A taxonomic revision of the genus *Calothamnus* Labill. (Myrtaceae: Leptospermoideae). Part 1. The 4-merous species

T.J. Hawkeswood

49 Venner Road, Annerley, Brisbane, Queensland, 4103.

Abstract

Hawkeswood, T.J. A taxonomic revision of the genus *Calothamnus* Labill. (Myrtaceae: Leptospermoideae). Part 1. The 4-merous species. Nuytsia 6(1):67-126 (1987). A taxonomic account is provided for the 23 4-merous *Calothamnus* species presently recognized. Two new subgenera are described. Two taxa are elevated from variety or form to species: *C. crassus* (Benth.) T.J. Hawkeswood and *C. pallidifolius* (Benth.) T.J. Hawkeswood. In addition, 2 species are raised from synonomy: *C. huegelii* Schauer and *C. robustus* Schauer. A key is provided for the 23 species; distributional and ecological data are provided where known for each taxon.

Introduction

The genus *Calothamnus* Labill. (Myrtaceae: Leptospermoideae) is endemic to Western Australia. The concentration of species is in the coastal heathlands, woodlands, and dry sclerophyll forests from Shark Bay on the west coast to Cape Arid on the Great Australian Bight. No species are known from any of the offshore islands near the Western Australian coast.

The original description of the genus was published in 1806 by J.J.H. de Labillardiere following a visit he made to Australia. Since Labillardiere's (1806) publication and his description of *C. sanguineus,* numerous other species have been described. Robert Brown (1812) added three species (viz. *C. quadrifidus, C. gracilis* and *C. villosus*) based on collections he made as naturalist aboard the ship *Investigator* with Matthew Flinders during December 1801 and January 1802 at King George Sound (Albany district). All three names are still currently accepted. J.C. Schauer (1843) and Schauer in Lehmann (1844), was the first botanist to thoroughly study the genus but he had very little material at his disposal. Despite this disadvantage he produced the first reasonably reliable account of *Calothamnus* (and of the closely related genus *Beaufortia*). Bentham (1867) modified the work of Schauer and previous authors. Since then many additional species have been discovered and some extensive collections of the more common species have been built up in herbaria within Australia, in particular, the Western Australian Herbarium (PERTH). Hence Bentham's treatment is now of limited use and has led to numerous misidentifications on herbarium specimen sheets, in published papers and in popular gardening and plant identification guides. Most of the new species collected this century have been published by Hawkeswood (1984a, 1984b). Since some of these new species are rare and endangered, the papers were published ahead of the main revision. *Calothamnus accedens* T.J. Hawkeswood, one such species, is only known from 14 plants, hence it was necessary to induce awareness of these in the light of further threats to their survival.

Morphology and terminology

The genus *Calothamnus* in general exhibits little inter- or intra-specific variation. Most are shrubs growing to about 2 or 3 m high with terete often pungent leaves, densely crowded and randomly distributed on the stem. The oil glands are usually prominent, but in some species such as *C. planifolius* Lehm., *C. pallidifolius* (Benth.) T.J. Hawkeswood and *C. torulosus* Schauer they are usually obscure. Some species such as *C. rupestris* Schauer and *C. formosus* T.J. Hawkeswood grow to small trees about 3 or 4 m high, while others such as *C. schaueri* Lehm., *C. preissii* Schauer and *C. lehmannii* Schauer usually grow as decumbent shrubs to about 30 cm high. All species in the genus are evergreen, and only one, *C. sanguineus* Labill., is known to naturally drop its fruits. The root systems are usually extensive with a lateral network of rootlets. One species, *C. tuberosus* T.J. Hawkeswood, is very unusual in having tuberous roots (Hnatiuk 1977, Pate & Dixon 1982) although most species have not been examined for this character.

Most species have terete leaves, without evident venation, although in some such as *C. pallidifolius, C. planifolius, C. blepharospermus* F. Muell. and *C. homalophyllus* F. Muell. they are flat and oblanceolate with large central, marginal and smaller cross veins.

The flowers of *Calothamnus* are sessile and are usually arranged in unilateral or, more commonly, in cylindrical spikes, often in scattered clusters, rarely solitary. The name "One-sided Bottlebrush" has been given to the group but this is rather an improper common vernacular due to the fact that many species do not have unilateral spikes or clusters. The flowers are embedded (or partially so) in the often corky rhachis. In some species, the buds break through a protective membranous structure, e.g. *C. graniticus* T.J. Hawkeswood. The calyx-tube is usually covered in oil glands. The calyx-lobes are usually thick with membranous margins. The petals, usually with large oil glands in the centre and smaller ones on the margins, are deciduous and usually fall soon after the stamens have unfolded. In some species, e.g. *C. graniticus* and *C. rupestris,* the petals have a prominent basal claw, but in the majority the claw is absent or poorly developed. The styles are usually thick and often continue growth before and after anthesis. The staminal claws are usually equal in length and width, and deep red to orange-red in colour. However, the staminal claws in *C. sanguineus* are unusual in that the upper two are fused to form a single broad claw, while the lower ones are reduced to a single stamen. The staminal claws of *C. pachystachyus* Benth. are also unusual in that the two upper ones are broad, while the lower ones are narrow; all are yellow-brown (brown at base) in colour. The anthers of *Calothamnus* are basifixed, mostly glabrous, arranged marginally on the staminal claws. In one species, *C. torulosus,* there are also submarginal filaments and the anthers and filaments are covered in a peculiar cobweb-like substance. The nature of this phenomenon has not been examined by the author. The number of marginal filaments on the staminal claws is of some taxonomic significance. The ovary is inferior, 3-locular, with numerous ovules per loculus. Usually few fertile seeds are produced per capsule. The shape and size of the seeds and colour of the testa is of considerable taxonomic significance. The angled seeds are usually linear to linear-cuneate in shape, (truncate at one or both ends), 1-3 mm long and yellow, yellow-brown, red-brown or dark brown and even grey in colour. They are usually glabrous (sometimes shiny), but in some species, e.g. *C. blepharospermus,* each angle has a row of closely arranged, stiff, erect cilia. The ovulodes (sterile ovules) are usually smaller than the fertile seeds; they are glabrous and usually coloured yellow to orange-brown. The fruit is perhaps the most variable and taxonomically useful character in the genus. It is a dry, sessile capsule, depressed globular to cylindrical or ovoid in shape; the calyx-lobes (2, 3 or 5) may be thickened and persistent, or absent so that the fruit is ± truncate. The fruit is smooth or wrinkled, glabrous or pubescent, embedded (or partially so) in the corky or non-corky rhachis. As soon as the capsule dries, the seeds are released (usually within the first year after flowering) the valves open and the seeds fall from the fruit through the action of gravity and wind. The capsules usually remain on the plant for a number of years.

The terminology used in this paper follows that of Hawkeswood (1980, 1984a, 1984b). The term "calyx-tube" has been adopted and follows the terminology of Bentham (1867) since there appears to be little agreement amongst modern authors on the correct use of terms to describe this floral structure and its associated appendages. The correct interpretation of calyx, stamens and petals must await the results of embryological and developmental studies.

This revision is based mainly on the collections in the Western Australian Herbarium (PERTH) which undoubtedly holds the most comprehensive collections of *Calothamnus* of any herbarium.

The Botany Department Herbarium of the University of Western Australia (UWA) and the Kings Park Botanic Garden Herbarium, Perth (KP) have both contributed useful material and additional records to those of PERTH. In addition, the holdings of *Calothamnus* at the Royal Botanic Gardens, Sydney (NSW) have been examined and annotated. While I was in Western Australia during 1979-80 I attempted to examine as many *Calothamnus* species as possible in the field but I was unable to collect all of them. Further collections of all species growing in the Stirling Ranges and the Fitzgerald River area, where I was unable to visit, are needed.

In addition to the usual herbarium abbreviations (Holmgren, Keuken & Schofield 1981), KP has been used for herb. Kings Park Botanic Garden, Perth. Where a herbarium holds more than one sheet of a collection, this has been indicated by the relevant number in brackets after the specimen's citation.

For some of the species described herein, not every specimen seen by the author has been cited. In these cases, specimens with no collection data have not been cited and for well collected species such as *C. quadrifidus* and *C. sanguineus* not all collections have been cited due to space limitations; however, those collections omitted have been included in the figure for total number of specimens examined.

Taxonomy

Schauer (1843) divided the genus into two sections, i.e. *Callithamnus,* those species with staminal claws having numerous anthers ("phalanges polyandrae") and *Stromnothamnus,* those with 3-7 anther filaments ("phalanges 3-7-andrae"). Since I regard this as too artificial a division, and consider a more natural splitting of the genus to be on the basis of the number of floral parts, two subgenera are proposed below.

Calothamnus Labill., Nov. Holl. Pl. Sp. 2:25, t.164 (1806); R. Br. in W.T. Aiton Hort. Kew. ed. 2, 4:418 (1812); DC., Prod., 3:211 (1828); Lindley, Sketch Veg. Swan. Riv. Col. 9 (1839); Lehm., Del. Sem. Hort. Bot. Hamb. 7 (1842); Endl. in Endl. et al., Enum. Pl. Hueg. 48 (1837); Schauer, Regelia Beaufortia Caloth. 24 (1843); Schauer in Lehm., Pl. Preiss. 1:151 (1844); Kunze, Linnaea 20:58 (1847); Turcz., Bull. Soc. Imp. Naturalistes Moscou 20:168 (1847); Turcz., op. cit. 22:25 (1849); Turcz., Bull. Cl. Phys. -Math. Acad. Imp. Sci. Saint Petersbourg 10:428 (1852); F. Muell., Fragm. 3:111 (1862); Benth., Fl. Austral. 3:172 (1867); F. Muell., Fragm. 10:31 (1876); Niedenzu in Engl. & Prantl, Die Nat. Pflanzen. 3:97 (1893); J.D. Hook., Bot. Mag. 129, t. 7906 (1903); S. Moore, J. Linn. Soc. Bot. 14:205 (1921); Domin, Vestn. Kral. Ceske. Spoceln. Nauk. Tr. Mat.-Prir. 2:91 (1923); Blackall, How to Know Western Austral. Wildfl. 305 (1954); Beard, Descr. Cat. Western Austral. Plants 72 (1954); Fairall, Western Austral. Pl. in Cult. 8 (1970); Erickson, George, Marchant & Morecombe, Fl. & Pl. of Western Austral. (1973); Hawkeswood, Austral. Pl. 11:5 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:146-155 (1980); Hawkeswood, Nuytsia 5:123 (1984); Hawkeswood, Nuytsia 5:310 (1984). *Type: C. sanguineus* Labill.

Billotia Colla, Hortus Ripul. 20 t. 23 (1824). *Type: B. acerosa* Colla (= *Calothamnus quadrifidus* R.Br.).

Shrubs, erect or decumbent, compact to spreading, single or multi-stemmed, much-branched, glabrous or if pubescent often glabrous with age, 30 cm to about 3.5 m high (rarely 4 m). *Bark* smooth and thin when young, often hard, grey, splitting near base of trunk with age. *Older stems* usually with prominent leaf scars. *Root system* extensive, in one species tuberous. *Leaves* scattered or densely crowded at ends of branches, sessile, linear to oblanceolate, terete or flattened, erect or semi-erect, rigid or flaccid, shortly mucronate, obtuse or acuminate, sometimes pungent, glabrous, or pubescent; *oil glands* variable in size, randomly distributed, more prominent in living plants. *Flowers* few to numerous per inflorescence, in clusters or in unilateral to cylindrical spikes, usually on portions of the stems from which the leaves have fallen. Flowers 4- or 5-merous. *Calyx-tube* small to large, extended globular, campanulate to almost cylindrical, glabrous or pubescent, usually green, verrucose with prominent oil glands, embedded (or partially so) in the rhachis. *Rhachis* often swollen or dilated at base of calyx-tube. *Calyx-lobes* erect or spreading, glabrous or pubescent outside, usually shortly pubescent within, equal or unequal, if equal then usually all thickened and persistent on fruit, or only one retained and deflexed over fruit orifice; in some 4-merous species two opposite lobes are thicker and wider than the other two; lobes usually deltoid, acute or obtuse, concave or slightly so, usually thick but with thin, scarious, often fimbriate (or partially so) margins. *Petals* 4 or 5, elliptical to broadly ovate, obtuse to slightly acute, concave, glabrous, some species with a prominent claw, pink to pale orange-brown, deciduous, usually with prominent oil glands in the centre and smaller glands towards the margins. *Staminal claws* ± equal or unequal; if unequal, upper two broad, fused together (in one species) or free, lower two reduced in size and with reduced number of filaments; glabrous (or covered in whitish cobweb-like hairs in one species), pink, to crimson, orange-red, purple-red, or greenish-brown in colour, usually paler at base; *marginal filaments* few to numerous; (several submarginal filaments on the upper two staminal claws in one species); *anthers* basifixed, linear to linear-oblong, yellow, pale brown, dark brown or black. *Style* usually thick, tapering towards the tip, glabrous, stigma usually small. Summit of *ovary* usually densely pubescent. *Fruit* sessile, ± ovoid, cylindrical, globular to depressed globular, smooth, wrinkled or verrucose, glabrous or if pubescent often becoming glabrous with age, style often persistent. *Capsules* usually retained on plant for several years (in one species, the fruit falls in the first or second year after flowering). *Fertile seeds* few to many per capsule, linear to linear-cuneate, linear-oblong or oblong, usually truncate at one or both ends, angular (angles sharp or rounded), glabrous or (in several 5-merous species) with hirsute angles; testa usually dull, grey, dark grey, buff-brown, orange-brown, reddish-brown to chocolate brown. *Ovulodes* numerous per capsule, linear to linear-cuneate, usually smaller than the fertile seeds, truncate, angular (angles sharp or rounded), glabrous, cream, yellow, yellow-brown, orange-brown or light brown in colour.

Key to subgenera

Flowers 4-merous.....subg. *Calothamnus*
Flowers 5-merous.....subg. *Pentacalothamnus*

Calothamnus Labill. subg. **Calothamnus**

Billotia Colla, op. cit. (1824). *Calothamnus* b. *Billotia* (Colla) Reichb., Consp. Regni Veg. 175 (1828). *Type: Billotia acerosa* Colla

Calothamnus sect. *Callithamnus* Schauer, Regelia Beaufortia Caloth. 24 (1843), nom. illeg. (includes type of *Calothamnus*).

Calothamnus sect. *Stromnothamnus* Schauer, op. cit. 31 (1843). *Lectotype: C. lehmannii* Schauer, lecto nov.

Flowers 4-merous.

Calothamnus subg. **Pentacalothamnus** T.J. Hawkeswood, subgenus nov.

Typus: Calothamnus gracilis R.Br.

Calothamnus sect. *Pentaphalanx* Reichb. ex T. Post et Kuntze, Lex. Gen. Phan. 93 (1903); Reichb., Consp. Regni Veg. 175 (1828) nomen nudum. *Neotype: Calothamnus gracilis* R.Br., neo nov.

Flores pentameri.

Key to species of *Calothamnus* subg. *Calothamnus*

1. Two upper staminal claws broad, flat; two lower ones narrow....2
1.* Staminal claws all narrow....5
2. Calyx-tube (at time of flowering) entirely immersed in the thick, swollen rhachis...3
2.* Calyx-tube (at time of flowering) not immersed in the rhachis (rhachis not prominently swollen)....4
3. Leaves flat, 8-15 cm long (Mogumber, Moora area)....1. *C. pachystachyus* Benth.
3.* Leaves terete, 15-30 cm long (Eneabba area)....2. *C. longissimus* F. Muell.
4. Two upper staminal claws fused; anthers glabrous; leaves mostly 1-2 cm long (Cape Naturaliste to Kalbarri)....3. *C. sanguineus* Labill.
4.* Two upper staminal claws free; anthers covered in long, cobweb-like hairs; leaves mostly 2-4 cm long (Perth to Eneabba) ....4. *C. torulosus* Schauer
5. Calyx-tube (at time of flowering) ± immersed in the swollen rhachis or rhachis somewhat dilated at base of calyx-tube....6
5.* Calyx-tube (at time of flowering) not immersed in the rhachis....14
6. Rhachis swollen....7
6.* Rhachis not swollen....8
7. Flowers in unilateral spikes 4-10 cm long (Perth along south-west coast to Albany)....5. *C. lateralis* Lindley
7.* Flowers in unilateral spikes 3-4 cm long (Hyden to Woodanilling, Stirling Range to Fitzgerald River)....6. *C. huegelii* Schauer
7.**Flowers in ± cylindrical spikes 3-8 cm long (Scott River, Stirling Range ....7. *C. crassus* (Benth.) T.J. Hawkeswood
8. Leaves flat....9
8.* Leaves terete....11
9. Leaves with two longitudinal grooves both adaxially and abaxially (Stirling Range)....9. *C. microcarpus* F. Muell.
9.* Leaves without grooves....10
10. Leaves linear to linear-cuneate, mostly 4-5 cm long, 3-5 mm wide (Pingelly to Albany)....13. *C. planifolius* Lehm.
10.* Leaves oblanceolate, mostly 5-6 cm long, 6.5-10 mm wide (Whicher Range) ....14. *C. pallidifolius* (Benth.) T.J. Hawkeswood
11. Staminal claws more than 1.5 cm long....12

11.* Staminal claws less than 1 cm long.....13
12. Staminal claws ± equal, mostly with 7 filaments; shrubs to 2 m high (Stirling Ranges).....8. *C. affinis* Turcz.
12.* Staminal claws not equal, the upper two with 5 or 7 filaments, the lower two with 1 or 2 filaments; shrubs to 40 cm high (Tutanning Reserve, Cranbrook, Frankland).....10. *C. preissii* Schauer
13. Leaves 10-20 cm long; staminal claws ± equal, each with 2-4 filaments (Stirling Range, Mt Barker).....11. *C. schaueri* Lehm.
13.* Leaves 1-2.5 cm long; staminal claws not equal, the upper two with 4 or 5 filaments, the lower two reduced to 1 or 2 filaments (Bowelling to the Stirling Range).....12. *C. lehmannii* Schauer
14. Fruit retaining all 4 lobes (two of which are reflexed and prominently thickened, the other two less thickened, deflexed).....15
14.* Fruit retaining 2 lobes that are prominently thickened and reflexed (or fruit very shortly 4-lobed).....16
15. Leaves short, mostly 2-2.5 cm long, stiff, pungent; calyx-tube densely pubescent; fruit mostly 15-20 mm long, 13-18 mm wide (Red Hill, Gosnells, Boyagin Rock) .....15. *C. rupestris* Schauer
15.* Leaves long, mostly 5-7 cm long, shortly mucronate; calyx-tube usually glabrous; fruit mostly 16-18 mm long, 12-15 mm wide (Cape Naturaliste, Dwellingup, Collie).....16. *C. graniticus* T.J. Hawkeswood
16. Fruit shortly 4-lobed (leaves 8-12 cm long, glaucous; fruit depressed globular, 5-7 mm wide) (Peak Charles, Knapp Rock, Barbalin Rock, Spinifex Rock) .....23. *C. tuberosus* T.J. Hawkeswood
16.* Fruit with two prominently thickened lobes.....17
17. Leaves pungent, rigid, densely crowded (flowers hidden by the dense foliage) (Mt Barren Range).....18. C. *pinifolius* F. Muell.
17.* Leaves not pungent..... 18
18. Flowers usually 2-5 (8) together in a small cluster amongst leaves 19
18.* Flowers usually arranged in a dense spike..... 22
19. Leaves flat..... 20
19.* Leaves terete..... 21
20. Leaves mostly 1.5-2 cm long, 1.4-2 mm wide, narrowly oblanceolate (Wongan Hills).....17. *C. asper* Turcz.
20.* Leaves mostly 2-4 cm long, 3-8 mm wide, usually oblanceolate (Geraldton to the Kalbarri National Park).....21.*C. homalophyllus* F. Muell.
21. Calyx-tube densely hirsute; flowers 3-5 in a cluster (Cape Riche) .....19. *C. robustus* Schauer
21.* Calyx-tube usually glabrous, (sometimes finely pubescent); flowers mostly 3 together in a cluster (Mt Barren Range).....20. *C. validus* S. Moore
22. Leaves mostly oblanceolate (sometimes narrowly oblanceolate), glabrous (Geraldton to the Kalbarri National Park).....21. *C. homalophyllus* F. Muell.
22.* Leaves linear, usually with spreading hairs (occasionally glabrous) (Shark Bay to Cape Arid).....22. *C. quadrifidus* R. Br.

1. **Calothamnus pachystachyus** Benth., Fl. Austral. 3:173 (1867); Blackall, How to Know Western Austral. Wildfl. 305 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 8 (1970); Hawkeswood, Austral. Pl. 11:6 (1980); Blackall

& Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:149 (1980). *Type:* Swan River, *J. Drummond* 3rd Coll. no. 53 (lecto, here designated: ? K, n.v.; isolecto: MEL n.v., NSW).

Erect, much branched, often straggly, pubescent shrub to 1 m high, with thick, corky branches; leaf scars prominent on older branches. Young shoots densely pilose. *Leaves* scattered or crowded at the ends of branches, sessile, thick, flat, attenuate at base, (8) 10-12 (15) cm long, (2.5) 3-5 (6) mm wide, acuminate to acute, dark green, pilose (especially on the margins), often glabrous with age, oil glands prominent. *Flowers* 5-20 in loose or densely crowded clusters amongst leaves, partially embedded in the corky rhachis. *Calyx-tube* broadly campanulate, 3-5 mm long, shortly pubescent; *calyx-lobes* ± equal or opposite pair slightly larger than the other two, deltoid or narrow-deltoid, obtuse to slightly acute, (2) 2.5-3 mm long, 2-3 mm wide, slightly concave, erect or slightly spreading, finely pubescent outside and inside. *Petals* broadly elliptical to oblong-elliptical, concave, obtuse, 5-7 mm long, glabrous, papery, thin, orange-brown to pale brown, margins scarious, partially ciliate. *Staminal claws* not equal; upper two claws broad, flat, (20) 22-25 (30) mm long, 5-7 mm wide, glabrous, dirty green-yellow in life (dark red to black in dried specimens); marginal filaments 25-30; lower two claws short, 12-18 mm long, c. 2 mm wide at the base, narrowing at the apex, dirty green-yellow, each with one anther; *anthers* linear, 1.5-2 mm long, dark brown. *Style* 20-25 mm long, slender, glabrous, yellow-green; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, truncate, conical to almost ovoid, 6-8 mm diameter at base, 4-5 mm wide at apex and 5-7 mm long (including the short, thickened calyx-lobes); two opposite lobes thickened (slightly reflexed), other two lobes initially present but wearing away with age; fruit embedded in the corky, pubescent rhachis; orifice 3-4 mm diameter. *Fertile seeds* few per capsule, oblong, truncate at widest end, attenuate at other, 1.2-1.5 mm long, 0.6-0.8 mm wide, slightly flattened, testa grey-brown, smooth, glabrous. *Ovulodes* few per capsule, linear, 1-1.5 mm long, c. 0.2 mm wide, glabrous, yellow-brown.

Derivation of name. From the Greek *pachys*, meaning "thick", and *stachyus*, meaning "flower-spike", referring to the spike of flowers situated in the swollen, corky stems.

Habitat. Grows in sand over laterite or in lateritic gravel in sandplain heath communities. Flowers mostly from September to October.

Distribution. Presently only known from the Mogumber-Bindoon area (c. 31°00' S, 116°00' E) where it is only locally common. Map 1. This species has probably suffered extinction in some areas through clearing of land for agriculture and is thus in need of protection. Recommendations for its conservation have been provided by Leigh, Boden & Briggs (1984).

Specimens examined. WESTERN AUSTRALIA: W. Australia. *J. Drummond*, 1844, 2nd Coll., no. 71, NSW 144109 (NSW); Murchison (?), Oct. 1902, *C. Andrews* s.n. (PERTH); 76 m.p. Great Northern Highway, 23 Aug. 1976, *H. Demarz* D6140 (PERTH, KP); Yenert, 1842, *J. Gilbert* 46 (PERTH); Moore River, Aug. 1901, *F.L.E. Diels & E. Pritzel* s.n. (PERTH); Moore River, Oct. 1934, *C.A. Gardner* 12708 (2) (PERTH); Mogumber, 30 Sept. 1932, *W.E. Blackall* 2944 (2) (PERTH); Mogumber, Moore River, 16 Oct. 1903, *A. Morrison* s.n. (PERTH); Mogumber, 1903, *W.V. Fitzgerald* NSW 144110 (NSW); Mogumber, 26 Oct. 1955, *R.D. Royce* 5201 (PERTH); Mogumber, 19 Dec. 1922, *C.A. Gardner* 1393 (PERTH); 5-6 miles S of New Norcia, 1 Oct. 1947, *C.A. Gardner* 8676 (2) (PERTH); W of Bindoon, 9 July 1952, *R.D. Royce* 3828 (PERTH); 8 miles N of Mogumber on road to Moora, 10 May 1964, *A.R. Fairall* 1495 (KP); Mogumber and north to Moora, 25 Sept. 1954, *B.J. Grieve* s.n. (UWA); Wannamal-Mogumber road, 12 Sept. 1955, *B.J. Grieve* s.n. (UWA).

Total number of specimens examined. 20.

Comments. This species is closely related to *C. longissimus* F. Muell. but can be readily distinguished by its flat leaves mostly 10-12 cm long, 3-4 mm wide with pilose margins and staminal claws which are yellow-green in colour. *Calothamnus longissimus* has terete, glabrous leaves mostly 15-25 cm long, 1-1.5 mm wide, and staminal claws red in colour.*Calothamnus longissimus* exhibits little intra-specific variation throughout its range.

The ranges of these two species do not appear to overlap. *Calothamnus pachystachyus* has a more southerly distribution while *C. longissimus* occurs from Arrino, Three Springs and Eneabba to Dandaragan and Badgingarra. The locality of one record from the Murchison River (?) (*C.R. Andrews* s.n., PERTH) is thought to be incorrect as it is outside the present known distribution area.

Bentham (1867) noted that the upper staminal claws of *C. pachystachyus* material that he examined had 15-20 marginal filaments while the lower ones were undivided and without anthers. This discrepancy has undoubtedly arisen due to damaged material.

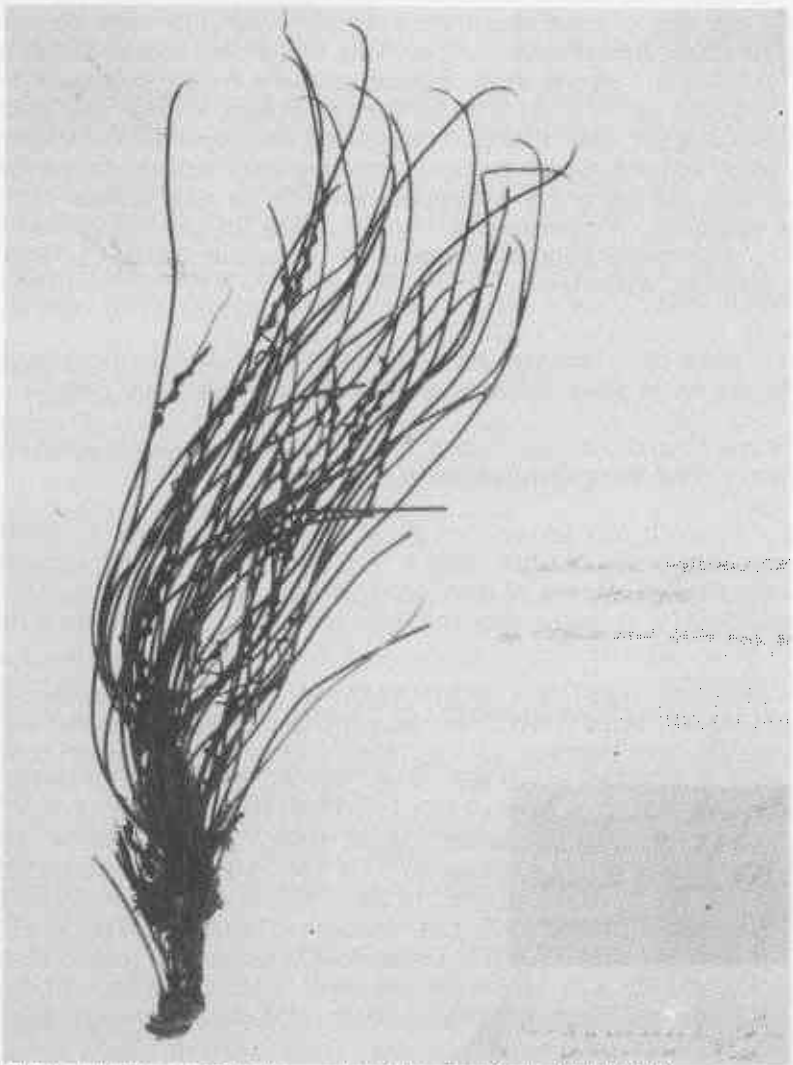


Figure 1. Holotype of *Calothamnus longissimus* F. Muell. (MEL 105190).

2. **Calothamnus longissimus** F. Muell., Fragm. 3: 112 (1862); Benth., Fl. Austral. 3:174 (1867); Blackall, How to Know Western Austral. Wildfl. 305 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 8 (1970); Hawkeswood, Austral. Pl. 11: 6,8,9 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:149 (1980). *Type:* "In planitiebus arenosis prope Cujong Australiae occidentalis. Oldfield" (holo: MEL, Figure 1).

Erect, much-branched, often straggly, low, bushy shrub to 1 m high, with thick, corky branches; leaf scars prominent on older branches. Young shoots shortly but densely pubescent; leaves and stems becoming ± glabrous with age. *Leaves* crowded, often arranged in whorls, sessile, slender-terete, somewhat scabrous, (13-)16-25 (-30) cm long, (1-) 1.2-1.5 (-2) mm wide, acuminate, not pungent, usually glabrous but sometimes retaining hairs at base, usually with a layer of corky tissue extending from base to about 1 cm along the leaf; oil glands prominent. Flowers 5-15 (-25) in short, dense, unilateral or cylindrical spikes amongst leaves. *Calyx-tube* almost campanulate, somewhat narrowed at base, 4-5 mm long, densely covered in short silver-white hairs (sometimes ± glabrous at the base), embedded in the swollen (sometimes softly pubescent) corky stems. *Calyx-lobes* unequal, an opposite pair slightly broader than the other two, erect, broadly deltoid, obtuse, concave, (3-) 4-5 mm long, 2.5-4 mm wide, thick, densely but shortly pubescent outside, inside, and on the margins. *Petals* broadly obovate-oblong to broadly elliptical, concave, obtuse, 7-10 mm long. glabrous (margins often with a few scattered cilia), narrowed at base, pale brown, with thin, wide, scarious margins; central vein often prominent. *Staminal claws* unequal, upper two claws broad, equal in size (25-) 30-32 (-35) mm long, 3-4 mm wide, glabrous, deep red; marginal *filaments* 30-36; two lower staminal claws sterile, short, glabrous, 14-16 mm long, 2-2.5 mm wide at the base, gradually tapering to a point; *anthers* linear-oblong, c. 1.5 mm long. *Style* (25-) 30-35 mm long, slender, glabrous, deep red, tapering upwards; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, truncate-conical, 8-9 mm diameter at base and 4-5 mm wide at apex, 6-7 mm long; immature fruit usually at least half embedded in the corky stems and retaining calyx-lobes, mature fruit on old stems often embedded and without corky covering, ± smooth and truncate; orifice c. 3 mm wide. *Fertile seeds* few per capsule, oblong, truncate at widest end, attenuate at other, 1.2-1.5 mm long, 0.6-0.8 mm wide, slightly flattened, testa grey-brown, smooth, glabrous. *Ovulodes* few per capsule, linear, 1-1.5 mm long, c. 0.2 mm wide, glabrous, yellow-brown.

Derivation of name. From the Latin *longissimus*, meaning "very long", referring to leaves of this species.

Habitat. Grows in lateritic gravelly soils in low shrubby heath associations. Flowers August to September.

Distribution. Confined to areas from Arrino, Three Springs, Eneabba to Dandaragan and Badgingarra. Map 1. This species is now probably very localized due to clearing of land for agriculture. Recommendations for its conservation have been provided by Leigh, Boden & Briggs (1984).

Selected specimens examined. WESTERN AUSTRALIA: Swan River, 1844, *J. Drummond* 2nd Coll. no. 74, NSW 144108 (NSW); Arrino, Sept. 1903, *W.V. Fitzgerald* NSW 144105, 144107 (NSW); 5 miles W of Arrino, 30 Aug. 1965, *K.R. Newbey* 2244 (PERTH); N of Eneabba, on road to Dongara, 7 Sept. 1969, *A.M. Ashby* 3030 (PERTH); 30 miles W of Three Springs, Sept. 1940, *W.E. Blackall* 4877 (2) (PERTH); 35 km NE of Eneabba on Three Springs Road, (29°39' S, 115°34' E), 27 April 1977, *R.J. Hnatiuk* 770012 (PERTH); Eneabba Creek, 27 Aug. 1948, *C.A. Gardner* 9126 (5) (PERTH); Eneabba Creek, Sept. *C.A. Gardner* 9301 (PERTH); Coorow, 29 Aug. 1941, *C.A. Gardner* s.n. (PERTH); less than 19 km E of Eneabba on Three Springs Road, (c. 29°48' S, 115°09' E), 12 Sept. 1978, *R.J. Hnatiuk* 780136

(PERTH); small valley E of "Western Titanium" leases, 8 km S of Eneabba, (29°53' S 115°19' E), 13 Sept. 1977, *R.J. Hnatiuk* 770917 (PERTH); Hill River, 22 Sept. 1951, *N.H. Speck* s.n. (3) (UWA); Badgingarra, Sept. 1965, *F.G. Smith* 1837 (PERTH); 5 miles E of Moora, 11 Sept. 1932, *W.E. Blackall* 2533 (2) (PERTH); Dandaragan, Sept. 1953, *H. Smith* s.n. (PERTH); 5 miles W of Moora, 23 Sept. 1962, *J.S. Beard* 1841 (PERTH, KP); 63 mile tank, 22 Sept. 1953, *N.H. Speck* s.n. (UWA).

Total number of specimens examined. 28.

Comments. This species is closely related to *C. pachystachyus* Benth., but can be readily distinguished on leaf characters and the colour of the staminal claws (see comments under *C. pachystachyus*).

The species exhibits little variation throughout its range.

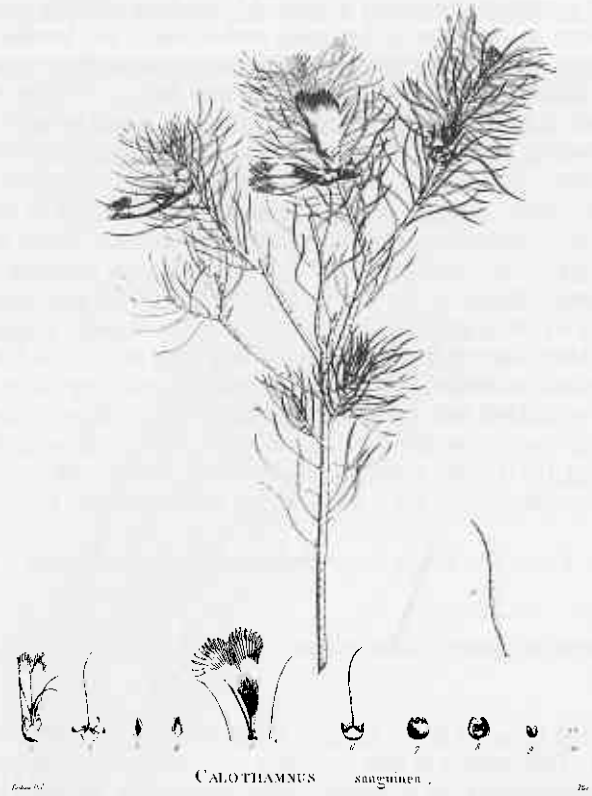


Figure 2. Illustration of *Calothamnus sanguineus* Labill. from *J.C. Labillardiere* (1806 tab. 164).

3. **Calothamnus sanguineus** Labill., Pl. Nov. Holl, 2:25, t. 164 (1806); DC., Prodr. 3: 211 (1828); Schauer, Regelia, Beaufortia & Caloth. 24 (1843); Schauer in Lehm., Pl. Preiss. 1:151 (1844); Benth., Fl. Austral. 3: 174 (1867); Blackall, How to Know Western Austral. Wildfl. 305 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 84 (1970); Hawkeswood, Austral. Pl. 11: 6,10 (1980); Blackall and Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:149 (1980). *Type*: "Habitat in terra van-Leuwin" (Geographe Bay) (lecto, here designated: FI, photograph seen, Figure 2).

Calothamnus eriocarpa Lindley, Sketch Veg. Swan Riv. Col. 9 (1839). *Type:* no citation (holo: CGE, photograph seen).

Calothamnus blepharantherus F. Muell. Fragm. 3:112 (1862); Benth., Fl. Austral. 3:174 (1867): F. Muell., Fragm. 10:55 (1876). *Type*: "In plagis aridis ad flumen Murchison, Oldfield" (holo: MEL, Figure 3).

Erect, much-branched, usually single-stemmed, compact shrub 30-80 cm high; branches smooth, or often with prominent leaf scars with age. *Leaves* crowded on older branches, erect to perpendicular, sessile, terete or slightly flattened, (1-) 1.5-2 (-2.5) cm long, 0.8-1 mm wide, densely pilose when young, ± glabrous with age, often S-shaped, acute but not pungent; oil glands usually prominent. *Flowers* 3-25 in small clusters or in short, ± unilateral or cylindrical spikes amongst leaves at the end of older branches. *Calyx-tube* campanulate to broadly campanulate, 2.5-4 mm long, densely pubescent, rhachis slightly to prominently dilate at its base; *calyx-lobes* ± equal, or two opposite ones slightly wider than the other two, deltoid, obtuse to slightly acute, concave, 2-2.5 (-3) mm long, densely pubescent outside, shortly and finely pubescent inside; margins thin, scarious and fimbriate. *Petals* oblong, oblong-elliptical to broadly obovate, 5-7 mm long, concave, obtuse, glabrous, papery, dark orange-brown, oil glands prominent in centre; margins thin, scarious, orange, often partially ciliate. *Staminal claws* unequal, glabrous, blood red, often yellow at base; the upper two claws fused together to form a very broad single claw (20-) 22-25 (-30) mm long, (4-) 5-7 (-8) mm wide, with 26-36 marginal filaments; the two lower claws undivided, linear (4-) 8-9 (-10) mm long, each with usually one sterile anther (some populations possess 2, 3 or 4 sterile anthers per lower claw); *anthers* linear, sparsely ciliate; 1.2-1.5 mm long, dark brown to black. *Style* thick at base otherwise slender, (8-) 15-25 (-30) mm long, blood red, glabrous; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, ovoid to almost globular, 8-12 mm long (including calyx-lobes), (6.5-) 7-8 (-9) mm wide, initially pubescent, becoming glabrous with age, then smooth or wrinkled; calyx-lobes dry, persistent, an opposite pair becoming thickened, remaining two not thickened, wearing away with age; orifice almost covered by thick lobes, 2-3 mm in diameter. *Fertile seeds* few per capsule, linear-oblong, 1.5-2 mm long, 0.6-0.8 mm wide, glabrous, somewhat shiny, smooth, outer ones curved, testa chocolate brown. *Ovulodes* numerous, linear-clavate, 1.5-2 mm long, 0.2-0.4 mm wide, glabrous, angular, usually obliquely truncate at wider end, pale brown.

Figure 3. Holotype of *Calothamnus blepharantherus* F. Muell. (MEL 98614).

Derivation of name. From the Latin *sanguineus*, meaning "blood- coloured", referring to the usual colour of the staminal claws. Naturally occurring yellow-flowering variants may also occur (Figure 4).

Habitat. Commonly grows on sandplains north of Perth in heath and mallee-heath communities in association with dominant species of *Acacia*, *Hakea*, *Grevillea*, *Banksia* and *Eucalyptus*. In many localities, *C. sanguineus* occurs sympatrically with *C. quadrifidus* R. Br., *C. torulosus* Schauer, *C. blepharospermus* F. Muell, and *C. glaber* (Benth.) T.J. Hawkeswood. *Calothamnus sanguineus* is uncommon in coastal jarrah (*Eucalyptus marginata*) forests in shallow sand over laterite or granite from Perth to the Whicher Range (33°47' S, 115°31' E). Flowers mostly June to October but in some areas flowering occurs for most of the year.

Distribution. From Kalbarri National Park in the north (c. 27°45' S, 114°20' E) to Perth in the south. The species has a disjunct distribution south of Perth, occurring at Cape Naturaliste (33°35' S, 115°02' E), Dwellingup (32°42' S, 116°02' E), Narrogin (32°56' S, 117°10' E), Stirling Range (c. 34°20' S, 118°10' E) and the Perup River (34°17' S, 116°42' E). Map 2.

Selected specimens examined. WESTERN AUSTRALIA: Murchison River, 6 Sept. 1949, *N.H. Speck* s.n. (UWA); Murchison River, 20 Sept. 1948, *C. Morrison & D.L. Serventy* s.n. (PERTH); Kalbarri sandplain reserve, 17 July 1966, *A.M. Ashby* 1833 (PERTH, NSW); 5 km E of Kalbarri, 12 May 1968, *P.G. Wilson* 6723 (PERTH); near mouth of Murchison R., 10 July 1963, *F.G. Smith* 1689 (PERTH); Loop Road, Kalbarri Nat. Park, 7 Aug. 1976, *R.J. Hnatiuk* 760508 (PERTH); between Geraldton and Mullewa, 23 Sept. 1932, *W.E. Blackall* 2752 (PERTH); 4 miles W of Ellendale, 5 July 1971, *R.A. Saffrey* 1551 (PERTH); 37 miles W of Coorow, Sept. 1967, *C.H. Gittins* 1693 (PERTH); Mingenew, June 1901, *Diels* and *Pritzel* s.n. (PERTH); S of Dongara on Eneabba road, 7 Sept. 1969, *A.M. Ashby* 3016 PERTH); Irwin River, 28 May 1950, *W.A. McArthur* s.n. (UWA); N of Arrowsmith River, (29°34' S, 115°13' E), 4 Aug. 1976, *R.J. Hnatiuk* 760278 (PERTH); S of Arrowsmith R., 10 Sept. 1967, *A.C. Burns* 57 (PERTH); E of Greenhead, 24 Sept. 1962, *J.S. Beard* 1907 (PERTH, KP); Mt Lesueur, 16 Sept. 1976, *J.S. Beard* 7823 (PERTH); Hill River, June 1943, *C.A. Gardner* s.n. (PERTH); 35 miles W of Watheroo on Badgingarra road, 18 July 1965, *J.C. Anway* s.n. (UWA); 5 km SW of Badgingarra, 9 Sept. 1979, *G.J. Keighery* 2576 (PERTH); 65 miles NNW of Gingin, 2 Sept. 1970, *T.E.H. Aplin* and *R.G. Coveny* 3138 (PERTH, NSW); Cataby, near Dandaragan West, 2 Sept. 1973, *E.C. Nelson* ANU 17273 (PERTH); 14.4 km S of Dandaragan West, (30°45' S, 115°40' E), 17 March 1979, *T.J. Hawkeswood* A2 (NE); 35 km N of Gingin, (31°05' S, 115°46' E), 17 March 1979, *T.J. Hawkeswood* A1, A2, A4 (NE); Wongan Hills, 9 Aug. 1949, *E. Salisbury* s.n. (PERTH); 2 miles W of Wongan Hills, 5 June 1969, *M.I.H. Brooker* 1830 (PERTH); Mimegarra-Mt Misery, 22 Sept. 1951, *N.H. Speck* s.n. (UWA); Waddington, 24 July 1952, *G.M. Storr* s.n. (PERTH); near New Norcia, 4 Sept. 1962, *F.W. Went* 89 (PERTH); 122 miles N of Perth on Wongan Hills to Northam Rd., S of Ballidu, 4 Aug. 1977, *G.J. Keighery* 2238 (KP); Bindoon area, 25 April 1963, *A.H. Larner* (2) (PERTH); Mogumber, Aug. 1929, *W.E. Blackall* s.n. (PERTH); 14 miles from Gingin, 29 Sept. 1968, *M.E. Phillips* CBG028454 (NSW); 65 km SW of Three Springs, 19 April 1979, *T.J. Hawkeswood* s.n. (PERTH); 50 km SW of Three Springs, (29°35' S, 115°35' E), 19 April 1979, *T.J. Hawkeswood* 90, 91, 92, 93, 94 (PERTH); 8 miles W of Calingiri, 24 April 1959, *T.E.H Aplin* 456 (PERTH); 15 km E of Gingin, 14 Dec. 1978, *A. Coates* S4470 (KP); 60 m.p. Perth-Moora, 4 May 1964, *A.R. Fairall* 1433 (KP); Yanchep, 11 Aug. 1971, *M. Miller* s.n. (UWA); Yanchep, 17 Oct. 1963, *A.M. James* 65 (PERTH); Wanneroo, 25 July 1963, *F.G. Smith* 1721 (PERTH); Wanneroo to Yanchep, 24 Sept. 1970. *H. Salasoo* 4213 (NSW); S of Wanneroo, 22 Sept. 1970, *H. Salasso* 4135 (NSW); Toodyay Rd., 31 Aug. 1976, *H. Demarz* 6150 (KP); 2 miles E of Mullaloo, July 1965, *J.R. Knox* 650718 (PERTH); Greenmount, May 1901, *C.R Andrews* s.n. (PERTH); Maddington, 24 July 1952, *G.M. Storr*

s.n. (UWA); Kalamunda-Darlington, 15 May 1930, *R.F. Williams* s.n. (UWA); Darlington, 11 June 1949, *B.A. Roark* (?) (UWA); Helena Valley, 10 July 1977, *J. Seabrook* 46 (PERTH); Kalamunda, western slopes, 6 May 1948, *N.H. Speck* s.n. (UWA); Whicher Range, cr Jacka and Smith Forestry Roads, 23 March 1976, *M.E. Trudgen* 1656 (PERTH); Sabina Road, Whicher Range, 15 May 1980, *T.J. Hawkeswood* 287 (PERTH); Whicher Road, Whicher Range, 16 May 1980, *T.J. Hawkeswood* 288, 297 (PERTH); Cape Naturaliste, 1 Sept. 1952, *N.H. Brittan* s.n. (UWA); Meelup Brook, Cape Naturaliste, 25 Dec. 1927, *H.C. Guvney* s.n. (UWA); Meelup Beach, Cape Naturaliste, 16 May 1980, *T.J. Hawkeswood* 289 (2) (PERTH); Eagle Bay, Cape Naturaliste, 23 June 1979, *M. Peterson* 1 (PERTH); Clackline, May 1950, *J. Kennedy* s.n. (PERTH); Yallingup, 30 May(?), no collector or year given (UWA); SW of Cunderdin, 27 Sept. 1970, *H. Salasso* 4365 (NSW); Tuttaning Reserve, 17 miles SE of Pingelly, 24 May 1966, *A.S. George* 7747 (PERTH); Narrogin, 18 Aug. 1916, *F. Stoward* s.n. (PERTH); 15 miles S of Borden, 11 Aug. 1962, *K.R. Newbey* 307 (PERTH); East Stirling Range at Moir Hill, 15 Oct. 1972, *E.C. Nelson* ANU 16778 (PERTH); Red Gum Hill, Stirlings, 10 May 1979, *G.J. Keighery* 2280 (PERTH, KP); South Stirling Range, May 1950, *A. Holland* s.n. (UWA); Perup River, 30 April 1974, *P. Christensen* 814 (PERTH).

Figure 4. Naturally occurring yellow-flowered variant of *Calothamnus sanguineus* Labill. (Mt Lesueur, W.A.; photo: M. Peterson).

Total number of specimens examined. 254.

Comments. This is one of the most common and widely distributed of the *Calothamnus* species. It is most closely related to C. *torulosus* Schauer with which it occurs sympatrically in the Eneabba-Badgingarra sandplain habitats north of Perth. *Calothamnus sanguineus* can be easily distinguished from *C. torulosus* in having the upper two staminal claws fused together whereas in the latter species they are free, as is the case with all other *Calothamnus* species. One characteristic feature of *C. sanguineus*, not present in other species, is the sparsely ciliate anthers, although *C. torulosus* possesses anthers with unusual, long, cobweb-like hairs.

Bentham (1867) noted that the two fused upper staminal claws of *C. sanguineus* readily separated. In the field these claws do not separate but in some herbarium specimens some degree of splitting has occurred no doubt as a result of drying. Bentham also noted that the lower staminal claws did not possess anthers. This is erroneous since flowers of all specimens I have examined in the field (localities: Murchison River, Dandaragan, Gingin, Yanchep, Kalamunda, Dwellingup, Cape Naturaliste, and the Whicher Range), possessed lower staminal claws with one anther. Populations at Kalamunda were found to possess 2-4 anthers per lower staminal claw. The anthers of the short, tapering lower staminal claws are weakly attached, and it is likely that the specimens Bentham examined had lost these anthers as a result of handling. Another distinctive feature of *C. sanguineus* is its habit of dropping the fruiting capsules when the seeds are mature.

Specimens of *C. sanguineus* from Perth to Cape Naturaliste are generally more bushy and spreading, possess more densely crowded, thinner, usually cylindrical leaves and possess fewer flowers and smaller fruits than plants growing in sandplains from Perth to Kalbarri, the wheatbelt localities (e.g. Narrogin, Borden) and the Stirling Range. However, the variability is not sufficient to warrant a separate subspecies being created for these populations. Differences in soil type (i.e. lateritic soils in the Darling Range and granitic soils at Cape Naturaliste) from that from Kalbarri to Perth (i.e. sandy, quartzite soil) may be one factor contributing to this variation. However, the soil at the Stirling Range where *C. sanguineus* occurs is also a sandy quartzite soil, yet the populations there resemble those at Cape Naturaliste.

Calothamnus sanguineus is one of only a few species of the genus that are widespread and exhibit variation throughout their range. Its apparent disjunct distribution in south-west Western Australia is of much interest, since it is unlikely that limited collecting and/or land clearing in this vast area would account for the paucity of records.

Although specimens of *C. sanguineus* may be seen in flower in many areas throughout the year, its main flowering period is during the spring months, August to October. The occasional yellow-flowering plant has been observed in the Mt Lesueur area, north of Perth (Hawkeswood 1980). Figure 4.

4. **Calothamnus torulosus** Schauer, Regelia, Beaufortia & Caloth. 25 (1843); Schauer in Lehm., Pl. Preiss. 1:152 (1844); Benth., Fl. Austral. 3:175 (1867); Blackall, How to Know Western Austral. Wildfl. 305 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 8 (1970); Hawkeswood, Austral. Pl. 11:10, 11 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:150 (1980). *Type*: "In calculosis ad radices iugi montium Darling-Range dicti, haud procul a villa Maddington, Novembri a, 1839; L. Preiss! J. Drummond!" (lecto, here designated: Preiss 212, LD, Figure 5).

Low, erect or prostrate, somewhat rigid or sprawling, many-stemmed, sometimes glaucous shrub to about 40 cm high, with stems often possessing irregularly distributed bulges (thickenings). Young shoots with scattered, erect to spreading hairs; stems and leaves becoming glabrous with age. *Leaves* sessile, crowded, erect to semi-erect, slender terete, (1.5-) 2-4 (-5) cm long, 0.5-1 (-1.4) mm wide, shortly mucronate, slightly pungent, usually somewhat scabrous, pale olive green or sometimes glaucous, glabrous, or with scattered, erect or semi-erect simple hairs (especially at the base). *Flowers* 2-5 together in short clusters almost hidden by the crowded, erect leaves, strongly and characteristically scented. *Calyx-tube* short, broadly campanulate, 2-3 mm long, covered in short, appressed, whitish hairs, rhachis prominently dilated at its base; *calyx-lobes* unequal, two opposite lobes (or only one lobe) thick, broadly ovate, acute or slightly obtuse, concave, 3-4 mm long, the remaining lobes shorter, thin, ovate-oblong, concave, acute or slightly obtuse, 2.5-3 mm long, glabrous outside (or sparsely covered in short, white hairs), sparsely pubescent inside, thin and fimbriate on margins. *Petals* obovate-oblong to obovate-elliptical, obtuse, concave, 7-8 mm long, glabrous, papery, thin, with thin scarious margins, orange-brown. *Staminal claws* unequal: upper two claws broad, 22-35 mm long, 4-6 (-7) mm wide, scarlet, becoming orange towards base with 30-40 marginal filaments; lower two claws narrow, 20-25 mm long, 1.5-2 mm wide, scarlet, becoming orange and green towards base with 25-35 marginal filaments; upper staminal claws with *fertile anthers* (linear, c. 2 mm long) at apex of claw, and *sterile anthers* (short, oblong, 0.3-0.5 mm long) lower down; anthers and filaments covered in loose, coiled, cobweb-like hairs. *Style* filiform, glabrous, 25-30 mm long, curved near apex, scarlet; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, few per plant, nearly globular, 5-9 mm long, 6-8 mm wide, densely pubescent, usually hidden by the leaves; two calyx lobes thickened and enclosing the orifice; style sometimes persistent in young fruit. *Fertile* seeds few to many per capsule, oblong or oblong-cuneate, 1.5-1.8 (-2) mm long, truncate at wider end, glabrous, light chocolate-brown. *Ovulodes* numerous, linear, 1.5-2 mm long, truncate at one end, glabrous, cream to yellow-brown.

Figure 5. Lectotype of *Calothamnus torulosus* Schauer (LD).

Derivation of name. From the Latin *torulus*, meaning "a little bulge or protuberance", and *-osus*, meaning "abounding in". This name, which probably refers to the occasional irregular thickenings on the branches, is somewhat of a misnomer.

Habitat. Grows in deep grey or light-coloured sands in low coastal heath (from the Arrowsmith River to Mt Misery) with species of *Eremaea*, *Hakea*, *Verticordia*, *Isopogon* and *Xanthorrhoea*, or in rocky, granitic soils amongst open woodland vegetation (in the Darling Range east of Perth). Flowers September to October.

Distribution. This species appears to have a disjunct distribution. The northern populations occur from near the Arrowsmith River (c. 29°35' S, 115°10' E) to Eneabba, Cockleshell Gully, Mt Lesueur, Hill River, Badgingarra and to Mt Misery (30°56' S, 115°22' E). Only three records

are known from near Perth i.e. Swanview (*Royce* 6395), Crystal Brook Hill (*George* 11041), and Lesmurdie (*Muldownie* s.n.). Map 3.

Selected specimens examined. WESTERN AUSTRALIA: 8 miles S of Arrowsmith River, 18 Oct. 1971, *H. Demarz* 3470 (PERTH, KP); c. 12 km N of Eneabba, 4 Aug. 1976, *R.J. Hnatiuk* 760249 (PERTH); Eneabba, (29°50' S, 115°18' E), 19 April 1979, *T.J. Hawkeswood* s.n. (PERTH, UWA, NE); Eneabba turnoff, (29°50' S, 115°17' E), 19 April 1979, *T.J. Hawkeswood* 7,8,9 (PERTH); On Eneabba-Cockleshell Gully road, Sept. 1969, *C. Brindley* s.n. (PERTH); Mt Lesueur, 4 Nov. 1962, *R.D. Royce* 7737 (PERTH); slopes of Mt Lesueur, *N.H. Speck* s.n. (UWA); top of Mt Lesueur, *N.H. Speck* s.n. (UWA); 23 miles from Jurien Bay towards Eneabba, 24 Sept. 1968, *M.E. Phillips* CBG 027196 (NSW); Cockleshell Gully, Sept. 1931, *W.E. Blackall* 3556 (PERTH); Cockleshell Gully, Aug. 1967, *S.H. James* (UWA); Hill River, 30 Sept. 1969, *C.A. Gardner* 12793 (2) (PERTH); 7 miles NW of Badgingarra, 3 Oct. 1960, *B.G. Briggs* NSW 144103 (NSW); 7 miles from Jurien Bay turnoff on road to Watheroo, 16 Oct. 1966, *F. Lullfitz* 5628 (PERTH); 4 miles NW of Dinner Hill, 31 Aug. 1975, *K.R. Newbey* 2301 (PERTH); Badgingarra, 18 Sept. 1959, *C.A. Gardner* 12316 (PERTH); Badgingarra, Aug. 1968, *C.A. Gardner* s.n. (PERTH); Badgingarra, 10 Sept. 1960, *L. Steenholm* s.n. (PERTH); Badgingarra, 23 Sept. 1962, *J.S. Beard* 1869 (PERTH); Badgingarra, Sept. 1965, *C.A. Gardner* s.n. (2) (PERTH); Badgingarra, 18 Sept. 1977, *A.C. Burns* 112 (PERTH); 67 miles NNW of Gingin, 2 Sept. 1970, *T.E.H. Aplin* and *R.G. Coveny* 3142 (NSW); between Dandaragan and Jurien Bay, 27 Sept. 1932, *W.E. Blackall* 2901, 2923 (PERTH); Mingenew-Mt Misery, (undated), *N.H. Speck* s.n. (PERTH); Swanview, 1 Oct. 1960, *R.D. Royce* 6395 (PERTH); Crystal Brook Hill, Darling Scarp, (32°01' S, 116°01' E), 15 Sept. 1971, *A.S. George* 11041 (PERTH); Melaleuca Road, Lesmurdie, 29 Sept. 1969, *C. Muldownie* (UWA); Swan River, *J. Drummond* no. 128 (NSW).

Total number of specimens examined. 40.

Comments. Although the species has a somewhat restricted distribution in comparison to a number of other *Calothamnus* species, it is common throughout its range. It is especially common in the Eneabba-Badgingarra-Cockleshell Gully area where it occurs sympatrically with *C. quadrifidus* R. Br. and *C. sanguineus* Labill. Like its close relative, *C. sanguineus*, *C. torulosus* has a disjunct distribution in the southern portion of its range. In the northern part of its distribution, the most southerly record is from Mimegarra-Mt. Misery. There are no collections between here and Perth (c. 100 km distance) where only three records are known. There are no morphological differences between these plants and those of the northern populations. The absence of records from Perth to Mt Misery may be indicative of lack of collections or the results of land clearing (Hawkeswood 1980). The collections from Perth are from suburbs in which residential development has occurred so the survival of the species in this area appears doubtful in the advent of further development. The size and ecology of the three known populations of *C. torulosus* in the Perth area has not been documented and, clearly, field studies should be initiated in order to secure areas for its conservation.

Bentham (1867) stated that *C. torulosus* may be a variety of *C. sanguineus*. However, although they are similar and closely related, they differ in many characters, not least by the fused upper staminal claws in *C. sanguineus* which is lacking in *C. torulosus*. Bentham's (1867) description of *C. torulosus* is inaccurate due to the inclusion of specimens of *C. graniticus* T.J. Hawkeswood.

5. **Calothamnus lateralis** Lindley, Sketch Veg. Swan Riv. Col. 9 (1839); Benth., Fl. Austral; 3:177 (1867); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 8 (1970);

Hawkeswood, Austral. Pl. 11:11 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:152 (1980). *Type*: Swan River, *Anon.* (holo: CGE, photograph seen).

Calothamnus longifolia Lehm., Del. Sem. Hort. Bot. Hamb. 7 (1842); Schauer, Regelia, Beaufortia, Caloth. 34 (1843); Schauer in Lehm., Pl. Preiss. 1:155 (1844); *Calothamnus lateralis* forma *longifolius* (Lehm.) Benth., Fl. Austral. 3:177 (1867). *Type*: "In locis turfosis hieme inundatis prope oppidulum Perth in Australia meridionali legit Cl. L. Preiss" (Herb. Preiss. No. 200) (lecto, here designated: LD, Figure 6).

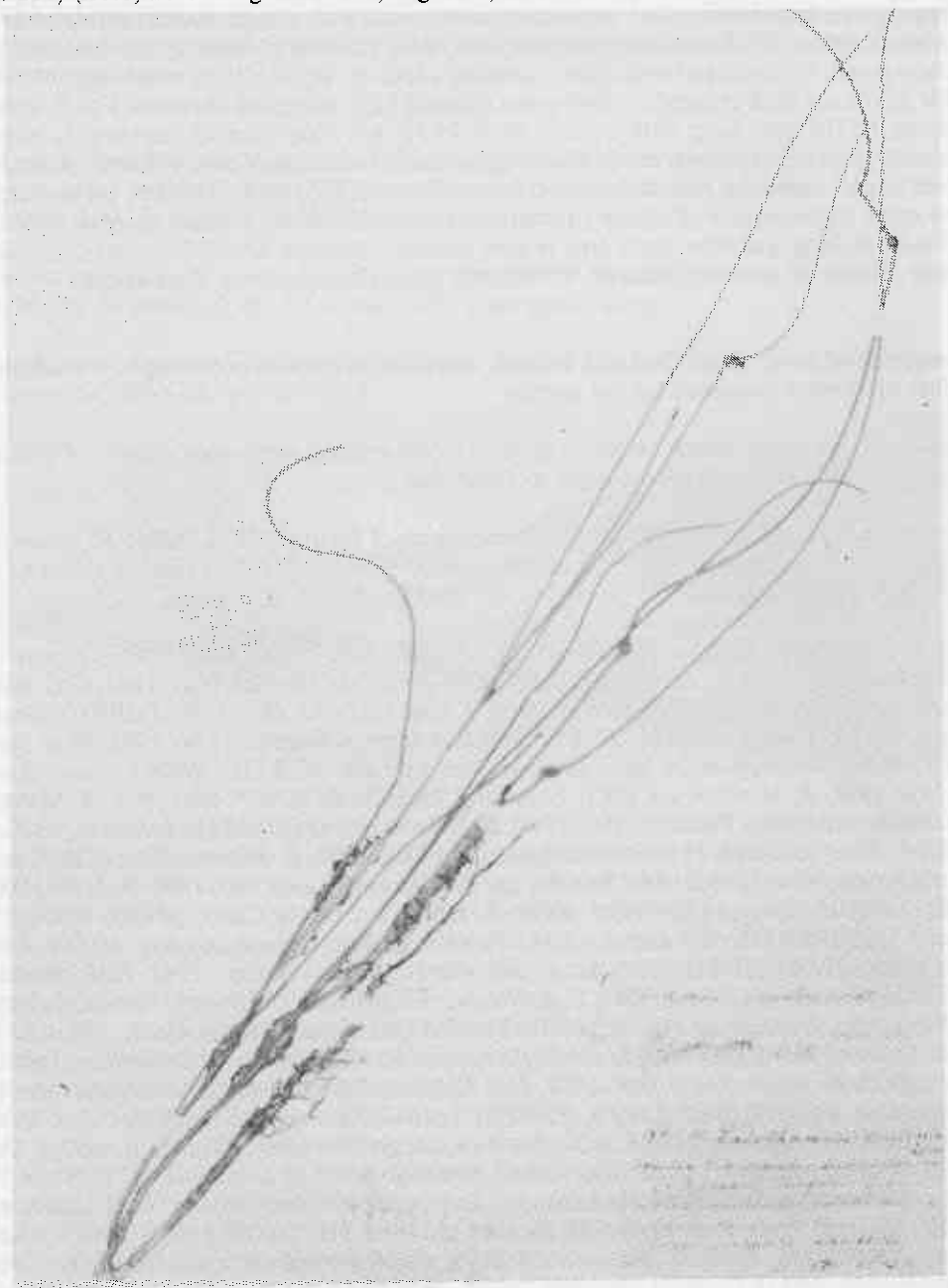


Figure 6. Lectotype of *Calothamnus longifolia* Lehm. (LD).

Erect, slender, straggly, single-stemmed, few-branched, glabrous, shrub to 2.5 m high. Young stems and leaves glabrous. *Leaves* scattered, often 4 or 5 leaves together arising from about the same position on the stem, sessile, slender terete, semi-erect to erect, rigid, (10-) 25-30 (-35) cm long, 1.5-2 mm wide, obtuse or shortly mucronate, slightly pungent to pungent, oil glands not prominent. *Flowers* numerous, arranged in unilateral spikes, (4-) 7-10 (-13) cm long, usually on leafless portions of stems. *Calyx-tube* short, broadly campanulate, 1.5-2 mm long, glabrous, green, embedded in the swollen, corky rhachis; *calyx-lobes* erect, deltoid, acute, slightly concave, 0.7-1 mm long, 0.5-0.8 mm wide, glabrous outside and within; two opposite lobes slightly larger than other two; margins thin, scarious, ciliate. *Petals* narrow obovate, obtuse, concave, 2.5-3mm long, glabrous, thin, with scarious partially ciliate margins; pale yellow-green, often tinged with pink. *Staminal claws* ± equal, 20-25 mm long, 0.7-1 mm wide, glabrous, dark crimson, yellow-green towards base; marginal filaments 4 or 5; *anthers* oblong, f.7-0.8 mm long, dark brown. *Style* 15-28 mm long, slender, tapering to stigma, glabrous, pale red, yellow-green at base; stigma small. Summmit of *ovary* densely pubescent. *Fruit* sessile, depressed globular, 2-3 (-4) mm wide, embedded in the swollen, corky rhachis; two calyx lobes persistent on top of fruit. *Fertile seeds* few per capsule, narrow-pyriform, 0.7-0.8 mm long, glabrous; testa grey-brown, smooth, glabrous. *Ovulodes* numerous, linear, linear-clavate or narrow pyriform, 0.7-0.8 mm long, thin, glabrous, dark cream.

Derivation of name. From the Latin *lateralis*, meaning "at the side", referring to the unilateral spikes of flowers possessed by the species.

Habitat. Grows in swamps or damp ground in the coastal south-west corner of Western Australia. Flowers mostly from June to December.

Distribution. From Lake Pinjar near Wanneroo, north of Perth (31°40' S, 115°47' E), to swamps in the Perth district, to Busselton, near Blackwood River (34°10' S, 115°15' E) then to the Albany-Walpole district (c. 35°00' S, 117°40' E). Map 4.

Selected specimens examined. WESTERN AUSTRALIA: Swan River, 1843, *Turner* s.n. (BRI); Lake Pinjar, 24 June 1977, *J.S. Beard* 8034 (PERTH); Muchea, Nov. 1964, *G.G. Smith* s.n. (UWA); Neaves Road, NE of Wanneroo, 3 Aug. 1966, *J.J. Havel* 310 (PERTH); Neaves Road, 12 Oct. 1966, *J.J. Havel* 327 (PERTH); Cannington Swamp, 6 May 1948, *N.H. Speck* s.n. (UWA); Cannington, 21 Nov. 1903, *A. Morrison* s.n. (PERTH); lower Canning River, 12 Nov. 1898, *A. Morrison* s.n. (BRI); Bayswater, lower Swan River, 5 Dec. 1908, *A. Morrison* s.n. (BRI); sandplain, Perth, 12 Oct. 1977, *R.J. Cranfield* 49 (PERTH); Jandakot, 28 Sept. 1979, *R. Cary* s.n. (PERTH); near Banksiadale, 1 Dec. 1968, *E. Wittwer* 735a (KP); 9 miles W of Harvey, Nov. 1958, *D.M. Churchill* s.n. (UWA); Serpentine, Oct. 1899, *R. Helms* NSW 144012 (NSW); Serpentine, 29 Oct. 1899, *R. Helms* s.n. (BRI); Capel, 27 Oct. 1946, *R.D. Royce* 1320 (PERTH); 4.9 miles on Lake Road from North Dandalup bog, 15 Oct. 1969, *H. Demarz* 1754 (PERTH, KP); along road near Busselton, 13 Sept. 1962, *F.W. Went* 36 (PERTH); Busselton, 27 Sept. 1944, *C.A. Gardner* s.n. (PERTH); Tutunup, Busselton district, 13 Sept. 1956, *R.D. Royce* 5462 (PERTH); Flooded Gum Swamp, Muja, Collie, 1 Nov. 1979, *R.A. Saffrey* 1779 (PERTH); 3 km E of Blackwood River Crossing on Brockman Highway on Augusta-Nannup road, 3 Nov. 1978, *G.J. Keighery* 1879 (KP); near Chorkerup near Mt Barker, Dec. 1939, *W.E. Blackall* s.n. (PERTH); Lake Chorkerup, 20 Dec. 1939, *C.A. Gardner* 4330 (PERTH); Merven Lake, c. 12 miles S of Bridgetown near Wilgarup turnoff, 3 Dec. 1962, *W.A. Loneragan* 244 (UWA); Windy Harbour Road, 8 Jan. 1967, *E. Wittwer* 570 (KP); Torbay junction (between Denmark and Albany), Dec. 1902, *C.R Andrews* s.n. (PERTH); Bow River, Dec. 1912, *S.W. Jackson* s.n. (PERTH, K, MEL, CANB, NSW); Scott River Road, 7 Jan. 1967, *E. Wittwer* 554 (KP); near Ravenswood roadside, 13 Oct. 1965, *A.R. Fairall* 1693 (KP); King George's Sound, 1828-1829, *W. Baxter* s.n. (BRI).

Total number of specimens examined. 42.

Comments. *Calothamnus lateralis* is closely related to *C. huegelii* Schauer, but can be clearly distinguished by growth habit and the length of the leaves, mostly 25-30 cm long (only mostly 4-6 cm long in *C. huegelii*). In the field, the two species can also be distinguished by the lengths of the flowering spikes; mostly 7-10 cm long in *C. lateralis* and mostly 3-4 cm long in *C. huegelii*. *Calothamnus lateralis* exhibits little morphological variation throughout its range.

The habitat favoured by *C. lateralis* is swampy ground. In the Perth district the species appears to have suffered from fires and residential development. Populations should be monitored closely.

6. **Calothamnus huegelii** Schauer, Regelia, Beaufortia & Caloth. 34 (1843); Schauer in Lehm., Pl. Preiss. 1: 154 (1844). *Type*: "In Australia meridionali-occidentali, ad Sinum Regis Georgii III. l. ill. L.B. de Hügel!" (holo: W, photograph seen, Figure 7).

Calothamnus nodosus Turcz., Bull Soc. Imp Naturalistes Moscou 20: 168 (1847). *Type*: "Nova Hollandia, Drummond no. 60" (holo: KW, photograph seen).

Calothamnus lateralis Lindley forma *rigidus* Benth., Fl. Austral. 3:177 (1867). *Type*: *J. Drummond*, 3rd Coll. no. 60 (n.v.)

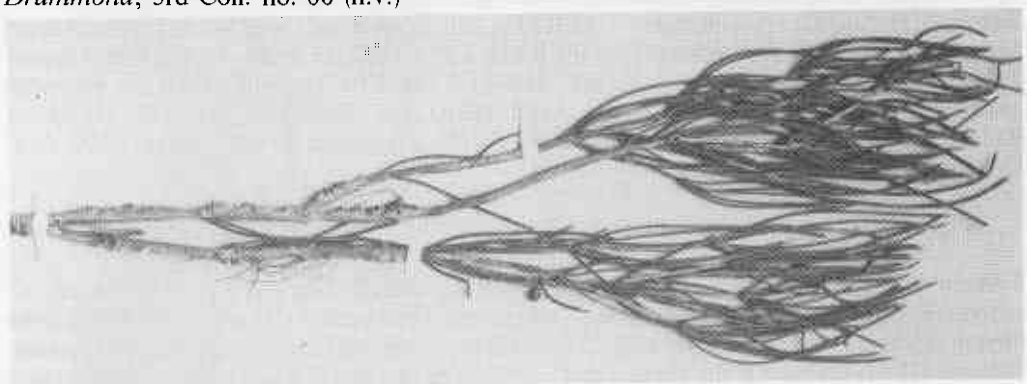


Figure 7. Holotype of *Calothamnus huegelii* Schauer (W).

Erect, slender to slightly spreading, single-stemmed, much-branched, glabrous shrub to about 2 m high. Young stems and leaves glabrous. *Leaves* scattered to crowded, sessile, slender, terete, semi-erect to erect, rigid, (3) 4-6 (9) cm long, c. 1 mm wide, shortly mucronate, glabrous, pungent, oil glands not prominent. *Flowers* numerous, arranged in unilateral spikes, (2) 3-4 (6) cm long, usually on portions of stems without leaves. *Calyx-tube* short, broadly campanulate, 1.5-2 mm long, glabrous, embedded in the swollen, corky rhachis; *calyx-lobes* erect, deltoid, acute, slightly concave, 0.6-1 mm long, 0.5-0.7 mm wide, glabrous outside and within; two opposite lobes slightly larger than the other two; margins thin, scarious, ciliate. *Petals* narrow obovate, obtuse, concave, 2.5-3 mm long, glabrous, thin with partially ciliate margins; pale yellow-green, often tinged with pink. *Staminal claws* ± equal, 20-25 mm long, 0.7-1 mm wide, glabrous, dark crimson, yellow-green towards base; marginal filaments 4-5 (-7); *anthers* oblong, 0.7-0.8 mm long, dark brown. *Style* 15-28 mm long, slender, tapering to stigma, glabrous, pale red, yellow-green at base; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, depressed globular, 2-3 (4) mm wide, embedded in the swollen, corky rhachis; two calyx lobes persistent on top of fruit. *Fertile seeds* few per capsule, narrow-pyriform, 0.7-0.8 mm long, glabrous; testa grey-brown, smooth, glabrous. *Ovulodes* numerous, linear, linear-clavate or narrow pyriform, 0.7-0.8 mm long, thin, glabrous, dark cream.

Derivation of name. Named after Karl Alexander Anselm Freiherr von Hügel (1794/96-1870), German born Austrian soldier and horticulturist, who collected in Australasia during 1830-1837.

Habitat. Grows in sandy or gravelly clay or sand over laterite in heath or tall mallee scrub. Locally common. Flowers mostly from April to May and sometimes to September, depending on local environmental conditions.

Distribution. From Hyden (32°28' S, 118°42' E), Corrigin (32°25' S, 117°48' E) to near Woodanilling (33°35' S, 117°30' E) then to areas north of the Stirling Range such as Ongerup, Jerramungup (33°55' S, 118°58' E) and the Fitzgerald River. Map 4.

The distribution of this species in the wheatbelt has most certainly been reduced through land clearing; the lack of collections in these areas may be largely attributed to this factor.

Specimens examined. WESTERN AUSTRALIA: Hyden, 8 Sept. 1966, *M. Barrow* 80 (PERTH, KP); NW Plantagenet, June 1901, *E. Pritzel* 346 (PERTH, NSW); Avon Locations 19769, SE of Corrigin (32°31' S, 117°56' E), 7 April 1977, *A.S. George* 14433 (PERTH, CANB); sandplain S of Pootenup (between Tambellup and Cranbrook), 11 Sept. 1947, *N.T. Burbidge* 2460 (BRI); Cranbrook, May 1901, *F.L.E. Diels & E. Pritzel* s.n. (PERTH); 10 miles E of Ongerup, 22 April 1962, *A.S. George* 3684 (PERTH); 14 miles E of Ongerup, 29 April 1962, *K.R. Newbey* s.n. (PERTH); Jerramungup, 26 Aug. 1964, *F. Lullfitz* L3644 (KP); N of Stirling Range, March 1952, *W.A. Atkins* 97 (PERTH); Salt River Road, N of Stirlings, near Camel Lake, 7 May 1979, *G.J. Keighery* 2296 (PERTH, KP); Salt River Road, 5 miles from Chester Pass, Stirlings, 3 April 1964, *A.R. Fairall* 1430 (PERTH, KP); 3 miles E of Albany Highway along road W from Woodanilling 27 April 1969, *A.S. George* 9307 (PERTH); W of Ravensthorpe, May 1964, *A. Kessell* 86 (PERTH); Fitzgerald River, 5 May 1964, *C.A. Gardner* 14716 (PERTH).

Total number of specimens examined. 19.

Comments. This species has been confused with *C. lateralis* Lindley, *C. affinis* Turcz., *C. crassus* (Benth.) T.J. Hawkeswood and *C. microcarpus* F. Muell. to which *C. huegelii* is most closely related. For comparisons with *C. huegelii* see comments under the respective species. Schauer (1843) compared the species to *C. gracilis* R. Br. but it is not closely related since *C. gracilis* is a 5-merous species.

There is need to examine the biology and conservation of this species since there are few collections and it appears likely that there has been significant range reduction due to clearing in the wheatbelt.

7. **Calothamnus crassus** (Benth.) T.J. Hawkeswood, stat nov.

Calothamnus lateralis Lindley forma *crassus* Benth., Fl. Austral. 3:177 (1867); Blackall and Grieve, How to Know Western Austral. Wildfl. ed.2,3A:152 (1980). *Type*: Swan River, *J. Drummond*. 2nd Coll. no. 73. (lecto, here designated: K, n.v.; isolecto: NSW, Figure 8).

Erect, much-branched, usually compact but sometimes straggly, shrub to 1.5 m high, often with thick, corky branches; leaf scars prominent on older branches. Young shoots glabrous. *Leaves* crowded at the ends of branches, sessile, slender, terete, glabrous, semi-erect to erect, rigid, (5-) 7-9 (-10) cm long, 0.8-1.2 (-1.5) mm wide, shortly mucronate, pale green; oil glands prominent. *Flowers* in dense, ± cylindrical spikes 3-8 (-9) cm long on portions of stems from

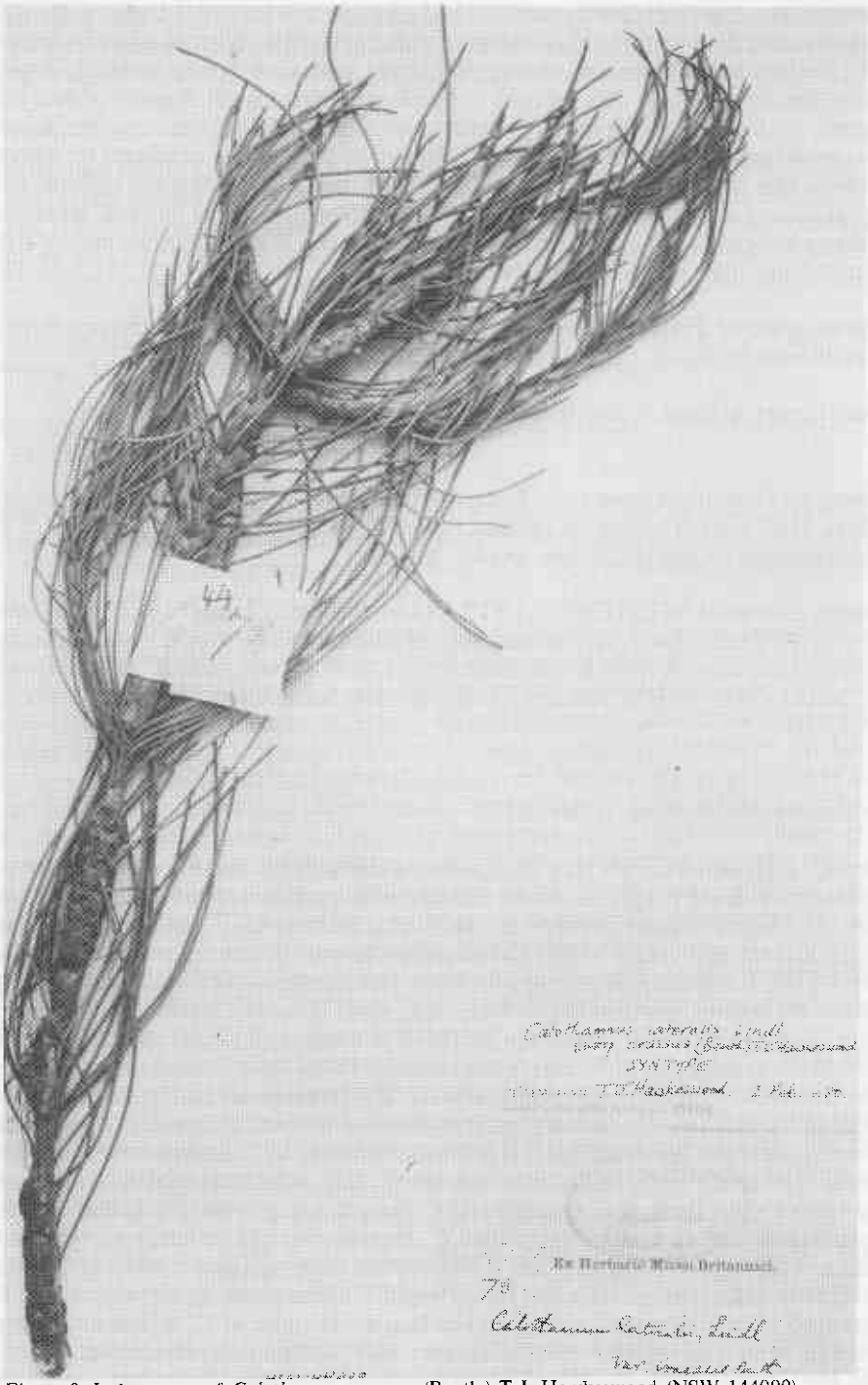


Figure 8. Isolectotype of *Calothamnus crassus* (Benth.) T.J. Hawkeswood (NSW 144009).

which the leaves have fallen. *Calyx-tube* narrowly campanulate, 2-2.5 mm long, glabrous, embedded in the swollen, corky rhachis; *calyx-lobes* erect, deltoid, acute, slightly concave, 0.7-1 mm long, 0.5-0.8 mm wide, glabrous outside and within. *Petals* narrow elliptical, concave, acute, 2.5-3 mm long, glabrous, papery, thin, orange-brown to pale brown; margins scarious,

partially ciliate. *Staminal* claws equal, (22-) 25-28 (-30) mm long, 0.7-1 mm wide, glabrous, dark crimson to dark purple-red, sometimes pale coloured at base; marginal filaments (6-) 7-8 (-9); *anthers* linear-oblong to oblong, 0.8-1 mm long, dark brown to black. *Style* 20-25 mm long, slender, glabrous, dark crimson to purple-red, stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, ± depressed globular, 3-4 (-5) mm wide, 3-5 mm long (including calyx-lobes), embedded in the swollen corky rhachis; two opposite lobes persistent on top of fruit, the thinner two wearing or breaking away with age. *Fertile seeds* few per capsule, pyriform to almost oblong, 0.7-1 mm long, 0.4-0.7 mm wide, often truncate at one end, glabrous; testa pale orange-brown. *Ovulodes* numerous per capsule, linear, linear-clavate or narrow-pyriform, 0.6-1 mm long, thin, glabrous, pale buff-brown.

Derivation of name. From the Latin *crassus*, meaning "thick", probably referring to the thick, swollen rhachis in which the fruits are embedded.

Habitat. Grows in sand in heath associations. Flowers October to November.

Distribution. Presently known only from Bluff Knoll in the Stirling Range National Park (34°23' S, 118°17' E). There is an isolated record from the Scott River (c. 34°20' S 118°15' E) which appears to belong to this species. Map 5.

Specimens examined. WESTERN AUSTRALIA: Stirlings, 22 Aug. 1952, *N.H. Speck* s.n. (UWA); Bluff Knoll, lower part on east side of summit, 12 Nov. 1961, *A.S. George* 3140 (PERTH); south slope of Bluff Knoll, 28 Oct. 1962, *K.R. Newbey* 633 (PERTH); Bluff Knoll massif, 24 Dec. 1979, *H.E.M. Dobson* 79022 (PERTH); Scott River, 17 Jan. 1945, *R.D. Royce* 84 (PERTH).

Total number of specimens examined. 7.

Comments. Although there are very few specimens available for assessment, I have felt justified in elevating this taxon to specific status. *Calothamnus crassus* is closely related to *C. lateralis* Lindley, *C. huegelli* Schauer. and *C. affinis* Turcz. with which it has been confused in the literature and on herbarium labels. *Calothamnus crassus* differs from *C. lateralis* in being usually a more compact, multi-stemmed shrub, with thicker, corky branches. The leaves of *C. crassus* are shorter, being mostly 7-9 cm long, while those of *C. lateralis* are mostly 25-30 cm long. The flowers of *C. crassus* are arranged in dense, cylindrical spikes, while those of *C. lateralis* are arranged in unilateral spikes mostly 7-10 cm long. The calyx-tube of *C. crassus* flowers is narrowly campanulate, and the petals are prominently acute. In *C. lateralis* (and *C. huegelii*) the calyx-tube is broadly campanulate and the petals obtuse. The staminal claws of *C. crassus* have (6-) 7-8 (-9) marginal filaments, while those of *C. lateralis* have 4 or 5 marginal filaments. The fertile seeds of all three species are similar but those of *C. crassus* are pale orange-brown while those of *C. lateralis* and *C. huegelii* are grey-brown. In leaf morphology, *C. crassus* resembles *C. huegelii* more than *C. lateralis*, but can be easily recognized by the differences outlined above. In addition, *C. crassus* has been confused with *C. affinis*, but they can be clearly distinguished on a few flower and fruit characters. In *C. crassus*, the flowers are arranged in uninterrupted, cylindrical spikes, while those of *C. affinis* are arranged in interrupted, unilateral spikes — the flowers are also prominently clustered in threes. In *C. crassus*, the flowering spikes are usually on portions of the stems from which the leaves have fallen, while in *C. affinis* they are usually situated amongst the leaves. In *C. crassus* the calyx-tube and fruit are embedded in the prominently corky rhachis, while those of *C. affinis* are only partially embedded in the slightly corky rhachis. The fruit of *C. affinis* is also usually larger than in *C. crassus*.

Although *C. crassus* is a rare and localized species its survival in the Stirling Range National Park seems assured, although fires may be an occasional threat. Its present status in the Scott River area is unknown since no material has been collected since 1945.

8. **Calothamnus affinis** Turcz., Bull. Cl. Phys-Math. Acad. Imp. Sci. Saint Petersbourg 10:346 (1852); F. Muell, Fragm. 8:184 (1874); Domin, Vestn. Kral. Ceske Spolecn. Nauk. Tr. Mat.-Prir. 2:92 (1923); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Hawkeswood, Austral. Pl. 11:12,13 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:152 (1980). *Type*: *J. Drummond*, 5th Coll. no. 182 (holo: KW, photograph seen).

Calothamnus microcarpus F. Muell. var. *teres* Benth., Fl. Austral. 3:177 (1867). *Type*: *J. Drummond*, 5th Coll. no. 182 (holo: K, photograph seen, Figure 9).

Calothamnus affinis var. *teres* Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:152 (1980), nomen invalidum.

Calothamnus affinis var. *longistamineus* Domin, Vestn. Kral. Ceske Spolecn. Nauk. Tr. Mat.-Prir. 2:92 (1923); Blackall & Grieve, How to Know Western Austral. Wildfl. ed. 2, 152 (1980). *Type*: "Cranbrook to Warrungup, sandy plains, A.A. Dorrien-Smith" (holo: PR, n.v.).

Erect, compact or spreading, rigid, single- or multi-stemmed, much-branched, usually glabrous shrub to 1.5 mm high. Young shoots glabrous or pilose (becoming glabrous with age). *Leaves* crowded or scattered, sessile, slender, terete, semi-erect to erect, rigid, (4.5-) 6-8 (-9) cm long, 0.7-1 mm wide, glabrous, usually shortly mucronate, sometimes obtuse, oil glands prominent and randomly scattered. *Flowers* in short prominent clusters of 2-4 (mostly 3) arranged in interrupted, unilateral spikes (2-) 3-6 (-7) cm long usually on portions of younger stems amongst leaves. *Calyx-tube* short, broadly campanulate, 1.5-2 mm long, glabrous, partly immersed in the slightly corky rhachis; *calyx-lobes* erect, deltoid, acute to obtuse, concave, 1-1.5 mm long, 0.6-0.8 mm wide, glabrous outside and within; two opposite ones slightly larger than the other two; margins thin, scarious, ciliate. *Petals* oblong-elliptical, obtuse or slightly acute, concave, 2-2.5 mm long, glabrous, orange-brown, thin, with thin, scarious, partially ciliate margins; central vein prominent. *Staminal claws* ± equal, 20-25 (-30) mm long, 0.5-1 mm wide, glabrous, purple-red becoming yellow-green at base; marginal filaments (5-) 7 (-9); *anthers* oblong, 0.5-0.7 (-1) mm long, black. *Style* 20-30 mm long, slender, tapering to stigma, glabrous, scarlet, becoming yellow-green at base; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, depressed globular, densely crowded, (3.5-) 5-6 (-6.5) mm wide, 2-4 mm long, only the base immersed in the rhachis; lobes initially present, inflexed, two opposite lobes prominently thickened, the remaining two thin, dry, often wearing away with age. *Fertile seeds* few per capsule, narrow-pyriform, 0.7-0.9 mm long, testa smooth, glabrous, grey-brown. *Ovulodes* numerous, thin, linear to linear-clavate or narrow pyriform, 0.6-0.8 mm long, glabrous, cream.

Derivation of name. From the Latin *affinis*, meaning "neighbouring", "allied to", "akin to". I am not sure to which species Turczaninow related *C. affinis*.

Habitat. Grows in gravelly lateritic soil or sand in shrub woodland communities. Flowers mostly from August to October and occasionally as late as March depending on local environmental conditions.

Distribution. Confined to the Stirling Range National Park east of Chester Pass road to Bluff Knoll and north of Mt Success. Map 6.

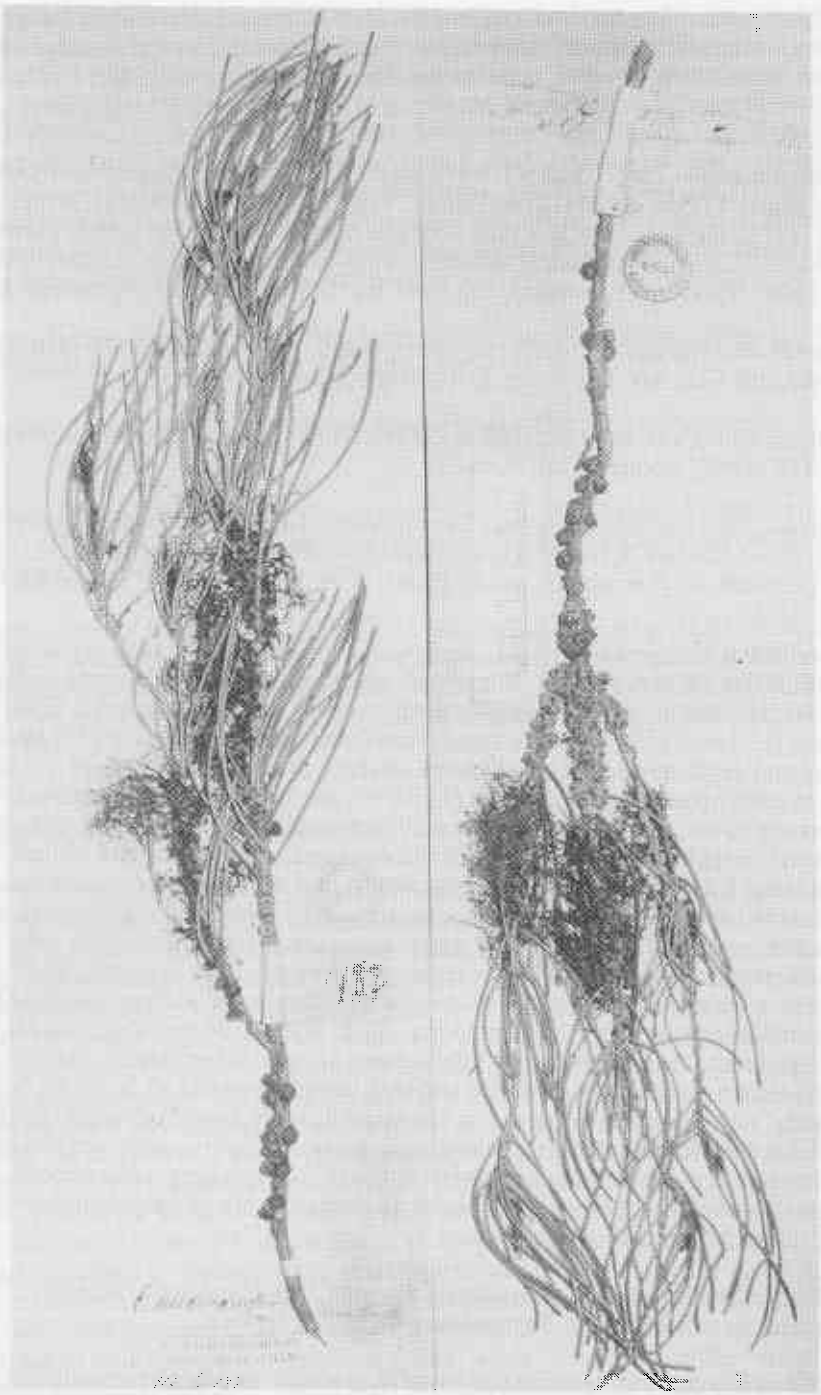


Figure 9. Syntypes of *Calothamnus microcarpus* F. Muell. var. *teres* Benth. (K).

Specimens examined. WESTERN AUSTRALIA: Stirlings, 22 Aug. 1952, *N.H. Speck* s.n. (UWA); Stirling Range, 5 Aug. 1968, *G. Byrne* s.n. (UWA); Chester Pass-Stirling Range, 11 Oct. 1971, *Anon.* (UWA); Stirling Range Drive, 15 km E of Red Gum Pass, 5 Oct. 1976, *B.G. Briggs* 6648 (PERTH, NSW); Bluff Knoll, 16 Aug. 1964, *F. Lullfitz* L3381 (KP); 3 miles

N of Mt Success, 28 Oct. 1962, *K.R. Newbey* 588 (PERTH); Foot of Ellen's Peak, Stirling Range, Oct. 1928, *C.A. Gardner* & *W.E. Blackall* s.n. (PERTH); Stony foothills, Ellen's Peak, Stirling Range, 5 Oct. 1928, *C.A. Gardner* 2135 (2) (PERTH); on sandy land, Salt River Road, Stirling Range National Park, Mar. 1966, *F.A. Spratt* 15 (PERTH); gravelly country on Chester Pass Road, Stirling Range National Park, Mar. 1966, *F.A. Spratt* 6 (PERTH); Tolls Creek, 3 Oct. 1902, *A. Morrison* s.n. (PERTH).

Total number of specimens examined. 12.

Comments. Calothamnus affinis is closely related to *C. huegelii* Schauer. They are difficult to distinguish in the field since both have leaves of similar length; ((3-) 4-6 (-9) cm long in *C. huegelii* and (4.5-) 6-8 (-9) cm long in C. *affinis*) and the flowers in spikes usually measuring 2-6 cm long in both taxa. In addition, the fruit and seeds are identical. The differences between the two taxa are outlined in Table 1 below.

Table 1. Differences between *Calothamnus huegelii* Schauer and *C. affinis* Turcz.

C. huegelii	*C. affinis*
1. Flowers densely crowded, arranged in uninterrupted spikes (2-) 3-4 (-6) cm long.	Flowers in groups of (2-) 3 (-4) in usually interrupted spikes (2-) 4-6 (-7) cm long
2. Spikes usually on portions of stems without leaves	Spikes usually on portions of stems amongst leaves
3. Calyx-tube and fruit embedded in the swollen, corky rhachis	Calyx-tube and fruit only partially embedded in the slightly corky rhachis
4. Staminal claws with 4-5 (-7) marginal filaments	Staminal claws with (5-) 7 (-9) marginal filaments
5. Fruit 2-4 mm wide	Fruit 3.5-6.5mm wide

Calothamnus affinis is also closely related to *C. microcarpus* F. Muell. but the latter species possesses flat leaves 1.5-2.5 mm wide, and staminal claws with marginal filaments (3-) 5 or 7 (-9). In all other characters the two species are identical. They occur sympatrically in the Stirling Range National Park although *C. microcarpus* appears to have a wider distribution north of the Stirling Range. Map 7.

Calothamnus affinis is also closely related to *C. crassus* (Benth.) T.J. Hawkeswood which also occurs sympatrically in the Stirling Range National Park. The differences between these two species are outlined in the discussion of *C. crassus*.

There have been no attempts to study the ecology and conservation of *C. affinis*. It may form hybrids with the related species *C. huegelii*, *C. crassus* and *C. microcarpus* in the Stirling Range area.

9. **Calothamnus microcarpus** F. Muell., Fragm. 3:113 (1862); Benth., Fl. Austral. 3:117 (1867); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967). *Type*: "Ad flumen Kalgan Australiae occidentalis. Aug. Oldfield" (n.v.)

Erect, compact or spreading, rigid, single- or multi-stemmed, much-branched, usually glabrous shrub to 1.5 m high. Young shoots densely appressed pilose, becoming glabrous with age. *Leaves* sessile, linear, thick, flat, rigid, semi-erect to erect, (4-) 5-9 (-10) cm long, 1.5-2.5 mm wide, glabrous, shortly mucronate or sometimes obtuse, twice channelled above and below, tapering slightly at base, dark green; oil glands prominent and randomly distributed. *Flowers* in short, prominent clusters of 2-3 (mostly 3) arranged in interrupted, unilateral spikes (3-) 4-6 (-7) cm long, usually on portions of younger stems amongst leaves. *Calyx-tube* short, broadly campanulate, 1.5-2.5 mm long, glabrous, rhachis prominently dilated at base of calyx-tube; *calyx-lobes* erect, deltoid, acute to obtuse, 1-1.5 mm long, 0.6-0.8 m wide, glabrous outside and within; margins thin, scarious, ciliate. *Petals* oblong-elliptical, obtuse or slightly acute, concave, (1.5-) 2-2.5 mm long, glabrous, orange-brown, thin, with thin, scarious, partially ciliate margins; central vein prominent. *Staminal claws* ± equal, 20-25 (-28) mm long, 0.3-0.8 (-1) mm wide, glabrous, dark red, becoming yellow-green towards base; marginal filaments (3-) 5 or 7 (-9); *anthers* linear-oblong, 0.5-0.7 mm long, dark brown to black. *Style* 20-30 mm long, slender, tapering to stigma, glabrous, dark red, becoming yellow-green at base; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, depressed globular, densely crowded, (2-) 3-4 (-5) mm long, 4-6 mm wide, only the base immersed in the rhachis; lobes initially present, inflexed, two opposite lobes prominently thickened, the remaining two thin, dry, usually wearing away with age; orifice c. 1.5 mm diameter. *Fertile seeds* few per capsule, narrow-pyriform, 0.7-0.9 mm long, glabrous; testa grey-brown. *Ovulodes* numerous, thin, linear to linear-clavate or narrow-pyriform, 0.6-0.8 mm long, glabrous, cream.

Derivation of name. From the Greek *micros*, meaning "small", and *carpos*, meaning "fruit", referring to the small capsules. However, its closest relatives, *C. affinis C. schaueri*, *C. lehmannii*, *C. planifolius*, *C. lateralis* and *C. huegelii* and *C. preissii* all possess similar fruits which are the smallest type in the genus.

Habitat. Grows in lateritic clay soil in *Eucalyptus* scrub or sandy soil in mallee heaths. Flowers mostly from September to November.

Distribution. Cranbrook area (c. 34°20' S, 117°35' E) and the Stirling Range National Park to an area between Napier and Mt Many Peaks (c. 34°52' S, 118°05' E). Map 7.

This species has been poorly collected between the Stirling Range National Park and the Napier-Mt Many Peaks area. This may be due to lack of collecting, but more likely is a result of land clearing.

Specimens examined. WESTERN AUSTRALIA: 15 miles E of Cranbrook, 26 Sept. 1965, *K.R. Newbey* 1870 (PERTH); Albany Highway, Cranbrook turnoff, 11 Nov. 1961, *A.S. George* 3090 (PERTH); near Cranbrook, 10 Nov. 1927, *C.T. White* s.n. (PERTH); Stirling Range, 9 Oct. 1902, *A. Morrison* s.n. (2) (PERTH); Stirling Range, 10 Nov. 1927, *C.T. White* 5439 (BRI); Red Gum Pass, 9 Oct. 1902, *A. Morrison* s.n. (PERTH); E from Solomon's Well, 28 Sept. 1902, *A. Morrison* s.n. (2) (PERTH); Peak Donnelly, Oct. 1956, *C.A. Gardner* s.n. (PERTH); Stirling Range, Sept. 1921, *E.H. Pelloe* s.n. (PERTH); Stirling Range, Oct. 1951, *A.M. Baird* s.n. (UWA); Stirling Range, Oct. 1930, *E. Ashby* NSW 144001 (NSW); Stirling Ranges, Oct. 1901, *E. Pritzel* NSW 144002 (NSW); Mt Hamilla, Stirling Range, on Hancock property, 9 miles along Salt River road from Cranbrook, 9 Oct. 1968, *E.M. Canning* CBG 031863 (NSW); Between Napier and Mt Many Peaks, 5 Oct. 1967, *A.R. Fairall* 2245 (PERTH); Stirling Range, 9 Oct. 1902, *A. Morrison* s.n. (2) (PERTH).

Total number of specimens examined. 15.

There is a morphological variant of this species which may warrant subspecific category. It occurs in the Stirling Range area and differs from the typical form in having more rigid, erect, pale grey-green leaves measuring (2.5-) 3-4 (-8) cm long and 1.5-2.5 mm wide. However, there is not enough material available at present for this variant to be clearly assessed. It may represent a hybrid or be only a local variant.

Specimens examined. S of Stirling Range National Park on Red Gum Pass Road, 5 Oct. 1963, *R.D. Royce* 8074 (PERTH); Stirling Range, 8 Oct. 1964, *C.A. Gardner* s.n. (PERTH); top of breakaway overlooking plain between Kalgan River and Porongorups, Oct. 1951, *A.M. Baird* s.n. (2) (UWA); between Porongorups and Stirlings, Oct. 1963, *W. Rogerson* 74 (PERTH).

Total number of specimens examined. 5.

Comments. This species is most closely related to *C. planifolius* Lehm., *C. crassus* (Benth.) T.J. Hawkeswood and *C. huegelii* Schauer, but can be readily distinguished by the flat leaves which are characteristically two-channelled abaxially and adaxially. For further comments see discussion under *C. planifolius* and *C. affinis* Turcz.

Calothamnus microcarpus is a variable species, especially in leaf morphology, and complex hybridization with related species may be occurring in the Stirling Range area. Further collections and ecological studies should be undertaken in this area to shed light on its variation.

10. **Calothamnus preissii** Schauer, Regelia, Beaufortia & Caloth. 31 (1843); Schauer in Lehm., Pl. Preiss. 1: 154 (1844); Benth., Fl. Austral. 3: 177 (1867); Domin, Vestn. Kral. Ceske Spolecn. Nauk. Tr. Nat.-Prir, 2:92 (1923); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Desc. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11:8, 14 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:150 (1980). *Type*: "Habitat in Australia meridonali- occidentali: in solo glareoso silvae cis fluvium Gordon Novembri a 1840 legit. cl Preiss!" (Herb. Preiss. No. 209) (lecto, here designated: LD).

Calothamnus laxa Kunze, Linnaea 20: 58 (1847). *Type:* "E Nova Hollandia absque nomine dedit h.r. Berolinensis. Decbr. 1846" (holo: B, type destroyed).

Low, decumbent, often prostrate, mostly glabrous shrub to 0.3 m high with thin stems. Young shoots often pilose. *Leaves* scattered or arranged in loose whorls, sessile, slender, terete, (5-) 7-10 (-13) cm long, 0.7-1 mm wide, pale green to glaucous, glabrous or slightly pilose, shortly acuminate, slightly pungent. *Flowers* in dense, cylindrical spikes 3-5 cm long, usually amongst leaves at the end of the branches. *Calyx-tube* short, broadly campanulate, (1-) 1.5-2 mm long, glabrous, rhachis slightly dilate at base; *calyx-lobes* equal, 0.6-0.8 mm long, deltoid, acuminate-obtuse, glabrous outside and inside; margins partially fimbriate. *Petals* almost elliptical, acute to slightly obtuse, concave, 1.2-1.5 (-2) mm long, glabrous, papery, orange-brown with thin, pale, ciliate margins. *Staminal* claws unequal, glabrous, dark scarlet to violet-red, often pale at the base; upper two claws (10-) 12-15 (-20) mm long, 0.6-0.8 (-1) mm wide with 5 or 7 marginal filaments; lower two claws (7-) 8-10 (-12) mm long, 0.5-0.8 mm wide, with 1 or 2 marginal filaments; *anthers* oblong, 0.7-0.9 mm long, dark brown or black. *Style* slender, 5-20 mm long, glabrous, stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, densely crowded, truncate-conical to almost cylindrical, (3-) 3.5-4 (-5) mm long, (including lobes), 3-4 (-5) mm wide, smooth or sometimes wrinkled, dark grey; lobes initially present, two opposite lobes thinner, often wearing away with age. *Styles* often persistent in fruit. *Fertile seeds* few to many per capsule, 0.6-0.8 (-1) mm long, 0.5-0.7 mm wide, narrow-

pyriform to pyriform, usually truncate, glabrous; testa dark grey-brown. *Ovulodes* numerous per capsule, 0.5-0.8 mm long, linear or linear-cuneate, glabrous, pale yellow.

Derivation of name. Named after Dr Johann Augustus Ludwig Preiss (1811-1883), who collected plants in Western Australia during 1839-1841.

Habitat. Grows in well-drained gravelly sand or gravel-clay in closed heath with *Xanthorrhoea reflexa*, *Banksia sphaerocarpa*, *Calothamnus quadrifidus* etc., or in open heath with *Eucalyptus marginata*, *Banksia*, *Melaleuca* etc. Flowers mostly from July to October and early November.

Distribution. From Tutanning Reserve, east of Pingelly (c. 32°32' S, 117°25' E), to Kojonup (33°50' S, 117°10' E), Tambellup (34°03' S, 117°38' E) and Cranbrook (34°18' S, 117°32' E). The most southerly limit of the species' range occurs near Albany (34°59' S, 117°58' E). Map 8.

Specimens examined. WESTERN AUSTRALIA: Tutanning Reserve, 17 miles E of Pingelly, 19 Sept. 1962, *R.D. Royce* 7597 (PERTH); Tutanning Reserve, 17 miles E of Pingelly, 10 Oct. 1967, *G. Heinsohn* 41 (PERTH); Yornaning Reserve 18952, c. 19 km E of Yornaning Siding, 35 km SE of Pingelly, 12 Sept. 1975, *B.G. Muir* 489 (4.2) (2) (PERTH); Albany Highway, 144 km, 20 July 1967, *F. Lullfitz* 1122 (KP); Near Haddleton Springs, between Boyup Brook and Darkan (33°38' S, 116°34' E), 3 Oct. 1971, *A.S. George* 11135 (PERTH); 142 mile peg Albany Highway, (near Kojonup), 20 July 1962, *F. Lullfitz* 648/62/2 (PERTH); 147 mile peg, Albany Highway (Kojonup), 9 Aug. 1958, *A.S. George* 175 (PERTH); Tambellup (undated), *F. Lullfitz* s.n. (PERTH); 10 miles NW of Cranbrook, 20 Oct. 1963, *K.R. Newbey* 1162 (PERTH); 49 km SW of Kojonup on Frankland road (Towerlup Road), (34°10' S, 116°59' E), 3 Oct. 1978, *A.S. George* 15243 (PERTH); Ledge Point Road, (34°59' S, 117°58' E) (near Albany), 9 Nov. 1974, *D.J.E. Whibley* 5171 (PERTH); Denmark, 9 Dec, 1962, *A.S. George* 4288 (PERTH).

Total number of specimens examined. 15.

Comments. The type of this species was collected from near the Gordon River in 1840, west from the present site of Cranbrook. However, there appear to be no recent collections from the Gordon River, although one has been made north-west of Cranbrook. Most of the remaining populations are now confined to road verges, particularly in the southern part of the species range. Land clearing for agriculture has eliminated most of the original occurrence of the species. The future of the roadside populations seems tenuous in view of future roadworks, road maintenance and the invasion of weeds. Only a few plants of *C. preissii* are known to occur in reserves, i.e. at Tutanning and Yornaning, and a combination of increased fire frequency and drought appears to be placing the species under stress in these areas. Recommendations for the conservation of this rare species have been provided by Leigh, Boden & Briggs (1984).

It is interesting to note the differences in the type descriptions and the redescriptions of *C. preissii* regarding the number of marginal filaments (anthers) of the staminal claws. Schauer (1843) and Schauer in Lehmann (1844) noted that the largest staminal claws had 5 anthers, while the smaller ones had 3 each. On the other hand, Bentham (1867) stated that the largest staminal claws had 5-9 marginal filaments each, while the others possessed 1 or 2. Kunze (1847), in his description of *C. laxa* (which undoubtedly is a synonym of *C. preissii* despite the destruction of the type specimen during World War II), stated that the stamens each have 7 anthers. In the material I had available for dissection in 1980, the larger staminal claws possessed 5 or 7 anthers (in undamaged material) and the lower ones 1 or 2. It therefore appears that Bentham was the most accurate in regards to the description of these floral structures. Following Schauer's early diagnosis, I erroneously stated (Hawkeswood 1980) that

the two upper staminal claws of *C. preissii* had 3 to 5 marginal filaments; this should be amended to 5 or 7. *Calothamnus preissii* is closely related to *C. schaueri* Lehm. and *C. lehmannii* Schauer but may be distinguished by the combination of leaf length and the number of filaments (anthers) of the staminal claws. See discussion under these two species.

11. **Calothamnus schaueri** Lehm., Del. Sem. Hort. Bot. Hamb. 7 (1842); Schauer, Regelia, Beaufortia & Caloth. 32 (1843); Schauer in Lehm., Pl. Preiss. 1: 154 (1844); Benth., Fl. Austral. 3: 178 (1867); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Desc. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11: 14 (1980); Blackall & Grieve, How to Know Western Austral. Pl. ed.2,3A:153 (1980). *Type*: "In regionibus interioribus sterilibus Australiae meridionali- occidentalis collegit Cl. L. Preiss". (Herb. Preiss No. 202) (lecto, here designated: LD).

Calothamnus schoenophylla Schauer, Regelia, Beaufortia & Caloth. 33 (1843); Schauer in Lehm., Pl. Preiss. 1: 154 (1844). *Type*: "Habitat in Nova-Hollandia austro-occidentali: in solo subturfoso-arenoso inter frutices silvae ad planitiem prope oppidulum Albany, districti Plantagenet, Decembri m.a. 1840 fructiferam legit cl. Preiss!" (Herb. Preiss. No. 201) (lecto, here designated: LD, Figure 10).

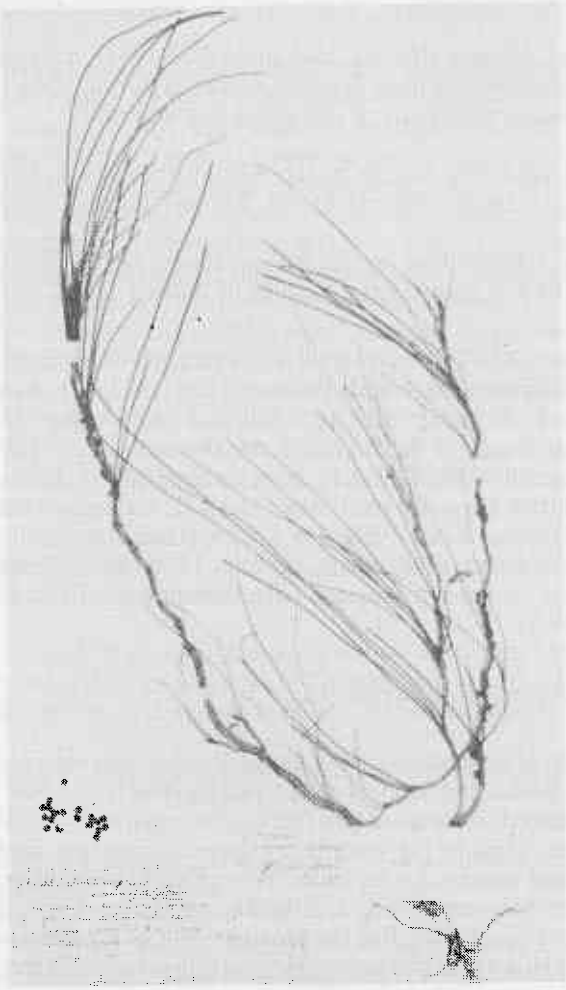


Figure 10. Lectotype of *Calothamnus schoenophylla* Schauer (LD).

Low, often prostrate, spreading shrub to 30 cm high, with thin stems. Young shoots usually glabrous but sometimes pilose. *Leaves*, scattered or arranged in loose whorls, sessile, linear, terete or slightly flattened, (10-) 12-20 (-25) cm long, 0.6-1 mm wide, pale green, glabrous or slightly pilose, finely acuminate, not pungent. *Flowers* in dense cylindrical spikes 2-3.5 cm long, usually on portions of stems without leaves. *Calyx-tube* short, broadly campanulate, 1.5-2 mm long, glabrous, rhachis slightly dilate at base; *calyx-lobes* equal, deltoid, acuminate-obtuse, 0.5-0.8 mm long, 0.5-0.8 mm wide, slightly concave, erect or slightly spreading, glabrous outside and inside, margins slightly fimbriate. *Petals* almost elliptical, concave, acute, 1-1.5 (-2) mm long, glabrous, papery, pale brown with thin, pale, ciliate margins. *Staminal claws* equal, (4-) 5-6 mm long, 0.3-0.5 mm wide, glabrous, deep red-brown; marginal filaments 2-4; *anthers* oblong-elliptical, 0.6-0.7 mm long, dark brown. *Style* slender, 5-8 mm long, glabrous; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, densely crowded, truncate-conical to almost cylindrical, (2.5-) 3-4 mm diameter at base, (2.5-) 3-4 mm long (including calyx-lobes), smooth or sometimes wrinkled, dark-grey; calyx-lobes initially persistent; thinner two opposite lobes wearing with age. *Styles* often persistent in fruit. *Fertile seeds* few to many per capsule, narrow-pyriform to pyriform, 0.6-0.8 mm long, 0.5-0.7 mm wide, usually truncate at one end, glabrous, testa dark grey-brown. *Ovulodes* numerous per capsule, linear or linear-cuneate, 0.5-0.8 mm long, glabrous, pale yellow.

Derivation of name. Named after J.C. Schauer (1813-1848), who published on Myrtaceae (*Beaufortia* and *Calothamnus*) from Western Australia during 1843-1845 and who provided the first comprehensive treatment of the genus *Calothamnus*.

Habitat. Grows in sand over laterite in the Albany area and in sand on edges of swamps near Mt Barker and near the Stirling Range. Flowers mostly from October to December.

Distribution. From Chester Pass in the Stirling Range (34°22' S, 118°08' E) to Mt Barker (34°37' S, 117°38' E) and areas in the vicinity of Albany (35°02' S, 117°53' E). Map 9.

Specimens examined. WESTERN AUSTRALIA: 3 km S of Mt Barker, 20 Oct. 1974, *K.F. Kenneally* 2375 (PERTH); 3 km S of Mt Barker, 25 Oct. 1977, *K.F. Kenneally* 6476 (PERTH); 4 miles (6.4 km) S of Mt Barker, 11 Dec. 1973, *K.F. Kenneally* 1223 (PERTH); 4.1 miles S from Chester Pass Road, 14 Sept. 1966, *E.M. Bennett* 1019 (PERTH); Chester Pass, 10 Oct. 1962, *A.R. Fairall* 556 (PERTH, KP); 10 miles N of Albany, 29 Aug. 1966, *K.R. Newbey* 2503 (PERTH); Albany-Denmark road, April 1943, *C.A. Gardner* s.n. (PERTH); Denmark, 9 Dec. 1962, *A.S. George* 4288 (PERTH); King George Sound, (undated), *W. Baxter* s.n. (PERTH); Gull Rock Road, E of Albany, 22 Oct. 1975, *A.S. George* 14187 (PERTH); 2.5 miles W of Narrikup, junction of Hay and Lake Barns Roads, 10 Sept. 1971, *K.F. Kenneally* 71/255 A & B (UWA).

Total number of specimens examined. 13.

Comments. The type of *C. schaueri* and of its synonym *C. schoenophylla* were both collected from King George Sound (Albany) by (J.A.) Ludwig Preiss in 1840. Later collectors have not significantly extended the range of this species. It is apparently rare and localized, occurring in small populations. Most of the records are from road verges, with the remainder from private property. Land clearing for agricultural purposes has eliminated much of the original habitat of this species between Albany and the Stirling Range. There is only one record from the Stirling Range National Park, but the present status of *C. schaueri* at this locality is not known. Recommendations for the conservation of this rare, distinctive species have been provided by Leigh, Boden & Briggs (1984).

12. **Calothamnus lehmannii** Schauer, Regelia, Beaufortia & Caloth. 31 (1843); Schauer in Lehm., Pl. Preiss. 1: 153 (1844): Benth., Fl. Austral. 3: 178 (1867); Domin, Vestn. Kral. Ceske Spolecn. Nauk. Tr. Mat.-Prir. 2:92 (1923); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11: 15 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:151 (1980). *Type*: "In regionibus interioribus Australiae meridionali-occidentalis, in itinere a Sinu Regis Georgii III ad oppidulum York, Februario m.a. 1840, legit cl. Preiss!" (Herb. Preiss. No. 218) (lecto, here designated: LD, Figure 11).

Figure 11. Lectotype of *Calothamnus lehmanii* Schauer (LD).

Calothamnus plumosus Turcz., Bull. Soc. Imp. Naturalistes Moscou 22: 25 (1849). *Type*: "Nova Hollandia. Drum. n. 59" (3rd Coll.) (holo: KW, photograph seen; iso: K, Figure 12).

Low, decumbent, often prostrate, few-branched, mostly glabrous shrub to 40 cm high, with thin stems. Young shoots usually pilose. *Leaves*, scattered or densely crowded, sessile, slender, terete, 1-2.5 (-3.5) cm long, 0.5-1 mm wide, glabrous or sometimes finely pubescent, shortly mucronate but not pungent, erect or slightly spreading, pale green; oil glands often prominent. *Flowers* in dense cylindrical spikes (sometimes ± unilateral), 2-4 (-7) cm long, usually amongst leaves at the ends of branches , rhachis usually prominently dilate beneath flowers. *Calyx-tube* short, almost campanulate, 1-1.5 mm long, glabrous, green, *calyx-lobes* equal, 0.5-1 mm long, deltoid, acute or slightly obtuse, slightly concave, erect, glabrous outside and inside; margins scarious, ciliate. *Petals* obovate, obtuse, slightly concave, 1-2 mm long, glabrous, papery, orange-brown to brown with ciliate margins. *Staminal claws* unequal, glabrous, deep purple-red; two upper claws 5-8 (-12) mm long, c. 0.5 mm wide, with 4 or 5 marginal filaments; two lower claws 2.5-6 mm long, 0.2-0.3 mm wide, with 1 or 2 marginal filaments; *anthers* oblong, c. 0.5 mm long, dark brown to black. *Style thick*, tapering, 2-10 mm long; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, ± depressed globular, densely crowded, 2.5-3 mm wide, c. 2 mm long, glabrous, calyx-lobes usually persistent (sometimes two absent). Styles often persistent in fruit. *Fertile seeds* few per capsule, narrow obovoid to narrow pyriform, 0.6-0.8 (-1) mm long, 0.5-0.7 mm wide, usually truncate at one end, glabrous; testa chocolate brown, finely wrinkled. *Ovulodes* numerous, c. 1 mm long, linear-oblong to oblong, glabrous, pale yellow.

Derivation of name. Named in honour of Johann Georg Christian Lehmann (1792-1860), a German botanist who described three species of *Calothamnus* (viz. *C. planifolius*, *C. schaueri* and *C. longifolius*, the last being a synonym of *C. huegelii* Schauer).

Habitat. Grows in sandy soil on laterite in open *Eucalyptus-Banksia* mallee-heathlands. Flowers August to October.

Distribution. From near Bowelling (c. 33°32' S, 116°32' E), Frankland (c. 34°28' S, 117°00' E) to Tenterden (34°22' S, 117°33' E) to the Stirling Range (34°30' S, 117°30' E). Map 10.

Specimens examined. WESTERN AUSTRALIA: N.W. Plantagenet District, Sept. 1901, *E. Pritzel*, NSW 144004 (NSW); 7 miles S of Bowelling, Aug. 1959, *M.J. Tichborn* s.n. (PERTH); 2 miles S of Tambellup, 20 Oct. 1963, *K.R. Newbey* 1165 (PERTH); Red Gum Springs, 17

Sept. 1965, *F.W. Humphreys* s.n. (PERTH); 2 miles N of Red Gum Pass, Stirling Range, 10 Sept. 1960, *B.G. Briggs* NSW 144005 (NSW); Stirling Range, 8 Oct. 1964, *C.A. Gardner* F340 (PERTH): Western Stirlings, 27 Sept. 1963, *E. Wittwer* 294 (PERTH, KP); 49 km SW of Kojonup on Frankland Road (Towerlup Road), (34°10' S, 116°59' E), 3 Oct. 1978, *A.S. George* 15238 (PERTH); S of Tenterden, 25 Sept. 1902, *A. Morrison* s.n. (2) (PERTH); south border of Stirling Range National Park, 8 Oct. 1962, *A.R. Fairall* 430 (KP).

Total number of specimens examined. 12.

Comments. Calothamnus lehmannii is closely related to *C. schaueri* Lehm. and *C. preissii* Schauer. It differs from the former species in having the staminal claws unequal (the two upper claws are larger with more anthers than the lower ones). In *C. schaueri*, the staminal claws are more or less equal with 2-4 anthers. In *C. preissii*, the upper staminal claws have 5 or 7 anthers, while the two lower ones have 1 or 2. In *C. lehmannii*, the upper staminal claws have 4 or 5 anthers while the lower ones have 1 or 2. In the field, *C. lehmannii* can be easily distinguished from these other two species in having shorter leaves mostly 1.5-2.5 mm long and shorter staminal claws usually less than 1 cm long. In the original description of Schauer (1843) (and also that of Schauer in Lehmann, 1844), the upper staminal claws are described as having 7 anthers only, with the lower ones being sterile (without anthers). This is clearly erroneous. Likewise, the description of Bentham (1867) is somewhat misleading. He claimed that the staminal claws are narrow, "one with 5 to 7 filaments, one with 3 to 5, the two others tapering into a single filament with one anther". Turczaninow (1849) in his description of *C. plumosus* noted the upper staminal claws possessed 3 anthers only while the lower ones were reduced to one anther. It should be noted that the anthers of *Calothamnus* have weak connectives and in dried specimens they break off with the slightest disturbance.

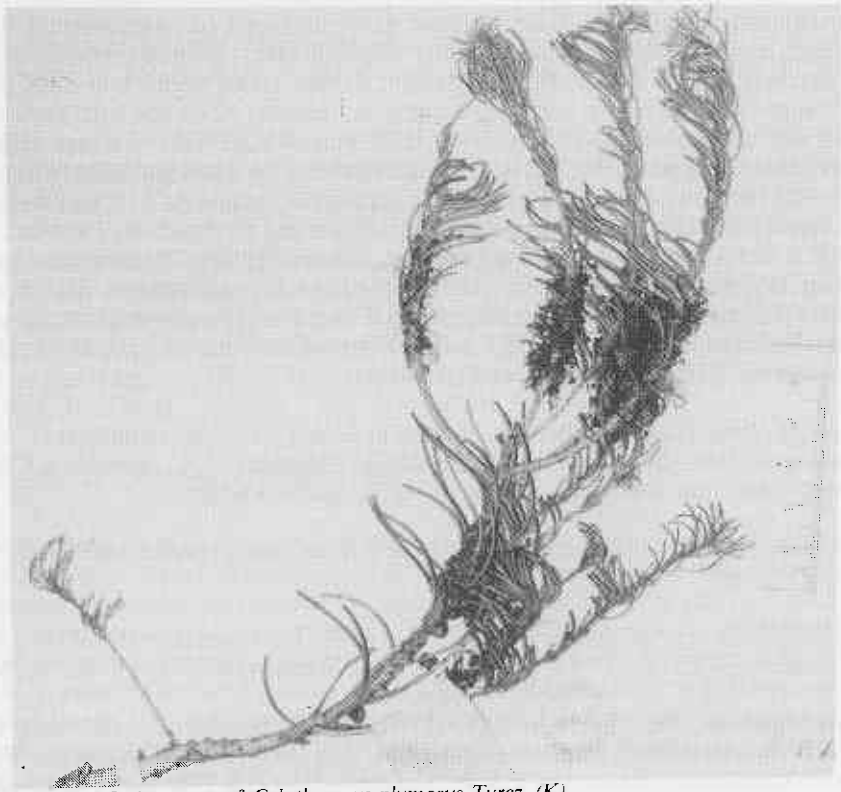


Figure 12. Isolectotype of *Calothamnus plumosus Turcz. (K).*

This may explain the low numbers of anthers (i.e. inaccurate counts) noted by the early authors, although there may be populations of the species of which I am unaware that have reduced anthers. In the material I have examined, however, the upper staminal claws possessed 4 or 5 anthers while the lower ones possessed 1 or 2.

Calothamnus lehmannii is a poorly collected species only known from the Frankland and Tenterden areas and the southern slopes of the Stirling Range. A collection made over 20 years ago from near Bowelling, is the most northerly record of the species but it has not been re-collected from that area. The paucity of herbarium specimens is most likely due to its being uncommon throughout its range and therefore seldom encountered in the field. Apart from Stirling Range, the species is now largely restricted to small populations on a few road verges. Only a few plants are known from within the Stirling Range National Park. Much of the original populations have been eliminated by land clearing, grazing and fires. Surviving roadside populations are liable to elimination by roadworks and are at risk from habitat invasion by weeds. The very small populations in the Stirling Range National Park are adjacent to farmlands and may be threatened by increased fire frequency. Recommendations for the conservation of this rare species have been provided by Leigh, Boden and Briggs (1984).

13. **Calothamnus planifolius** Lehm., Del. Sem. Hort. Bot. Hamb. 7 (1842); Benth., Fl. Austral. 3: 176 (1867); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11: 15, 16 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:151 (1980). *Type*: "In solo glareoso plantiei prope lacum Mathilda (distr. Hay), Novembri 1840 florens" (Herb. Preiss. No. 205) (lecto, here designated: LD).

Calothamnus planifolius forma *angustifolius* Schauer, Regelia, Beaufortia & Caloth. 35 (1843); Schauer in Lehm., Pl. Preiss. 1: 155 (1844), nom. illeg. Based on type of *Calothamnus planifolius* Lehm. (Herb. Preiss. No. 205).

Calothamnus planifolius forma *latifolius* Schauer, Regelia, Beaufortia & Caloth. 36 (1843); Schauer in Lehm., Pl. Preiss. 1: 155 (1844). *Type*: "In interioribus plagis Sinum Regis Georgii et oppidulum York interjacentibus Februario 1840" (Herb. Preiss. No. 206) (lecto, here designated: LD).

Erect, much-branched, glabrous shrub to 1.5 m high. Young shoots usually glabrous, sometimes shortly pilose. *Leaves* scattered or crowded at ends of branches, sessile, flat, linear to linear-cuneate, slightly attenuate at base, (3.5-) 4-5 (-7) cm long, 3-5 mm wide, obtuse or shortly mucronate, not pungent, usually olive green, slightly scabrous, glabrous, mid-vein prominent on undersurface; oil glands prominent. *Flowers* 2-4 (mostly 3) in dense ± uninterrupted unilateral spikes 3-7 cm long, embedded in the swollen, corky rhachis. *Calyx-tube* broadly campanulate, 2-2.5 (-3) mm long, glabrous; *calyx-lobes* ± equal, erect to semi-erect, acute to slightly obtuse, 0.7-1 mm long, c. 0.8 mm wide, concave, acute, 2-2.5 mm long, glabrous, papery, thin, pale brown; margins scarious, partially ciliate. *Staminal claws* ± equal (20-) 22-25 (-30) mm long, 0.7-1 mm wide, glabrous, purple-red in upper half to two-thirds, yellow-green in lower portion; marginal filaments (5-) 7 (-9); *anthers* oblong, 0.8-1 mm long, black. *Style* 20-35 mm long, slender, stigma small. Summit of ovary densely pubescent. *Fruit* densely crowded, depressed globular, 3-5 mm diameter, 3-4 mm long, usually embedded in the swollen corky rhachis; two opposite lobes thick, persistent and deflexed, remaining two lobes wearing away with age; orifice 1.5-2 mm wide. *Fertile seeds* few per capsule, pyriform to narrow-pyriform, 0.8-1 mm long, 0.5-0.7 mm wide, usually truncate at one end, glabrous, testa dark grey-brown. *Ovulodes* numerous per capsule, linear-oblong to oblong, mostly clavate, 0.5-1 mm long, mostly truncate at one end, glabrous, buff in colour.

Derivation of name. From the Latin *planus*, meaning "flat", and *folium*, meaning "leaf".

Habitat. Grows in gravelly clay soil in mallee-heath communities. Near Nyabing the species grows in clay in mallee-*Melaleuca* scrub. Flowers September to November.

Distribution. From Boyagin Rock Reserve (32°30' S, 116°55' E) and Pingelly Reserve (32°31' S, 117°25' E) to the Kukerin-Tarin Rock area (33°06' S - 33°11' S, 118°00' E - 118°13' E) and the Nyabing-Pingrup area (33°30' S, 118°05' E - 118°35' E) with an isolated record from near Kojonup (33°38' S, 117°05' E). Map 9.

Specimens examined. WESTERN AUSTRALIA: 1844, *Drummond.* 2nd Coll. No. 58. NSW 144014 (NSW); Narrogin, 18 Oct. 1957, *W.H. Butler* s.n. (PERTH); Tuttaning Reserve, 17 miles E of Pingelly, 19 Sept. 1962, *R.D. Royce* 7572 (PERTH); Tarin Rock, 29 Oct. 1961, *C.A. Gardner* 13648 (PERTH); 16 miles W of Lake Grace, 11 Nov. 1931, *W.E. Blackall* 1319 (3) (PERTH); 20 miles W of Lake Grace, 12 Oct. 1960, *A.S. George* 1532 (PERTH); 5 miles W of Kukerin, 29 Oct. 1962, *J.S. Beard* 2140 (PERTH, KP); 4 miles NW of Nyabing, 29 Sept. 1963, *K.R. Newbey* 992 (PERTH); 15 miles W of Pingrup, 14 Sept, 1961, *R.D. Royce* 6696 (PERTH); Boyagin Rock Reserve, 6 Nov. 1969, *H. Demarz* 1845 (KP); 1 mile SE of Nyabing, 14 Nov. 1969, *V. Mann* and *A.S. George* 153 (PERTH); Nyabing, Oct. 1956, *V.F. McDougall* 6182 (PERTH); 16 miles N of Kojonup on Albany Highway, 26 Oct. 1977, *J.S. Beard* 8197 (PERTH).

Total number of specimens examined. 16.

Comments. Calothamnus planifolius has been confused with *C. microcarpus* F. Muell. in herbaria. Although the leaves of both taxa are flat and similar in other morphological features, the leaves of *C. microcarpus* are mostly 5-9 cm long, 1.5 — 2.5 mm wide, with two, prominent longitudinal furrows both adaxially and abaxially. In *C. planifolius,* the leaves are mostly 4-5 cm long, 3-5 mm wide and without furrows; however, the midrib is prominent on the abaxial surface and in dried specimens becomes even more so due to shrinkage of tissue either side of the central vein. The fruit of *C. microcarpus* are usually larger (4-6 mm diameter) than those of *C. planifolius* (3-5 mm diameter). The flowers of *C. microcarpus* are arranged in groups of 2-4 (mostly 3) in interrupted spikes, whereas those of *C. planifolius* are crowded into more or less uninterrupted spikes. *Calothamnus microcarpus* occurs in the Stirling Range and associated areas to the south, while *C. planifolius* has a more northerly distribution.

There are no published studies on the ecology of this species and land clearing throughout the wheatbelt north of the Stirling Range has undoubtedly reduced its populations. Studies should be undertaken to monitor populations in these areas as further threats of fire and more clearing may lead to its extinction. Its status in Tuttaning Reserve (east of Pingelly) and Boyagin Rock Reserve should be examined in the near future since fire, drought and human disturbance may be threats to its survival in these areas.

14. **Calothamnus pallidifolius** (Benth.) T.J. Hawkeswood, stat. nov.

Calothamnus planifolius Lehm. var. *pallidifolius* Benth., Fl. Austral. 3:177 (1867); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:151 (1980). *Type*: "J. Drummond n.40, and 2nd Coll. n. 72" (lecto, here designated: *Drummond* 2nd Coll n. 72 (1844) ? K, n.v.; iso: NSW 144015, Figure 13).

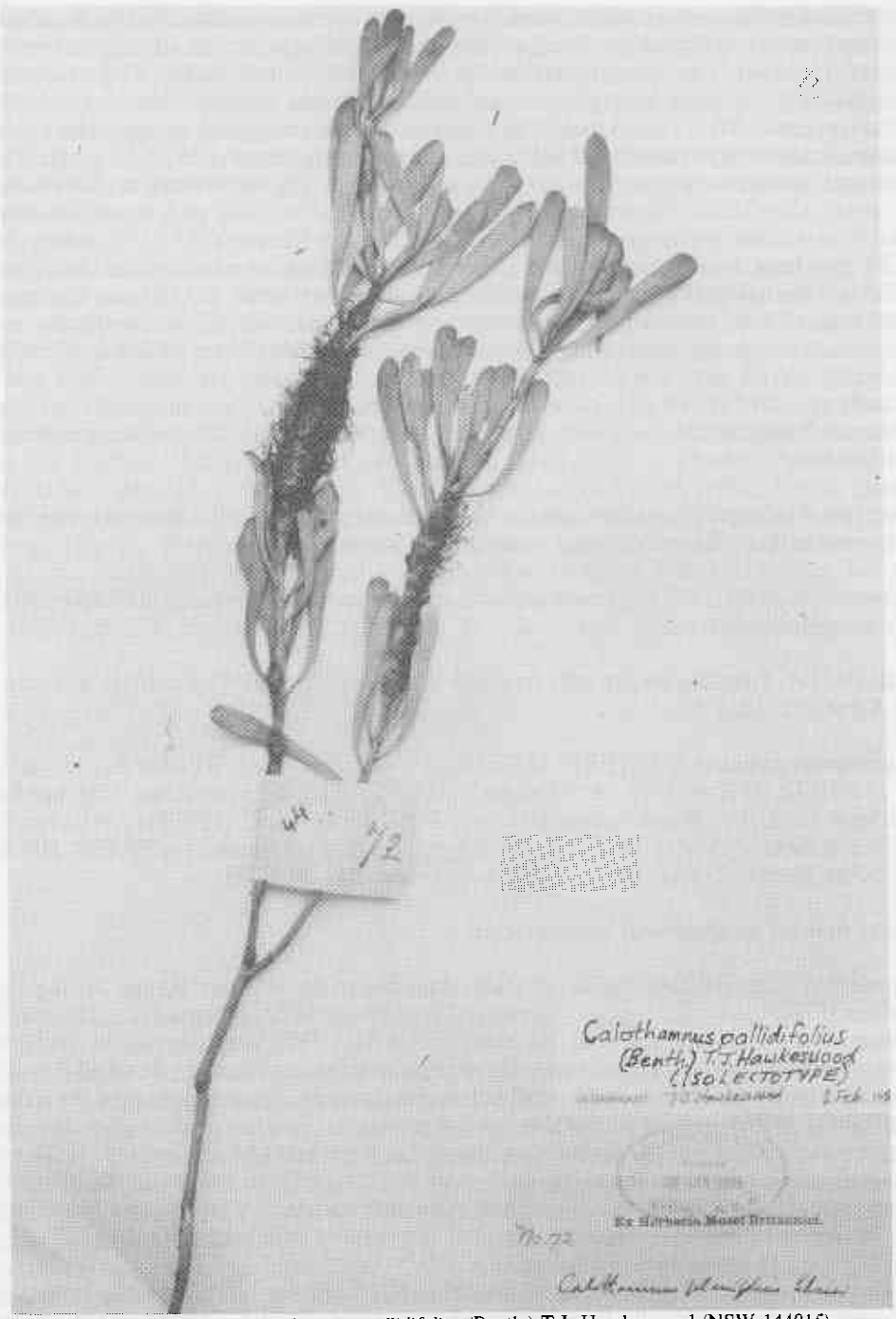


Figure 13. Isolectotype of *Calothamnus pallidifolius* (Benth.) T.J. Hawkeswood (NSW 144015)

Erect, straggly, much-branched, glabrous shrub to 0.5-0.7 (-1) m high, with thin branches, the older ones often becoming slightly corky. Young shoots glabrous. *Leaves* scattered at the ends of branches, sessile, flat, oblanceolate, (4.5-) 5-6 (-7) cm long, (6-) 6.5-10 (-13) mm wide, smooth, coriaceous, glabrous, glaucous, pale green, with a short, acuminate tip or

sometimes obtuse, not pungent; veins prominent in dried specimens; oil glands prominent. *Flowers* mostly in threes, in dense, unilateral to almost cylindrical, usually uninterrupted spikes, (3-) 4-6 (-7) cm long, embedded in the swollen, corky rhachis. *Calyx-tube* shortly campanulate, 2-2.5 mm long, glabrous; *calyx-lobes* ± equal, deltoid, acute to slightly obtuse, concave, erect, 0.8-1.2 (-1.4) mm long, glabrous outside and inside; margins thin, scarious, ciliate. Petals narrow-elliptical to elliptical, acute to slightly obtuse, (1.5-) 2-2.5 (-2.8) mm long, glabrous, orange-brown, papery, with thin, scarious, partially ciliate margins. *Staminal claws* ± equal, (20-) 22-25 (-30) mm long. 0.7-1 mm wide, glabrous, dark pink to crimson in upper half to two-thirds, yellow-green in lower portion; marginal filaments (5-) 7 (-9); *anthers* oblong, 0.7-1 mm long, dark brown or black. *Style* 20-35 mm long, slender, stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, ± depressed globular, 4-5 (-6) mm diameter, 2-3 mm long, densely crowded, almost covered by the prominently dilate and slightly swollen rhachis; two opposite lobes prominently thickened and deflexed over orifice; orifice c. 2 mm diameter. *Fertile seeds* few per capsule, linear-clavate to broadly pyriform, 0.7-0.9 mm long, usually truncate at one end, glabrous, testa dark brown. *Ovulodes* numerous per capsule, linear to linear-clavate, 0.7-1 mm long, often obliquely truncate at one end, glabrous, pale buff-brown.

Derivation of name. From the Latin *pallidus*, meaning "pale", and *folium*, meaning "a leaf", referring to the pale green leaves possessed by this species.

Habitat. In lateritic soil in open woodland of *Eucalyptus marginata* and *E. haematoxylon*. Flowers November.

Distribution. Presently known only from the Whicher Range (33°47' S, 115°31' E) south-west of Busselton. Map 9.

Specimens examined. WESTERN AUSTRALIA: Whicher Road, Whicher Range, (± 33°47' S, 115°31' E), 23 Nov. 1975, *A.S. George* 14218 (PERTH); Whicher Road, Whicher Range, 15 May 1980, *T.J. Hawkeswood* 290, 291, 292, 293, 294, 295 (PERTH); Whicher Road, Whicher Range, 15 May 1980, *T.J. Hawkeswood & D.G. Knowles* 1 (PERTH); Hill Road, Whicher Range, 15 May 1980, *T.J. Hawkeswood* 296 (PERTH).

Total number of specimens examined. 10.

Comments. This is a rare species, probably endemic to the Whicher Range. At the time of writing (1980) the species was not represented in any Reserve or National Park. The specimens collected by the author and D.G. Knowles during May 1980 were growing in sandy soil in disturbed situations by the roadside. These populations were found to be small (i.e. < 100 plants) at each locality. Due to the small population sizes and exposed habitats by the roadsides, the plants would appear vulnerable to the effects of roadwork extensions and similar disturbances. The flora of the Whicher Range has been listed by Hussey (1977). The "new species" of *Calothamnus* listed in that report is *C. pallidifolius*. It would seem vital that protection should be given to this rare and vulnerable endemic by setting up a National Park in the Whicher Range to conserve this and many other rare taxa (Hussey 1977).

Calothamnus pallidifolius is closely related to *C. planifolius* Lehm. and to a lesser degree, *C. microcarpus* F. Muell. It is clearly distinguished from *C. microcarpus* by having oblanceolate, mostly glaucous, somewhat coriaceous, smooth leaves mostly 4-6 cm long and 6.5-10 mm wide. In *C. microcarpus*, the leaves are linear, dark green, mostly 5-9 cm long and 1.5-2.5 mm wide, with two distinct furrows adaxially and abaxially. It was Bentham (1867) who first noticed the close relationship between *C. pallidifolius* and *C. planifolius*, but he only recognized the former as a variety of the latter, stating that *pallidifolius* differed in

having larger, glabrous, thick, more obtuse leaves which were "more or less penninerved when dry". In the field, the morphology of the leaves immediately distinguishes the two species. *Calothamnus pallidifolius* also differs from *C. planifolius* in having the branches (rhachis) usually more corky than in *C. planifolius*. The flowers, fruits and seeds of *C. pallidifolius* are identical to those of *C. planifolius*. Bentham (1867) also stated that the stamens of *C. planifolius* var. *pallidifolius* were "apparently greenish-yellow". In the material I have examined only the lower portion of the staminal claws are pale-coloured, the remainder being dark pink to crimson.

Bentham (1867) cited two syntypes of *C. planifolius* var. *pallidifolius*. I have only been able to see a duplicate of *Drummond* 2nd Coll. n. 72 in herb. NSW (NSW 144015). Since the specimen possesses flowers, fruits and leaves (the majority of material of *C. pallidifolius* available for study at present (1980) is without flowers), I have chosen this as lectotype.

15. **Calothamnus rupestris** Schauer, Regelia, Beaufortia & Caloth. 26 (1843); Schauer in Lehm., Pl. Preiss. 1:152 (1844); Benth., Fl. Austral. 3:179 (1867); J. Hooker, Bot. Mag. 59, t. 7906 (1903); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult., 8 (1970); Erickson, George, Marchant & Morecombe, Western Austral. Pl. (1973); Hawkeswood, Austral. Pl., 11:16, 17 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:153 (1980). *Type*: "Inter rupes quarzinas ad latera montium Darling-Range, Novembri m.a. 1839, legit cl. L. Preiss!" (Herb. Preiss. No. 211) (lecto, here designated: LD, Figure 14).

Figure 14. Lectotype of *Calothamnus rupestris* Schauer (LD).

Erect, compact or spreading, single- or multi-stemmed, much branched, mostly glabrous shrub to 1.5 mm high (sometimes a small tree to 3 m tall), with hard bark often splitting at the base of the trunks. Older branches usually with prominent leaf scars. Young branches with a few, sparse, microscopic hairs, becoming glabrous with age. *Leaves* crowded on younger branches, sessile, slender terete, (1.5-) 2-2.5 (-3.5) cm long, 0.5-1 mm wide, glabrous, mucronate, pungent, grey green to dark green, oil glands prominent. *Flowers* 1-10, scattered or arranged in dense ± unilateral clusters or in loose, ± cylindrical spikes, usually on portions of the stem from which the leaves have fallen. *Calyx tube* broadly campanulate, (4-) 6-7 (-8) mm long, densely pubescent; rhachis slightly dilated at base of calyx-tube; *calyx-lobes* almost equal, densely pubescent outside and inside, thick, but with thin, fimbriate margins; two opposite lobes larger, broadly deltoid, (3-) 4-5 (-6) mm long, 4-5 mm wide ± acute, slightly concave, erect to semi-erect; two smaller lobes narrow-deltoid, (3-) 4-5 mm long, (2-) 2.5-3 mm wide, ± acute, slightly concave, erect to slightly spreading. *Petals* broadly obovate, obtuse, (6.5-) 7-8 (-8.5) mm long, including a short claw 2-3 mm long, concave, glabrous, yellow-brown to orange-brown, papery, with broad, thin, scarious margins. *Staminal claws* ± equal, (25-)

30-35 (-40) mm long, (2-) 2.5-3.5 (-4) mm wide, glabrous, pink to dark pink; marginal filaments (20-) 22-26 (-28); *anthers* linear, 2-2.5 mm long, yellow-brown. *Style* slender (20-) 25-32 (-35) mm long, glabrous, stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, ovoid, 15-22 mm long (including the thickened calyx-lobes), 11-15 mm wide, densely pubescent but becoming glabrous with age; two opposite lobes prominently thickened, reflexed; remaining two lobes thinner, sometimes wrinkled, deflexed, often wearing away with age. *Fertile* seeds numerous per capsule, linear, 2-2.5 mm long, 0.3-0.6 mm wide, usually truncate at one end, angular, glabrous; testa chocolate-brown. *Ovulodes* numerous per capsule, similar to fertile seeds, c. 2 mm long, yellow-brown.

Derivation of name. From the Latin *rupes*, meaning "rock or cliff", referring to the habitat of this species.

Habitat. Grows amongst rocks or in rocky, skeletal granitic soil in heath or semi-woodland, usually along watercourses with *Grevillea pinnatifida*, *Petrophile biloba*, *Dryandra nivea*, *Daviesia pectinata*, *Hibbertia hypericoides* and *Xanthorrhoea preissii* (Darling Range) and species of *Dryandra*, *Melaleuca* and *Casuarina* (Boyagin Rock). Flowers mostly from August to October.

Distribution. This species has a restricted distribution, the northern limit is in the Red Hill area (on road to Toodyay) north-east of Perth, along the Darling Scarp to the Gosnells area (east of Perth). A disjunct population occurs at Boyagin Rock (32°30' S, 116° 54' E) which is the most eastern and southern record for the species. Map 11.

Selected specimens examined. WESTERN AUSTRALIA: 0'Brien Road, off 21 m.p. Toodyay Road, "on granite rocks in gravelly sand", 14 Sept. 1964, *R.A. Saffrey* 129 (2) (PERTH); O'Brien Road, ± 3 miles N of Toodyay Road, 1 Oct. 1963, *A.S. George* 5921 (PERTH); towards top of Red Hill, Toodyay Rd., 16 Aug. 1961, *A.S. George* 2660 (2) (PERTH); c. 16 km from Albany Highway turnoff on Brookton Road, 3 Dec. 1968, *H. Demarz* D833 (PERTH, KP); near Canning Dam, 16 Nov. 1977, *R. Tinetti* s.n. (UWA); Red Hill on Toodyay Rd., at Darling Scarp, 5 Sept. 1969, *K.R. Newbey* 2977 (PERTH); Gosnells, 1 Sept. 1957 (1), 2 Dec. 1957 (3), 5 Oct. 1958 (2), *McLachlan* s.n. (PERTH); Pages Way, Gosnells, 1 Sept. 1978, *R.J. Cranfield* 521C (2) (PERTH); Pages Way, Gosnells, 20 June 1979, *T.J. Hawkeswood & R.J. Cranfield* 1 (PERTH); Pages Way, Gosnells, Darling Range, 4 Aug. 1979, *T.J. Hawkeswood* 82 (3) (PERTH); Barrington Quarry, 11 Sept. 1979, *H. Demarz* D7471 (PERTH); Boyagin Rock (32°30'S, 116°54'E), 21 Oct. 1972, *E. Wittwer* W877 (PERTH, KP); Boyagin Rock, 28 July 1976, *M.E. Trudgen* 1690 (PERTH); Boyagin Rock, 1 May 1980, *T.J. Hawkeswood* s.n. (PERTH).

Total number of specimens examined. 26.

Comments. This is a rare but distinctive species related closely only to *C. graniticus* T.J. Hawkeswood (see comments under this species).

This species is commonly called "Mouse-ears" because the fruiting capsules bear thickened calyx-lobes (Figures 15, 16), of which the two thinner opposite ones are curled backwards and resemble the ears of a mouse. The fruit is usually covered in short, dense, silver hairs adding to this appearance (Figures 15, 16). Sometimes only one lobe becomes thickened (Figure 16); this rarely occurs in other *Calothamnus* species.

Bentham (1867) related *C. rupestris* to *C. villosus* R.Br. but there is no close relationship because *C. villosus* is a 5-merous species. Schauer (1843) and Schauer in Lehmann (1844)

noted that the marginal filaments of *C. rupestris* numbered less than 15, but the actual number varies considerably from 20-28; Schauer undoubtedly examined damaged material.

Figure 15. Close-up of mature fruit of *Calothamnus rupestris* Schauer, showing two opposite, thickened lobes and hairs wearing away with age.

The species is occasionally grown in Perth gardens but is generally not well known, due to its scarcity. It is probably the rarest species in the genus. In the Perth district it is threatened by urban development, quarrying and bauxite mining, fires and recreational pressures. A small population of about 30 plants occurs in the reserve at Boyagin Rock, but these plants must be considered to still be at some risk because of recreational pressures and fire. Recommendations for the conservation of this rare species have been provided by Leigh, Boden & Briggs (1984).

16. **Calothamnus graniticus** T.J. Hawkeswood, Nuytsia 5:127 (1984). *Type:* Little Meelup Beach, Cape Naturaliste area, 24 June 1979, *T.J. Hawkeswood* 110 (holo: PERTH; iso: CANB, MEL, NSW, PERTH).

Erect, single or multi-stemmed shrub to 2 m high. *Leaves* terete, mostly 4-8 cm long, 1-1.5 mm wide, shortly mucronate, pungent, glabrous or clothed with short white hairs. *Flowers* 2-25 in clusters or irregular spikes. *Petals* broadly ovate, mostly 6-7 mm long with a claw 5-7 mm long. *Staminal claws* 32-40 mm long, 3-5 mm wide, dark pink to crimson, marginal filaments mostly 20-22; *anthers* 2.5-3 mm long. *Fruit* almost ovoid, 15-22 mm long, 10-18 mm wide, smooth or slightly wrinkled. *Fertile seeds* 2-2.5 mm long, linear-cuneate, truncate, glabrous, testa dark brown. *Ovulodes* 1.5-2.5 mm long, linear to linear-cuneate, glabrous, light brown. For a more complete description of the species and its subspecies see Hawkeswood (1984a).

Distribution. Map 11; see also Hawkeswood (1984a).

During early 1984 Mr W.M. Molyneux of Victoria sent me specimens of *C. graniticus* ssp. *leptophyllus* (Benth.) T.J. Hawkeswood that he had collected from the Stirling Ranges. This collection represents a considerable range extension from the Dwellingup and Wellington Dam areas to which I stated (Hawkeswood 1984a) it was confined. This disjunct distribution is somewhat similar to that of the related species *C. rupestris* (Map 11). The conservation of subspecies *leptophyllus* is rather tenuous in the Dwellingup and Wellington Dam areas due to its small population sizes (less than 40 plants at each site) and the heavy industrial development in these areas. However, Mr Molyneux informs me (pers. comm. 1984) that the subspecies is common but locally distributed in the Stirling Range and its survival there seems assured at least for the short term.

The closest relative of *C. graniticus* is *C. rupestris* Schauer, but the two species can be clearly distinguished in leaf morphology and pubescence on the calyx-tube. The leaves of *C. graniticus* measure mostly 4-8 cm long, whereas those of *C. rupestris* are mostly 2-2.5 cm long. The calyx-tube of *C. rupestris* is densely pubescent, while that of *C. graniticus* is usually glabrous and verrucose.

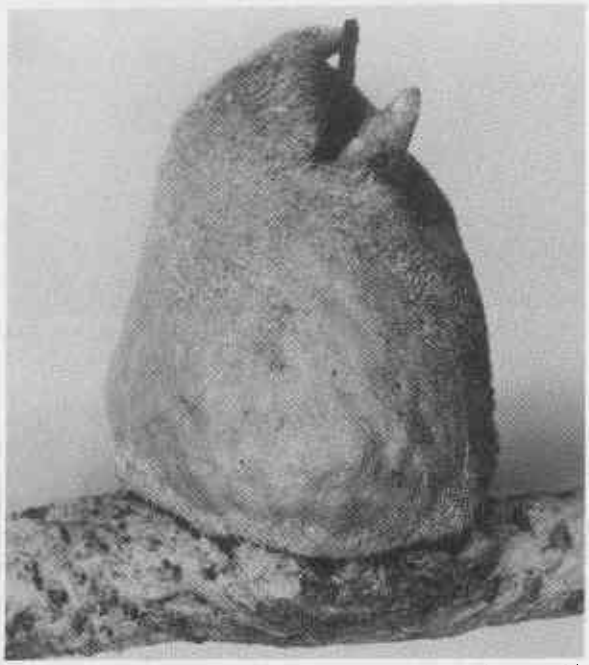


Figure 16. Close-up of mature fruit of *Calothamnus rupestris* Schauer, showing one thickened lobe, (the small one is thin and will wear away with age), an unusual feature of *Calothamnus* fruit.

17. **Calothamnus asper** Turcz., Bull. Soc. Imp. Naturalistes Moscou 22: 25 (1849); Benth., Fl. Austral. 3: 180 (1867); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11:19 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:154 (1980). *Type*: *Drummond* 4th Coll. no. 60 (holo: KW, photograph seen, Figure 17; iso: LE, photograph seen, Figure 18).

Erect, single-trunked, much-branched, tall shrub mostly to 3.5 m high, branches often with leaf scars; trunks with thick bark often splitting at the base. Young shoots sparsely pilose. *Leaves* densely crowded at ends of branches, sessile, erect, broadly linear, attenuate towards

base, (1-) 1.2-1.8 (-2) cm long, 1.4-2 mm wide, scabrous, shortly and sparsely pilose especially on the margins, shortly acuminate but not pungent. *Flowers* 3-5 (-8) in short, sessile clusters, usually amongst leaves at ends of branches. *Calyx-tube* broadly campanulate, (4-) 5-6 (-7) mm long, verrucose, glabrous; *calyx lobes* ± equal, 2-2.5 mm long, broadly deltoid, obtuse, concave, glabrous outside and inside; margins thin, scarious, partially ciliate. *Petals* 5-6 (-7) mm long, elliptical, obtuse, concave, glabrous, deciduous; papery with thin scarious margins, brown. *Staminal claws* equal, 22-28 (-30) mm long, 2-2.5 (-3) mm wide, glabrous, blood-red; marginal filaments 27-30; *anthers* linear-oblong, 1-1.2 mm long, yellow brown. *Style* 20-25 mm long, glabrous; stigma small. *Fruit* ± ovoid to ellipsoid, 9-12 mm long, 8-10 mm wide, grey, rugose, two opposite lobes prominently thickened. *Fertile seeds* few per capsule, linear-cuneate, 1.5-2 mm long, glabrous, truncate at widest end, testa chocolate brown. *Ovulodes* numerous, linear-cuneate, 1.5-2 mm long, glabrous, truncate at widest end, brown.

Derivation of name. From the Latin *asper*, meaning "rough to the touch", referring to the scabrous leaves.

Habitat. Grows in red soil over laterite with *Melaleuca radula*, *Casuarina campestris* and *Hakea* spp., shrubland. Flowers September to March depending on climatic conditions of previous season.

Distribution. Presently only known from the Wongan Hills area (c. 30°49' S, 116°38' E) where it is locally common. Map 12.

Specimens examined. WESTERN AUSTRALIA: Wongan Hills (Monks Well Gully), 195 km NE of Perth, 3 Sept. 1975, *B.G. Muir* 509 (PERTH); Monks Well Gully, Wongan Hills (30°49' S, 116°38' E), 17 Feb. 1980, *T.J. Hawkeswood* 158, 159 (PERTH); 18.5 km NW of Wongan Hills towards Piawaning, (30°50' S, 116°39' E), 27 Aug. 1976, *R. Coveny* 7843 and *B.R. Maslin* (NSW); 6 miles from Wongan Hills, on Piawaning Rd., 3 Oct. 1972, *F. Lullfitz* L1655 (PERTH, KP).

Figure 17. Holotype of *Calothamnus asper* Turcz. (KW).

Total number of specimens examined. 6.

Comments. Bentham (1867) in his redescription of *C. asper* noted that the species was closely related to *C. quadrifidus* R.Br. but differed in the "foliage and in the large fruits". *Calothamnus asper* is certainly closely allied to *C. quadrifidus*, but several characters justify the retention of *C. asper* as a separate species. *Calothamnus asper* has flat, pilose leaves (especially pilose on the margins), mostly 1.2-1.8 mm long, 1.4-2 mm wide, the calyx-tube is broadly campanulate, mostly 5-6 mm long, glabrous, and the staminal claws have 27-30 marginal filaments. The fruit is 9-12 mm long, 8-10 mm wide and the testa of the fertile seeds is chocolate brown in colour. *Calothamnus quadrifidus* has slightly flattened to terete, pilose to hirsute leaves (sometimes glabrous), mostly 1.5-2 cm long, 0.8-1.5 mm wide; the calyx-tube is usually narrow campanulate, 3-4 mm long, glabrous or shortly pubescent; the staminal claws have mostly 18-20 marginal filaments. The fruit measures mostly 7-9 mm long and 7-8 mm wide, and the testa of the fertile seeds varies in colour from grey to light chocolate brown.

Kenneally (1977, p. 66) records *C. asper* in red soil at Monks Well Gully and Fowlers Gully. On the other hand, in the Wongan Hills area *C. quadrifidus* is recorded only from Mortlock Creek in the Mortlock Reserve (no. 23313) on yellow sand. My own observations there in 1980 verified that there was no overlap in distribution between the two species, and it seems probable that no gene flow occurs between them. *C. asper* is restricted to closed scrub with *Casuarina campestris*, *Melaleuca radula* and *Acacia acuminata* at Monks Well Gully (Kenneally 1977, p. 18) and on the alluvial gully floor with *Acacia ligustrina*, *Casuarina campestris*, *M. radula* and *Dodonaea* species (Kenneally 1977, p. 20). In the Mortlock Flora Reserve *C. quadrifidus* is restricted to shrubland with *Hakea*, *Acacia* and *Persoonia* species (Kenneally 1977, p. 16).

Calothamnus asper is also closely related to *C. homalophyllus* F. Muell., but differs in having leaves mostly 1.2-1.8 cm long, 1.4-2 cm wide, pilose on the margins, scabrous and densely crowded at the ends of branches, and the marginal filaments on the staminal claws number 27-30. In *C. homalophyllus*, the leaves are mostly 2.8-5 cm long, 3.5-10 mm wide, glabrous, smooth, coriaceous, scattered while the marginal filaments number 20-25.

Calothamnus asper, while protected in the Wongan Hills area, would still seem to be under threat from fires and drought. The populations should be monitored for any decline due to these factors.

18. **Calothamnus pinifolius** F. Muell., Fragm. 3:153 (1862); Benth., Fl. Austral. 3:179; (1867); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11:16-19 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:153 (1980). *Type*: "In locis saxosis aridis montium juxta rivum Phillips River. Maxw." (holo: MEL, Figure 19).

Erect, much-branched, prickly shrub to 2 m high. Young shoots pilose; stems and leaves often becoming glabrous with age, mature leaves often pilose on lower half. *Leaves* densely crowded, sessile, slender, terete, (1.2-) 1.8-2.5 (-3) cm long, 1-1.4 mm wide, mucronate, pungent, dark green, glabrous or pilose. *Flowers* in a short, cylindrical (sometimes ± unilateral) spike of 5-20 flowers, almost hidden by dense foliage. *Calyx-tube* ± campanulate, tapering somewhat at base, densely pubescent, 4-5 mm long, rhachis slightly dilate at base; *calyx-lobes* almost equal, two opposite lobes slightly larger than other two, narrow deltoid, acute, slightly concave, 3-4.5 mm long, densely pubescent outside, shortly pubescent inside. *Petals* narrow obovate, concave, obtuse, 2.5-3 (-3.5) mm long, glabrous, papery with thin, scarious, often partially ciliate margins, pale brown. *Staminal claws* ± equal, 20-25 mm long 1-1.4 mm wide, glabrous,

crimson; marginal filaments 12-15; *anthers* oblong, 1-1.4 mm long, dark brown to black. *Style* 14-25 mm long, thick, tapering towards stigma, glabrous; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, ovoid to almost globular, 7-12 mm long (including thickened lobes), 7-10 mm wide; two opposite lobes thickened, acute, persistent; two remaining lobes present on young fruit but wearing away with age. *Fertile seeds* few per capsule, linear-oblong, 1.2-1.5 mm long, glabrous, angular, often obliquely truncate at one end, testa dark buff-brown. *Ovulodes* many to numerous per capsule, oblong-clavate, 1.2-1.5 mm long, glabrous, angular, usually obliquely truncate at wider end, yellow to dark yellow-brown.

Derivation of name. From the Latin *pinus*, meaning "pine" and *folium*, meaning "leaf", referring to the pungent leaves of this species which, however, more resemble those of *Cedrus*.

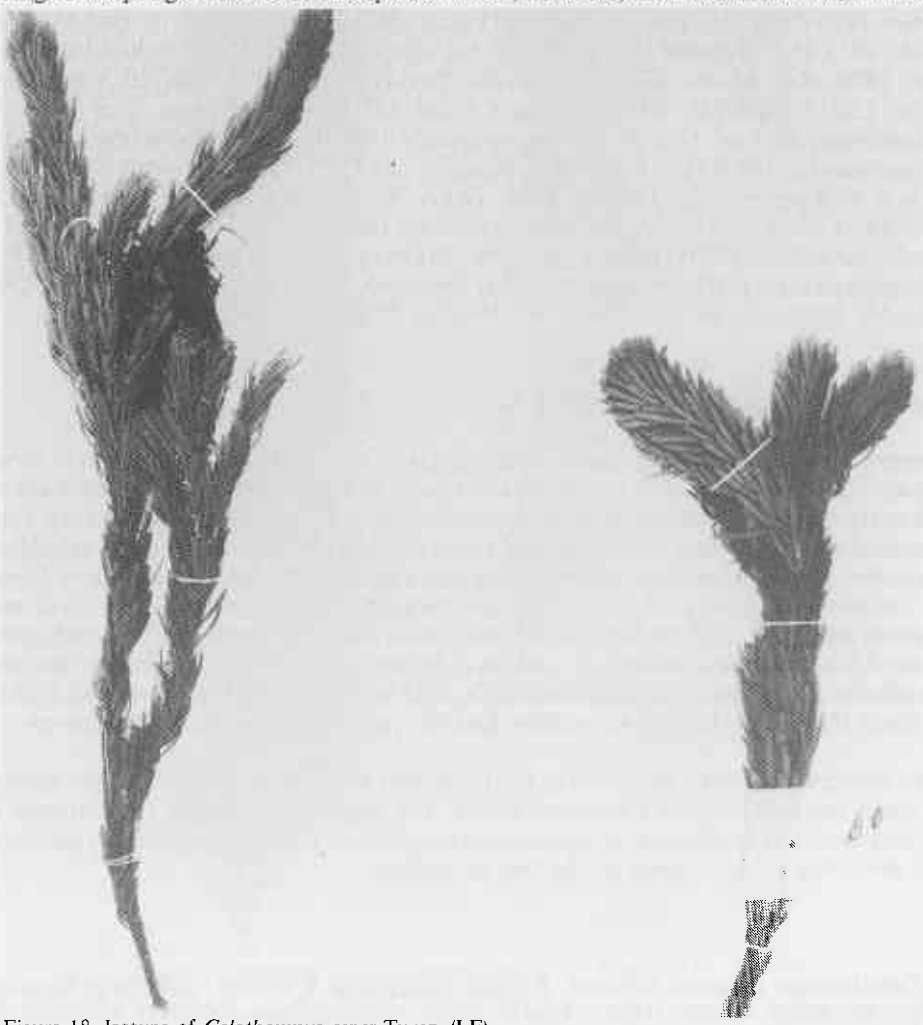


Figure 18. Isotype of *Calothamnus asper* Turcz. (LF).

Habitat. Grows in coastal sandplain mallee-heath vegetation in quartzite soil with species of *Banksia*, *Hakea*, *Acacia*, *Eucalyptus* etc. Flowers mostly from August to October but occasionally to December.

Distribution. From the Mt Barren Range near Qualup (34°15' S, 119°25' E) to the Mt Desmond-Ravensthorpe area (c. 33°40' S, 120°03' E). Map 12.

Specimens examined. WESTERN AUSTRALIA: 0.25 miles N of Qualup Homestead, 13 June 1969, *H. Demarz* D1109 (PERTH, KP); Hill behind Qualup Homestead, 28 Nov. 1960, *A.S. George* 1755 (PERTH); Hill behind Elverdton Coppermine, 12 Sept. 1959, *A.S. George* 293 (2) (PERTH); West Mt Barren, 29 Nov. 1960, *A.S. George* 1800 (PERTH); Fitzgerald Reserve, summit of Woolberup Range, 4 Aug. 1970, *K.M. Allan* 341 (PERTH); Thumb Peak Range, 31 Oct. 1965, *A.S. George* 7158 (PERTH); Middle Mt Barren, south of Ravensthorpe, Sept. 1925, *C.A. Gardner* and *W.E. Blackall* s.n. (PERTH); Middle Mt Barren, Nov. 1931, *C.A. Gardner* and *W.E. Blackall* s.n. (PERTH); Whoogarup Range, Hamersley River, 28 Nov. 1931, *C.A. Gardner* 2975 (2) (PERTH); East Mt Barren, Aug. 1924, *A. Johnson* 850a (PERTH); foot of East Mt Barren, 31 Oct. 1962, *J.S. Beard* 2194 (PERTH, KP); E of Barrens, 11 Oct. 1967, *A.R. Fairall* 2384 (PERTH, KP); East Mt Barren Range, 23 Sept. 1925, *C.A. Gardner* 1889 (PERTH); East Mt Barren, 11 Oct. 1967, *Young* Y289 (KP); East Mt Barren, 17 Nov. 1979, *R.J. Cranfield* 1324 (PERTH); No Tree Hill area, near Fitzgerald River Reserve, 2 Oct. 1970, *B.R. Maslin* 963 (PERTH); No Tree Hill near Hopetoun, 20 Aug. 1964, *F. Lullfitz* L3534 (PERTH, KP); Hopetoun Road, off Esperance Road, c. 9 miles E of Ravensthorpe, 30 Aug. 1968, *E.M. Scrymgeour* 2410 (PERTH); Ravensthorpe, Dec. 1929, *H. Steedman* s.n. (PERTH); 2 miles S of Kundip, 21 Oct. 1962, *K. Newbey* 571 (PERTH); 25 km S of Ravensthrope, 12 Nov. 1974, *D.J.E. Whibley* 5401 (PERTH); 15 miles N of Hopetoun, 13 Aug. 1951, *N.H. Brittan* s.n. (UWA); 15 miles N of Hopetoun, 13 Aug. 1951; *R.D. Royce* 3670 (2) (PERTH); Mt Desmond, 20 Oct. 1961, *C.A. Gardner* 13700 (PERTH); Ravensthorpe area, just below summit of Mt Desmond, 9 Jan. 1979, *Barnsley* 465 (PERTH, CBG); Mt Desmond, 19 July 1979, *R.J. Hnatiuk* 790022 (PERTH).

Total number of specimens examined. 33.

Comments. Calothamnus pinifolius F. Muell. is related to *C. validus* S. Moore and *C. robustus* Schauer but it is a distinctive species and is clearly distinguished by the densely crowded, mucronate, pungent leaves on most of the plant, measuring mostly 1.8-2.5 cm long, and the staminal claws which have 12-15 marginal filaments. In *C. robustus*, the leaves are obliquely acuminate, shortly mucronate but not pungent, and are crowded at the ends of branches only; the leaves are mostly 1.3-1.5 cm long and marginal filaments number 18-20. In *C validus*, the leaves are mostly 2-2.8 cm long, shortly mucronate and slightly pungent; marginal filaments number 12-20. In these characters, *C. validus* is perhaps intermediate between the two species. *C. pinifolius* can be clearly distinguished in the field from *C. validus* by the smaller fruit (7-12 mm long) (12-15 mm long in *C. validus*) and the pungent, densely crowded leaves.

The conservation of *C. pinifolius* in the Fitzgerald River National Park seems assured at this stage, but fires may be a constant threat. The populations outside the National Park are threatened due to clearing for agricultural purposes. It is recommended that populations of *C. pinifolius* are monitored in the face of decline.

19. **Calothamnus robustus** Schauer, Regelia, Beaufortia & Caloth. 26 (1843); Schauer in Lehm., Pl. Preiss. 1:152 (1844); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11:18, 20 (1980). *Type:* "Habitat in Australia meridionali-occidentali. In glareosis sterilibus ad radices collium Konkoberup promontorii Cape-Riche, Novembri a. 1840 defloratam legit cl. Preiss! (v.s. cult. ex Horto Berol.)" (Herb. Preiss. no. 213) (lecto, here designated: LD Figure 20).

Calothamnus knightii Hort. ex Schauer, Regelia, Beaufortia & Caloth. 27 (1843). No type designated.

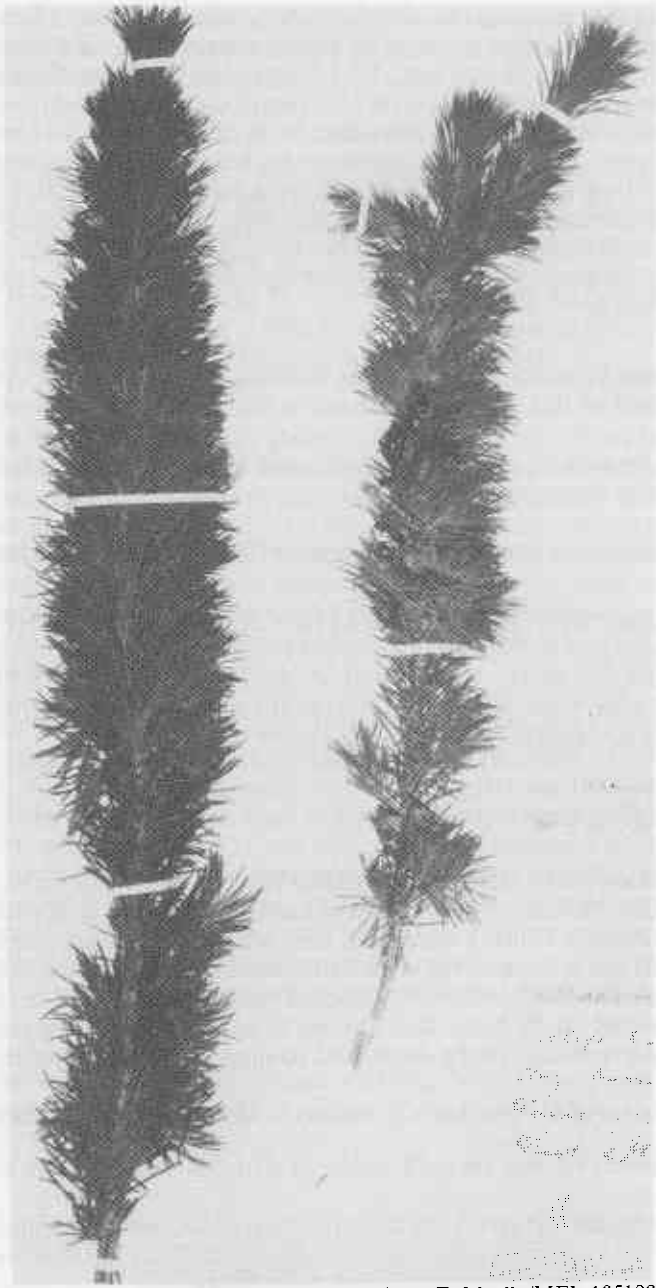


Figure 19. Holotype of *Calothamnus pinifolius* F. Muell. (MEL 105199).

Erect, much-branched, small, compact shrub to 0.8 m high; branches with prominent leaf scars. Young shoots densely pubescent; older stems and mature leaves glabrous. *Leaves* crowded at the ends of branches, sessile, slender, terete, rigid, mostly perpendicular or almost so to the stems, (1) 1.3-1.5 (1.8) cm long, c. 1 mm wide, glabrous, obliquely acuminate, shortly mucronate but not pungent, pale green. *Flowers* 2-8 in a tight or loose cluster amongst leaves or on portions of stems from which the leaves have fallen. *Calyx tube* shortly campanulate, c. 3 mm long, densely pubescent; rhachis slightly dilated at base; *lobes* narrow deltoid, acute, slightly concave, erect, 2.5-3 mm long, densely pubescent outside and within; two opposite

slightly larger than the remaining two. *Petals* obovate, concave, obtuse, 4-5 mm long, glabrous, orange-brown, papery, margins scarious, oil glands prominent in the centre. *Staminal claws* ± equal, free, glabrous, 25-28 mm long, 1.2-1.5 mm wide, dark crimson; marginal filaments 18-20; *anthers* linear, c. 1.5 mm long. *Style* 12-20 mm long, slender, glabrous, crimson; stigma small. *Fruit* almost ovoid but rounded and widest in the middle, sessile, 9-11 mm long (including thickened calyx lobes), 8-10 mm wide, pubescent but becoming glabrous with age; two larger lobes thickened on top of fruit, remaining two breaking off with age; style often persistent. *Fertile seeds* few per capsule, linear, 1.5-1.8 mm long, glabrous, variously angular, angles smooth or sharp; testa dark brown. *Ovulodes* few to many per capsule, linear to linear-subulate, 1.5-1.8 mm long, glabrous, yellow-brown, often obliquely truncate at wider end, variously angular, angles sharp.

Derivation of name. From the Latin *robustus*, meaning "strong", "robust", probably referring to the growth form of this species or perhaps to the branches and leaves.

Habitat. Grows on rocky quartzite or granitic soils in heath lands. Only locally common. Flowers October to November.

Distribution. Confined to the Cape Riche area (34°36' S, 118°47' E). Map 12.

Specimens examined. WESTERN AUSTRALIA: Cape Riche, on coast NE of Albany, Oct. 1928, *C.A. Gardner* and *W.E. Blackall* s.n. (PERTH); Cape Riche, Oct. 1928, *C.A. Gardner* s.n. (2) (PERTH); Cape Riche, 27 Oct. 1961, *C.A. Gardner* 13806 (PERTH); Mt Melville, (Cape Riche), 22 Nov. 1964, *K.R. Newbey* 1716 (PERTH); district West Plantagenet, July 1901, *E. Pritzel* s.n. (NSW).

Total number of specimens examined. 7.

Comments. Bentham (1867) included *C. robustus* Schauer, as a synonym of *C. villosus* R.Br. stating (p. 178) that "Schauer appears to have examined a flower accidentally 4-merous, in the specimen of Preiss's, which I have seen, they are mostly at least 5-merous". However, Schauer (1843) did not make an error in his determination of the species. Bentham may have examined damaged material or incorrectly labelled specimens of *C. villosus*. Apart from being 4-merous, *C. robustus* can be easily distinguished from *C. villosus* by the characteristic short leaves, mostly perpendicular to the stems and having obliquely acuminate tips.

The closest relative of *C. robustus* is *C. validus* S. Moore; for a comparison, see comments under the latter.

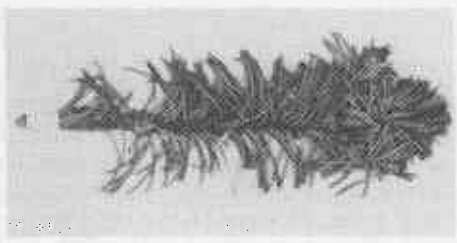


Figure 20. Lectotype of *Calothamnus robustus* Schauer (LD).

The ecology and conservation status of *C. robustus* is unknown. Its survival at this stage seems assured in the Cape Riche National Park. However, further collections and observations on its ecology and distribution are needed.

20. **Calothamnus validus** S. Moore, J. Linn. Soc. Bot. 14: 205, fig. 11C (1921); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 84 (1970); Ferguson, Bot. Mag. t. 614 (1972); Erickson, George, Marchant & Morcombe, Flowers & Pl. of Western Austral. 182, pl. 260 (1973); Hawkeswood, Austral. Pl. 11:20, fig. 3e (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. 154 (1980). *Type*: "W. Australia, in a rocky creek near West Mt Barren; Maxwell" (holo: BM, photograph seen, Figure 21).

Erect, rigid, much-branched, mostly glabrous shrub to 2 m high; branches with prominent leaf-scars. Young shoots glabrous or minutely and sparsely pubescent; branches becoming glabrous with age. *Leaves* crowded at the ends of branches, usually erect, slender, terete, sessile, rigid, pale green, (1.5-) 2-2.8 (-3.5) cm long, 0.5-1 mm wide, shortly mucronate, slightly pungent; oil glands prominent. *Flowers* 3-6 (mostly 3) together in a short, sessile cluster (often unilateral) amongst leaves. *Calyx-tube* campanulate, (3-) 4-7 mm long, verrucose, glabrous or finely pubescent, the base slightly immersed in the rhachis; *lobes* more or less equal, deltoid-oblong, obtuse, erect, slightly concave, 3-4 (-5) mm long, slightly concave, glabrous outside, finely pubescent within; margins narrow, scarious, ciliate. *Petals* obovate-elliptical, obtuse, concave, 4-5 mm long, with a short claw 2-3 mm long, glabrous, papery, yellow-brown; oil glands prominent. *Staminal claws* ± equal, (22-) 25-32 mm long, (1.5-) 2-3 mm wide, glabrous, rich crimson, orange-red or orange at the base; marginal filaments 12-20; *anthers* linear to linear-oblong, c. 2 mm long, dark brown. *Style* slender, glabrous, (12-) 20-25 mm long, red, becoming colourless at base; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, almost globular to nearly ovoid, 12-15 mm long, (including persistent lobes), 10-13 mm wide, reddish-brown, at first 4-lobed , later becoming grey, woody, wrinkled, with two persistent lobes; style often persistent. *Fertile seeds* numerous per capsule, linear-oblong (sometimes linear-cuneate), glabrous, 2-2.5 mm long, truncate (often obliquely so), angles rounded or sharp; testa thin, chocolate-brown. *Ovulodes* numerous per capsule, linear, sometimes linear-cuneate, c. 2 mm long, glabrous, truncate, yellow-brown, somewhat shiny, angles sharp.

Derivation of name. From the Latin *validus*, meaning "strong, stout", referring to the habit of this species.

Habitat. Grows in rocky quartzite hills in heath. Flowers July to October.

Distribution. Confined to the Mt Barren Range in the Fitzgerald River National Park and neighbouring areas. Map 13.

Specimens examined. WESTERN AUSTRALIA: East Mt Barren, 18 Sept, 1925, *C.A. Gardner* 1801 (PERTH); East Mt Barren, Sept 1925, *C.A. Gardner & W.E. Blackall* s.n. (2) (PERTH); Rocky terrace on south side of East Mt Barren, 1 Oct. 1970, *B.R. Maslin* 910 (PERTH); Between Hamersley River and East Mt Barren, 30 Sept. 1970, *B.R. Maslin* 901 (PERTH); Fitzgerald River National Park, 23 Oct. 1970, *R.D. Royce* 9271 (PERTH); N end of Thumb Peak Range, 31 Oct. 1965, *A.S. George* 7109 (PERTH); Middle Mt Barren, (34°03' S, 119°41' E), 16 July 1970, *A.S. George* s.n. (PERTH); Summit of West Mt Barren, 28 Oct. 1965, *A.S. George* 6973 (PERTH); West Mt Barren, 29 Nov. 1960, *A.S. George* 1796 (PERTH); Slopes of Mt Barren, (undated), *N.H. Speck* s.n. (UWA).

Figure 21. Holotype of *Calothamnus validus* S. Moore (BM).

Total number of specimens examined. 12.

Comments. This species is most closely related to *C. robustus* Schauer but can be readily separated from the latter by usually having a glabrous or sometimes finely pubescent calyx-tube. In *C. robustus* the calyx-tube is densely pubescent. The leaves of *C. robustus* are almost

invariably held perpendicular to the stem and usually have an oblique acuminate tip whereas the leaves of *C. validus* are usually held more or less erect to semi-erect. The fruit of *C. validus* is also larger (12-15 mm long, 10-13 mm wide) than those of *C. robustus* (9-11 mm long, 8-10 mm wide). The geographic ranges of the two species do not overlap, *C. robustus* is presently only known from Cape Riche.

The survival of *C. validus* in the Fitzgerald River National Park seems assured at this stage, but the populations of the species should be monitored for the effects of fires and disturbances through tourist development.

21. **Calothamnus homalophyllus** F. Muell., Fragm. 3:111 (1862); Benth., Fl. Austral. 3: 180 (1867); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Fairall, Western Austral. Native Pl. in Cult. 8 (1970); Erickson, George, Marchant & Morecombe, Western Austral. Pl. (1973); Hawkeswood, Austral. Pl. 11: 8,9,20,21 (1980); Blackall & Grieve, How to Know Western Austral. Pl. ed.2, 3A:155 (1980). *Type*: "In eremis flumen Murchison versus, nec non prope sinum litoralem Champion Bay. Walcott et Oldfield" (holo: MEL, Figure 22).

Calothamnus quadrifidus R.Br. var. *homalophyllus* Blackall, How to Know Western Austral. Wildfl. 306 (1954), nom. inval.

Erect, compact or straggly, glabrous shrub to 1.5 m high, with smooth, pale bark, often splitting at the base on older trunks. Young leaves and shoots usually densely pilose, becoming glabrous with age. *Leaves* scattered or crowded on younger branches, sessile, flat, narrow oblanceolate, (2-) 2.8-5 (-6) cm long, (3.5-) 5-10 (-14) mm wide, glabrous, coriaceous, narrowed into a prominent, short, acute apex, oil glands and veins usually obscure on live leaves, often prominent on dried material. *Flowers* 2-4 in short clusters on portions of stems from which the leaves have fallen or more frequently in loose interrupted or continuous, ± unilateral spikes 4-7 cm long containing 10-30 flowers. *Calyx-tube* broadly campanulate to almost cylindrical, (2.5-) 3-3.5 (-4) mm long, mostly glabrous, sometimes shortly and finely pubescent on lower half, prominently verrucose; rhachis slightly dilated at base; *calyx-lobes* short, erect, deltoid to narrow deltoid, (0.5-) 1-1.5 (-1.8) mm long, acute to obtuse, slightly concave, glabrous outside and inside, margins thin, somewhat scarious, partially ciliate. *Petals* obovate-oblong, obtuse, concave, (3.5-) 4-5 (-5.5) mm long, deciduous, papery with thin, scarious margins, pink to orange-brown. *Staminal* claws ± equal, 20-32 mm long, (1-) 1.5-2 (-2.5) mm wide, glabrous, crimson to blood-red; marginal filaments 20-25; *anthers* linear-oblong, (0.5-) 0.8-1 mm long, dark brown. *Style* slender, glabrous, (15-) 20-25 (-35) mm long, orange-red; stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, almost globular, bumpy, 8-10 mm long, 8-9 mm wide, usually densely crowded on stem; two opposite lobes prominently thickened at apex; remaining two lobes thin, occasionally persistent, usually wearing away with age; orifice c. 2 mm wide. *Fertile seeds* few to many per capsule, linear-oblong, 1.5-2 mm long, glabrous, angular, angles rounded; testa light grey-brown. *Ovulodes* many to numerous per capsule, linear-cuneate, c. 2 mm long, glabrous, usually obliquely truncate at one end, shiny, angular, light yellow-brown.

Derivation of name. From the Greek *homalos*, "level", "even", and *phyllon*, "a leaf", referring to the flat, smooth, coriaceous leaves of the species.

Habitat: Grows in white or yellow-brown sandy soil in low heath in association with species of *Acacia*, *Melaleuca*, *Banksia*, *Hibbertia*, *Beaufortia* etc. Flowers mostly from August to October.

Distribution. From the Kalbarri National Park (27°42' S, 114°10' E) to Mullewa, east of Geraldton (29°40' S, 115°15' E). (Map 13).

Figure 22. Holotype of *Calothamnus homalophyllus* F. Muell. (MEL 105185).

The specimen labelled "South of Hamelin", probably represents the most northerly occurrence of the species. Likewise, the specimen labelled "Between Arrino and Dongara" appears to represent the most southerly record. However neither record provides precise locality.

Selected specimens examined. WESTERN AUSTRALIA: South of Hamelin (Homestead?), 24 Sept. 1953, *N.H. Speck* s.n. (UWA); 255 miles S of Carnarvon, 5 Aug. 1967, *I. Olsen* 586 (NSW); 35 miles N of Galena on Carnarvon Road, 15 Sept. 1940, *W.E. Blackall* 4710 (PERTH); Red Bluff, Kalbarri National Park, 18 Sept. 1968, *M.E. Phillips* CBG 036050 (NSW); Red Bluff, 27 Sept. 1962, *J.S. Beard* 2023 (PERTH, KP); Ross Graham Lookout, Kalbarri National Park, 8 May 1968, *P.G. Wilson* 6635 (PERTH); Kalbarri, 8 Oct. 1972, *J.N. Hutchinson* 186 (PERTH); Murchison River mouth, 27 Sept. 1962, *J.S. Beard* 2071, 2072 (PERTH, KP); Kalbarri National Park, 4 Aug. 1979, *M. Peterson* s.n. (PERTH); Pot Alley Gorge, 5 miles S of Kalbarri, Oct. 1963, *W. Rogerson* 7 (PERTH); 0.5 miles from Kalbarri, 3 Sept. 1963, *A.R. Fairall* 1177 (KP); 5 miles inland from Murchison River, 27 Sept. 1962, *M.E. Phillips* CBG 022736 (NSW); Murchison River, 18 Sept. 1968, *M.E. Phillips* CBG 027255 (BRI); Murchison River, 31 Aug. 1966, *A.C. Burns* 1027 (PERTH); Murchison River gorge, ± 15 miles W of Ajana, 13 May 1961, *A.S. George* 2376 (PERTH); 25 miles

above Murchison River mouth, 27 Sept. 1972, *J.S. Beard* 2057 (PERTH, KP); Murchison River, 6 Sept. 1949, *N.H. Speck* s.n. (2)(PERTH); Murchison River, Sept. 1948, *D.L. Serventy* s.n. (PERTH); 0.25 miles S of Murchison River gorge, 7 Sept. 1966, *R. Filson* 8646 (PERTH); Murchison River 21 Aug. 1961, *C.A. Gardner* 13260 (PERTH); Ajana, Sept. 1960, *C.A. Gardner* 12814 (2)(PERTH); 12 miles NW of Northampton, 6 April 1975, *J.S. Beard* 7386 (PERTH); Northampton, Oct. 1909, *J.H. Maiden* NSW 143985 (NSW); Northampton, Sept. 1928, *C.A. Gardner* s.n. (2)(PERTH); Northampton, 14 Nov. 1959, *L. Steenholm* and *F. Lullfitz* s.n. (PERTH); Oakajee Reserve (12 miles N of Geraldton), 13 Oct. 1972, *R. Edmiston* E287 (PERTH); 12.9 miles from Geraldton, 21 Sept. 1968, *E.M. Canning* CBG 027367 (NSW); Geraldton, Jan. 1951, *H.C. Cheeshough* NSW 143988 (NSW); Utakarra, 3 miles E of Geraldton on Geraldton-Mullewa Road, 26 Aug. 1970, *R. Coveny* 3033 (PERTH, NSW); 10 miles NE of Geraldton, 8 Sept. 1962, *F.W. Went* 67 (PERTH); 30 miles E of Geraldton, 1 Aug. 1960, *J. Long* 41 (PERTH); Geraldton, Sept. 1903, *M.V. Fitzgerald* s.n. (PERTH); 37 miles Geraldton-Mullewa road, 3 Oct. 1966, *E.M. Scrymgeour* 1507 (PERTH); between Geraldton and Mullewa, 23 Sept. 1932, *W.E. Blackall* 2750 (2)(PERTH); between Arrino and Dongara, 15 Sept. 1932, *W.E. Blackall* 2622 (PERTH).

Total number of specimens examined. 62.

Comments. This species is closely related to *C. asper* Turcz. and *C. quadrifidus* R.Br. For comparisons of *C. homalophyllus* with these see comments under the respective species.

Calothamnus homalophyllus is a variable species in the shape of the leaves, height and in the number of flowers per inflorescence. It may hybridize with *C. quadrifidus* in the Geraldton area forming intermediates between the two species.

The survival of this species seems assured since most of the populations are situated within the Kalbarri National Park. However, it appears to have suffered considerable range restriction due to land clearing for agriculture in the Geraldton, Mullewa and Ajana areas.

Figure 23. Syntype of *Calothamnus quadrifidus* R.Br. (BM).

22. **Calothamnus quadrifidus** R.Br. in Sims, Bot. Mag. t. 1506 (Nov. 1812); R.Br. in W.T. Aiton, Hort. Kew. ed.2, 4:418 (Dec. 1812); Reichb., Icon et Descr. Pl. T. 9 (1822); G. Lodd., Bot. Cab. t.737 (1823); DC., Prod. 3:211 (1828); Schauer, Regelia, Beaufortia & Caloth. 29 (1843); Schauer in Lehmann, Pl. Preiss. 1:153 (1844); Benth., Fl. Austral. 3:179 (1867); F. Muell., Fragm. 10:31 (1876); Diels & Pritzel, Bot. Jahrb. 35:433 (1904); Blackall, How to Know Western Austral. Wildfl. 306 (1954); Beard, Descr. Cat. Western Austral. Pl. 72 (1967); Hawkeswood, Austral. Pl. 11:5,21,22 (1980); Blackall & Grieve, How to Know Western Austral. Wildfl. ed.2, 3A:154 (1980). *Calothamnus quadrifidus* f. *normalis* Benth.,Fl. Austral. 3:180 (1867), nom. illeg. *Type*: Lucky Bay, *Robert Brown* (syn: BM, photograph seen, Figure 23; isosyn.: NSW, Figure 24).

Calothamnus laevigata Schauer, Regelia, Beaufortia & Caloth. 31 (1843); Schauer in Lehm., Pl. Preiss. 1: 153 (1844). *Type*: "In Australia meridionali-occidentali, inter Sinum Regis Georgii et vicum Perth, Februario 1840 (Herb. Preiss. No. 215)" (lecto, here designated: LD).

Calothamnus purpurea Endl. in Endl. et al., Enum. Pl. Hueg. 48 (1837). *Type*: "In collibus littoris prope Freemantle/Swan-River (Huegel)" (holo: W, photograph seen, Figure 25).

Calothamnus clavata Mackay ex Schauer, Regelia, Beaufortia & Caloth. 28 (1843); Schauer in Lehm., Pl. Preiss. 1:152 (1844); G. Lodd., Bot. Cab. t. 1447 (1829), without analysis. *Type*: "In solo sublimoso ad ripam fl. Avon, prope praedium rusticum cl. Whitfield, Martio 1840, fructifera. Fructiferan legit cl. Preiss! Florentum, a cl. I. Drummond missam, vidi in Herb. Caes. Vindob. (v.v. cult.)" (lecto, here designated: Preiss 210, LD).

Billotia acerosa Colla, Hort. Ripul. 20, t. 23 (1824). *Calothamnus quadrifidus* f. *acerosus* Benth. Fl. Austral. 3:180 (1867). *Type*: Cult. Rivoli, n.v.

Calothamnus quadrifidus f. *obtusus* Benth., Fl. Austral. 3:179 (1867). *Type:* Murchison River, *Oldfield*. (holo: ? K, n.v.).

Calothamnus quadrifidus var. *hirsutus* Regel, Index Sem. quae Hort. Bot. Imp. Petro. 39 (1856). *Type*: not cited.

Erect, compact or spreading, multi-stemmed, much-branched, usually pilose shrub to 2.5 m high. Young shoots usually pilose. *Leaves* erect or spreading, densely crowded, sessile, linear, flat to almost terete, (1-) 1.5-2 (-3.5) cm long, 0.8-1.5 mm wide, shortly acuminate but not pungent, sometimes glabrous but usually sparsely pilose to hirsute, dark or light green; oil glands prominent and randomly distributed. *Flowers* mostly in dense unilateral spikes 2-8 cm long (sometimes 3-10 flowers in a dense cluster), amongst leaves or on portions of branches from which leaves have fallen. *Calyx-tube* narrow campanulate, (2.5-) 3-4 (-5) mm long, usually glabrous or sometimes finely pubescent, especially at the base, verrucose; *calyx-lobes* ± equal (or sometimes two opposite ones larger), deltoid, acute to obtuse, 1-2 mm long, erect or spreading, verrucose and usually glabrous outside, smooth and glabrous within; margins thin, scarious, often partially ciliate. *Petals* obovate-elliptical, broadly elliptical or elliptical, 3-5 (-6.5) mm long, deciduous, glabrous, pink-green to pale brown, papery, margins thin, scarious; oil glands prominent in centre. *Staminal claws* ± equal, (20-) 25-30 (-35)mm long, 1-1.5 mm wide, glabrous, scarlet; marginal filaments (17-) 18-20 (-22); *anthers* oblong to linear-oblong, 0.7-1 mm long, yellow, yellow-brown or dark brown. *Style* 20-35 mm long, slender, glabrous, scarlet becoming pale yellow-green at base; stigma small. *Fruit* sessile, almost ovoid, 7-9 mm long, 7-8 mm wide (widest in the centre), usually smooth or with wide, smooth undulations; two opposite lobes persistent and prominently thickened at apex; orifice 1.5-2.5 mm wide. *Fertile seeds* few per capsule, linear to linear-cuneate, 1.2-1.5 mm long, angular, truncate, glabrous; testa grey to light chocolate brown. *Ovulodes* numerous, linear to linear-cuneate, 1-1.5 mm long, angular, truncate, dark orange-brown.

Figure 24. Isosyntype of *Calothamnus quadrifidus* R.Br. (NSW 144091).

Derivation of name. From the Latin *quadrifidus*, meaning "split into four parts". R. Brown described two other species (viz. *C. villosus* and *C. gracilis*) both being 5-merous, hence the name of *quadrifidus* for the only 4-merous, actinomorphic species known at the time (*C. sanguineus* was known, but its flowers are zygomorphic).

Habitat. Grows in a wide variety of habitats from coastal sandplain heaths in sand, lateritic soils amongst rocks, mallee-heathlands in sand over laterite and occasionally in jarrah forests

in gravelly lateritic soil. Usually a dominant species in all these habitats. Flowers mostly from August to October.

Distribution. From Shark Bay (25°45' S, 113°35' E) down the western coast to just south of Perth, inland throughout the wheatbelt, then south to Albany and east to Cape Arid (33°30' S, 123°55' E). Appears to be absent from the deep south-west of Western Australia. Map 14.

Selected specimens examined. WESTERN AUSTRALIA: Peron Peninsula, 27 Aug. 1931, *C.A. Gardner* 2553 (PERTH); 5 miles E of Tamala Homestead, 23 Aug. 1979, *M. Peterson* s.n. (PERTH); 25 miles S of Shark Bay, 27 Aug. 1931, *W.E. Blackall* 551 (PERTH); 22 miles (35.2 km) W of Hamelin Homestead, (26°35' S, 113°55' E), 17 April 1979, *T.J. Hawkeswood* 57, 57a, 58, (PERTH); Tamala Road, on Nanga Station, Shark Bay, 26 Aug. 1973, *E.C. Nelson* ANU 17300 (PERTH); 46 and 60 miles S of Billabong Roadhouse, off North West Coastal Highway, 17 April 1979, *T.J. Hawkeswood* 33, 34 (PERTH); Dewar Creek, Badgingarra, 8 Oct. 1977, *J. Dodd* s.n. (UWA); between Moora and Watheroo, 13 Sept. 1932, *W.C. Blackall* 2549 (PERTH); E of Mingenew, 21 Sept. 1904, *A. Morrison* s.n. (PERTH); Wongan Hills Research Station, 3 Oct. 1962, *F.J. Lullfitz* L1641 (PERTH); between Arrino and Dongara, 15 Sept. 1932, *W.E. Blackall* 2622 (PERTH); Watheroo, 4 Nov. 1954, *R.D. Royce* 4939 (PERTH); c. 8 km W of Lake Indoon, 4 Aug. 1976, *R.J. Hnatiuk* 760224 (PERTH); Watheroo National Park, 7 Oct. 1971, *R.D. Royce* 9689 (PERTH); Moore River State Forest, 22 Sept. 1965, *J.J. Havel* 114 (PERTH); Mingenew, 20 Aug. 1977, *B. Jack* 2 (PERTH); 50 miles N of Moora, 6 Sept. 1962, *F.W. Went* 207 (PERTH); N of Wanneroo, 16 Oct. 1962, *F.G. Smith* 1583 (PERTH); Gingin-Lancelin Road, 1 Dec. 1974, *A.E. Orchard* 4270 (PERTH); Coomallo Creek, 19 April 1979, *T.J. Hawkeswood* 1,2,3,4,5,6 (PERTH); 1 km N of Badgingarra by Hill River, 1 Nov. 1965, *P.G. Wilson* 3788 (PERTH); 1 mile N of Eneabba, 19 Aug. 1971, *H. Demarz* 3390 (PERTH); 16 miles W of Winchester on road to Eneabba, 30 Sept. 1966, *E.M. Bennett* 1397 (PERTH); 6 miles N of Three Springs, 3 Sept. 1966, *R. Filson* 8509 (PERTH); Yanchep National Park, 18 Nov. 1963, *A.M. James* 92 (PERTH); W of Wanneroo, 28 Aug. 1961, *T.E.H. Aplin* 939 (PERTH); Mt Misery-Dandaragan, 22 Sept. 1951, *N.H. Speck* s.n. (2) (UWA); Yanchep, 32 miles N of Perth, 3 Nov. 1965, *F.G. Smith* 1881 (PERTH); Red Hill, 6 Nov. 1958, *T.E.H. Aplin* (PERTH); Red Hill, Toodyay Road, 5 Sept. 1969, *K.R. Newbey* 2976 (PERTH); Cottesloe, Aug. 1895, *A.M. Lea* s.n. (PERTH); Cottesloe, June 1902, *C.R Andrews* s.n. (PERTH); 15 mi. E of Perth, 27 Oct. 1964, *R.A. Saffrey* 143 (PERTH); Welshpool, 5 Nov. 1918, *F.M.C. Schock* 427 (PERTH); Cottesloe, 11 Aug. 1897, *R. Helms* s.n. (PERTH); Greenmount, Darling Range, 25 Aug. 1897, *R. Helms* s.n. (PERTH); Reabold Hill, 26 Nov. 1971, *B.R. Maslin* 2306 (PERTH); Helena Valley, 11 Sept. 1977, *J. Seabrook* 187 (PERTH); Forestfield, 17 Oct. 1978, *R.J. Cranfield* 891 (PERTH); Claremont, 30 Nov. 1907, *A. Morrison* s.n. (PERTH); N of Brookton, March 1970, *M.D. Tindale* 129 and *B.R. Maslin* (PERTH); 5 miles E of Piawaning, 9 Sept. 1959, *T.E.H. Aplin* s.n. (PERTH); Tuttaning Reserve, 17 mi. E of Pingelly, 17 Oct. 1967, *G. Heinsohn* 49 (PERTH); Nyabing, Oct. 1956, *V.F. McDougall* KO56182 (PERTH); between Corrigin and Quairading, 4 Oct. 1933, *W.E. Blackall* 3239 (PERTH); 3 km E of Woodanilling, 3 Nov. 1978, *R.J. Cranfield* s.n. (PERTH); Yornaning Reserve, 35 km SE of Pingelly, 12 Sept. 1975, *B.G. Muir* 473 (PERTH); Bonnie Rock, Wialki, 11 Sept. 1957, *A.R. Main* s.n. (PERTH); 15 km SW of Newdegate, 16 Jan. 1979, *J.M. Koch* N134 (PERTH); Pallarup Rocks, SE of Lake King, 13 Oct. 1960, *A.S. George* 1552 (PERTH); Muntagin, Sept. 1947, *T.W. Stove* 847 (PERTH); Cranbrook, 22 Sept. 1971, *F. Stoward* s.n. (PERTH); Trayning Reserve, 5 Nov. 1972, *A. Chapman* 6 (PERTH); Stirling Range(?), 25 Oct. 1902, *G. Berthoud* s.n. (PERTH); 1 mi. NE of King Rocks, 13 Oct. 1963, *K.R. Newbey* 1089 (PERTH); Oldfield River, 13 Oct. 1968, *N.N. Donner* 3007 (PERTH); Ravensthorpe, Nov. 1944, *C.A. Gardner* s.n. (PERTH); Stokes Inlet, 18 Oct. 1968, *A.E. Orchard* 1658 (PERTH); 25 km S of Ravensthorpe, 12 Nov. 1974, *D.J.E. Whibley* 5399 (PERTH); N of Thistle Cove, 21 Jan. 1966, *A.S. George* 7524 (PERTH); Lucky Bay, E of Esperance, 10 Sept. 1966, *E.M.*

Bennett 893A (PERTH); Howick Hill, 25 Oct. 1963, *T.E.H. Aplin* 2625a (PERTH); Boyatup Hill, 110 km E. of Esperance, 1 Oct. 1968, *H. Eichler* 20066 (PERTH); Wittenoom Hills, c. 50 km NNE of Esperance, 4 Oct. 1968, *N.N. Donner* 2874 (PERTH); Mt Ragged, 27 Oct. 1967, *J.S. Beard* 5246 (PERTH); 1 mi. NE of Isrealite Bay, 21 Sept. 1976, *R.J. Hnatiuk* 761239 (PERTH); Between Hamersley River and East Mt Barren, 30 Sept. 1970, *B.R. Maslin* 852 (PERTH); ± 19 miles SW of Mt Ragged, 6 Dec. 1960, *A.S. George* 2071 (PERTH); Fitzgerald River National Park, 21 Oct. 1970, *R.D. Royce* 9180 (PERTH); Cape Arid, 23 Oct. 1960, *C.A. Gardner* 12960 (PERTH); Cape Arid National Park, 29 Nov. 1971, *R.D. Royce* 9869 (PERTH).

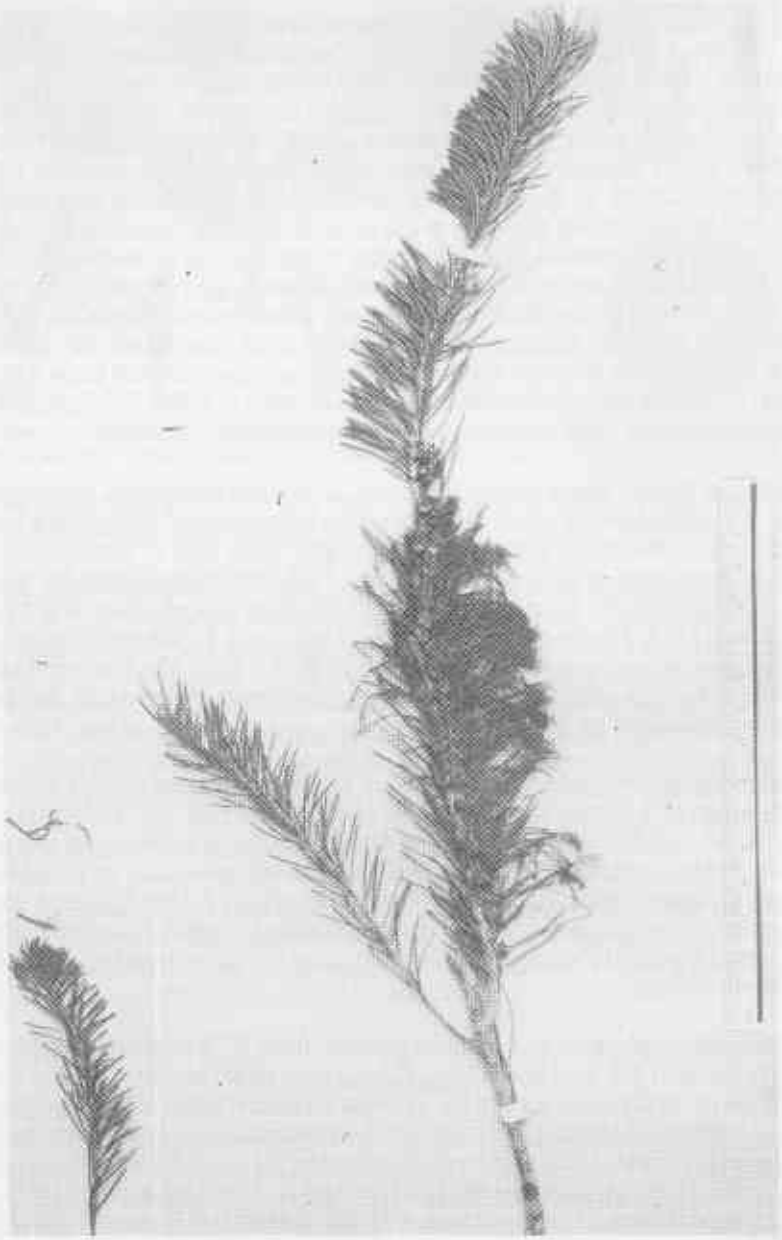


Figure 25. Holotype of *Calothamnus purpurea* Endl. (W).

Total number of specimens examined. 526.

Comments. Calothamnus quadrifidus is the most variable and widely distributed species in the genus. This has resulted in the rather complex synonomy. The type specimens were collected from Bay 1 (Lucky Bay, east of Esperance)and very briefly described by Robert Brown in 1812. Subsequent authors described new species and varieties based mainly on leaf size (e.g. Bentham, 1867). Bentham (1867) recognized three distinct "forms". The first of these, forma *acerosus* was circumscribed by having slender, terete leaves "sometimes above 1 in long" (Bentham 1867, p. 180). This is the typical variant from districts around Perth and to Eneabba (Figure 26). The second form, *normalis*, encompassed the typical and common short-leaved variant from the south-west coastal areas of Western Australia ranging from Albany to Cape Arid in the wet coastal mallee-heath and heath associations (Figures 23 and 24). Bentham (1867) stated that this form had leaves under 1 inch (2.5 cm) long, more or less flattened and mostly acute. The leaves of this variant are more or less erectly held and its flowers are mostly in leafy spikes. Bentham's third form, *obtusus*, is the variant commonly encountered in the Murchison River area where *C. quadrifidus* overlaps the range of *C. homalophyllus* F.Muell. to which it is very closely related. It is possible that some hybridization has occurred in this overlap area but at the present time this variant with flat, thick, linear-clavate leaves will be included within the range of variation of *C. quadrifidus*. Bentham does not give form status to any of the arid adapted variants of *C. quadrifidus* which often have slightly larger flowers in less dense spikes, densely pilose leaves and slightly larger, pubescent fruit (becoming glabrous with age). Such variants occur from Shark Bay through the semi-arid areas of south-west Western Australia to Norseman, Zanthus and Cape Arid. Throughout this range, *C. quadrifidus* often grows sympatrically with *C. gilesii* F. Muell. and *C. tuberosus* T.J. Hawkeswood (at Peak Charles and associated granite outcrops).

From Shark Bay to Perth, along the coast, *C. quadrifidus* grows sympatrically with *C. formosus* T.J. Hawkeswood subsp. *formosus* (Shark Bay area), *C. sanguineus* Labill. (Kalbarri National Park to Perth), *C. asper* Turcz. (Wongan Hills) and *C. homalophyllus* F. Muell. (Murchison River area in the Kalbarri National Park). At present there are no substantiated records of *C. quadrifidus* from the peaks of the Stirling Range where other species, e.g. *C. crassus* (Benth.) T.J. Hawkeswood, *C. affinis* Turcz. and *C. schaueri* Lehm., appear to be endemic. There is one record, *Berthoud* s.n. (PERTH) from the Stirling Range, but there is no specific locality and the specimen may have been collected at the base or in the surrounding woodland or heathlands areas.

Calothamnus quadrifidus may be regarded as a very variable species which has adapted to a wide range of habitats which differ in climate, soil type and topography. It is one of the most widely distributed of all Western Australian plants and has the largest distribution for a *Calothamnus* species. It appears likely that it has given rise to *C. homalophyllus* F. Muell. and *C. asper* Turcz. (the only two species to which *C. quadrifidus* is closely related). It also appears likely that interbreeding occurs between *C. quadrifidus* and *C. homalophyllus* in the Kalbarri National Park resulting in the smaller-leaved variant (i.e. *C. quadrifidus* forma *obtusus* of Bentham).

Calothamnus quadrifidus can be distinguished from *C. homalophyllus* by the following characters: leaves (1-) 1.5-2 (-3) cm long, 0.8-1.5 mm wide, almost terete to sometimes flat, usually pilose or hirsute, flowers usually in dense unilateral spikes 2-8 cm long, staminal claws with 17-22 marginal filaments, testa of fertile seeds light chocolate-brown, and fertile seeds and ovulodes 1-1.5 mm long. *C. homalophyllus* has leaves (2-) 2.8-5 (-6) cm long, (3.5-) 5-8 (-12) mm wide, glabrous, flowers usually in clusters of 2 to 4 (or occasionally in a unilateral spike of up to 30 flowers), staminal claws with 20-25 marginal filaments, testa of fertile seeds light grey-brown, and fertile seeds and ovulodes c. 2 mm long.

The differences between *C. quadrifidus* and *C. asper* are given under comments for *C. asper*.

Calothamnus quadrifidus is well represented in National Parks and Reserves throughout its range, and since it is well known in cultivation, its survival is indeed assured, unlike many other species of the genus.

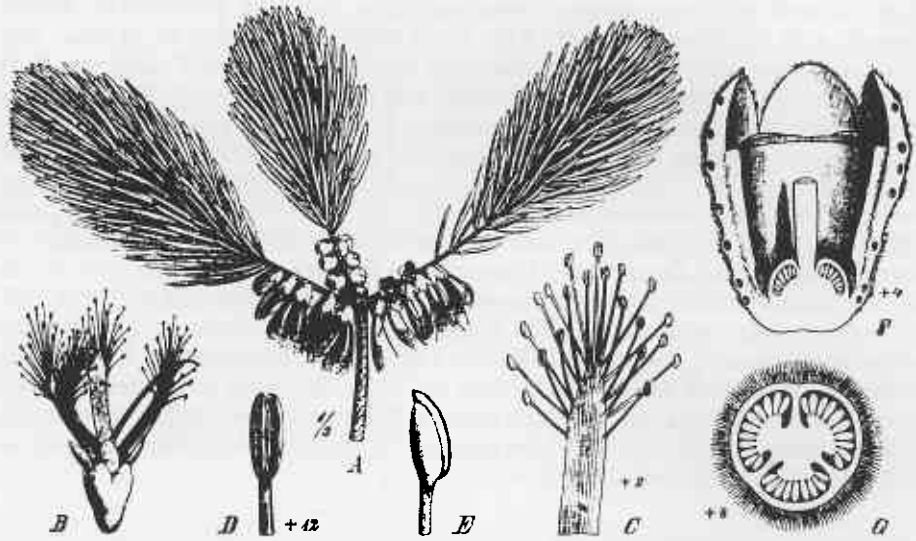


Figure 26. *Calothamnus quadrifidus* R.Br., showing the structure of the flower and the densely crowded leaves at the ends of the branches, and flowers on leafless portions (characteristic features of many *Calothamnus* species.

23. **Calothamnus tuberosus** T.J. Hawkeswood, Nuytsia 5:133 (1984). *Type:* Peak Charles, 10 April 1971, *A.S. George* 10626 (holo: PERTH).

Erect, compact, much-branched, glabrous, gnarled shrub mostly to 2.5 m high. *Leaves* terete, mostly 5-8 cm long, 1.2-2 mm wide, mucronate, pungent, glabrous. *Flowers* in dense spikes. *Petals* broadly elliptic, mostly 3-4 mm long. *Staminal claws* 22-28 mm long, 1-1.2 mm wide, deep orange-red; marginal filaments 12-16; anthers c. 1 mm long. Fruit depressed globular to globular, 4-5 mm long, 4-7 mm wide, smooth, shortly 4-lobed or almost truncate. *Fertile seeds* mostly 0.6-0.8 mm long, linear-oblong, truncate, glabrous; testa dark brown. *Ovulodes* 0.6-1 mm long, linear-oblong to oblong, glabrous, dark yellow-brown. (For a more detailed description, see Hawkeswood 1984a, 133).

Distribution. Map 15; see Hawkeswood (1984a, p. 140).

Comments. This tuberous species with its flowers and fruits mostly resembling those of some 5-merous species, rather than the 4-merous ones, is undoubtedly the most bizarre species of the genus and may be intermediate (or an ancestor) between the 4- and 5-merous groups. For further discussion on this species see Hawkeswood (1984a, pp. 134-135).

Acknowledgements

I would like to thank the following people for various assistance and who have made this work on *Calothamnus* possible: Mr P.G. Wilson, (W.A. Herbarium, PERTH) has assisted me greatly in literature searches, Latin diagnoses, translations and type acquisitions; I am also grateful for his continued correspondence over the several years since this research commenced in March 1979; Dr N.G. Marchant (W.A. Herbarium) for helpful discussions

on Myrtaceae and for much needed assistance while I was ill during the latter half of 1979 in Perth; Dr J.W. Green for facilities enabling the examination of preserved plant material and working space, discussions on *Calothamnus* and encouragement; Dr N.H. Brittan (University of Western Australia) and Mr M. Trudgen (W.A. Herbarium) provided helpful discussions and assisted me in a number of other ways during my stay in Perth; Mr A.S. George assisted with photography; other assistance has been provided by Messrs K.F. Kenneally and R.J. Cranfield, Mrs J.W. Lee-Frampton and Miss V. Hamley (all W.A. Herbarium). Assistance in field work has been provided by Messrs P. Johnson, S. Wilson, D. Knowles and M. Peterson, Miss M. Brady and Ms A. Kreger. Mr W.M. Molyneux of Victoria sent me specimens of *Calothamnus* during 1984. I am also very grateful to the curators of the following herbaria who sent photographs of types or specimens: CBG, W, KW, LD, K, FI, MEL and NSW. During 1982-85, assistance in the preparation of this paper has been obtained at the Queensland Herbarium, Brisbane, and I thank June Sawyer of that institution for encouragement and assistance with type photographs and library acquisitions. Mr P.I. Forster, of the Botany Department, University of Queensland, Brisbane, has provided me with enormous assistance and encouragement to proceed with the completion of this work. This research was commenced while I was a student in receipt of a Commonwealth Postgraduate Research Award at the Botany Department, University of Western Australia during April to October 1979 and February to June 1980. Since then, the majority of this research has been undertaken on private funds in Brisbane, Queensland, and finally I express my thanks to my mother, Mrs D.E. Hawkeswood for facilities and financial support, without which this paper would not be possible.

References

Bentham, G. (1867). "Flora Australiensis". Vol. 3. (Reeve & Co: London.)

Brown, R. (1812). In "Aiton, Hortus Kewensis." Edn.2. (London).

Hawkeswood, T.J. (1980). The genus *Calothamnus*. Part I. Austral. Plants 11: 5-23.

Hawkeswood, T.J. (1984a). Nine new species of *Calothamnus* Labill. (Myrtaceae: Leptospermoideae) from Western Australia. Nuytsia 5: 123-153.

Hawkeswood, T.J. (1984b). *Calothamnus accedens* T.J. Hawkeswood (Myrtaceae), a rare and endangered new species from Western Australia. Nuytsia 5: 310-315.

Holmgren, P.K., Keuken, W. and Schofield, E.K. (1981). "Index Herbariorum Part I. The herbaria of the World." Ed. 7. (Bohn, Scheltema and Holkema: Utrecht and W. Junk: The Hague.)

Hnatiuk, R.J. (1979). Tuberous roots in *Calothamnus* (Myrtaceae) Western Australia. Search 10: 281-282.

Hussey, B.J.M. (1977). Whicher Range-Donnybrook sunklands. Western Austral. Naturalist 13:211-216.

Kenneally, K.F. (1977). The flora. In: "The Natural History of the Wongan Hills." (Western Australian Naturalists Club Perth.)

Kunze, O. (1847). Linnaea 20: 58.

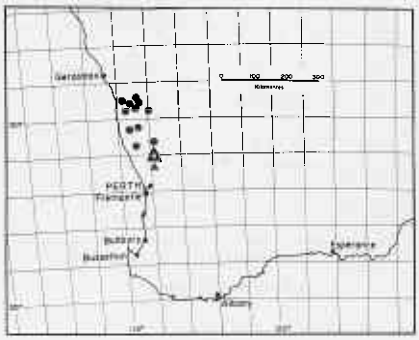
Labillardiere, J.J.H. de (1806). "Novae Hollandiae Plantarum Specimen." (D. Huzard: Paris), Reprinted in "Historiae Naturalis Clasica" series (1966).

Leigh, J.H., Boden, R. & Briggs, J. (1984). "Extinct and Endangered Plants of Australia." (Macmillan Australia: Melbourne.)

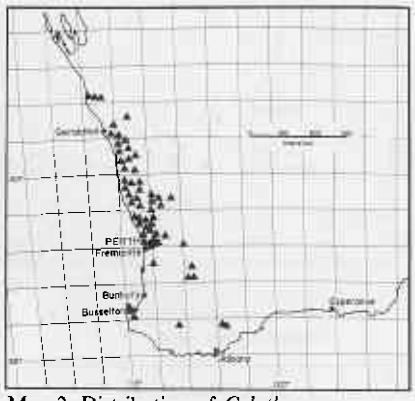
Pate, J.S. & Dixon, K.W. (1982). "Tuberous, cormous and Bulbous Plants." (University of Western Australia Press Nedlands.)

Schauer, J.C. (1845). "Dissertatio phytographica de Regelia, Beaufortia et Calothamnus, generibus plantarum Myrtacearum." (Vratislaviae et Bonnae, 1845.) (Being Nov. Act. Acad. Caes. Leop.- Carol. Nat. Cur. 21, 1845, pp. 1-32, pl. 1). Also issued as a preprint: Schauer, J.C. (1843) "De Regelia, Beaufortia et Calothamno dissertatio gratulatoria." (Bratislava, typ. universtatis, 1843, Universitati litterarum erlangensi secularia prima, A.D. 10 kal. Sept. 1843.)

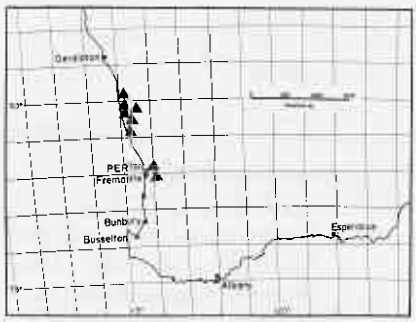
Schauer, J.C. (1844; In Lehmann, J.G.C. "Plantae Pressianae." Vol. 1. (Meissner: Hamburg.)



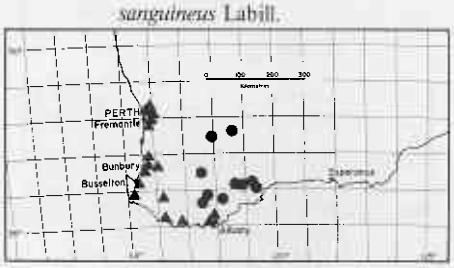
Map 1. Distribution of *Calothamnus pachystachyus* Benth. (▲) and *C. longissimus* F. Muell. (●).



Map 2. Distribution of *Calothamnus sanguineus* Labill.

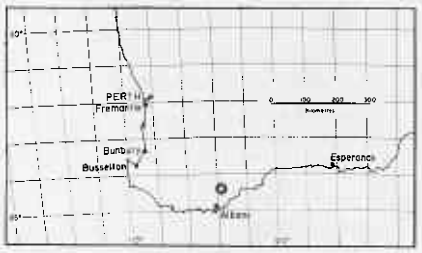


Map 3. Distribution of *Calothamnus torulosus* Schauer.

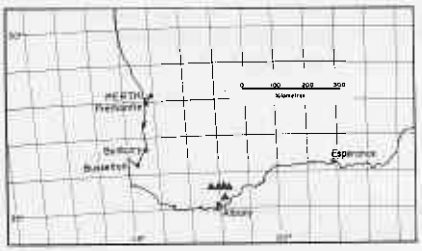


Map 4. Distribution of *Calothamnus lateralis* Lindley (▲) and *C huegelii* Schauer (●).

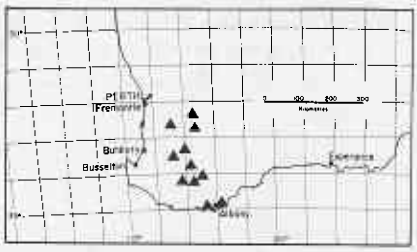
Map 5. Distribution of *Calothamnus crassus* (Benth.) T.J. Hawkeswood.



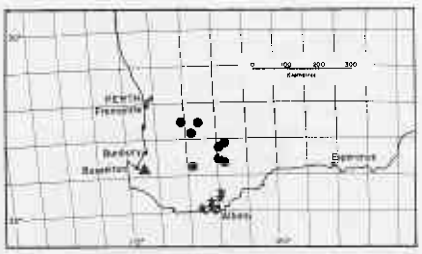
Map 6. Distribution of *Calothamnus affinis* Turcz.



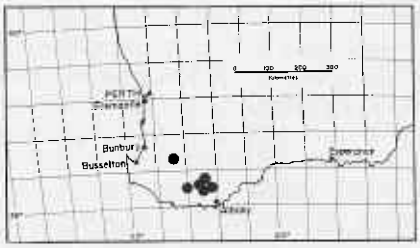
Map 7. Distribution of *Calothamnus microcarpus* F. Muell.



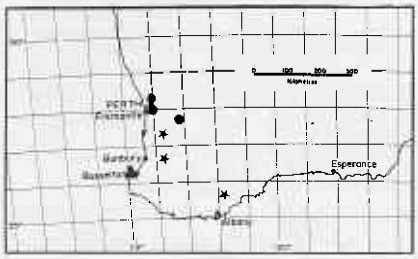
Map 8. Distribution of *Calothamnus preissii* Schauer.



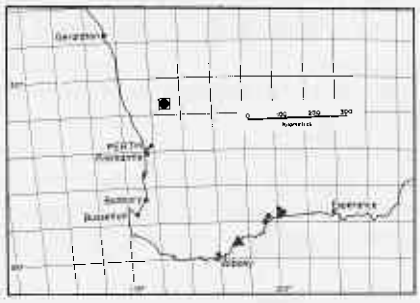
Map 9. Distribution of *Calothamnus schaueri* Lehm. (★), *C. planifolius* Lehm. (●) and *C. pallidifolius* (Benth.) T.J. Hawkeswood (▲).



Map 10. Distribution of *Calothamnus lehmannii* Schauer.

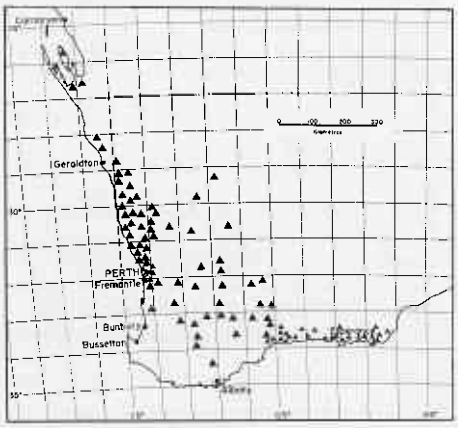


Map 11. Distribution of *Calothamnus rupestris* Schauer (●), *C. graniticus* T.J. Hawkeswood subsp. *graniticus* (▲), *C. graniticus* subsp. *leptophyllus* (Benth.) T.J. Hawkeswood (★).

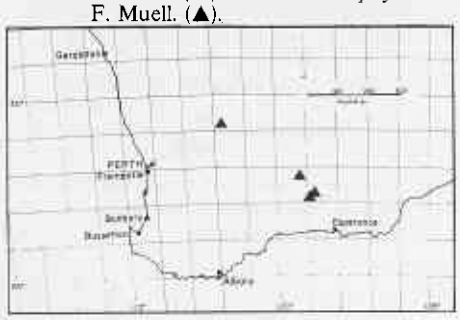


Map 12. Distribution of *Calothamnus asper* Turcz. (◉), *C. pinifolius* F. Muell. (●) and *C. robustus* Schauer (▲).

Map 13. Distribution of *Calothamnus validus* S. Moore (●) and *C. homalophyllus* F. Muell. (▲).



Map 14. Distribution of *Calothamnus quadrifidus* R.Br.



Map 15. Distribution of *Calothamnus tuberosus* T. J Hawkeswood.