Nuytsia The journal of the Western Australian Herbarium

24: 269–306 Published online 27 November 2014

An update to the taxonomy of some Western Australian genera of Myrtaceae tribe Chamelaucieae. 3. *Thryptomene*

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Abstract

Rye, B.L. An update to the taxonomy of some Western Australian genera of Myrtaceae tribe Chamelaucieae. 3. *Thryptomene*. *Nuytsia* 24: 269–306 (2014). Fifteen new species of *Thryptomene* Endl. that belong to sect. *Astraea* Stapf *s. lat.* are described: *T. caduca* Rye & Trudgen, *T. calcicola* Rye, *T. dampieri* Rye, *T. globifera* Rye, *T. hubbardii* Rye & Trudgen, *T. nitida* Rye & Trudgen, *T. orbiculata* Rye & Trudgen, *T. pinifolia* Rye & Trudgen, *T. podantha* Rye & Trudgen, *T. repens* Rye & Trudgen, *T. shirleyae* Rye, *T. spicata* Rye & Trudgen, *T. stapfii* Rye & Trudgen, *T. velutina* Rye & Trudgen and *T. wannooensis* Rye. A key is supplied for sect. *Astraea* and line illustrations or images for seven of the new taxa. *Thryptomene urceolaris* F.Muell. is selected as the lectotype of *T.* sect. *Thryptocalpe* Stapf. Lectotypes are also selected for *T. stenophylla* F.Muell. and for *Scholtzia decandra* F.Muell., which is a synonym of *T. saxicola* (A.Cunn. ex Hook.) Schauer. Most of the new taxa are conservation-listed. Species or species groups needing further study are noted.

Introduction

This paper, the third in a series describing clearly defined new species and subspecies of Myrtaceae tribe Chamelaucieae DC., deals with *Thryptomene* Endl. It gives descriptions of 15 new Western Australian species belonging to sect. *Astraea* Stapf *s. lat*. All but two of these new taxa are listed as having priority for conservation.

A number of other new taxa currently included in *Thryptomene* are omitted from this paper because their generic placement is still not certain. Other taxa are omitted because they belong to complexes that need further study or because they are too poorly known at present to describe adequately.

A lectotype is selected for *T.* sect. *Thryptocalpe* Stapf; this is particularly important as one of the three species originally cited is now considered to be a taxonomic synonym of the type species of *T.* sect. *Paryphantha* (Schauer) Stapf. Lectotypes are also selected for two of the published names within *T.* sect. *Astraea*. The same methods are used as outlined in the first paper of this series (Rye 2013).

Background

The earliest botanical specimens originating from Australia, including one of a species of *Thryptomene*, were collected by William Dampier at Shark Bay on the central, western coast of Australia in August

http://florabase.dpaw.wa.gov.au/nuytsia/
ISSN 2200-2790 (Online)
ISSN 0085-4417 (Print)

1699 (George 1971). Almost 130 years were to pass before any members of the genus were described and almost 140 years before the genus itself was named.

De Candolle (1828) described the species that had been collected by Dampier, naming it *Baeckea micrantha* DC. However, this epithet cannot legitimately be transferred to *Thryptomene* because the name *T. micrantha* J.D.Hook. was subsequently published (Hooker 1853) for an eastern Australian species. Surprisingly, Dampier's species has remained without any legitimate name and hence is described here as *T. dampieri* Rye.

Two further species that were named by Hooker (1832) and Lindley (1838) under the genus *Baeckea* L. are now known as *T. saxicola* (A.Cunn. ex Hook.) Schauer and *T. calycina* (Lindl.) Stapf respectively. The former occurs along the south coast of south-western Australia and is widespread in cultivation, while the latter is an eastern Australian species.

There followed a burst of publication of generic names (see Table 1), from late 1838 to 1846. *Thryptomene* Endl. *nom. cons.*, based on *T. australis* Endl., was shortly preceded by the description of *Gomphotis* Raf. *nom. rej*. based on Hooker's species. Two further generic names, *Astraea* Schauer *nom. illeg.* (published by Schauer 1843) and *Bucheria* Heynh. *nom. illeg.*, were based on the same type species as *Gomphotis*; however, Schauer (1844) soon transferred the type species of *Astraea* to *Thryptomene*. Schauer also named *Paryphantha* Schauer in 1843, based on *T. calycina*.

In his *Flora Australiensis* treatment of Myrtaceae, Bentham (1867) adopted a broad circumscription of *Thryptomene*, incorporating *Gomphotis* and *Paryphantha* and also several new species groups. Stapf (1924) placed most of the species of *Thryptomene s. lat.* in five sections (Table 1), including two new groups, sect. *Oligandra* Stapf (based on *T. oligandra* F.Muell.) and sect. *Thryptocalpe* (based on three species including *T. urceolaris* F.Muell.). Stapf excluded some species that have recently (Rye & Trudgen 2000) been transferred to *Aluta* Rye & Trudgen, such as *A. aspera* (E.Pritz.) Rye & Trudgen. He was also unsure whether his last section, sect. *Paryphantha*, should be included in *Thryptomene* or treated as a distinct genus.

Table 1. The generic and sectional names that have been applied to six species groups included in *Thryptomene* by Bentham (1867).

Generic name and year of publication	**Section (Stapf 1924)**	**Current name of type species**
Thryptomene Endl. (1838)	sect. *Thryptomene*	*T. australis* Endl.
Gomphotis Raf. (1838) *Astraea* Schauer *nom. illeg.* (1843) *Bucheria* Heynh. *nom. illeg.* (1846)	sect. *Astraea* Stapf ditto ditto	*T. saxicola* (A. Cunn ex Hook.) Schauer
–	sect. *Thryptocalpe* Stapf	*T. urceolaris* F.Muell.*
–	sect. *Oligandra* Stapf	*T. oligandra* F.Muell.
Paryphantha Schauer (1843)	sect. *Paryphantha* (Schauer) Stapf	*T. calycina* (Lindl.) Stapf
Aluta Rye & Trudgen (2000)	–	*A. aspera* (E.Pritz.) Rye & Trudgen

*newly selected lectotype (see below)

Current studies

The first publication resulting from current studies of *Thryptomene s. lat.* established the genus *Aluta*, which is widespread in arid and semi-arid regions of Australia (Rye & Trudgen 2000). Shortly afterwards the typical section of *Thryptomene* was revised (Rye & Trudgen 2001). As noted in those two papers, the typical anther morphology found in sect. *Thryptomene* is also found in sect. *Astraea*; however, some differences are found in the anthers and fruits of sections *Paryphantha* and *Thryptocalpe*. *Aluta* has both a unique anther morphology and distinctive reticulate pitting on its ovary summit.

Thryptomene sect. *Astraea sensu* Stapf (1924) is far larger and more variable than sect. *Thryptomene* and may need to be split into a number of sections. A molecular cladogram based on chloroplast DNA sequence data (Wilson *et al.* 2004) included samples of two of the species of sect. *Astraea s. lat.*, *T. denticulata* (F.Muell.) Benth. and the type species *T. saxicola*. These formed a strongly supported monophyletic group but did not group with two species with atypical anther and/or fruit morphology. However, unpublished molecular studies sampling a greater range of species and using ETS as well as chloroplast sequence data have indicated that species of all of these groups do belong in the same overall clade (Peter G. Wilson pers. comm. 2004).

Need for further work

Most of the informal names that are listed on Western Australia's vascular plant census (Western Australian Herbarium 1998–) for *Thryptomene* sect. *Astraea* (see Table 2) are being removed from use by the publication of new species here. Another one, *T.* sp. Geraldton (H. Demarz 5145), is a synonym of *T. baeckeacea* F.Muell. *s. str.* Three of the four remaining informal names, *T.* sp. Carrarang (M.E. Trudgen 7420), *T.* sp. Lancelin (M.E. Trudgen 14000) and *T.* sp. Red Bluff (A.G. Gunness 2358), apply to the highly variable *T. baeckeacea* species group, which needs further study to determine how many taxa should be formally recognised. Another taxon, *T.* sp. Eagle Gorge (A.G. Gunness 2360), is too similar to *T. caduca* Rye & Trudgen for its status to be clear. Variability within a number of other taxa within *T.* sect. *Astraea*, such as *T. hyporhytis* Turcz., also needs more study to determine whether any of the variants warrant formal recognition.

Two of the informal names, both established in 2004, apply to members of sect. *Thryptomene*. *Thryptomene* sp. Coolgardie (E. Kelso s.n. 1902) is a very poorly known, possibly extinct, variant in the *T. mucronulata* Turcz. group, while *T.* sp. Leinster (B.J. Lepschi 4362 & L.A. Craven) is one of three main variants of the *T. decussata* (W.Fitzg.) J.W.Green group. The status of the variants in both groups needs further study.

One new species belonging to sect. *Thryptocalpe*, and two that belong to, or are at least similar to, sect. *Paryphantha* are currently recognised as *T.* sp. Londonderry (R.H. Kuchel 1763), *T.* sp. Mt Clara (R.J. Cranfield 11702) and *T.* sp. Wandana (M.E. Trudgen 22016). All three are well defined but their generic placement in *Thryptomene* needs confirmation.

Table 2. Informal names recognised on Western Australia's vascular plant census for *Thryptomene* sect. *Astraea s. lat.*, with the year established and formal names published here.

Informal name	Year	Formal name
T. strongylophylla subsp. Tamala (M.E. Trudgen 7384)	1994	*T. caduca* Rye & Trudgen
T. sp. Billabong (M.E. Trudgen 12858)	2008	*T. podantha* Rye & Trudgen
T. sp. Carnamah (J. Borger, A. Dring 1510-25 & F. Falconer)	2009	*T. shirleyae* Rye
T. sp. Carrarang (M.E. Trudgen 7420)	1994	–
T. sp. Eagle Gorge (A.G. Gunness 2360)	1996	–
T. sp. East Yuna (J.W. Green 4639)	1994	*T. hubbardii* Rye & Trudgen
T. sp. Eneabba (R.J. Cranfield 8433)	1994	*T. spicata* Rye & Trudgen
T. sp. Eurardy (D. & B. Bellairs 1649)	1994	*T. pinifolia* Rye & Trudgen
T. sp. Geraldton (H. Demarz 5145)	1996	= *T. baeckeacea* F.Muell.
T. sp. Greenough River (J. Docherty 169)	2010	*T. orbiculata* Rye & Trudgen
T. sp. Kalbarri limestone (D. & B. Bellairs 1652 A)	2008	*T. calcicola* Rye
T. sp. Lancelin (M.E. Trudgen 14000)	1996	–
T. sp. Mingenew (Diels & Pritzel 332)	1996	*T. nitida* Rye & Trudgen
T. sp. Moresby Range (A.S. George 14873)	1999	*T. stapfii* Rye & Trudgen
T. sp. Red Bluff (A.G. Gunness 2358)	2003	–
T. sp. Steep Point (M.E. Trudgen 7421)	1994	*T. repens* Rye & Trudgen
T. sp. Tamala (M.E. Trudgen 7384) = *T. strongylophylla* subsp. Tamala	1996	*T. caduca* Rye & Trudgen (see above)
T. sp. Yuna Reserve (A.C. Burns 100)	1996	*T. velutina* Rye & Trudgen

Lectotypifications

Scholtzia decandra F.Muell., *Fragm.* 4: 75 (1864). *Type citation*: 'In locis arenosis et rupestribus ad sinum Doubtful Bay et in insula Bald Island, Oldfield; ad rivum Robertson's Brook et ad fluvium Gardner River et prope Kalgan, Mx.' *Type specimens*: Kalgan River, [Western Australia], *G. Maxwell s.n.* (*lecto*: MEL 70797, here designated); Mt Gardner, [Western Australia], *G. Maxwell s.n.* (*syn*: MEL 70789); Robertson's Brook, [Western Australia], *G. Maxwell s.n.*, (*syn*: MEL 70788); Bald Island, [Western Australia], *A.F. Oldfield s.n.*, (*syn*: MEL 70791 & 70792); Doubtful Bay, [Western Australia], *A.F. Oldfield s.n.* (*syn*: MEL 70792 & 70793).

Typification. Mueller (1864) based his description of this taxon on collections made at two localities by Augustus Oldfield and at three localities by George Maxwell, making use of both fruiting and flowering material obtained by both collectors. Oldfield's specimens could not have been suitable to describe the flowers at anthesis as those from Doubtful Bay (MEL 70792 & 70793) are in early bud and those from Bald Island (MEL 70791 & 70792) have mostly bare peduncles, with just a few fruits attached.

Maxwell's specimens have either copious flowers or copious fruits. The best of the flowering specimens is that from Kalgan River, which is selected as the lectotype. A second flowering specimen is from Mt Gardner (MEL 70789) and the last of Maxwell's specimens, from Robertson's Brook (MEL 70788), is in fruit.

Notes. The reason Mueller (1864) described the species as a *Scholtzia* Schauer rather than a *Thryptomene* may have been because he considered it to have two loculi in the ovary, based apparently on his dissections of the fruit. However, as noted below in the section describing characteristics of sect. *Astraea*, the one-locular ovary in this plant group develops a hard partition across half of its diameter in fruit, which gives the impression that two loculi are present. Mueller's description of the seed as 'renata-ovatum' and his detailed description of the embryo shows that he did observe at least one mature seed.

Scholtzia decandra is currently regarded as a synonym of *T. saxicola*, a very widespread and variable taxon with two major disjunctions in its known range. The largest disjunction occurs between Fitzgerald River National Park and the Esperance area.

Thryptomene stenophylla E.Pritz. *in* L. Diels & E. Pritzel, *Bot. Jahrb. Syst.* 35: 412–413 (1904). *Type citation*: 'in distr. Irwin pr. Chapman River in fruticetis subcarcareis flor. m. Jun. (E. PRITZEL Pl. Austr. occ. 419; D. 3217).' *Type specimens*: near Chapman River, [Western Australia,] June 1901, *E. Pritzel* 419 (*lecto*: B 10 0294626, here designated; *isolecto*: A 00112582, BM 001015109, BR 0000005304738, GH 00071576, M 0137544, NSW 531325, PH 00030009, S-G-6087 and US 00118347); near Chapman River, [Western Australia], 27 June 1901, *L. Diels* 3217 (*syn*: PERTH 01096435 & 01096842).

Typification. Two collections are cited in the protologue of *T. stenophylla*, *E. Pritzel* 419 and *L. Diels* 3217. Numerous duplicates of the former are currently available through *Global Plants* (see http://plants.jstor.org/), including an NSW specimen (NSW 531325) annotated as the lectotype by John Green (determinavit dated 2 February 1984); however, this lectotypification was never published. Only two duplicates of Diels' collection are known, both of which were acquired from B by Charles Gardner before World War II and brought back to PERTH. The Myrtaceae collection at B was subsequently largely destroyed (Botanischer Garten und Botanisches Museum Berlin-Dahlem 2014), although Pritzel's duplicate of *T. stenophylla* is still extant (B 10 0294626). This specimen is selected as the lectotype since Diels and Pritzel were based at B and duplicate material of that collection is widely distributed.

Thryptomene sect. **Thyptocalpe** Stapf, *Curtis's Bot. Mag.* 149: t. 8995 (1924). *Type*: *Thryptomene urceolaris* F.Muell., lectotype here designated.

Typification. Stapf (1924) listed three *Thryptomene* species for sect. *Thryptocalpe*: *T. tenella* Benth. [= *T. cuspidata* (Turcz.) J.W.Green], *T. urceolaris* and *T. thymifolia* Stapf [= *T. calycina*]. The first two species, both from Western Australia, are closely related and match the protologue well, whereas the last is a synonym of *T. calycina*, the type species of *Paryphantha*, which Stapf reduced to a section of *Thryptomene*. One of the two Western Australian species is therefore selected here as the lectotype.

Characteristics of *Thryptomene* sect. *Astraea s. lat.*

Thryptomene sect. *Astraea s. lat.* is restricted to Western Australia, extending from Cape Range south to Cape Leeuwin and south-east to Cape Arid, with the main concentration of species in the northern sandplains of the South West Botanical Province. Although Bean (1997) also included the Northern Territory species *T. remota* A.R.Bean in sect. *Astraea*, that species differs in stamen arrangement from all the Western Australian species, having its ten stamens arranged opposite the sepals and petals rather than alternating with them. It also differs in having a white rim on the sepals and it has white petals, whereas Western Australian species have pale to deep pink petals, or (in *T. saxicola*) either

white or pink petals. Unpublished molecular data (Peter G. Wilson pers. comm.) show *T. remota* to be allied to the white-flowered Queensland species *T. oligandra*, suggesting that it should be placed in sect. *Oligandra*. It should be noted, however, that there are many morphological differences between *T. remota* and *T. oligandra*.

Habit and leaves. All of the species placed in *T.* sect. *Astraea s. lat.* are glabrous shrubs with opposite and decussate, sessile or shortly petiolate leaves. The leaf blades are more or less concolorous, with one or more irregular longitudinal rows of oil glands on each side of the midvein on the abaxial surface. The two central rows, i.e. the ones on either side of the midvein, tend to have the most numerous and/or largest glands.

Flowers. The flowers are separated by little or no pedicel from a pair of bracteoles but usually have a distinct peduncle below the bracteoles. They have five sepals and petals, the outer sepals tending to have slight auricles. The stamens are commonly ten and either uniformly spaced, alternating with the sepals and petals, or in pairs opposite the sepals. Some species or specimens have variable, lower numbers of stamens down to five per flower, or consistently have five stamens. In all cases where the number is reduced to five, the stamens are antisepalous, but where there are intermediate numbers of six to nine, the stamens tend to be somewhat irregular in their arrangement, often with two partially fused stamens opposite one of the sepals. Anthers are dorsifixed to a more or less terete filament and are wider than long, with basally divergent, obovoid or broadly obovoid thecae. The ovary is fully inferior and one-locular, with the style terminal. There are two collateral ovules, with a slight ridge between them.

Fruits. Fruits are fully inferior (except for the shallow bulge formed by the convex summit) and indehiscent. Usually, most of the fruits fail to produce a seed, the few fertile ones being one-seeded and depressed- or very depressed-obovoid. Fertile fruits have a large, transversely reniform or similarly compressed loculus curved around much of the circumference of the fruit and a very hard section that extends inwards to the centre of the fruit, forming a thick partition. This hard partition seems to be formed by growth of the slight ridge that separates the two ovules in the ovary. The fruit wall is also very hard. Infertile fruits tend to become spherical and somewhat larger than the fertile fruits, and they are very hard throughout, making them difficult to dissect.

Like the fruit loculus, the enclosed seed is broader than long, usually transversely reniform. It has a membranous, pale to golden brown testa.

Chromosome numbers. The most common chromosome number within *T.* sect. *Astraea s. lat.* is $n = 11$ but some reduced dysploid numbers of $n = 9$ and $n = 10$ and tetraploid numbers of $n = 18$ and $n = 22$ have also been recorded (see Rye 1979). This variation in number is of some taxonomic value in separating species and probably also in limiting hybridisation. Breeding barriers appear to be well developed in sect. *Astraea* as no natural hybrids have been reported within the section despite a number of co-occurring species pairs being known.

Key to species of *Thryptomene* sect. *Astraea s. lat.*

1. Sepals widely spreading or with distal half widely spreading in fruit, more than half as long as to slightly exceeding the petals

2. Leaves long-linear in outline, thick; apical point recurved, *c*. 1 mm long. Stamens 7 or 8, almost equidistant, irregularly arranged in relation to the sepals and petals (Kalbarri NP) ..... **T. pinifolia**

2: Leaves depressed-ovate or circular to almost linear, not very thick but with margins incurved; apical point absent or up to 0.3 mm long. Stamens usually 10 alternating with the sepals and petals, occasionally 9, with one pair of stamens reduced to a solitary antisepalous stamen

3. Sepals with an oil-dotted, herbaceous, keel and scarious margins. Stamens *c.* 1/3 as long as the petals (East Yuna NR–Indarra Springs NR)..... **T. hubbardii**

3: Sepals without an obvious keel, rather petaloid. Stamens 1/2–2/3 as long as the petals

4. Leaves very narrowly to broadly obovate, rarely almost circular, the broadest ones 1–2.5 mm wide. Flowers 3.5–6 mm diam. Stamen filaments 0.7–1.3 mm long (N of Geraldton–Kulin) ..... **T. racemulosa**

4: Leaves broadly ovate to depressed-obovate, often ± circular, the broadest ones 2.3–3.3 mm wide. Flowers 5–8 mm diam. Stamen filaments 1.2–1.6 mm long (East Yuna NR–E of Walkaway)..... **T. orbiculata**

1: Sepals fairly erect to tightly closed inwards in fruit, much shorter than petals in many species but more than half the length of the petals in a few species

5. Flower buds with apex concave to flat. Bracteoles mostly persistent in mature fruit and sepals closed almost horizontally in fruit

6. Leaves 5–12 times longer than wide, not keeled. Hypanthium pitted in fruit

7. Leaves with 2 or 3 main rows of oil glands on each side of the midvein; glands 20–40 per row. Sepals glossy (Kalbarri NP)..... **T. calcicola**

7: Leaves with 1 or 2 main rows of oil glands on each side of the midvein; glands 8–15 per row. Sepals dull (Chapman River area) ..... **T. stenophylla**

6: Leaves ranging from slightly wider than long to 4 times longer than wide, often strongly keeled. Hypanthium smooth in fruit or with irregular wrinkles and bumps, sometimes pitted in between

8. Hypanthium smooth in fruit (near Irwin River–Mingenew–Arrino) ..... **T. nitida**

8: Hypanthium rugose in fruit

9. Leaves 2.5–7 × 0.7–2 mm, much longer than broad. Seed (where known) 1.5–1.7 mm across (Cape Range NP–Kalbarri NP)…….. ..... **T.** spp. **aff. baeckeacea***

9: Leaves 1.2–3(–3.5) × 0.6–2.2 mm long, *c.* 1/2 as broad as long to broader than long. Seed (where known) 1.2–1.5 mm across

10. Leaves with 1 or 2 rows of prominent oil glands on each side of midvein. Hypanthium pitted-rugose, without any obvious longitudinal markings. Occurring in hilly terrain (Hutt River–Chapman River area)…..... **T. baeckeacea**

10: Leaves often with 3–5 rows of oil glands on each side of midvein. Hypanthium irregularly wrinkled or grooved longitudinally. Occurring on coastal dunes and limestone (Exmouth area–Dirk Hartog Island–Hamelin Pool) ..... **T. dampieri**

5: Flower buds with apex convex to conic or flat in most species, but concave to flat in *T. podantha*. Bracteoles caducous to persistent, if persistent then sepals fairly erect or only loosely closed inwards in fruit

11. Hypanthium ribbed in flower, becoming smooth or almost smooth in mature fruit, if not fully smooth then with a distinct pedicel as well as a peduncle

*including **T.** sp. **Carrarang**, **T.** sp. **Red Bluff** and long-leaved specimens from Cape Range

12. Bracteoles persistent after fruits fall. Petals 3–3.5 mm long. Stamen filaments *c*. 1.7 mm long. Fruits with a peduncle less than 0.2 mm long and no pedicel (S of Eneabba) ..... **T. spicata**

12: Bracteoles deciduous. Petals 2–2.5 mm long. Stamen filaments 0.6–1 mm long. Fruits with a peduncle 0.5–1.5 mm long and a pedicel 1–1.4 mm long (Meadow Station–near Yuna) ..... **T. podantha**

11: Hypanthium variously ornamented in flower, not becoming smooth in fruit, the pedicel ± absent

13. Bracteoles caducous or deciduous. Sepals with incurved margins forming an angle (rather than a uniform curve) at apex

14. Sprawling coastal dune plant, rooting at nodes of prostrate stems. Mature style *c*. 1.3 mm long, almost as long as the petals (Dirk Hartog Island & Steep Point)..... **T. repens**

14: Erect to widely spreading shrub, without adventitious roots, occurring inland or near coast but not on dunes. Mature style 0.3–0.8 mm long, much shorter than the petals

15. Stamen filaments 0.25–0.4 mm long. Mature style 0.3–0.4 mm long. Hypanthium longitudinally ribbed in fruit (Cooloomia NR–Meadow Stn–Pindar)..... **T. strongylophylla**

15: Stamen filaments 0.4–0.8 mm long. Mature style 0.5–0.8 mm long. Hypanthium rugose-tuberculate in fruit

16. Sepals usually 0.5–0.8 mm long. Stamen filaments usually 0.4–0.6 mm long (Tamala Stn–near Hamelin Pool–Kalbarri area)..... **T. caduca**

16: Sepals usually 0.8–1.6 mm long. Stamen filaments usually 0.6–0.8 mm long (?N of Zuytdorp NP–Kalbarri NP) ..... **T.** sp. **Eagle Gorge**

13: Bracteoles mostly persistent in fruit, if caducous then sepals with a rounded apex

17. Hypanthium (in flower) rugose with wrinkles or ridges as well as pits. Outer sepals distinctly auriculate

18. Mature peduncles 0.5–2.5 mm long. Sepals with a prominent keel, distinctly denticulate to laciniate, with margins often recurved or flat, not markedly incurved (Cooloomia NR–Wongan Hills) ..... **T. denticulata**

18: Mature peduncles ± absent or up to 0.3 mm long. Sepals not keeled, ± entire, with margins incurved

19. Leaves mostly with the apex (including dorsal ridge) recurved. Bracteoles with the keel not very prominent (Wannoo area)..... **T. wannooensis**

19: Leaves with the apex (of the dorsal ridge) incurved. Bracteoles with the keel forming a prominent compressed ridge (near Eurardy Stn–Mullewa)..... **T. globifera**

17: Hypanthium reticulate-pitted. Outer sepals not or scarcely auriculate

20. Peduncles solitary or 2 superposed in the axils, 1–3-flowered. Occurring near the south coast, mainly on granite (Augusta–Bremer Bay & Esperance area–Cape Arid NP–Middle Island)..... **T. saxicola**

20: Peduncles solitary in the axils, all 1-flowered or rarely a few of them 2-flowered. Occurring north of Perth, mainly on sand or laterite

21. Leaves 1.2–2.2 mm long. Mature peduncles 0.8–2 mm long, shorter than to about twice as long as the bracteoles. Bracteoles persistent (Carnamah–Wubin area) ..... **T. shirleyae**

21: Leaves 3.5–12 mm long. Mature peduncles 3–11 mm long, much longer than the bracteoles. Bracteoles usually caducous or deciduous

22. Hypanthium (in mature fruit) with very deep pits, not papillose. Occurring south of Geraldton (Arrowsmith River–Mullering Brook) ..... **T. hyporhytis**

22: Hypanthium (in mature fruit) with relatively shallow pits, sometimes also papillose. Occurring north and east of Geraldton

23. Mature peduncles 7–11 mm long. Bracteoles 0.5–1 mm long. Hypanthium not papillose in fruit (Moresby Ra.) ..... **T. stapfii**

23: Mature peduncles 4–8 mm long. Bracteoles 1.5–2.4 mm long. Hypanthium minutely papillose in fruit (East Yuna NR–Bindoo Hill NR) ..... **T. velutina**

Descriptions

Thryptomene caduca Rye & Trudgen, *sp. nov.*

Typus: Useless Loop Road [between Tamala and Hamelin], Western Australia [precise locality withheld for conservation reasons], 1 August 1996, *G.J. Keighery & N. Gibson* 1992 (*holo*: PERTH 05045878; *iso*: CANB, K, MEL).

Thryptomene strongylophylla subsp. Tamala (M.E. Trudgen 7384), Western Australian Herbarium, in *FloraBase*, http://florabase.dpaw.wa.gov.au/ [accessed 1 February 2014].

Thryptomene sp. Tamala (M.E. Trudgen 7384) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrubs 0.7–1.5 m high, spreading, commonly *c*. 1 m wide; flowering branchlets mostly with 2–6 pairs of flowers in a raceme-like arrangement. *Leaves* crowded on the branchlets, antrorse or almost appressed, mostly closely antrorse. *Petioles* usually less than 0.1 mm long, sometimes up to 0.2 mm long. *Leaf blades* obovate to broadly ovate or ± circular, 0.8–2.5 mm long, 1.0–1.2 mm wide, broadly obtuse, entire or sometimes minutely denticulate; abaxial surface fairly sharply keeled, with 1 or 2 longitudinal rows of 2–4 very prominent glands up to 0.2 mm diam.; adaxial surface concave. *Peduncles* 1–3 mm long at maturity. *Bracteoles* caducous, usually falling rather than separating and opening out in early bud, with a green herbaceous portion bounded by a wing-like, scarious keel and scarious margins, ovate or broadly ovate, 1–1.2 mm long, acute, entire. *Pedicels* ± absent. *Flower buds* with apex convex to almost flat when sepals are short, but conic when sepals are long. *Flowers* 5.5–7 mm diam. *Hypanthium* with a prominent pattern resembling coarse papillae. *Sepals* fairly erect in flower, erect or loosely closed inwards in fruit, narrowly keeled, broadly ovate or depressed-ovate-cordate, 0.5–0.8 mm long or sometimes longer, 0.6–0.9 mm wide, with distal margins tending to be pinched in and with the keel incurved at apex, deep pink at least along centre, entire or sometimes minutely denticulate; auricles less than 0.2 mm long and not always developed. *Petals* erect to slightly spreading in flower, loosely closed inwards in fruit, broadly obovate, 1.5–2.3 mm long, pink, broadly obtuse, ± entire. *Stamens* 7–9, some in pairs alternating with the sepals and petals, other pairs either fused into a single broad filament with two anthers or reduced to a single antisepalous stamen. *Filaments* usually 0.4–0.6 mm long, pale pink. *Anthers c.* 0.3 mm wide. *Style* 0.5–0.7 mm long. *Fertile fruits* depressed-obovoid, commonly 1.2–1.4 mm long, 1.4–1.7 mm diam.; hypanthium prominently rugose with a close pattern of rounded bumps; seed transversely reniform, *c*. 1.1 mm high, *c*. 1.5 mm across. (Figure 1A)

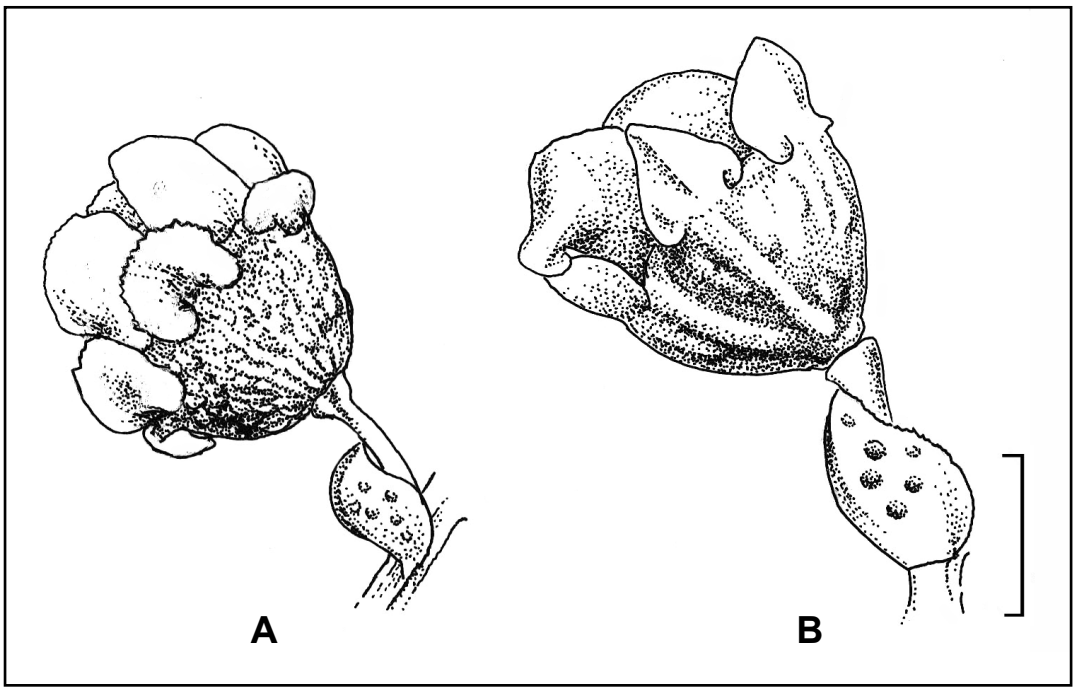

Figure 1. *Thryptomene strongylophylla* species group. A – *T. caduca* fruit, peduncle and subtending leaf; B – *T. strongylophylla* fruit, peduncle and subtending leaf. Scale = 1 mm. Drawn by Margaret Pieroni from *A.H. Burbidge* 4370 (A) and *W.E. Blackall* 4855 (B).

Diagnostic features. *Leaf blades* obovate to broadly ovate or ± circular, 0.8–2.5 × 1.0–1.2 mm, with 1 or 2 rows of oil glands on each side. *Mature peduncles* 1–3 mm long. *Bracteoles* caducous, 1–1.2 mm long. *Bud apex* conic to almost flat. *Sepals* 0.5–0.8 mm long. *Petals* 1.5–2.3 mm long, pink. *Stamens* 7–9, most alternating with the sepals and petals but some opposite sepals. *Style* 0.5–0.7 mm long. *Fruits* prominently rugose (with low rounded bumps) on hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 8 Apr. 1975, *J.S. Beard* 7392 (CANB, NSW, PERTH); 28 Aug. 1991, *A.H. Burbidge* 4370 (PERTH); 29 Aug. 1991, *A.H. Burbidge* 4371 (PERTH); 20 Aug. 1986, *H. Demarz* 11302 (PERTH); 27 Aug. 1969, *A.S. George* 9590 (PERTH); 6 Aug. 1986, *S.D. Hopper* 5114 (PERTH); 16 Sep. 1989, *M.E. Trudgen* 7384 (PERTH); 12 Aug. 1976, *E. Wittwer* 1808 (PERTH).

Distribution and habitat. Extends from Tamala Station east to near Hamelin Pool and south to Kalbarri National Park (Figure 2), in sandy habitats, including coastal sand dunes, sand over limestone and sandplains, the vegetation often dominated by *Banksia* or *Eucalyptus* species.

Phenology. Flowers from July to September, also recorded April.

Conservation status. Recently downgraded to Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Tamala (M.E. Trudgen 7384) (Western Australian Herbarium 1998–). This species was previously listed as Priority One (see Smith 2013), but is now known from more locations.

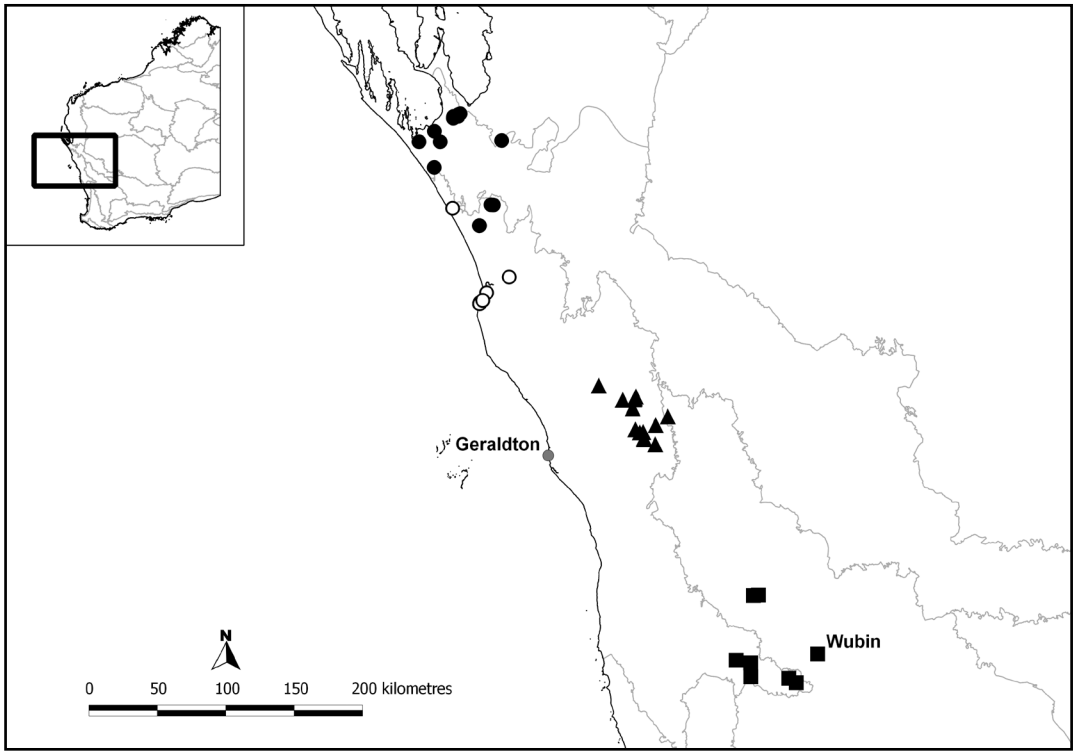

Figure 2. Distribution of *Thryptomene caduca* (●), *T. hubbardii* (▲), *T. shirleyae* (■) and *T.* sp. Eagle Gorge (○).

Etymology. From the Latin *caducus* (falling, dropping off early), referring to the early falling of the bracteoles, which are shed from the flower buds.

Affinities. Closely related to *T. strongylophylla* Benth., which differs in its more furrowed hypanthium in flower and smoother hypanthium in fruit (Figure 1B). That species also tends to have shorter stamens, a shorter style and a more pronounced scarious rim on the leaves.

Co-occurring species. While *T. caduca* is generally found north-west of the range of *T. strongylophylla*, the two taxa overlap in the Cooloomia to Kalbarri area. They have been recorded less than 1 km apart from one another on Murchison House Station, with *T. caduca* (*A.H. Burbidge* 4370) in cream-grey sand with mallees (*Eucalyptus eudesmoides*) dominant over *Acacia* and *Hakea* lower levels, and *T. strongylophylla* (*A.H. Burbidge* 4372) in more yellowish sand with *Banksia ashbyi* dominant over myrtaceous spp. However, there appears to be very little difference in the habitats occupied by the two species overall.

Notes. Southern specimens tend to have longer leaves and sepals than the northern ones. The taxon known as *T.* sp. Eagle Gorge (A.G. Gunness 2360), which occurs in Kalbarri National Park (see Figure 2), may warrant recognition as a subspecies or species, but seems to completely intergrade with the material placed under *T. caduca* making separation of the two taxa difficult. If the intermediates are disregarded, then *T.* sp. Eagle Gorge differs in having longer sepals (up to 1.6 mm) and correspondingly long bracteoles. It may also have larger fruits, those recorded so far being up to 1.8 mm long and 2 mm high if fertile and up to 2.3 mm long and wide if sterile. Only one seed was examined. It was depressed-ellipsoid, *c*. 1.3 mm high, and *c*. 1.7 mm across.

Thryptomene calcicola Rye, *sp. nov.*

Typus: Kalbarri National Park, Western Australia [precise locality withheld for conservation reasons], 21 September 2002, *M.E. Trudgen* 21641 (*holo*: PERTH 06361633; *iso*: AD, BRI, MEL, NSW).

Thryptomene sp. Kalbarri limestone (D. & B. Bellairs 1652 A), Western Australian Herbarium, in *FloraBase*, http://florabase.dpaw.wa.gov.au/ [accessed 1 February 2014].

Shrubs erect or sometimes low and widely spreading, 0.3–1.8 m high, commonly 0.9–1.5 m wide; flowering branchlets mostly with 4–15 pairs of flowers in a spike-like or raceme-like arrangement. *Leaves* mostly antrorse but usually becoming patent. *Petioles* 0.1–0.4 mm long. *Leaf blades* linear, 5–9 mm long, 0.4–0.8 mm wide, ± acute, often minutely denticulate; abaxial surface convex, with 2 or 3 main rows of oil glands on each side of the midrib and 20–40 glands < 0.1 mm diam. in each of the two central rows; adaxial surface concave, often as prominently dotted as abaxial surface. *Peduncles* 1-flowered, 0.6–1 mm long at maturity. *Bracteoles* persistent after fruit shed, with the keel and apex green and leaf-like, with broad scarious margins below the thick green apical point, ovate or broadly ovate, 2.2–3 mm long, glossy towards the base, entire. *Pedicels* ± absent. *Flower buds* with a flat to concave apex. *Flowers* 7–8 mm diam. *Hypanthium* irregularly ridged and pitted. *Sepals* erect in flower, tightly closed inwards in fruit, broadly ovate or depressed-ovate, 1–1.2 mm long, rather glossy, entire. *Petals* widely spreading in flower, loosely closed inwards in fruit, obovate, 2.5–3 mm long, pink-mauve, broadly obtuse, entire. *Stamens* 10(–12), when 10 alternating between the sepals and petals and ± equidistant, occasionally with 1 or 2 extra stamens opposite the sepals. *Filaments* 0.8–1.0 mm long, pink-purple. *Anthers c.* 0.35 mm wide. *Style c.* 0.6 mm long. *Fruits* not seen at maturity; hypanthium with many small pits.

Diagnostic features. *Leaf blades* linear, 5–9 × 0.4–0.8 mm, with 2 or 3 rows of oil glands on each side. *Mature peduncles* 0.6–1 mm long. *Bracteoles* persistent, 2.2–3 mm long. *Bud apex* ± flat. *Sepals* 1–1.2 mm long, rather glossy. *Petals* 2.5–3 mm long, pink. *Stamens* usually 10, alternating with the sepals and petals. *Style c.* 0.6 mm long. *Fruits* with many small pits on hypanthium.

Other specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 23 Aug. 1984, *D. & B. Bellairs* 1652 A (PERTH); 21 Aug. 1998, *D. & B. Bellairs* 5033 & *s.n.* (PERTH); 23 Aug. 1972, *H. Demarz* 3886 (PERTH); 9 Aug. 1994, *S.J. Patrick* 1986 (PERTH); 30 June 1980, *R.C. Wemm* 912 B (PERTH).

Distribution and habitat. Occurs in a very small area within Kalbarri National Park (Figure 3), associated with limestone, in *Acacia* shrublands.

Phenology. Flowers June to late August. Young fruits recorded in late August.

Conservation status. Listed by Smith (2013) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Kalbarri limestone (D. & B. Bellairs 1652 A). It has a known range of less than 5 km within a large national park. This species has been in cultivation for some time and one of the few specimens cited above (*B.L. Rye* 210204) is of cultivated material.

Etymology. From the Latin *calcis* (lime) and *-cola* (inhabitant), as this species occurs in limestone habitats.

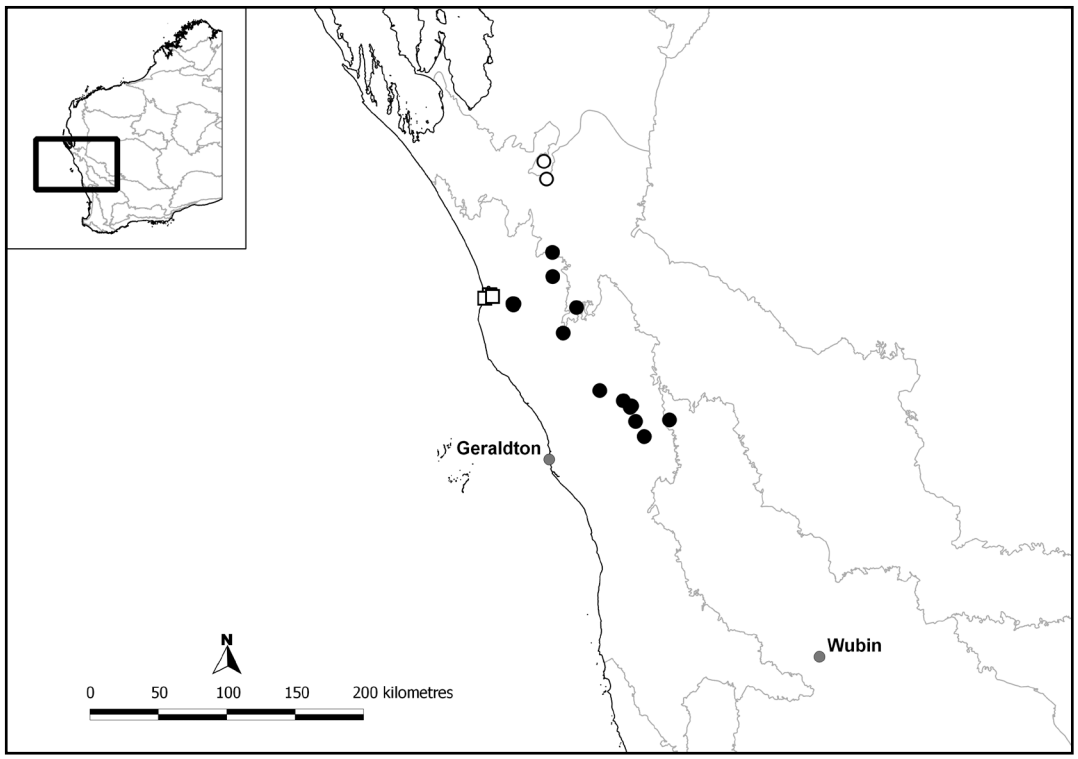

Figure 3. Distribution of *Thryptomene calcicola* (□), *T. globifera* (●) and *T. wannooensis* (○).

Affinities. This species was previously included within *T. stenophylla*. Both species have more slender leaves than other members of the *T. baeckeacea* species group, but their peduncles are very short in relation to the leaf length whereas other members of the group have relatively long peduncles. The new species differs from *T. stenophylla* in its longer leaves, larger peduncles and flowers, and more shiny sepals. The leaves have more numerous oil glands, both in terms of more rows across the leaf and more glands per row. These differences between the two taxa were maintained under cultivation in a private garden at Mandurah.

Co-occurring species. Not recorded growing with any other species of *Thryptomene*.

Notes. The sepals and bracteoles are similar to those found in *T. wannooensis* in being rather glossy.

Thryptomene dampieri Rye, *sp. nov.*

Typus: 2 miles [3 km] south of Denham, Western Australia, 21 July 1957, *J.W. Green* 1422 (*holo*: PERTH 02188368; *iso*: CANB, K, MEL, NSW, PERTH 02188600).

Baeckea micrantha DC., *Prodr.* 3: 230 (1828). *Thryptomene micrantha* (DC.) C.A.Gardner, *Enum. Pl. Austral. Occ.* 97 (1931), *nom. illeg. non* J.D.Hook. (1853). *Type citation*: 'in Novâ-Hollandiâ Suffrutex ramosissimus. (v.s. ex mus. Paris)'. *Type specimen*: 'Nouvelle Hollande, côte orient'[actually from Western Australia], collector unknown (*holo*: G 00486600).

Illustrations. A.P. de Candolle, *Mém. Soc. Phys. & Hist. Nat. Genève* Pl. 14 (1841–1842) [as *Baeckea micrantha*]; W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildflowers* 3A: 48 (1980) [as *Thryptomene baeckeacea*].

Shrub usually low and spreading, often rooting adventitiously from prostrate or sprawling stems, 0.2–0.7(–1) m high, up to 1.5 m wide; flowering branchlets with 2–8 pairs of flowers usually in a dense cluster. *Leaves* mostly crowded and widely antrorse. *Petioles* 0.2–0.5 mm long. *Leaf blades* often somewhat recurved towards apex (but with keel apex incurved), mostly broadly obovate to depressed-obovate and 1.3–3 mm long, 1.5–2.2 mm wide, broadly obtuse, usually entire but sometimes minutely denticulate; abaxial surface convex, with 3 or 4(5) main rows of oil glands on each side of midvein and 3–5 glands < 0.1 mm diam. in each of the two central rows, rarely with only 1 or 2 rows of glands obvious; adaxial surface concave. *Peduncles* 1-flowered, 0.2–0.8 mm long. *Bracteoles* persistent after fruit shed, with the keel green and leaf-like, with broad scarious margins below the thick green apical point, broadly ovate, 0.6–1.6 mm long, denticulate on the scarious margins or entire. *Pedicels* ± absent. *Flower buds* with a concave or flat apex. *Flowers* 4–6 mm diam. *Hypanthium* with many fine irregular longitudinal wrinkles or similar irregular patterning. *Sepals* fairly erect in flower, tightly closed inwards in fruit, very broadly ovate or depressed-ovate, 0.5–0.9 mm long, 1–1.4 mm wide, pale pink, minutely denticulate or sometimes entire, often distinctly auriculate. *Petals* erect at base and widely spreading above in flower, loosely closed inwards in fruit, usually broadly obovate, 1.5–2 mm long, pink or pink-purple, ± entire. *Stamens* usually 10, alternating between the sepals and petals, ± equidistant. *Filaments* 0.4–0.8 mm long. *Anthers c.* 0.3 mm wide. *Style* 0.5–0.8 mm long. *Fertile fruits* depressed-obovoid, *c.* 1.4 mm long, *c.* 1.8 mm diam.; hypanthium developing a pattern of irregular longitudinal furrows; seed transversely reniform, 1.1–1.2 mm high, 1.4–1.5 mm across.

Diagnostic features. *Leaf blades* broadly obovate to depressed-obovate, 1.3–3 × 1.5–2.2 mm, with 3–5 rows of oil glands on each side. *Mature peduncles* 0.2–0.8 mm long. *Bracteoles* persistent, 0.6–1.6 mm long. *Bud apex* concave or flat. *Sepals* 0.5–0.9 mm long. *Petals* 1.5–2 mm long, pink. *Stamens* usually 10, alternating with the sepals and petals. *Style* 0.5–0.8 mm long. *Fruits* developing irregular longitudinal furrows on hypanthium.

Selected specimens examined. WESTERN AUSTRALIA: inland of Herald Bay, Dirk Hartog Island, 18 Oct. 1974, *J.S. Beard* 7089 (PERTH); Shark Bay, 1699, *W. Dampier s.n.* (OXF, photo PERTH 02188554); 80 km from North West Coastal Highway along road to Denham, 1 Sep. 1972, *A.S. George* 11347 (PERTH); 7.25 km E of Cape Cuvier, 21 Aug. 1994, *G.J. Keighery & N. Gibson* 1630 (PERTH); Steep Point, Shark Bay, 24 July 1988, *Morat* 8330 (PERTH); Red Bluff, N of Cape Cuvier, 20 June 1976, *M.E. Murray* 21 (PERTH); 51.4 km S of Learmonth Airbase on Exmouth Rd, 28 July 2003, *M.E. Trudgen* 21947 (NSW, PERTH); Quoin Bluff area, Dorre Island, 21 Aug. 1977, *A.S. Weston* 10588 (PERTH); Point Quobba, 28 July 1969, *P.G. Wilson* 8372 (PERTH).

Distribution and habitat. Extends from the Exmouth area south along the west coast to the Hamelin Bay area, occurring off-shore on Dorre and Dirk Hartog Islands (Figure 4). Occurs on sand dunes and limestone, for example on white beaches or on red sand overlying limestone, often in low heath including spinifex or in taller *Acacia* shrubland, also recorded in salty brownish sand.

Phenology. Flowers from April to September. Fruits from August to October.

Conservation status. Not considered to be at risk as this species extends for a great distance along the coast.

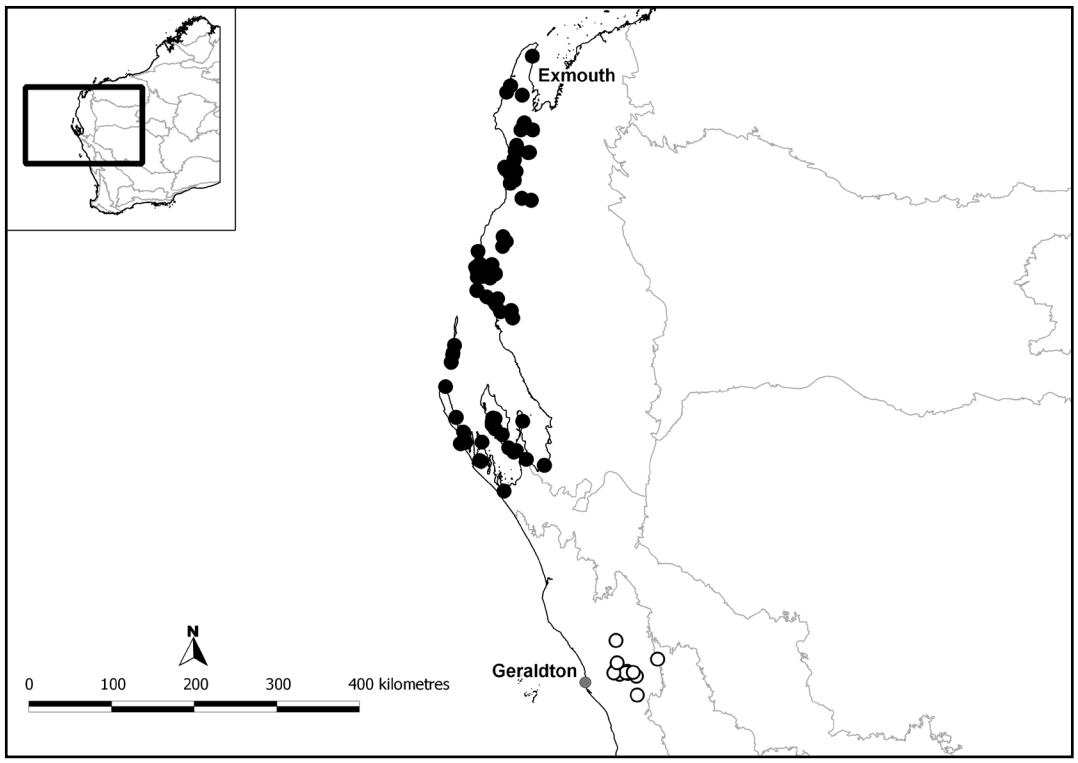

Figure 4. Distribution of *Thryptomene dampieri* (●) and *T. orbiculata* (○).

Etymology. Named after William Dampier (1652–1715), the famous English circumnavigator, naturalist and privateer, who collected this species in the Shark Bay area in 1699.

Affinities. Part of the *T. baeckeacea* group, differing from typical *T. baeckeacea* primarily in the hypanthium patterning but also tending to have broader, more markedly keeled leaves with usually three to five main rows of oil glands on each side of the midvein. In *T. baeckeacea* the leaves have only one or two main rows of oil glands.

Co-occurring species. See note under *T. repens*.

Typification. Type material of *Baeckea micrantha* DC. has not been examined directly to determine its identity, but Bentham (1867: 61) treated the taxon as a member of the *Thryptomene* species group to which Dampier's collection belongs. Images of several specimens at G and P certainly match *T. dampieri* well, having the characteristic habit and flattened flower buds.

G 00486600 appears to be the one and only specimen on which de Candolle's description is based as it bears the annotation 'Mus: de Paris 1821' and so is presumed to be the holotype. The locality 'côte orient' [east coast] and the name '*Imbricaria*' on the specimen imply that the identity of the taxon was considered to be the eastern Australian species now known as *Baeckea imbricata* (Gaertn.) Druce, which is the type species of *Imbricaria* Sm. *nom. illeg.*, [as *I. crenulata* Sm. *nom. illeg.*]. However, the specimen certainly does not match material of *B. imbricata.*

Images of two specimens from Paris (P 00292032 & 00292033) have a sufficiently different appearance in their overall habit to suggest that they were not collected from the same plant as G 00486600. Both have 'N. Holl.'[New Holland] on the label but one of them (P 00292032) also differs in having the locality of 'Port Jackson' while the other gives no further indication of its locality. The former collection is identified as '*Imbricaria*', raising the possibility that both it and the presumed holotype at G were assumed to come from localities in eastern Australia because they were identified as an eastern Australian species when in fact they had been collected from Western Australia.

Notes. This species is recorded as regenerating successfully from underground parts after fires. The bracteoles have a leafy keel and broad membranous sides, the apex usually prominent and leaf-like. The hypanthium is rugose, usually with numerous irregular wrinkles and grooves.

Polyploidy could contribute to the variability observed in this wide-ranging species. Seven specimens sampled from Yardie Creek south to Denham [as *T. baeckeacea*] had regular, highly fertile pollen, but a specimen from Dorre Island had pollen of low fertility (59%) with a small proportion (*c.* 4%) of its pollen grains of abnormal shape, suggesting that it might be polyploid (Rye 1980). There was also one specimen with regular pollen of low fertility (53%) from Point Quobba.

Most specimens with relatively long leaves have been excluded for now from *T. dampieri*, although a few larger leaves are present on some of the specimens used for the description. Long-leaved specimens are housed under two informal names. Short-leaved specimens from southern parts of the range of the *T. dampieri* complex are also excluded pending further investigation.

Thryptomene globifera Rye, *sp. nov.*

Typus: on a track along the north-west side of the railway line opposite Indarra, 0.9 km from Desmond Road intersection with Geraldton–Mount Magnet road, Western Australia, 22 August 2003, *B.L. Rye* 238100 *& M.E. Trudgen* (*holo*: PERTH 06744427; *iso*: CANB, K, MEL).

Shrubs 0.4–1.2(–1.6) m high, 0.6–1.5 m wide, single-stemmed or multi-branched at the base; flowering branchlets with 1–6 pairs of flowers in a small subterminal cluster. *Leaves* crowded on the branchlets, antrorse to patent. *Petioles* absent or up to 0.3 mm long. *Leaf blades* broadly obovate to depressed-obovate, 1.3–2.3 mm long, 1.5–2.2 mm wide, almost truncate at apex, with apex and margins incurved, entire; abaxial surface with midvein indented or flat in basal half and distally ribbed, with usually 3 or 4 main rows of oil glands on each side of midrib, the rows tending to be separated by longitudinal ribs, with usually 3 or 4 oil glands up to 0.15 mm diam. in each of the central rows; adaxial surface concave, less prominently gland-dotted than abaxial surface. *Peduncles* 1-flowered, 0–0.3 mm long. *Bracteoles* persistent, 1.5–2.2 mm long, with a broad keel and membranous incurved margins; keel with a prominent narrow ridge, green, prominently gland-dotted. *Pedicels* ± absent. *Flower buds* with a convex apex. *Flowers* 5–7 mm diam. *Hypanthium* usually hidden, fairly prominently patterned with irregular ridges and pits. *Sepals* loosely closed inwards in fruit, scarcely keeled, 1.1–1.5 mm long, rather scarious, with incurved margins and apex, ± entire, the outer ones with fairly obvious auricles up to 0.3 mm long. *Petals* (2–)2.5–3.3 mm long, broadly obtuse, pale pink or mauve, ± entire. *Stamens* usually 10 alternating with the sepals and petals but sometimes down to 7, ± equidistant. *Filaments* usually 0.6–0.7 mm long. *Anthers* 0.4–0.5 mm wide. *Style* usually 0.7–1.1 mm long. *Fertile fruits* depressed-obovoid, *c*. 1.8 mm long, 2.3–2.4 mm diam.; hypanthium rugose, with 3 or 4 small pits per irregular longitudinal row; seed depressed-ellipsoid or transversely reniform, *c*. 1.1 mm high, *c*. 1.6 mm across.

Diagnostic features. *Leaf blades* broadly obovate to depressed-obovate, 1.3–2.3 × 1.5–2.2 mm, with 3 or 4 rows of oil glands on each side; apex incurved. *Mature peduncles* ± absent. *Bracteoles* persistent, 1.5–2.2 long. *Bud apex* convex. *Sepals* 1.1–1.5 mm long. *Petals* 2–3.3 mm long, pale pink. *Stamens* usually 10, alternating with the sepals and petals. *Style* usually 0.7–1.1 mm long. *Fruits* irregularly pitted-rugose on hypanthium.

Selected specimens examined. WESTERN AUSTRALIA: East Yuna [Nature] Reserve, SE extension, 14 Nov. 1997, *P.G. Armstrong* 97/212 (PERTH); 1.5–2 km NE of Noodamurra Pool (in Greenough River) and 0.5 km N of Greenough River, 11 Oct. 1998, *P.G. Armstrong s.n.* (PERTH); McGausan Nature Reserve, 500 m W of Bindoo Rd on McGausan Rd, 22 Oct. 1998, *A. Desmond* 61/98 (NSW, PERTH); 14 miles [23 km] W of Mullewa, 27 Aug. 1965, *K.R. Newbey* 2147 (PERTH); 23 km from the town of Kalbarri along road to North West Coastal Hwy, Kalbarri National Park, 10 Oct. 1982, *A. Strid* 20825 (PERTH); *c.* 5 km E of North West Coastal Hwy on Ajana East Rd, 27 Sep. 2002, *M.E. Trudgen* 21737 (AD, BRI, NSW, PERTH).

Distribution and habitat. Extends from near Eurardy Station and Ajana south-east to near Mullewa (Figure 3), mainly in yellow or white sand, often on lateritic ridges, dominated by *Eucalyptus* woodlands or a variety of shrub species.

Phenology. Flowers from August to October.

Conservation status. Not considered to be at risk as its distribution extends from more than 150 km and some populations are protected in a large national park and two nature reserves.

Etymology. From the Latin *globus* (sphere, ball) and *-fer* (carrying), as the flowers are borne in a single globular cluster on each branchlet.

Affinities. This species and *T. wannooensis* differ from *T. denticulata* in their less prominently keeled leaves, very reduced to absent peduncles, more obtuse buds and more entire sepals with an incurved margin. See notes under *T. wannooensis*.

Co-occurring species. Recorded growing with *T. hubbardii* (see note under that species).

Notes. *Thryptomene globifera* has long been recognised as a distinct species, with several proposed informal names attached to the specimens, but has never been listed under an informal name on *FloraBase*. Its globular flower clusters distinguish it from all other species except for *T. wannooensis*.

Thryptomene hubbardii Rye & Trudgen, *sp. nov.*

Typus: south-west of Mullewa, Western Australia [precise locality withheld for conservation reasons], 11 September 2004, *G.J. & B.J. Keighery* 426 (*holo*: PERTH 07194625; *iso*: CANB, K, MEL, NSW).

Thryptomene sp. East Yuna (J.W. Green 4639) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrubs 0.5–1 m high, 0.7–2.2 m wide, commonly spreading wider than the height, single-stemmed or multi-branched at the base; flowering branchlets with 2–4 pairs of flowers in a small, subterminal cluster.

Leaves crowded on the branchlets, antrorse to patent. *Petioles* 0.4–1 mm long. *Leaf blades* broadly or very broadly obovate, 2.5–4.3 mm long, 2.8–3.4 mm wide, mucronulate, denticulate to ciliolate; abaxial surface almost flat to obviously convex, many-dotted, with 3–5 main rows of oil glands on each side of midrib and 5–8 oil glands 0.05–0.1 mm diam. in each of the two central rows, the keel narrow throughout and slightly raised in distal half; adaxial surface slightly to obviously concave, less prominently gland-dotted. *Peduncles* 1-flowered, 0.6–2.5 mm long. *Bracteoles* persistent, 1.5–2.5 mm long, with a prominent green keel and membranous incurved margins; keel broad, prominently gland-dotted; margins denticulate or ciliolate, pale. *Pedicels* ± absent. *Flower buds* with a convex apex. *Flowers* 6–8 mm diam. *Hypanthium* pitted-rugose. *Sepals* broadly cordate, with distal half widely spreading in fruit, the apex sometimes emarginate, 1.5–2.5 mm long, with a broad-based, prominent to shortly horned, herbaceous keel; which is exceeded by a broad margin or sometimes reaching apex and dividing margin into 2 broad lateral parts, minutely denticulate on the scarious margin(s); auricles small. *Petals* obovate-elliptic and broad-based, 2.5–3.3 mm long, broadly obtuse, usually pale pink, entire or minutely denticulate. *Stamens* 9 or more commonly 10, tending to alternate with the sepals and petals but somewhat irregular (occasionally with one pair of stamens reduced to a single antisepalous stamen). *Filaments* 0.5–0.7 mm long. *Anthers* 0.5–0.6 mm wide. *Style* 0.7–1 mm long. *Fertile fruits* depressed-obovoid, 1.3–1.5 mm long, 2–2.5 mm diam.; hypanthium shiny, with small, widely spaced pits; seed transversely reniform, 0.9–1.1 mm high, 1.5–1.7 mm across. (Figure 5A–E)

Diagnostic features. *Leaf blades* broadly or very broadly obovate, 2.5–4.3 × 2.8–3.4 mm, with 3–5 rows of oil glands on each side, ciliolate at first. *Mature peduncles* 0.6–2.5 mm long. *Bracteoles* persistent, 1.5–2.5 mm long. *Bud apex* convex. *Sepals* 1.5–2.2 mm long. *Petals* 2.5–3.3 mm long, pink. *Stamens* 9 or 10, irregular or alternating with the sepals and petals. *Style* 0.7–1 mm long. *Fruits* with small, widely spaced pits on hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 26 Oct. 1998, *P.G. Armstrong s.n.* (CANB, PERTH); 14 Nov. 2004, *A.D. Crawford* 737 (NSW, PERTH); 1960, *M. Cole* 1/12 (PERTH); 30 Aug. 1977, *J.W. Green* 4639 (PERTH); 2 Feb. 2000, *S. Patrick* 3375 (AD, BRI, PERTH); 22 Aug. 2003, *B.L. Rye* 238105 *& M.E. Trudgen* (MEL, PERTH).

Distribution and habitat. East Yuna Nature Reserve south to Indarra Springs Nature Reserve (Figure 2), in yellow sand or sandy soils, one record as a firebreak coloniser. There are two records from *Allocasuarina campestris* tall shrublands, these either with *Melaleuca hamata* or with mallee (*Eucalyptus*) woodlands.

Phenology. Flowers August to December. Fruits recorded in November.

Conservation status. Recently listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. East Yuna (J.W. Green 4639) (Western Australian Herbarium 1998–). It occurs in at least two nature reserves. This species was previously listed as Priority One, but is now known from more locations.

Etymology. Named after Richard T. Hubbard, who prepared a detailed manuscript for the entire Myrtaceae of Western Australia. Little of this great undertaking was published (see Hubbard 1976: 41) but the whole work is preserved in the Department of Parks and Wildlife library. The part of the manuscript dealing with *Thryptomene* was submitted to the then expert on the genus, John Green, for comment in 1979.

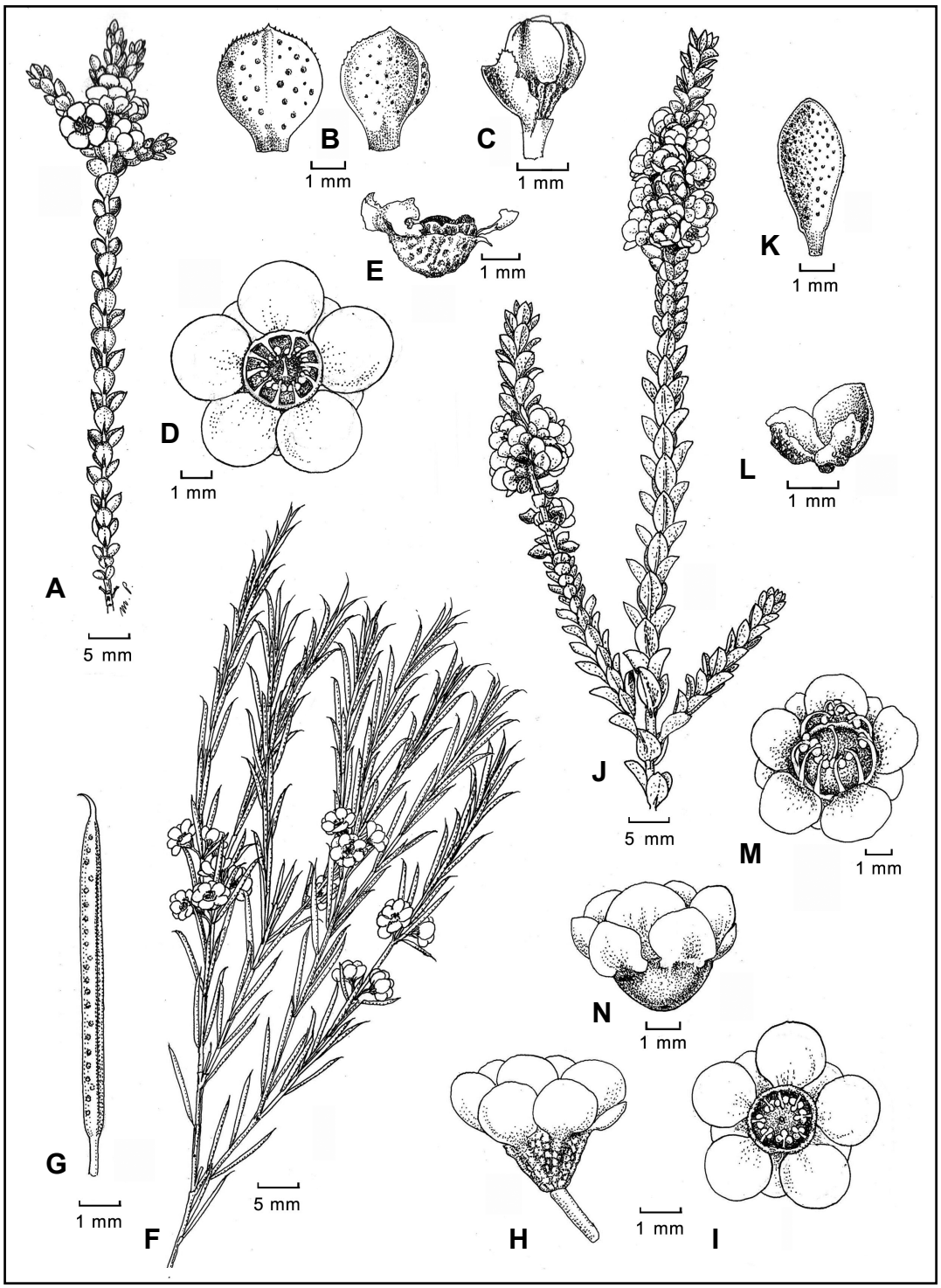

Figure 5. *Thryptomene* species without obvious close relatives. *T. hubbardii* (A–E). A – flowering branch; B – upper and lower surfaces of leaf; C – flower bud with one of the bracteoles visible; D – flower; E – fruit. *T. pinifolia* (F–I). F – flowering branch; G – side view of leaf; H – peduncle and old flower; I – flower. *T. spicata* (J–N). J – flowering branch; K – upper surface of leaf; L – bracteoles and subtending leaf; M –flower; N – young fruit. Drawn by Margaret Pieroni from *J.W. Green* 4639 (A–D), *F. Lullfitz* 2985 (E), *D. & B. Bellairs* 1649 (F–I) and *R.J. Cranfield & P. Spencer* 8433 (J–N).

Affinities. The affinities of *T. hubbardii* are unclear. Its sepals are unusual in having the distal half widely spreading in fruit and in the prominent green keel, which is sometimes slightly horned on the outer sepals. Two other *Thryptomene* species known to have somewhat horned outer sepals are not closely related; these are *T. elliottii* F.Muell. and the Northern Territory species, *T. remota*.

Co-occurring species. Although it sometimes occurs with several other *Thryptomene* species, *T. hubbardii* tends to flower later in the year. During field studies in the Indarra area in August 2003, *T. globifera* (*B.L. Rye* 238100 & 238101 *& M.E. Trudgen*) was observed in full flower growing with plants of *T. hubbardii* (*B.L. Rye* 238102 *& M.E. Trudgen*) that were mostly still in bud. At a nearby site, *T. strongylophylla* was observed colonising a disturbed road verge with *T. hubbardii* (*B.L. Rye* 238105 *& M.E. Trudgen*), the latter being only in bud. Flowering plants of *T. denticulata* were also seen not far from *T. hubbardii*.

Notes. The stamens tend to have an irregular arrangement, occasionally with only nine stamens present.

Thryptomene nitida Rye & Trudgen, *sp. nov.*

Typus: west of Three Springs, Western Australia [precise locality withheld for conservation reasons], 8 September 2003, *B.L. Rye* 239001 *& M.E. Trudgen* (*holo*: PERTH 06753140; *iso*: CANB, K, MEL, NSW).

Thryptomene sp. Mingenew (Diels & Pritzel 332) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrubs 0.3–0.8 m high, very widely spreading, the main branches tending to be prostrate and produce adventitious roots; flowering branchlets with 1–7 (usually 2–4) pairs of flowers in a subterminal, globular to spike-like cluster. *Leaves* mostly antrorse or widely antrorse and overlapping, ± appressed when separate. *Petioles* up to 0.3 mm long. *Leaf blades* obovate or broadly obovate, 1.8–2.4 mm long, 0.8–1.4 mm wide, broadly obtuse, with the keel incurved at apex, not or scarcely mucronulate, the narrow scarious margin with broad or narrow processes < 0.1 mm long; abaxial surface convex, with 1 or 2(3) main rows of oil glands and 4–6 prominent glands *c.* 0.1 mm diam. in each of the two central rows; adaxial surface concave, less prominently gland-dotted. *Peduncles* 1-flowered, 0.2–0.5 mm long at maturity. *Bracteoles* persistent, leaf-like, broadly or very broadly ovate to cordate, 1.3–1.5 mm long, with a thick herbaceous gland-dotted keel, scarious on the marginal 0.3–0.5 mm, mucronate with a short erect point, concave on adaxial surface, minutely denticulate or almost entire. *Pedicels* ± absent. *Flower buds* with a concave or flat apex. *Flowers* 4–5.5 mm diam. *Hypanthium* somewhat ribbed in bud, becoming smooth. *Sepals* almost erect in flower, tightly closed inwards in fruit, triangular to depressed-ovate, 0.5–0.7 mm long, 1.0–1.3 mm wide, the outermost one or two with an herbaceous keel, the remainder scarious, minutely denticulate. *Petals* apparently somewhat spreading in flower, loosely closed inwards in fruit, broadly obovate to almost circular, 1.5–2 mm long, pale purple or mauve-pink, broadly obtuse, entire. *Stamens* 10, alternating with the sepals and petals, equidistant. *Filaments* 0.6–0.8 mm long. *Anthers* 0.4–0.5 mm wide. *Style* 0.5–0.7 mm long. *Fertile fruits* depressed-obovoid, *c.* 1.5 mm long, *c.* 1.8 mm diam.; hypanthium smooth, shiny; seed not seen at maturity, apparently *c.* or at least 0.8 mm high and 1.3 mm across.

Diagnostic features. *Leaf blades* obovate or broadly obovate, 1.8–2.4 × 0.8–1.4 mm, usually with 1 or 2 rows of oil glands on each side. *Mature peduncles* 0.2–0.5 mm long. *Bracteoles* persistent, 1.3–1.5 mm long. *Bud apex* concave or flat. *Sepals* 0.5–0.7 mm long. *Petals* 1.5–2 mm long, pale

pink. *Stamens* 10, alternating with the sepals and petals, equidistant. *Style* 0.5–0.7 mm long. *Fruits* with a smooth, shiny hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 17 Aug. 1992, *A. Carr* 88 (PERTH); 2 Oct. 1981, *L.A. Craven & C. Chapman* 6847 (PERTH); 22 Nov. 2003, *A. Crawford* 458 (K, PERTH); June 1901, *F.L.E. Diels & E.G. Pritzel s.n.* (PERTH); 15 July 2000, *M. Hislop* 2034 (AD, PERTH); Nov. 1877, *F. Mueller s.n.* (MEL 75971); 30 Aug. 1965, *K.R. Newbey* 2239 (PERTH); 14 June 2001, *S.J. Patrick* 3896 *& L. Polomka* (PERTH).

Distribution and habitat. Extends from near Irwin River and Mingenew south-east to Arrino (Figure 6), mainly associated with creeks or minor drainage lines.

Phenology. Flowers from June to September. Fruits from August to October.

Conservation status. Listed by Smith (2013) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Mingenew (Diels & Pritzel 332). This species is geographically restricted, with its known range extending *c.* 40 km, and is not known from any national parks although it occurs in at least one reserve.

Etymology. From the Latin *nitidus* (shining), referring to the smooth, lustrous surface of the hypanthium in fruit.

Affinities. *Thryptomene nitida* was previously included under *T. baeckeacea*, but differs in its low-growing, layering habit, broader bracteoles, with the broader scarious margins extending further around the hypanthium, smooth shiny fruit, different habitat and distinct distribution. It shows some similarity to *T. podantha* in that the hypanthium often appears ribbed in bud and at anthesis but becomes quite smooth in fruit; however, these two species are very different in other respects and do not appear to be closely related.

Co-occurring species. Not recorded growing with any other *Thryptomene* species.

Notes. This very distinctive species is unusual among the inland species in having a low-growing, layering habit. Three specimens surveyed in the late 1970s had regularly three-sided pollen of high fertility (Rye 1980).

Thryptomene orbiculata Rye & Trudgen, *sp. nov.*

Typus: [north-east of Geraldton], Western Australia [precise locality withheld for conservation reasons], 31 July 2003, *M.E. Trudgen* 22011 (*holo*: PERTH 08237948; *iso*: CANB, K, MEL, NSW).

Thryptomene sp. Greenough River (J. Docherty 169), Western Australian Herbarium, in *FloraBase*, http://florabase.dpaw.wa.gov.au/ [accessed 1 February 2014].

Shrub 0.5–1.5 m high, 0.4–1.5 m wide; flowering branchlets with usually 5–15 pairs of flowers in a raceme-like arrangement, the pairs sometimes becoming widely spaced at maturity. *Leaves* appressed to widely antrorse. *Petioles* well defined, 0.4–0.7 mm long. *Lamina* broadly ovate to depressed-obovate, often ± circular, 2–3.5 mm long, 2.3–3.3 mm wide, obtuse, not pointed or with a mucro

up to 0.1 mm long, entire or minutely denticulate; abaxial surface slightly convex to fairly flat, with midvein prominent distally but usually flat towards the base, with 3 or 4 main rows of oil glands and 4–6 glands up to *c.* 0.1 mm diam. in each of the two central rows; adaxial surface with oil glands much less obvious than on abaxial surface. *Peduncles* 1-flowered, 1–2.5 mm long. *Bracteoles* persistent, 1.5–2.5 mm long, with a prominent green keel and somewhat scarious, denticulate to entire margins, the keel usually reaching the apex and often extended into an apical point 0.2–0.5 mm long. *Pedicels* ± absent. *Flower buds* with a convex apex. *Flowers* 5–8 mm diam. *Hypanthium* coarsely rugose and with small pits. *Sepals* widely spreading in flower and widely spreading to recurved in fruit, 2–2.5 mm long, rather petaloid, entire or rarely denticulate. *Petals* 2.2–2.4 mm long, pink or pink-mauve, ± entire. *Stamens* usually 10, alternating with the sepals and petals, equidistant. *Filaments* 1.2–1.6 mm long. *Anthers* 0.4–0.55 mm wide. *Style* 1.1–1.3 mm long. *Fertile fruits* depressed-obovoid, 2–2.2 mm long, 2.5–3 mm diam.; hypanthium prominently patterned with numerous small pits; seed apparently transversely reniform, not seen at maturity.

Diagnostic features. *Leaf blades* broadly ovate to depressed-obovate, 2–3.5 × 2.3–3.3 mm, with 3 or 4 rows of oil glands on each side. *Mature peduncles* 1–2.5 mm long. *Bracteoles* persistent, 1.5–2.5 mm long. *Bud apex* convex. *Sepals* 2–2.5 mm long. *Petals* 2.2–2.4 mm long, pink. *Stamens* 10, alternating with the sepals and petals, equidistant. *Style* 1.1–1.3 mm long. *Fruits* minutely pitted on hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 9 Oct. 1998, *P. Armstrong s.n.* (CANB, NSW, PERTH); 14 Aug. 1965, *A.M. Ashby* 1583 (PERTH); 10 Sep. 1901, *L. Diels* 4190 (PERTH); 23 July 2000, *J. Docherty* 23 (PERTH); 29 Aug. 1945, *C.A. Gardner s.n.* (PERTH); Oct. 1971, *D.J. McGauran s.n.* (PERTH); 2 Dec. 1999, *S. Patrick* 3361 A (PERTH); 12 Sep. 1986, *P.S. Short* 2863*, M. Amerena & B.A. Fuhrer* (AD, MEL, PERTH).

Distribution and habitat. Extends from the East Yuna area south to north-west of Mingenew (Figure 4), often in yellow sand.

Phenology. Flowers from July to October. Fruits recorded in October and November.

Conservation status. Recently listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Greenough River (J. Docherty 169) (Western Australian Herbarium 1998–). The geographic range of this taxon appears to be *c.* 60 km, but few, if any, of its populations occur in reserves.

Etymology. The epithet is Latin for circular, and refers to the rounded leaves.

Affinities. This species is a member of *T.* sect. *Astraea s. str.* but differs from other members of this group in commonly having an apical point on the bracteoles. It is very similar to *T. racemulosa* Turcz. but with broader, flatter leaves, tending to have a longer prominent midvein, a coarser reticulate pattern of pits on the hypanthium and usually longer stamens.

Co-occurring species. Occurs just inland of the range of *T. stapfii*, and mostly to the west and south of *T. velutina*, both of which also belong to *T.* sect. *Astraea s. str.* According to a note on one of the specimens, D.J. McGauran enquired in a letter dated 2/11/1971 about two 'forms' of '*T. racemulosa*' he had collected from the East Yuna area in October 1971, now identified as *T. orbiculata* (PERTH 02195186) and *T. velutina* (PERTH 08221723). However the letter is not attached and it is not known whether two taxa occurred intermixed or in adjacent stands, or well separated.

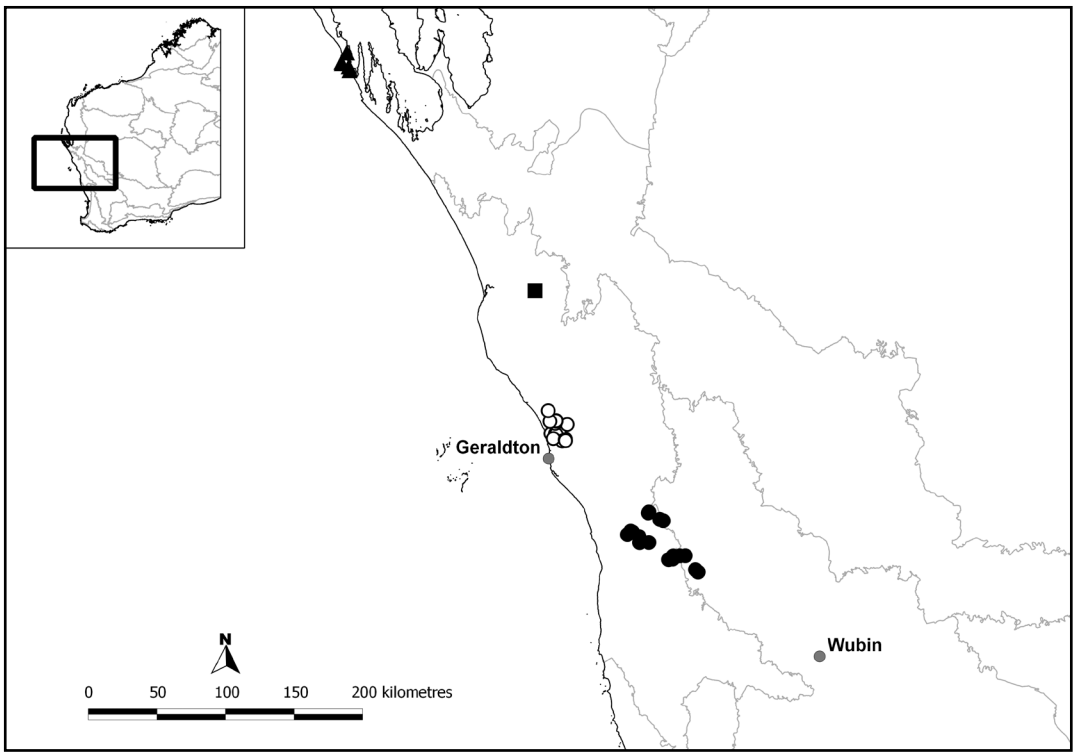

Figure 6. Distribution of *Thryptomene nitida* (●), *T. pinifolia* (■), *T. repens* (▲) and *T. stapfii* (○).

Notes. Presumably this species is single-stemmed or multi-branched at the base as in most related species, but this needs confirmation. Most of its distribution occurs inland of the northern part of the range of *T. racemulosa*.

Thryptomene pinifolia Rye & Trudgen, *sp. nov.*

Typus: south-west of Eurardy, Western Australia [precise locality withheld for conservation reasons], 4 November 1986, *D. & B. Bellairs* 1649 (*holo*: PERTH 02197162).

Thryptomene sp. Eurardy (D. & B. Bellairs 1649) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Illustration. Line illustration by B.J. Grieve on *D. & B. Bellairs* 1649.

Shrubs c. 0.5 m high; flowering branchlets with 2 or 3 pairs of flowers in a subterminal cluster. *Leaves* fairly densely arranged, usually antrorse. *Petioles c.* 1 mm long. *Leaf blades* linear in outline, *c.* 8.5 mm long, *c.* 0.4 mm wide, 0.3–0.5 mm thick, tapered to a curved apical point *c.* 1 mm long, prominently gland-dotted on both surfaces, entire; abaxial surface keeled, with one main row of 17–25 oil glands on each side of midvein; adaxial surface concave or in-folded. *Peduncles* 1-flowered, 0.8–1.3 mm long. *Bracteoles* not seen, caducous or deciduous. *Pedicels* ± absent. *Flower buds* not seen. *Flowers c.* 4.5 mm diam. *Hypanthium* coarsely and irregularly rugose and sometimes irregularly ridged. *Sepals* widely spreading in flower and fruit, very broadly ovate, *c.* 1.4 mm long, 1.3–1.5 mm wide, petaloid,

pale pink, entire, not auriculate. *Petals* erect in flower, loosely closed inwards in fruit, *c.* 1.6 mm long, pale pink, broadly obtuse, entire. *Stamens* 7 or 8, irregularly arranged opposite and between the sepals and petals, ± equidistant. *Filaments c.* 0.25 mm long. *Anthers c.* 0.4 mm wide. *Style c.* 0.3 mm long. *Fruits* not seen at maturity, *c*. 1.3 mm long, *c*. 2 mm diam.; hypanthium prominently patterned, *c.* 10-ribbed at summit and base but ribs scarcely visible in the irregularly rugose part in between. (Figure 5F–I)

Diagnostic features. *Leaf blades* linear in outline, *c.* 8.5 mm long, about as wide as thick, 0.3–0.5 mm thick, tapering to a long curved apical point, with one main row of oil glands on each side. *Peduncles* 0.8–1.3 mm long. *Bracteoles* caducous or deciduous. *Sepals c.* 1.4 mm long. *Petals c.* 1.6 mm long, pale pink. *Stamens c.* 8, irregular in position, ± equidistant. *Style c*. 0.3 mm long. *Fruits* ribbed at summit and base of hypanthium and prominently rugose in between.

Distribution and habitat. Recorded in yellow sand on sandplain in Kalbarri National Park (Figure 6).

Phenology. Flowers and fruits from October to November. No young flowers seen, only old flowers and immature fruits on the type specimen, which was collected in early November.

Conservation status. Listed by Smith (2013) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Eurardy (D. & B. Bellairs 1649). Plants were frequent in 1986 at the type locality in a large national park. The type population needs to be relocated and adjacent areas need to be surveyed for further populations of this species.

Etymology. From the Latin *pinus* (pine) and *folius* (-leaved), referring to the resemblance to pine foliage.

Affinities. This very distinctive species has the narrowest leaf shape of all the *Thryptomene* species. It is perhaps intermediate between sections *Astraea* and *Thryptomene* but is tentatively included in the former because of its rugose hypanthium and two ovules. The long apical point on its leaves and its stamen arrangement are atypical of sect. *Astraea*. *Thryptomene australis* of sect. *Thryptomene* is most similar in overall appearance, but differs in occurring on granite outcrops. It has somewhat shorter, broader leaves, and is readily distinguished by its more elongate and prominently ribbed hypanthium and more numerous ovules.

Notes. This species needs to be recollected to determine its conservation status and to allow it to be fully described. The description is incomplete as the single specimen has no bracteoles or flower buds and no mature fruits. Although taxa known from only one collection are normally excluded from this series of papers, an exception is made in this case because the taxon is considered to be so distinctive, that the possibility that it is a hybrid, diseased specimen or other abnormality seems negligible. The fact that it was described as being numerous at the type locality also suggests that it is a good taxon.

Thryptomene podantha Rye & Trudgen, *sp. nov.*

Typus: 18 km north of Yuna on the Dairy Creek–Gascoyne Junction road, Western Australia, 10 September 1984, *D.B. Foreman* 637 (*holo*: PERTH 07933177; *iso*: AD *n.v.*, CANB *n.v.*, K, MEL *n.v.*, NSW *n.v.*).

Thryptomene sp. Billabong (M.E. Trudgen 12858), Western Australian Herbarium, in *FloraBase*, http://florabase.dpaw.wa.gov.au/ [accessed 1 February 2014].

Shrub (0.3–)0.5–1.3 m high, 0.3–1.5 m wide, often widely spreading; flowering branchlets mostly with 2–7 pairs of flowers in a raceme-like or almost globular cluster. *Leaves* antrorse, overlapping. *Petioles* 0.4–0.7 mm long. *Leaf blades* obovate or broadly obovate, 2.5–6.5 mm long, 1.3–1.7 mm wide, indented at base, often mucronate, entire or minutely serrulate; abaxial surface with a somewhat flattened, broad central part and curved sides (rather than strictly convex), with 1–3 (usually 2) main rows of oil glands on each side of midvein and usually with 6–11 oil glands 0.05–0.1 mm diam. in each of the two central rows; adaxial surface concave, with oil glands usually inconspicuous; mucro (when present) recurved, up to 0.15 mm long. *Peduncles* 1-flowered, 0.5–1.5 mm long. *Bracteoles* caducous or deciduous, scarious, with a narrow keel bordered on each side by a broad gland-dotted portion and broad incurved margins, broadly ovate to obovate, 1–1.3 mm long, the apex incurved and often with a minute point, entire. *Pedicels* 1–1.4 mm long, ribbed. *Flower buds* concave or flat on summit, becoming convex not long before opening. *Flowers* 4.5–5.5 mm diam. *Hypanthium* with 5 prominent ribs opposite the sepals and 5 similar or less prominent ribs opposite the petals, the ribs sometimes branched towards the top. *Sepals* fairly erect in flower, erect in fruit, depressed-cordate, 0.5–1 mm long, 0.8–1.5 mm wide, broad-based, with the base gland-dotted and thickened at centre, the remainder scarious to petaloid, pink, entire or minutely denticulate. *Petals* apparently erect at the base and with the remainder spreading in flower, loosely closed inwards in fruit, broadly obovate, 2–2.4 mm long, pink, broadly obtuse at apex, ± entire. *Stamens* 10, alternating with the sepals and petals, fairly equidistant. *Filaments* 0.6–0.8 mm long, pink. *Anthers* 0.4–0.5 mm wide. *Style* 0.6–1 mm long. *Fertile fruits* depressed-obovoid, *c.* 1.5 mm long, *c.* 2 mm diam.; hypanthium with rounded, usually slight bumps and undulations on the surface (the ribs evident only as slight undulations); seed almost semicircular in outline but enlarged at one end, *c.* 0.9 mm high, *c.* 1.5 mm across.

Diagnostic features. *Leaf blades* obovate or broadly obovate, 2.5–6.5 × 1.3–1.7 mm, with 1–3 rows of oil glands on each side. *Mature peduncles* 0.5–1.5 mm long. *Bracteoles* caducous or deciduous, 1–1.3 mm long. *Bud apex* becoming convex. *Sepals* 0.5–1.5 mm long. *Petals* 2–2.4 mm long, pink. *Stamens* 10, alternating with the sepals and petals. *Style* 0.6–1 mm long. *Fruits* distinctly pedicellate, becoming smooth on hypanthium, with longitudinal ribs evident only as slight undulations.

Selected specimens examined. WESTERN AUSTRALIA: North West Coastal Hwy, *c.* 160 km N of Geraldton, 30 July 1967, *A.M. Ashby* 2177 (PERTH); between Yuna and Dartmoor, 19 Sep. 1940, *W.E. Blackall* 4798 (PERTH); S of Coolcalalaya Station, S side of E–W road, 9.4 km E of Coolcalalaya Rd, 30 Aug. 1990, *A.H. Burbidge* 4528 (PERTH); 4.6 km E of the Bella–Whelarra Rd on Binnu Rd East, 12 Jan. 2005, *A. Crawford* ADC 873 (PERTH); Wandana Nature Reserve, 15 Sep. 2003, *A. Chant* 492 (PERTH); 31 miles [50 km] N of Murchison River, North West Coastal Hwy, 20 July 1957, *J.W. Green* 1406 (PERTH); 13 km S of Wannoo, 3 Aug. 1985, *T.F. Houston* 614-6 B (PERTH); 412 mile peg, North West Coastal Hwy [161 km N of Geraldton], 12 Nov. 1963, *F. Lullfitz* 2916 (PERTH); 48 km N of Murchison River on North West Coastal Hwy, 21 Aug. 1973, *M.E. Trudgen* 598 (AD, BRI, CANB, K, MEL, PERTH); North West Coastal Hwy, 72.2 km S of Billabong Roadhouse and 17.5 km N of turnoff to Eurardy Station, 25 July 1995, *M.E. Trudgen* 12858 (HO, NSW, PERTH); Eurardy Station, N of the Murchison River, 29 Aug. 2003, *Wildflower Society of WA* EURA 35 (PERTH); 16 km S of The Loop, on E side of Murchison River gorge, 13 May 1968, *P.G. Wilson* 6749 A (PERTH).

Distribution and habitat. Extends from Meadow Station south-east to Wandana Nature Reserve (Figure 7), in yellow sand. Recorded at two localities (*A.H. Burbidge* 4528, *Wildflower Society of WA* EURA 35) forming an open shrubland, in both cases with *Eucalyptus* species dominant and acacias in a secondary layer.

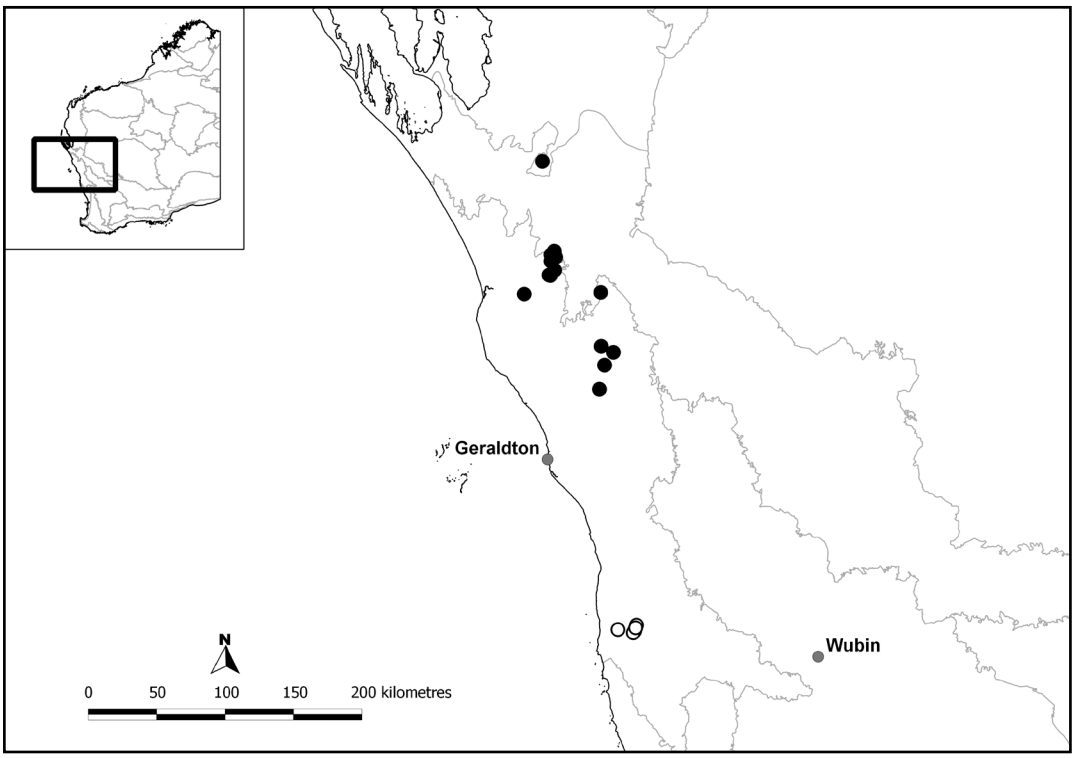

Figure 7. Distribution of *Thryptomene podantha* (●) and *T. spicata* (○).

Phenology. Flowers June to September. Fruits recorded November to January.

Conservation status. Not considered to be at risk.

Etymology. From the Greek *podos* (foot) and *anthos* (flower), referring to the presence of a distinct stalk below the base of the flower and fruit.

Affinities. This species does not appear to have any close relatives. It is unusual in having a definite pedicel and in having some of the ribs on the hypanthium distally branched.

Co-occurring species. Not recorded growing with other *Thryptomene* species, although it overlaps in range with many of them.

Notes. One roadside specimen (*M.E. Trudgen* 598) is recorded as having eight stems from ground level but whether this is a natural habit or one resulting from disturbance on a road verge is unknown.

Thryptomene podantha has a more obvious pedicel than any other species and is the only one to retain a definite pedicel in fruit. The hypanthium is also unusual among *Astraea s. lat.* species in being irregularly longitudinally ribbed in flower, but becoming smooth in fruit, although *T. nitida* is somewhat similar in this respect.

Thryptomene repens Rye & Trudgen, *sp. nov.*

Typus: Dirk Hartog Island, Western Australia [precise locality withheld for conservation reasons], 2 September 1972, *A.S. George* 11385 (*holo*: PERTH 02189194; *iso*: CANB, K, MEL).

Thryptomene sp. Steep Point (M.E. Trudgen 7421) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrubs up to 0.1 m high, prostrate and very widely spreading, rooting at nodes of the prostrate stems; flowering branchlets often erect, commonly 40–70 mm long, with mostly 2–7 pairs of flowers in a short, raceme-like arrangement. *Leaves* crowded on the branchlets, antrorse to patent, mostly widely antrorse. *Petioles* 0.2–0.4 mm long. *Leaf blades* narrowly obovate or obovate, 2.5–3 mm long, 0.6–1.3 mm wide, broadly obtuse, minutely denticulate especially towards apex; abaxial surface fairly sharply keeled, with usually 1 or 2 main rows of oil glands and 5–10 glands up to 0.15 mm diam. in each of the two central rows; adaxial surface concave. *Peduncles* 1-flowered, 1.5–2.5 mm long at maturity. *Bracteoles* deciduous, leaf-like but with very narrow scarious margins, narrowly oblong-obovate, 1.1–1.4 mm long, minutely denticulate or entire. *Pedicels* ± absent. *Flower buds* with a shallowly conic to deeply convex apex. *Flowers c.* 3 mm diam. *Hypanthium* with a prominent pattern of irregular bumps and/or ridges and with pits in between. *Sepals* fairly erect in flower, loosely closed inwards in fruit, broadly ovate-cordate, 0.6–1 mm long, *c.* 0.6 mm wide, with a prominent, somewhat wing-like keel, deep pink throughout or along keel outside, denticulate or entire. *Petals* erect to slightly spreading in flower, loosely closed inwards in fruit, broadly obovate, *c.* 1.5 mm long, pink, broadly obtuse, ± entire. *Stamens* 10, alternating with the sepals and petals but not equidistant, forming 5 pairs opposite the sepals. *Filaments c.* 0.8 mm long, pale pink. *Anthers c.* 0.3 mm wide. *Style c.* 1.3 mm long, pale pink with a deep pink stigma. *Fertile fruits* depressed-obovoid, 1.5–1.7 mm long, 1.8–2 mm diam.; hypanthium rugose with irregular pits and bumps or irregularly rugose and pitted; seed not seen at maturity.

Diagnostic features. *Shrub* with prostrate stems rooting at the nodes. *Leaf blades* narrowly obovate or obovate, 2.5–3 × 0.6–1.3 mm, with 1 or 2 rows of oil glands on each side. *Mature peduncles* 1.5–2.5 mm long. *Bracteoles* deciduous, 1.1–1.4 mm long. *Bud apex* conic. *Sepals* 0.6–1 mm long. *Petals c.* 1.5 mm long, pink. *Stamens* 10, alternating with the sepals and petals but forming pairs opposite the sepals. *Style c.* 1.3 mm long. *Fruits* irregularly rugose and pitted on hypanthium.

Other specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 31 Aug. 2005, *L.S.J. Sweedman* 6580 (PERTH); 13 Nov. 2005, *L.S.J. Sweedman* 6688 (PERTH); 6 Oct. 1989, *M.E. Trudgen* 7421 & 7422 (PERTH).

Distribution and habitat. Known only from Dirk Hartog Island and Steep Point (Figure 6), in coastal habitats including sand dunes.

Phenology. Flowers recorded August to September. Fruits recorded early September to October.

Conservation status. Recently downgraded to Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Steep Point (M.E. Trudgen 7421) (Western Australian Herbarium 1998–). This species was previously listed as Priority One (Smith 2013), but is now known to occur in Dirk Hartog Island National Park and is reported to be fairly common in the Steep Point area.

Etymology. The epithet is Latin for creeping, and refers to its prostrate, rooting habit.

Affinities. *Thryptomene repens* belongs in the *T. stronglylophylla* group but can be distinguished from all members of that group by its prostrate habit, with adventitious roots produced at nodes on prostrate stems, and its longer style. It is unusual in having stamens in obvious pairs.

Co-occurring species. This species grows in mixed stands with *T. dampieri s. lat.* at Steep Point. It differs from that species its more olive green foliage as well as having generally larger leaves, longer peduncles, deciduous bracteoles, distinctly keeled sepals, petals less spreading and with their bases closer and the stamens forming obvious pairs rather than being equidistant as in *T. dampieri*.

Notes. The mature style is distinctly longer than the stamens and not much shorter than the petals.

Thryptomene shirleyae Rye, *sp. nov.*

Typus: west of Dalwallinu, Western Australia [precise locality withheld for conservation reasons], 2 September 2008, *J.M. Collins* 506 (*holo*: PERTH 08077223; *iso*: K, MEL).

Thryptomene sp. Carnamah (J. Borger, A. Dring & F. Falconer AD 1510-25), Western Australian Herbarium, in *FloraBase*, http://florabase.dpaw.wa.gov.au/ [accessed 1 February 2014].

Shrub 0.3–1.1 m high. *Leaves* crowded on the branchlets, antrorse to patent; flowering branchlets with 2–5 pairs of flowers in a raceme-like arrangement. *Petioles* well defined, 0.2–0.4 mm long. *Leaf blades* broadly obovate to ± circular, 1.2–2.2 mm long, 1–1.5 mm wide, broadly obtuse to slightly emarginate, without an apical point, usually denticulate or with narrow processes up to 0.1 mm long; abaxial surface keeled, usually with 1 or 2 main rows of dark oil glands and 3–6 glands in each of the two central rows; adaxial surface concave, with oil glands much less obvious than on abaxial surface. *Peduncles* 1-flowered, 1.3–2 mm long. *Bracteoles* persistent, broadly ovate in outline, 1–1.5 mm long, keeled, with scarious, incurved margins and a greatly incurved apex, entire or minutely denticulate. *Pedicels* ± absent. *Flower buds* with a convex apex. *Flowers* 4–5 mm diam. *Hypanthium* somewhat ribbed and deeply pitted-rugose, the pits numerous and corresponding with dark oil glands. *Sepals* erect in flower and fruit, depressed-ovate, 0.9–1.2 mm long, petal-like, pink, entire or minutely denticulate, not markedly auriculate. *Petals* fairly erect in flower and fruit, almost circular, 1.7–2 mm long, pink, broadly obtuse, often minutely denticulate around summit. *Stamens* 10, alternating with the sepals and petals, equidistant. *Filaments* 0.7–1.2 mm long, pink. *Anthers* 0.3–0.4 mm wide. *Style* 1–1.4 mm long. *Fertile fruits* depressed-obovoid, *c*. 1.4 mm long, *c*. 1.5 mm diam.; hypanthium minutely pitted; seed transversely reniform, not seen at maturity. (Figure 8)

Diagnostic features. *Leaf blades* broadly obovate to ± circular, 1.2–2.2 × 1–1.5 mm, with 1 or 2 rows of oil glands on each side. *Mature peduncles* 1.3–2 mm long. *Bracteoles* persistent, 1–1.5 mm long. *Bud apex* convex. *Sepals* 0.9–1.2 mm long. *Petals* 1.7–2 mm long, pink. *Stamens* 10, alternating with the sepals and petals, equidistant. *Style* 1–1.4 mm long. *Fruits* minutely pitted on hypanthium.

Other specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 15 Oct. 2008, *J. Borger, A. Dring* 1510-25 *& F. Falconer* (PERTH); 30 Apr. 1985, *J.D. Briggs* 1719 (PERTH); 16 July 1980, *R.J. Cranfield* 1488 (PERTH); 23 Sep. 2013, *J. Borger s.n.* (PERTH); 5 Sep. 1959, *S. de la Hunty s.n.* (PERTH); 8 Sep. 1998, *G.J. Keighery & N. Gibson* 4994 (PERTH); 15 Sep. 2002, *B. Moyle* 02/05 (NSW, PERTH).

Figure 8. Habitat (A), habit (B) and flowering stems (C) of *Thryptomene shirleyae*. Photographs taken by Jenny Borger.

Distribution and habitat. Extends from east of Carnamah south to west of Dalwallinu (Figure 2). Two populations were from granite outcrops, where *T. shirleyae* and other shrub species such as *Oxymyrrhine s. lat.* and *Verticordia chrysanthella* form an open low shrubland, the outcrop surrounded by much taller vegetation including *Allocasuarina campestris*. Also recorded from yellow sand and other soil types, sometimes with *Callitris arenaria* and *Calothamnus quadrifidus*.

Phenology. Flowers from July to October. Fruits recorded in September and October.

Conservation status. Recently downgraded to Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Carnamah (J. Borger, A. Dring & F. Falconer AD 1510-25) (Western Australian Herbarium 1998–). This species was previously listed as Priority One (see Smith 2013), but is now known from more locations, partly through the redetermination of old specimens. It has a range more than 70 km long and one of its localities is in a nature reserve. At a recently discovered locality, at least 90 plants were recorded.

Etymology. Named after Shirley Barbara de la Hunty, nee Strickland (1925–2004), an outstanding athlete and ardent conservationist, who was the first to collect this taxon in 1959.

Affinities. This species is a member of *T.* sect. *Astraea s. str.* It is distinguished from *T. hyporhytis* by its shorter and/or broader leaves, shorter peduncles and less pronounced pitting on the hypanthium, also tending to have longer, more persistent bracteoles. It occurs south-east of the range of *T. hyporhytis*.

Thryptomene racemulosa is similar in the hypanthium pitting, short peduncles and persistent bracteoles but its sepals, which are usually almost as long as the petals, are widely spreading in flower and fruit. Its sepals and petals differ markedly in colour whereas those of *T. shirleyae* are quite similar in colour.

Co-occurring species. None recorded, although several species overlap in range with *T. shirleyae*.

Notes. This species has the smallest leaves in *T.* sect. *Astraea s. str.*, similar in size to those found in the *T. stronglophylla* group.

Thryptomene spicata Rye & Trudgen, *sp. nov.*

Typus: south of Eneabba, Western Australia [precise locality withheld for conservation reasons], 21 October 2004, *G. Cassis, M. Hall, C. Symonds & C. Weirauch* 2-19 (*holo*: PERTH 06986943; *iso*: AMNH, CANB, MEL).

Thryptomene sp. Eneabba (R.J. Cranfield 8433) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrubs erect, reaching at least 1.5 m high; flowering branchlets usually with 5–14 pairs of flowers in a spike-like, subterminal arrangement 10–30 mm long. *Leaves* mostly antrorse and overlapping, sometimes appressed when separate. *Petioles* 0.7–1 mm long. *Leaf blades* obovate to very broadly obovate, 3.5–5.5 mm long, 2.5–4 mm wide, obtuse, scarcely mucronate, entire; abaxial surface keeled-convex, many-dotted, with 4–6 main rows of oil glands and 6–9 oil glands < 0.1 mm diam. in each of the two central rows; adaxial surface concave, less prominently gland-dotted. *Peduncles* 1-flowered, less than 0.2 mm long. *Bracteoles* persistent in fruit, with a prominent herbaceous keel not reaching the apex and a scarious pale margin, ± obovate and strongly cupped, 1.8–2.5 mm long, incurved at

apex and margins incurved, the inner surface deeply concave; keel green, *c.* 0.5 mm deep. *Pedicels* ± absent. *Flower buds* not seen when very young, with a convex apex when mature. *Flowers* 5–7 mm diam. *Hypanthium* somewhat ribbed in bud, becoming smooth in flower. *Sepals* apparently fairly erect in flower and fruit, scarious, broadly ovate to depressed-ovate, 1.5–2 mm long, pale, entire or minutely denticulate. *Petals* apparently fairly erect in flower and fruit, broadly obovate, 3–3.5 mm long, pink, broadly obtuse, often dentate around summit but more entire below. *Stamens* 10, alternating with the sepals and petals, equidistant. *Filaments* 1.5–1.7 mm long. *Anthers* 0.6–0.8 mm wide. *Style* 1.4–1.7 mm long. *Fertile fruits c.* 1.7 mm long, *c.* 2.8 mm diam.; hypanthium shiny, smooth; seed transversely reniform, *c.* 1.1 mm high, *c.* 2.1 mm across. (Figure 5J–N)

Diagnostic features. *Leaf blades* obovate to very broadly obovate, 3.5–5.5 × 2.5–4 mm, with 4–6 rows of oil glands on each side. *Mature peduncles* ± absent. *Bracteoles* persistent, 1.8–2.5 mm long. *Bud apex* convex. *Sepals* 1.5–2 mm long. *Petals* 3–3.5 mm long, pink. *Stamens* 10, alternating with the sepals and petals, equidistant. *Style* 1.4–1.7 mm long. *Fruits* with a smooth, shiny hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: Nov. 2001, *T. Boland s.n.* (PERTH); 6 Nov. 1992, *R.J. Cranfield* 8433 *& P. Spencer* (PERTH); 27 Oct. 2005, *D. Marsh* 129 (PERTH); 17 Nov. 2005, *D. Rathbone* 83 (PERTH); 13 Sep. 2013, *F. Riviera* FR 11 (NSW, PERTH); 14 Mar. 2007, *Woodman Environmental Consulting* 07-24-13 (PERTH).

Distribution and habitat. Occurs south of Eneabba (Figure 7), recorded in sand over laterite in open shrubland. Scattered *Eucalyptus todtiana* trees were recorded at one of the localities while another had *E. accedens* and *E. eudesmoides*.

Phenology. Flowers: October to November. Fruits recorded in November.

Conservation status. Listed by Smith (2013) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Eneabba (R.J. Cranfield 4833). A geographically restricted species known from one reserve.

Etymology. From the Latin *spica* (spear, spike) and *-atus* (indicating possession or likeness), referring to the subsessile flowers in a spike-like inflorescence.

Affinities. A very distinctive species with the largest fruit and seed so far recorded in the genus, and possibly the largest anthers. It is also one of the few species with a smooth hypanthium, and its spike-like flower arrangement is fairly distinctive.

Co-occurring species. Not recorded with any other *Thryptomene* species although *T. hyporhytis*, *T. mucronulata* and *T. racemulosa* occur in the general vicinity.

Notes. The first collection of *T. spicata* described it as a shrub *c.* 1.5 m high. None of the five subsequent collections recorded the height or any other details of the habit apart from that it was a shrub. One of these recent collections (*G. Cassis, M. Wall, C. Symonds & C. Weirauch* 2-19) recorded it as a host for a lace bug, *Tingis* sp. (family Tingidae).

Thryptomene stapfii Rye & Trudgen, *sp. nov.*

Typus: Bella Vista Nature Reserve, Western Australia [precise locality withheld for conservation

reasons], 21 August 2003, *B.L. Rye* 238082 *& M.E. Trudgen* (*holo*: PERTH 06744605; *iso*: CANB, K, MEL, NSW).

Thryptomene sp. Moresby Range (A.S. George 14873) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrub 0.2–1 m high, erect to almost prostrate, commonly 0.5–1.5 m wide; flowering branchlets with 5–15 pairs of flowers in a raceme-like arrangement. *Leaves* not particularly crowded on the branchlets, mostly appressed to antrorse but a few ± patent. *Petioles* 0.4–1 mm long. *Leaf blades* narrowly obovate or obovate, 4–7 mm long, 1–2 mm wide, broadly obtuse to slightly emarginate and with a minute apical mucro, entire or minutely denticulate; abaxial surface convex, with 3–5 main rows of oil glands and usually 12–15 oil glands less than 0.1 mm diam. in each of the two central rows, the glands sometimes very inconspicuous; adaxial surface concave, the glands often as well developed as on abaxial surface. *Peduncles* 1-flowered, 7–11 mm long. *Bracteoles* caducous or rarely persistent, scarious except for the keel, ± obovate, concave and with apex much incurved so that the upper part is cupped, 0.5–1 mm long, entire. *Pedicels* ± absent. *Flower buds* with a convex or flat apex. *Flowers* 6–7 mm diam. *Hypanthium* somewhat ribbed and deeply pitted-rugose, the pits numerous and corresponding with dark oil glands. *Sepals* erect in flower, closing inwards in fruit, depressed-ovate to semicircular, 0.7–1 mm long, pink, minutely denticulate, not markedly auriculate. *Petals* fairly erect at base but upper part more spreading in flower, loosely closed inwards in fruit, almost circular, 1.8–2.3 mm long, deep pink, broadly obtuse, minutely denticulate. *Stamens* 10, alternating with the sepals and petals, equidistant. *Filaments* 0.8–1.3 mm long. *Anthers* 0.4–0.5 mm wide. *Style c.* 1 mm long. *Fertile fruits* depressed-obovoid, 1.6–1.8 mm long, 2.2–2.5 mm diam.; hypanthium prominently pitted, colliculate; seed transversely reniform, *c.* 0.8 mm high, *c.* 1.6 mm across. (Figure 9A–E)

Diagnostic features. *Leaf blades* narrowly obovate or obovate, 4–7 × 1–2 mm, with 3–5 rows of oil glands on each side. *Mature peduncles* 7–11 mm long. *Bracteoles* usually caducous, 0.5–1 mm long. *Bud apex* convex or flat. *Sepals* 0.7–1 mm long, *Petals* 1.8–2.3 mm long, deep pink. *Stamens* 10, alternating with the sepals and petals, equidistant. *Style c.* 1 mm long. *Fruits* with a prominently pitted hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 9 Oct. 1998, *P.G. Armstrong s.n.* (CANB, PERTH); 25 Aug. 1983, *R.J. Cranfield* 2861 (PERTH); 13 Sep. 1977, *A.S. George* 14873 (PERTH, CANB, MEL); 27 Aug. 1977, *N. McFarland s.n.* (NSW, PERTH); 18 June 1996, *S.J. Patrick* 2603 (PERTH); 15 Aug. 1996, *S.J. Patrick* 2730 (PERTH); 20 Aug. 2003, *B.L. Rye* 238063 *& M.E. Trudgen* (AD, BRI, HO, NSW, PERTH); 4 July 1971, *R.A. Saffrey* 1526 (PERTH).

Distribution and habitat. Occurs in the Moresby Range, north of Geraldton (Figure 6), in shrublands on rocky hillsides.

Phenology. Flowers June to September. Fruits recorded August to October.

Conservation status. Listed by Smith (2013) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Moresby Range (A.S. George 14873). It has a restricted distribution, but is protected in a few nature reserves.

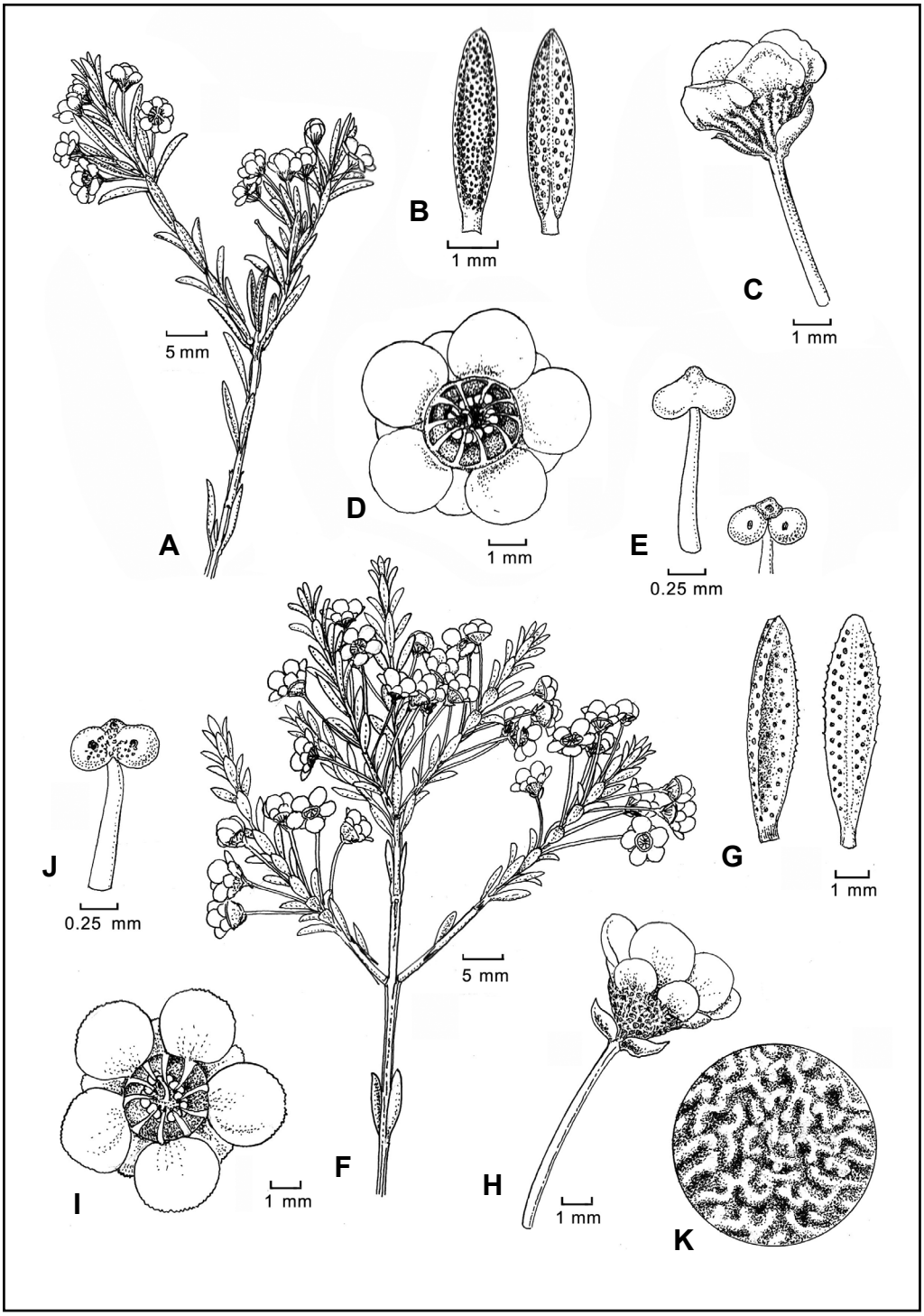

Figure 9. *Thryptomene* sect. *Astraea s. str. T. stapfii* (A–E). A – flowering branch; B – upper and lower surfaces of leaf; C – peduncle, bracteoles and old flower; D – flower; E – outside view of stamen and inside view of anther. *T. velutina* (F–K). F – flowering branch; G – upper and lower surfaces of leaf; H – peduncle, bracteoles and young fruit; I – flower; J – inside view of stamen; K – enlargement of the patterning on the hypanthium in fruit. Drawn by Margaret Pieroni from *R.J.Cranfield* 2861 (A–E), *A.C. Burns* 100 (F–K).

Etymology. Named after the Austrian botanist Otto Stapf (1822–1933), who held various positions at the Royal Botanic Gardens, Kew between 1890 and 1922, was editor of the *Botanical Magazine* from 1922 to 1933 (Stafleu & Cowan 1985), and made a significant contribution to the taxonomy of *Thryptomene*.

Affinities. This species is a member of *T.* sect. *Astraea s. str.* It is closely related to *T. hyporhytes* but differs in its occurrence further north-west and in having more numerous, shallower pits on its hypanthium. It also tends to have larger leaves and flowers, and longer peduncles.

Co-occurring species. Being restricted to rocky hillsides in the Howatharra area, *T. stapfii* does not occur with any closely related species (i.e. of *T.* sect. *Astraea s. str.*) but has been recorded growing with *T. stenophylla* on Mt Rennie, on moderate to steep slopes towards the base of a mesa.

Notes. *Thryptomene stapfii* is often rather mat-like with almost prostrate main stems. McFarland and McFarland (1977: 16) reported that this species [as *Thryptomene* sp. (NM.1080)] was 'covered with masses of pale pink to mauve flowers' and 'usually swarming with insect life'.

Thryptomene velutina Rye & Trudgen, *sp. nov.*

Typus: north-east of Geraldton, Western Australia [precise locality withheld for conservation reasons], 5 June 1968, *A.C. Burns* 7 (*holo*: PERTH 02191482; *iso*: CANB).

Thryptomene sp. Yuna Reserve (A.C. Burns 100) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 404 (2000).

Shrub 1–1.5 m high; flowering branchlets with 4–8 pairs of flowers in a cluster or raceme-like arrangement. *Leaves* mostly antrorse to appressed but a few sometimes patent, with incurved apex. *Petioles* 0.6–1 mm long. *Leaf blades* narrowly or very narrowly obovate, (6–)8–13 mm long, 1.3–2.6 mm wide, obtuse, with apex of keel and margins tending to be incurved, ± entire; abaxial surface convex, with 3–5 main rows of oil glands and 12–20 glands up to *c.* 0.1 mm diam. in each of the two central rows; adaxial surface concave, often as prominently dotted as abaxial surface. *Peduncles* 1-flowered, 4–8 mm long. *Bracteoles* caducous or deciduous, with a somewhat to very herbaceous keel, ± narrowly ovate, 1.5–2.4 mm long, entire. *Pedicels* ± absent. *Flower buds* with a convex apex. *Flowers* 5–6 mm diam. *Hypanthium* prominently ribbed and pitted-rugose, the pits corresponding with dark-coloured glands, minutely papillose. *Sepals* widely spreading and recurved in flower and fruit, very broadly ovate or depressed-ovate, 1.2–2 mm long, 2.2–2.5 mm wide, rather petaloid, similar in colour to the petals, almost entire, not markedly auriculate. *Petals* rather erect in flower, loosely closed inwards in fruit, very broadly obovate, 2.2–2.5 mm long, medium to deep pink-purple, broadly obtuse, almost entire. *Stamens* 10, alternating with the sepals and petals, equidistant. *Filaments* 0.9–1.2 mm long, pink. *Anthers* 0.5–0.6 mm wide. *Style* 0.8–1.5 mm long. *Fertile fruits* depressed-obovoid, 2.3–2.4 mm long, 2.8–3.3 mm diam.; hypanthium pitted-rugose to fairly smooth and spotted with dark glands, minutely papillose; seed not seen at maturity. (Figure 9F–J)

Diagnostic features. *Leaf blades* narrowly or very narrowly obovate, 6–13 × 1.3–2.6 mm, with 3–5 rows of oil glands on each side. *Mature peduncles* 4–8 mm long. *Bracteoles* caducous or deciduous, 1.5–2.4 mm long. *Bud apex* convex. *Sepals* 1.2–2 mm long. *Petals* 2.2–2.5 mm long, medium to deep pink-purple. *Stamens* 10, alternating with the sepals and petals, equidistant. *Style* 0.8–1.5 mm long. *Fruits* minutely papillose on hypanthium.

Selected specimens examined. WESTERN AUSTRALIA [localities withheld for conservation reasons]: 14 Nov. 1997, *P.G. Armstrong* 97/215 (PERTH); 11 Oct. 1998, *P.G. Armstrong s.n.* (AD, NSW, PERTH); 20 Aug. 1969, *A.C. Burns* 100 (PERTH); 10 Aug. 2003, *J. Docherty* 164 (PERTH); 1 Mar. 1994, *E.A. George s.n.* (MEL, PERTH); 27 Oct. 1998, *G.J. Keighery & N. Gibson* 4993 (PERTH); 20 Aug. 1968, *J. McGauran* 1–3 (all PERTH).

Distribution and habitat. Extends from East Yuna Nature Reserve south to Bindoo Nature Reserve in the northern part of the South West Botanical Province (Figure 10) in yellow to red sandy soils, often associated with sandstone, often with *Allocasuarina campestris* and *Callitris arenaria*.

Phenology. Flowers May to September. Fruits recorded September to early November.

Conservation status. Listed by Smith (2013) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, as *T.* sp. Yuna Reserve (A.C. Burns 100). This species has been cultivated in Perth gardens using cuttings and appears to be fairly well protected in three nature reserves.

Etymology. From the Latin *velutinus* (velvety), referring to the velvety appearance of the minutely and very densely papillose hypanthium, a character that distinguishes it from other *Thryptomene* species.

Affinities. This species is a member of *T.* sect. *Astraea s. str.* It is closely related to *T. hyporhytis*, which has smaller leaves, shorter bracteoles and a more deeply pitted-rugose ornamentation on the hypanthium, without papillae, on the mature fruits. It occurs further north than *T. hyporhytis*.

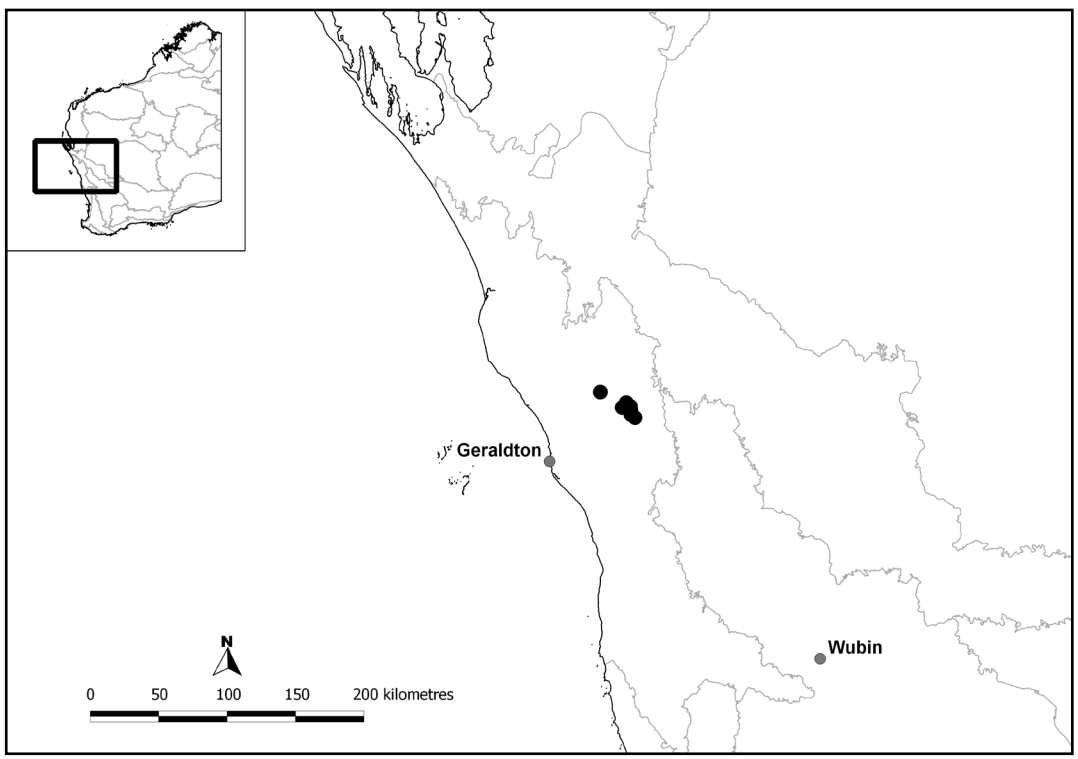

Figure 10. Distribution of *Thryptomene velutina* (●).

Co-occurring species. Possibly occurs with, or close to, *T. orbiculata* (see discussion under that species). It has been recorded (*M.E. Trudgen* 22015) growing with *T. strongylophylla* and *T.* sp. Wandana (M.E. Trudgen MET 22016) in McGauran Nature Reserve.

Notes. It is somewhat confusing that there are two *Thryptomene* specimens labelled *A.C. Burns* 100, with different dates but apparently with the same locality. The specimen (PERTH 02191504) that was used for the phrase name *T.* sp. Yuna Reserve (A.C. Burns 100) is illustrated in Figure 9F–K. It was collected on 20 August 1969, whereas the other specimen (PERTH 02195194) was collected on 4 October 1967 and is of *T. racemulosa*.

Thryptomene wannooensis Rye, *sp. nov.*

Typus: south of Billabong Roadhouse, Western Australia [precise locality withheld for conservation reasons], 6 August 1976, *R. Hnatiuk* 760404 (*holo*: PERTH 02189054; *iso*: MEL).

Shrubs c. 0.8 m high, width not recorded; flowering branchlets with usually 3–6 pairs of flowers in a small, subterminal cluster. *Leaves* crowded on the branchlets, antrorse to patent. *Petioles* 0–0.4 mm long. *Leaf blades* depressed-obovate to depressed-ovate, *c.* 2 mm long, *c.* 2.5 mm wide, broadly obtuse, with margins incurved but apex recurved, sometimes with a mucro up to 0.1 mm long, entire; abaxial surface with midvein either narrowly ridged distally (with base flattened) or ridged throughout, with usually 3 or 4 main rows of oil glands on each side of midrib, the rows tending to be separated by longitudinal ribs, with 4–6 glands up to *c.* 0.1 mm diam. in each of the two central rows. *Peduncles* very reduced (almost absent), 1-flowered. *Bracteoles* persistent, *c.* 2 mm long, somewhat glossy, with a broad, rounded keel and membranous incurved margins, which extend beyond the keel, which is prominently gland-dotted. *Pedicels* ± absent. *Flower buds* with a convex apex. *Flowers* 5–6 mm diam. *Hypanthium* usually hidden, fairly prominently patterned with irregular, crowded, flattened ridges and sometimes with pits. *Sepals* loosely closed inwards in fruit, scarcely keeled, 1–1.5 mm long, rather scarious and glossy, pinkish, with incurved margins and apex, entire, the outer sepals with distinct auricles up to 0.5 mm long. *Petals* spreading in flower, *c*. 2.5 mm long, pale pink-purple, entire. *Stamens* usually 10, alternating with the sepals and petals, ± equidistant. *Filaments* often 0.8–1 mm long. *Anthers c.* 0.5 mm wide. *Style c.* 1 mm long. *Fruits* not seen at maturity.

Diagnostic features. *Leaf blades* depressed-obovate to depressed-ovate, *c.* 2 × 2.5 mm, with 3 or 4 rows of oil glands on each side; apex recurved. *Mature peduncles* ± absent. *Bracteoles* persistent, *c.* 2 mm long. *Bud apex* convex. *Sepals* 1–1.5 mm long, glossy. *Petals c.* 2.5 mm long, pink. *Stamens* 10, alternating with the sepals and petals. *Style c.* 1 mm long. *Fruits* irregularly rugose on hypanthium.

Other specimen examined. WESTERN AUSTRALIA [locality withheld for conservation reasons]: 3 Aug. 1985, *T.F. Houston* 614-6A (PERTH).

Distribution and habitat. Occurs near Wannoo, south of Shark Bay (Figure 3), recorded in yellow sand on a ridge in low open heath.

Phenology. Flowers from July to August.

Conservation status. To be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). The known range of this species appears

to be less than 12 km long and it is possible that both collections were made from the same population if the latitudes given on the two specimens are not both accurate.

Etymology. The epithet refers to this taxon's occurrence in the Wannoo area.

Affinities. Very similar to *T. globifera*, which differs in leaf morphology, including having the leaf apex (of the dorsal ridge) incurved, and in having bracteoles with the herbaceous midrib more prominently keeled. *Thryptomene wannooensis* occurs north of the range of *T. globifera* and tends to have more numerous oil glands on the leaves.

Co-occurring species. None recorded.

Notes. A very poorly known taxon, particularly with respect to habit and fruit characters; it is in urgent need of a field survey.

Acknowledgements

This research was supported by funding from the Australian Biological Resources Study. Many of the species described here have informal names on *FloraBase* that were allocated by Malcolm Trudgen, whose contribution is acknowledged by joint authorship of those taxa. I am very grateful to staff at MEL for the loan of type material and G for images of type material, to Jenny Borger for images and field data for *T. shirleyae*, Margaret Pieroni for preparing the line drawings, Steve Dillon for assistance with mapping and the referee and editors for helpful comments. I also thank Wayne Gebert and Alex George for advice on one of the epithets and Lisa Rye for arranging the images and line drawings.

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