin 455 (PERTH); Mt Lesueur, near trig on summit; Mount Lesueur National Park, 1 Oct. 1997, E.A. Brown & G. Taaffe 97/149 (NSW, PERTH); 5 km SSW of Ironstone Knoll [Coomallo Nature Reserve], 21 June 1996, R. Davis 1414 (PERTH); 17 miles N of Regans Ford, 3 miles E of main road, 18 Feb. 1970, A.S. George 9820 (NSW, PERTH); off Jurien Rd, near Mt Benia, E of Jurien, 2 June 1978, E.A. Griffin 1022 (PERTH); proposed Mount Lesueur Reserve, S of Mt Peron, 21 May 1981, E.A. Griffin 3150 (PERTH); Hi Vallee property (D. & J. Williams) Warradarge, near intersection of track and boundary fenceline along NE boundary of main bush block, 1 May 2000, M. Hislop 2005 (PERTH); Coomallo Nature Reserve, S boundary fire break, 1.1 km SW of Brand Hwy, 11 Aug. 2009, M. Hislop 3909 (CANB, PERTH); Badgingarra National Park, *c.* 500 m along walk trail W of Brand Hwy, W of Badgingarra township, 11 Apr. 2010, M. Hislop 3997 (PERTH); near Bindoon, 50 miles [*c.* 80 km] NE of Perth, in the ranges, 16 Aug. 1964, D. Lewis 9 (NSW); 7 miles [*c.* 11.3 km] from Bindoon, 50 miles [*c.* 80 km] NE of Perth, 27 Apr. 1957, H.C. Lewis 34 (CANB, K, PERTH); 10 km S of hotel at New Norcia, E side of road, 13 May 1991, S. Patrick 545 (PERTH); 50 m W of NE corner of Nature Reserve 27595, at NE corner of Bindoon Army Training Area, 5 June 1991, S. Patrick 547 (PERTH); Reserve 28184 C6, 1.5 km E of parking bay, NW corner Bindoon Army Training Area, S side of road and for *c.* 100 m into reserve from road, 27 June 1991, S. Patrick 553 (PERTH); track to Mt Lesueur, 11 July 1982, J.M. Powell 1762 (K, NSW, PERTH); Old Plains Rd, 8.3 km [S] from Calingiri Rd, 4 July 2010, C. Puente-Lelièvre & E.A. Brown CPL 39 (NSW, PERTH); S of New Norcia, Nature Reserve on W side of Great Northern Hwy, 25 May 1989, A.J.G. Wilson 193, 194 (PERTH); NW corner of Bindoon Army Training Area NE of Bindoon town, 25 May 1989, A.J.G. Wilson 197 (PERTH); Eneabba CRA mine site, 23 June 1989, A.J.G. Wilson *s.n.* (PERTH).

Distribution and habitat. Found from Eneabba south to the Julimar State Forest, SSE of Bindoon (Figure 3). Grows in sandy soils over laterite, in open heath in the north of its range to woodlands dominated by *Eucalyptus wandoo* or *Corymbia calophylla* in the south.

Phenology. The main flowering period is May, although flowers have been recorded from February to July. Little fruiting material has been collected but mature drupes should be present about two months after flowering.



Figure 9. Scan of *Astroloma oblongifolium* (PERTH 08270953). Scale = 5 cm.

Etymology. The name refers to the apparent oblong shape of the leaves, which is accentuated by the recurved to revolute margins.

Conservation status. This species was previously assigned a Priority Four DEC Conservation Code. However, as a result of extensive survey in the last 20 years, it is now known to have a wide distribution and range of habitats, including in many Nature Reserves and National Parks. Therefore it is no longer considered of conservation significance.

Affinities. Most collections of this species have been previously assigned to *A. pallidum*, on the basis of a similar flower colour and growth habit. *Astroloma oblongifolium* differs primarily from *A. pallidum* in having recurved or revolute rather than adaxially concave leaves. And whereas the sepal margins of the new species are manifestly ciliate, those of *A. pallidum* are essentially glabrous — occasionally a few short hairs may be present about the base of the mucro. *Astroloma oblongifolium* and *A. pallidum* can be found in the same habitats across all but the northernmost part of the range of *A. oblongifolium*, but no apparent hybrids have been found. The peak flowering times for the two species differ, with *A. oblongifolium* flowering mainly in autumn and early winter, and *A. pallidum* mainly in late spring.

Notes. The description of the fruit given in the text above is based on a single collection and therefore cannot be regarded as definitive.

This species has a disjunct distribution with a southern population node in the northern Darling Range and a northern node closer to the coast on the Geraldton Sandplains. Plants from these two areas exhibit some differences, at least in their foliar morphology. Relative to those from the southern populations, plants from the Geraldton Sandplains (the type form) have generally hairier leaves (both surfaces being moderately to densely hairy) which are more abruptly contracted below the apical mucro. Some collections from the Mount Lesueur area however differ in this regard in having more or less glabrous leaves. The southern variant of the species is rather poorly known, most collections being either sterile or with only one or two old flowers present. In addition, only one fruiting collection of the species (this of the type form) has been made. This limits our capacity, at this stage, to fully assess other potential differences between the two forms.

Acknowledgements

We would like to thank the following people who assisted in the preparation of this paper: Skye Coffey for technical support, Juliet Wege for providing the distribution map and Paul Wilson for the Latin diagnoses and taxonomic advice. We are also grateful to Fred and Jean Hort and Elizabeth Brown for providing photographs.

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