

A revision of *Calothamnus quadrifidus* (Myrtaceae)

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Abstract

George, A.S. & Gibson, N. A revision of *Calothamnus quadrifidus* (Myrtaceae). *Nuytsia* 20: 57–77 (2010). The highly variable species *Calothamnus quadrifidus* R.Br. is discussed and an infraspecific classification with eight subspecies is proposed. The following new taxa are described: *Calothamnus quadrifidus* subsp. *petraeus* A.S.George & N.Gibson, *C. quadrifidus* subsp. *seminudus* A.S.George & N.Gibson and *C. quadrifidus* subsp. *teretifolius* A.S.George & N.Gibson. New combinations are *C. quadrifidus* subsp. *angustifolius* (Ewart) A.S.George & N.Gibson, *C. quadrifidus* subsp. *asper* (Turcz.) A.S.George & N.Gibson and *C. quadrifidus* subsp. *homalophyllus* (F.Muell.) A.S.George & N.Gibson, and a new status is given for *C. quadrifidus* subsp. *obtusus* (Benth.) A.S.George & N.Gibson.

Introduction

Calothamnus quadrifidus was described by Robert Brown in 1812 from specimens that he collected in January 1802 at Lucky Bay, east of where Esperance now stands, in Western Australia. It has since proved to be one of the most widespread and variable taxa in the south-western flora, extending west to Cape Naturaliste, north to Shark Bay and inland to just beyond Southern Cross. A number of names have been applied to some variants at either specific or infraspecific rank. These were reviewed by Hawkeswood (1987) who treated *C. quadrifidus*, *C. asper* Turcz., and *C. homalophyllus* F.Muell. at specific rank. He discussed the great variation in *C. quadrifidus* but recognised no infraspecific taxa. Since then, much more material has been collected that allows a more comprehensive study. The species, in the broad sense, is widely cultivated and has been used in revegetation work, unfortunately rarely using local provenances. This paper is based on morphological studies and examination of populations in the field. The largest herbarium collection is that in the Western Australian Herbarium (PERTH), some 750 sheets, and those of many other herbaria holding Australian material have been studied, especially to see type collections. A molecular study by Margaret Byrne, Department of Environment and Conservation, Perth, is currently in progress. The present work has had access to preliminary results but otherwise is based on morphological studies. It forms part of the background to an account of *Calothamnus* for the *Flora of Australia*, being prepared by A.S. George (George, in preparation).

Population sampling (5–15 plants per population) of 150 populations across the range of this species showed a high degree of within-population variation for many morphological characters (Gibson,

unpublished data). In addition, the existence of intergrades between the recognised taxa indicates that subspecies is the most appropriate taxonomic level.

The species belongs to *Calothamnus* subg. *Calothamnus*, containing the tetramerous species of the genus. As circumscribed here it includes the taxa previously known as *C. asper* Turcz. and *C. homalophyllus* F.Muell. The species is characterised by the obovate to linear or terete leaves, a non-immersed hypanthium, four bright red (rarely yellow) staminal bundles of equal size, a barrel-shaped fruit 6–14 mm long, and smooth seeds 1.5–2 mm long.

Taxonomy

Calothamnus quadrifidus R.Br., *Bot. Mag.* 37: t. 1506 (1812) as *quadrifida*

Typus: Lucky Bay [east of Esperance, Western Australia], January 1802, *R. Brown Iter Australiense* 4722 (*isosyn*: BM, E, K, MEL, NSW).

Calothamnus quadrifidus var. *hirsutus* Regel, *Ind. Sem. Hort. Bot. Imp. Petrop.* 39 (1856) as *quadrifida* β *hirsuta*. *Type*: none cited.

Erect or spreading *shrub* to 5 m, with or without lignotuber. *Stems* pilose or pubescent, glabrescent, or glabrous. *Leaves* narrowly linear to narrowly obovate, or terete, obtuse to acute, pilose, glabrescent, scabrid, or glabrous, commonly with small pustules, 10–50(–85) mm long, 0.8–10(–14) mm wide. *Flowers* 4-merous, usually among older leaves and commonly arranged to one side of the stem. *Hypanthium* cupular, 3–4 mm long, glabrous, or tomentose at base and glabrous above, or tomentose throughout, prominently pustulate. *Sepals* 1–2.5 mm long, tomentose inside, the margins minutely to densely ciliate. *Petals* 3.5–4 mm long, soon falling. *Staminal bundles* \pm equal, 18–35 mm long, bright to deep red, rarely yellow or apricot. *Pistil* 23–42 mm long. *Fruit* barrel-shaped, 6–14 mm long, smooth or warted; 2 sepals enlarged, incurved. *Seeds* 1.4–2 mm long, smooth.

Widespread and locally common throughout south-western Western Australia from Shark Bay to Busselton, east to Israelite Bay and inland to the Southern Cross area, except a triangle between Margaret River, Denmark and Collie (Figure 1). Grows in sandy, granitic, lateritic, quartzitic or calcareous soil, in kwongan, shrubland or woodland. Flowers mainly August–December. A highly variable species with eight subspecies accepted here. Characters used to separate subspecies include habit, leaf morphology and indumentum. Narrow leaves must be observed closely (especially in the dried state) to check whether they are terete rather than linear (in the fresh state this may be done by sectioning a leaf with a scalpel).

Only subsp. *teretifolius* currently has a conservation listing (Priority Four), but none of the subspecies is considered under threat, so no statements on conservation status are given.

1. At least some leaves longer than 40 mm
2. Leaves obovate, 5–14 mm wide (Eurardy Station to Mingenew) d. subsp. **homalophyllus**
- 2: Leaves narrowly obovate to linear, 1–3 mm wide (Northampton to central wheatbelt)..... c. subsp. **angustifolius**
- 1: All or most leaves less than 35 mm long

- 3: Leaves terete or semicircular in cross section
- 4: Leaves commonly pilose; hypanthium commonly hairy (Leeman to Mandurah, inland to Darling Range) **b. subsp. quadrifidus**
- 4: Leaves glabrous; hypanthium glabrous (Vasse district) **a. subsp. teretifolius**
- 3: Leaves flat
- 5: Leaves linear but usually widening slightly in upper half
- 6: Mature leaves glabrous
- 7: Leaves usually 20–50 mm long; young leaves, if hairy, closely silky; hypanthium glabrous or minutely hairy (Northampton to central wheatbelt). **c. subsp. angustifolius**
- 7: Leaves usually 10–25 mm long; young leaves, if hairy, spreading-pilose; hypanthium tomentose, sometimes in lower half only, or glabrous (Leeman to Mandurah, inland to central and southern wheatbelt and to south coast from Albany to Mt Ragged) **b. subsp. quadrifidus**
- 6: Mature leaves scabrid or hairy
- 8: Staminal bundles 18–20 mm long; hypanthium tomentose in lower half or almost glabrous (Shark Bay to Mullewa) **e. subsp. obtusus**
- 8: Staminal bundles 25–30 mm long; hypanthium tomentose for half to its full length
- 9: Hypanthium and sepals tomentose; fruit 10–11 mm long (eastern wheatbelt).... **g. subsp. petraeus**
- 9: Hypanthium tomentose in lower half to two-thirds, rarely throughout; sepals glabrous except finely ciliate margins; fruit 8–9 mm long (Ironcaps to Digger Rock, Bremer Range & Peak Charles) **h. subsp. seminudus**
- 5: Leaves narrowly obovate
- 10: All leaves less than 30 mm long
- 11: Leaves prominently scabrid (Wongan Hills) **f. subsp. asper**
- 11: Leaves smooth or obscurely scabrid (Shark Bay to Mullewa) **e. subsp. obtusus**
- 10: At least some leaves more than 30 mm long (Northampton to central wheatbelt) **c. subsp. angustifolius**

a. *Calothamnus quadrifidus* subsp. teretifolius A.S.George & N.Gibson, *subsp. nov.*

Ad *Calothamnus quadrifidus* subsp. *quadrifidus* arcte affinis, a qua planta glabra, interdum sparsim pilosa, foliis teretibus, differt.

Typus: west of [Whicher] Scarp, Western Australia [precise locality withheld for conservation reasons], 19 October 1995, *N. Gibson 2387* (*holo*: PERTH 04518748; *iso*: BRI, CANB).

Calothamnus sp. Whicher (B.J. Keighery & N. Gibson 230), in G. Paczkowska & A. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 350 (2000); Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

Shrub to 5 m tall, with or without lignotuber. Stems glabrous or sparsely pilose when young. Leaves terete, obtuse or shortly mucronate, 15–35 mm long, 0.6–1 mm wide, glabrous. Hypanthium glabrous, or variously hairy. Staminal bundles 26–29 mm long. Fruit 6.5–9 mm long, smooth. (Figure 2)

Selected specimens examined. WESTERNAUSTRALIA: [localities withheld for conservation reasons] 12 Dec. 2001, R.J. Cranfield 17664 (PERTH); 7 Dec. 1985, D.B. Foreman 1537 (MEL, PERTH); 19 Oct. 1985, N. Gibson 2386 (PERTH); 11 Nov. 1993, B.J. Keighery & N. Gibson 230b (PERTH); 8 Nov. 1992, B.J. Keighery & N. Gibson 664 (PERTH).

Distribution and habitat. Occurs inland from Busselton in clay with ironstone, wet in winter, with tall shrubland. (Figure 1)

Phenology. Flowers September–December.

Conservation status. Listed as Priority Four under the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora under the phrase name *Calothamnus* sp. Whicher (B.J. Keighery & N. Gibson 230) by Smith (2010).

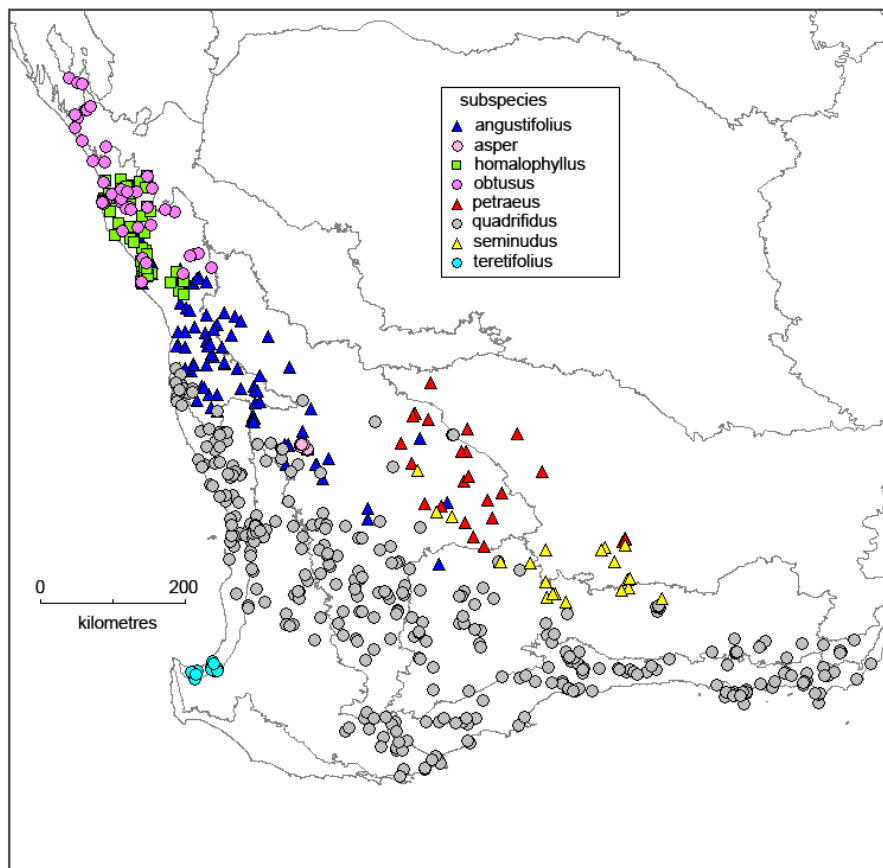


Figure 1. Distribution of the subspecies of *Calothamnus quadrifidus* in south-western Australia, with Version 6.1 IBRA Regions (Department of Environment, Water, Heritage and the Arts, 2008) shown in grey.



Figure 2. *Calothamnus quadrifidus* subsp. *teretifolius*. Holotype, west of [Whicher] Scarp, N. Gibson 2387 (PERTH 04518748). Scale bar = 5 cm.

Etymology. From the Latin *teres* (terete) and *folium* (a leaf).

Notes. This subspecies is typically glabrous. *D.B. Foreman* 1537 has sparse, spreading hairs on the young stems and a pubescent lower half of the hypanthium. *B.J. Keighery* 2207 from State Forest 12 (PERTH) has very sparse hairs on young stems and hairs at the very base of the hypanthium. *R.J. Cranfield* 17664 has pilose stems and the hypanthium is pubescent throughout but it is placed here on account of its slender terete leaves and locality.

A collection from west-north-west of Kojonup, *C.M. Lewis* 139A (PERTH), has terete leaves 0.4–0.5 mm wide, pilose when young, and a shortly pubescent hypanthium; it appears intermediate between subsp. *quadrifidus* and subsp. *teretifolius*.

b. *Calothamnus quadrifidus* subsp. *quadrifidus*

Billotia acerosa Colla, *Hortus Ripul.* 1: 20, t. 23 (1824); *Melaleuca acerosa* (Colla) G. Don, *Gen. Hist.* 2: 815 (1832); *Calothamnus quadrifidus* f. *acerosus* (Colla) Benth., *Fl. Austral.* 3: 180 (1867).
Type: cultivated at Rivoli, Italy, from seed from Australia (*holo?*: TO, photo: PERTH).

Calothamnus purpureus Endl., *Enum. Pl.* 48 (1837) as *purpurea*. *Type:* near Fremantle, towards Swan River, Western Australia, November–December 1833, *C. Huegel s.n.* (*holo:* W).

Calothamnus laevigatus Schauer, *Regelia, Beaufortia, Caloth.* 30 (1843) as *laevigata*. *Type:* between King George Sound and Perth, Western Australia, February 1840, *L. Preiss* 215 (*lecto:* LD, *fide* T.J. Hawkeswood, *Nuytsia* 6: 118 (1987); *isolecto:* MEL 2290292, 2290293).

Illustration. Corrick & Fuhrer, *Wildfls Western Australia* 116 pl. 343 (2009).

Shrub to 3 m tall, sprawling or erect, with or without lignotuber. *Stems* pilose or pubescent, glabrescent. *Leaves* linear, commonly slightly wider above middle, to terete or almost so, obtuse to acute, 10–35 mm long, 0.5–1 mm wide, glabrous or almost so, or spreading-pilose when young, sometimes silky-pubescent (e.g. *B.A. Fuhrer* 96/104), glabrescent, then smooth or finely scabrid. *Hypanthium* 3.5–4 mm long, closely tomentose or pubescent, commonly only in lower half, at base only, or glabrous, pustulate. *Sepals* ciliate. *Staminal bundles* 22–35 mm long. *Fruit* 7–10 mm long, smooth to warted. (Figures 3, 4)

Selected specimens examined. WESTERN AUSTRALIA: Ellis Brook valley reserve, 18 Oct. 2000, *H. Bowler* 665 (PERTH); Stockyard Rd, W of Quindanning–Darkan Rd, 11 Dec. 1997, *R. Davis* 4767 (PERTH); Hill River Nature Reserve, 22 Sep. 1991, *W. Greuter* 22301 (B, PERTH); Yanchep National Park, 18 Nov. 1963, *A.M. James* 92 (PERTH); Mt Ragged, 31 Dec. 1984, *R.A. Kilgour* 492 (MEL, PERTH); Mt Burdett, 8 Nov. 1992, *A. Lyne* 1083 *et al.* (AD, BRI, CANB, MEL, NSW, PERTH); Reabold Hill, 26 Nov. 1971, *B.R. Maslin* 2306 (CANB, L, PERTH); Hassell Beach, 16 Nov. 1985, *A.N. Rodd* 4994 & *J. McCarthy* (NSW, PERTH); Red Hill, Toodyay Rd, 27 Oct. 1964, *R.A. Saffrey* 143 (PERTH); 72 km E of Lake Grace, 11 Nov. 1974, *D.J.E. Whibley* 5367 (AD, PERTH).

Distribution and habitat. Occurs from about Leeman and Lake Indoon to Mandurah and inland through Badgingarra, Dandaragan and along the Darling Scarp to Dwellingup; then inland through the central wheatbelt to Hyden, southwards to Albany and eastwards to Israelite Bay and inland to Peak Charles and Mt Ragged. Grows on coastal dunes and rocky calcareous soil, farther inland in sandy, granitic or lateritic soil in kwongan, tall shrubland, and eucalypt woodland. (Figure 1)

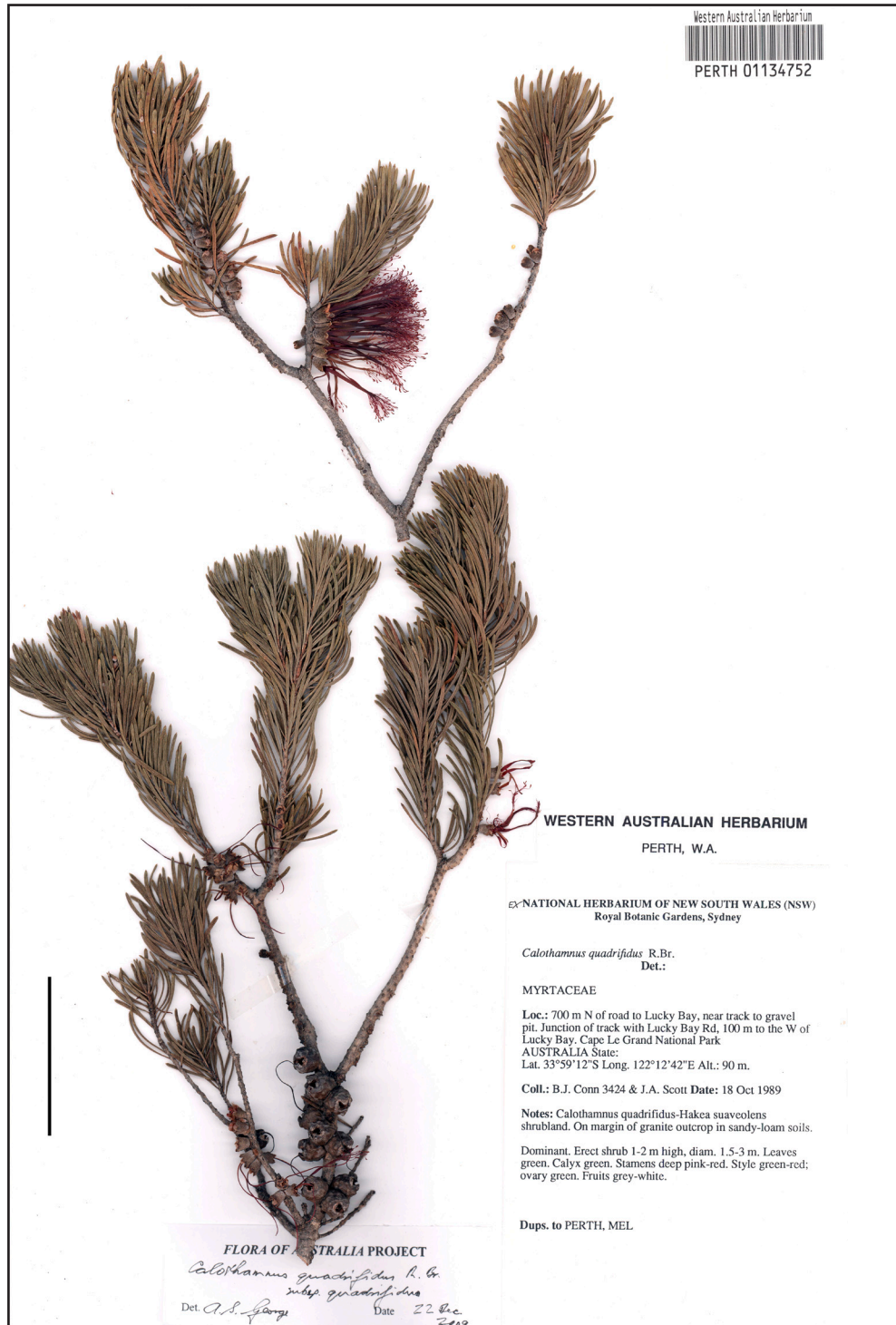


Figure 3. *Calothamnus quadrifidus* subsp. *quadrifidus*. Typical, south coast form. Lucky Bay, B.J. Conn 3424 & J.A. Scott (PERTH 01134752). Scale bar = 5 cm.

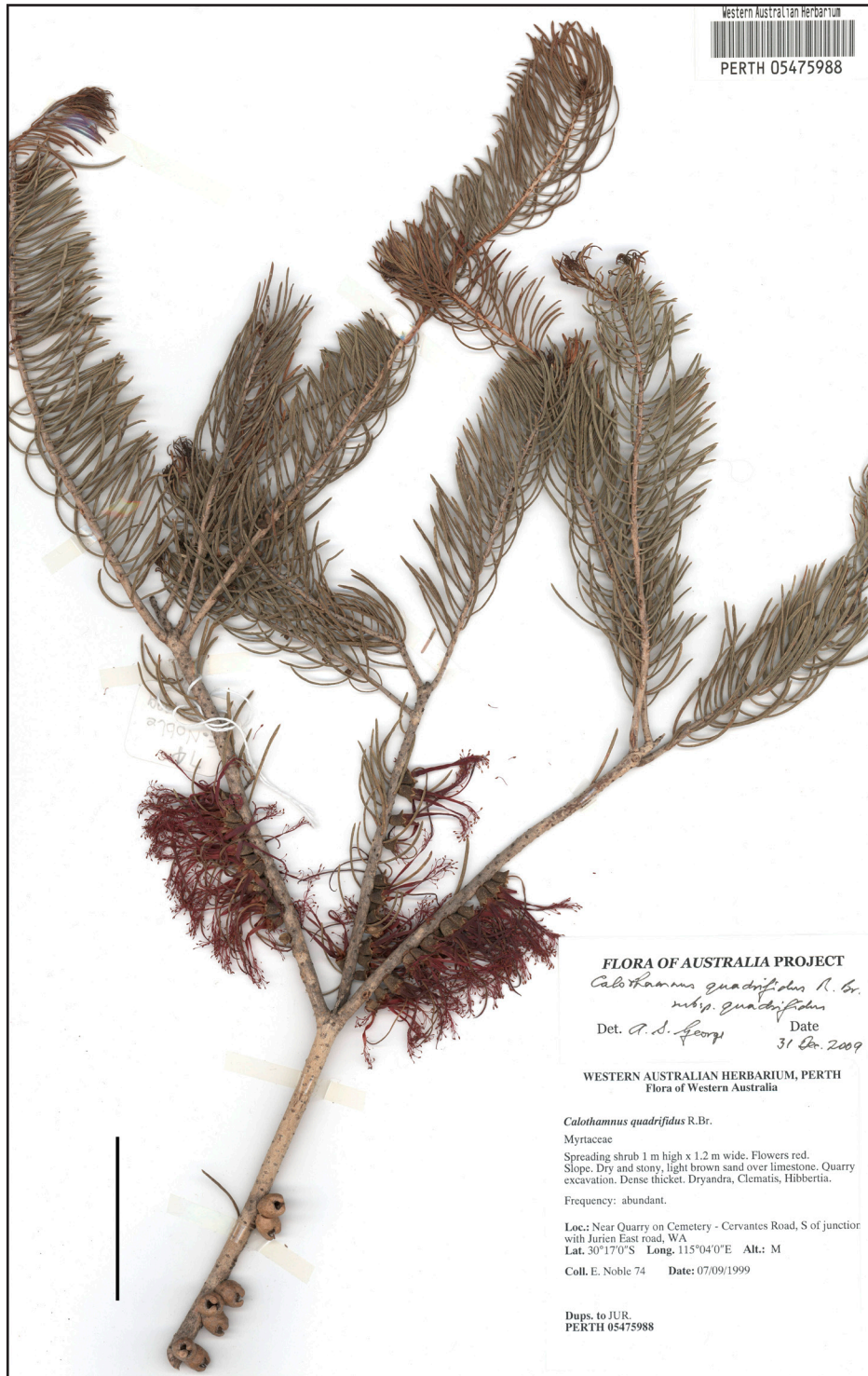


Figure 4. *Calothamnus quadrifidus* subsp. *quadrifidus*. West coastal form. Near Cervantes, E. Noble 74 (PERTH 05475988). Scale bar = 5 cm.

Phenology. Flowers mainly September–December.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Notes. The indumentum on vegetative parts may appear silky when very young but the hairs spread widely when mature. The plants are usually lignotuberous but occasionally not, e.g. Mt Short, A.S. George 17662 (PERTH).

This is the most variable subspecies of *C. quadrifidus*. The following are the major variants that may, with further study, warrant formal recognition.

Typical subsp. *quadrifidus* occurs along the south coast between Hopetoun and Israelite Bay and a short distance inland. Farther inland the leaves are usually a little longer and often not widened upwards. West from Hopetoun, plants are commonly less hairy, especially in the hypanthium, and the leaves are more slender.

Plants from Bettys Beach and Cheyne Beach to Cape Riche have thick, crowded leaves that are glabrous but somewhat scabrid, but otherwise are glabrous except finely ciliate sepals. About 10% of the population at Bettys Beach on the coastal granite have yellow stamens (November 2002); elsewhere this colour form of *C. quadrifidus* is very sporadic.

Some specimens from Mt Ragged and other parts of Cape Arid National Park, e.g. *D.B. Foreman* 1306 (MEL, PERTH), *A.N. Rodd* 5182 (NSW, PERTH), have a pubescent hypanthium. Similar to these are specimens from islands of the Recherche Archipelago, e.g. Middle Island, *A.S. Weston* 9877 (CANB, PERTH).

Populations on and near Peak Charles are varied, most (e.g. *D.E. Albrecht* 4076, MEL, PERTH) having less hairy leaves and the hypanthium almost glabrous except a ring of hairs at the base, similar to subsp. *quadrifidus*, but others from the same locality (e.g. *D.E. Albrecht* 4075, MEL, PERTH) are similar in indumentum to subsp. *seminudus*.

Two collections from south-east of Frankland that are glabrous and have slender, terete leaves approach subsp. *teretifolius*. One, *A.R. Annel*s 4349B (PERTH), was growing in gravelly clay on a valley floor, the other, *A.R. Annel*s ARA 3894 (PERTH), was in yellow sand on a mid-slope. However other nearby collections (c. 500 m away), although variable, are clearly subsp. *quadrifidus* (*N. Gibson* (4645–4649) & *M. Byrne*, PERTH). Further collections from these areas would be useful.

Through the southern and central wheatbelt the leaves vary greatly in length and width, but within the dimensions given in the description.

On the Swan coastal plain, the leaves are usually more slender, sometimes almost terete. The hypanthium is glabrous, or hairy only at the base. Populations on the Darling Scarp and plateau also usually have slender leaves and have an either glabrous or shortly tomentose hypanthium. Some populations are mixed, e.g. one on Gobby Road, south of Serpentine, in which plants range from hairy throughout to almost glabrous. Northwards, the subspecies grades into subsp. *angustifolius* in having longer leaves, e.g. Marchagee Track, 45 km east of Brand Hwy, *D.B. Foreman* 493 (AD, CANB, MEL, PERTH).

Populations are scattered between the Darling Scarp and wheatbelt but they grade into wheatbelt forms of subsp. *quadrifidus*, e.g. Mercer Road Rock, west-south-west of York, *B. Wagner et al.* CJ 45 (PERTH); Wooroloo, *M. Koch* NSW 75126 (NSW, PERTH).

c. *Calothamnus quadrifidus* subsp. *angustifolius* (Ewart) A.S.George & N.Gibson, *stat. et comb. nov.*

Calothamnus homalophyllus var. *angustifolius* Ewart, *Proc. Roy. Soc. Victoria* ser. 2, 24 (1): 63 (1911).
Type: central Greenough, Western Australia, September 1910, *M. Koch* 2086 (*holo*: MEL 2290291; *iso*: K).

Illustration. Erickson *et al.*, *Fls Pls Western Australia* 101 (1973) (as *Calothamnus homalophyllus*).

Erect to spreading *shrub* to 4 m tall, without lignotuber. *Leaves* narrowly obovate to linear, acute to pungent, 20–55(–85) mm long, 1–3 mm wide, glabrous, or silky when young, later glabrous, obscurely pustulate, smooth. *Hypanthium* 3 mm long, glabrous to minutely hairy; oil glands obscure. *Sepals* glabrous outside, tomentose inside. *Staminal bundles* 22–36 mm long. *Fruit* 6–10 mm long, smooth or warted. (Figure 5)

Selected specimens examined. WESTERN AUSTRALIA: 46.5 km E of Geraldton on Geraldton–Mullewa Rd, 9 Sep. 1997, *S. Donaldson* 1555 & *G. Flowers* (CANB, PERTH); Mingenew, 20 Aug. 1997, *B. Jack* 2 (PERTH); 17 km W of Morawa, 17 Aug. 1997, *F. Keast* M1A (PERTH); Uberin Rock, NW of Dowerin, 30 Apr. 2006, *L.A. Phillips* 13 (PERTH); Watheroo National Park, 7 Oct. 1971, *R.D. Royce* 9689 (PERTH); Cairn Hill, N of Moora, 23 Oct. 2000, *M. Trudgen* 21182 (PERTH).

Distribution and habitat. Occurs from Northampton to Dongara and Mullewa, southwards to Badgingarra and through the northern wheatbelt to Northam and Bruce Rock, in sand or loam with tall shrubland and kwongan. (Figure 1)

Phenology. Flowers August–November.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Notes. This and subsp. *homalophyllus* have the longest leaves of the *quadrifidus* complex. Some plants are glabrous e.g. north of Eneabba, Brand Highway, *J.M. Fox* 88/091 (PERTH); Trayning Reserve, *A. Chapman* 6 (PERTH). Leaves become shorter through the Moora–Calingiri region but are long and tending terete around Wongan Hills. From Mt Lesueur and Badgingarra southwards, and through the central wheatbelt (Goomalling to Northam and Bruce Rock), the subspecies grades into subsp. *quadrifidus* as the leaves become shorter and narrowly linear. Near-coastal plants have spreading (not silky) hairs on the new growth, e.g. Coorow–Greenhead Rd, Lesueur National Park, *G. Cassis et al.* 49-312 (PERTH). Two northern collections appear to be intermediate between subsp. *angustifolius* and subsp. *obtusus*, having narrowly obovate, shortly acute leaves 10–40 mm long and 1–3 mm wide: Balla–Whelarra Rd, 0.5 km north of junction with Ogilvie Rd East, *A.S. George* 17633 *et al.*, a single plant (PERTH); heading east to Matts Well, DH road reserve, *D.M. Porter* 287 (PERTH).

A collection from Mt Matilda, Wongan Hills (*M. Wheeler & L. Duffy* MW 28, PERTH), in fruit only, has most leaves 20–30 mm long but is placed here tentatively.



Figure 5. *Calothamnus quadrifidus* subsp. *angustifolius*. Casuarina-Mingenew road, B. Jack (PERTH 02329514). Scale bar = 5 cm.

d. *Calothamnus quadrifidus* subsp. *homalophyllus* (F. Muell.) A.S.George & N.Gibson, *stat. et comb. nov.*

Calothamnus homalophyllus F.Muell., *Fragm.* 3: 111 (1862) as *homalophylla*. *Type*: Red Point [Red Bluff?], Murchison River, Western Australia, 18--., *A. Oldfield* s.n. (*lecto*, here chosen: MEL 105185); Champion Bay, Western Australia, 18--., *P. Walcott*, s.n. (*syn*: MEL 105187, 105188).

Calothamnus homalophyllus var. *trachycarpus* F.Muell., *Fragm.* 3: 112 (1862) as *trachycarpa*. *Type*: none cited.

Illustrations. Erickson *et al.*, *Fls Pls Western Australia* 101 pl. 297 (1973); Corrick & Fuhrer, *Wildfls Western Australia* 115 pl. 339 (2009), both as *Calothamnus homalophyllus*.

Erect to spreading *shrub* to 5 m, without lignotuber. *Stems* glabrous. *Leaves* obovate, rounded-obtuse, shortly mucronate, glabrous, or silky-pilose and soon glabrous, 30–50 mm long, 5–10(–14) mm wide. *Hypanthium* 3–5 mm long, glabrous; sepals 1–2 mm long, glabrous. *Petals* 4–5 mm long. *Staminal bundles* 27–32 mm long. *Pistil* 23–31 mm long. *Fruit* globose, 6–8 mm long, warted or smooth. (Figure 6)

Selected specimens examined. WESTERN AUSTRALIA: The Brothers, Moresby Range, 8 July 2000, *J. Brooker* 46 (PERTH); Yerina Springs Rd, c. 6 km N of Port Gregory Rd, 27 Sep. 1985, *J. D'Alonzo* 611 (CANB, PERTH); 32 km S of Northampton, 8 Sep. 1984, *D.B. Foreman* 593 (MEL, PERTH); Z Bend, Murchison R., Kalbarri National Park, 2 Oct. 1991, *W. Greuter* 22487 (PERTH); Eurardy Station, 30 Sept. 2007, *K.R. Thiele* 3398 (PERTH).

Distribution and habitat. Occurs from Eurardy Station and the lower Murchison River to Mingenew, Western Australia, in sand or sandy loam, often over sandstone, in kwongan and tall shrubland. (Figure 1)

Phenology. Flowers mainly August–November.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Notes. Four sheets at MEL must be considered in the lectotypification of the name *Calothamnus homalophyllus*: MEL 105184, Murchison River, *A. Oldfield*; MEL 105185, Red Point [probably Red Bluff, Murchison River], *A. Oldfield*; MEL 105187, Champion Bay, *P. Walcott*; and MEL 105188, Champion Bay, collector not given. MEL 105187 and 105188 appear to be duplicates of the one collection; they have flowers but no fruit, and new growth that is glabrous or almost so. MEL 105184 has no flowers or fruit, and rather short leaves (showing a tendency towards subsp. *obtusus*). The best candidate is MEL 105185 which has broader leaves than the other collections, flowers and a single fruit that is smooth. Oldfield's label for this collection describes the plant as an 'upright shrub 4–5 ft' which fits Mueller's description 'Frutex 4–6' altus, erectus'. This was labelled holotype by Hawkeswood (1987). There is no sheet at MEL annotated by Mueller as var. *trachycarpus* and none that has flowers with three staminal bundles as he described (presumably one had fallen, as happens commonly).

Subsp. *homalophyllus* may be recognised by the large, obovate leaves and usually knobby fruit. There are two variants, one with glabrous young shoots (represented by the lectotype), the other silky-pubescent becoming glabrous. Both variants occur in Kalbarri National Park but only the latter

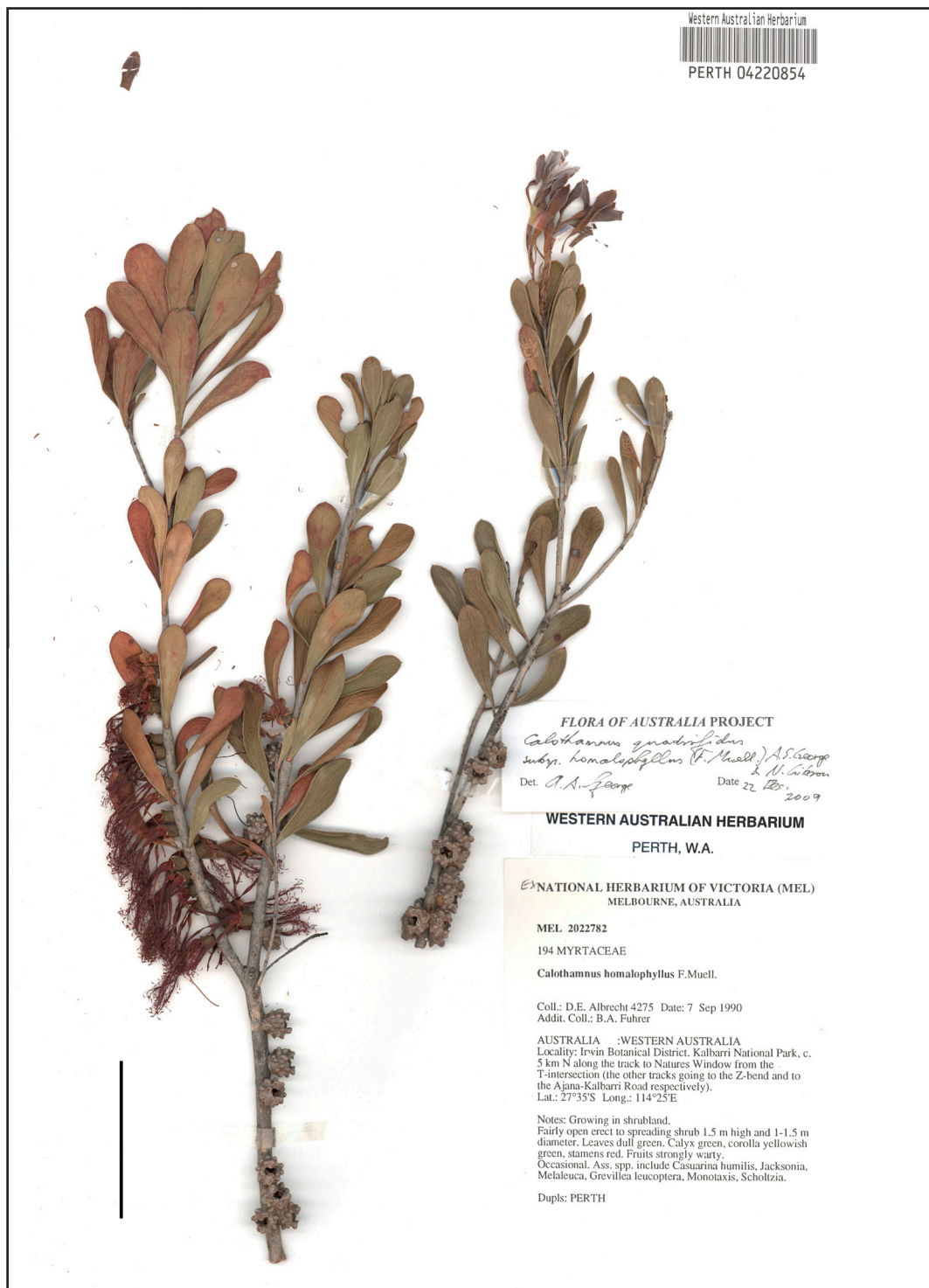


Figure 6. *Calothamnus quadrifidus* subsp. *homalophyllus*, c. 5 km along track to Natures Window, Kalbarri National Park, D.E. Albrecht 4275 & B.A. Fuhrer (PERTH 04220854). Scale bar = 5 cm.

around Ajana and Northampton. Although the taxon typically has distinctive, large, obovate leaves, it is variable in leaf form and grades into subsp. *angustifolius*; an intermediate collection is c. 33 km east of Geraldton on road to Mullewa, *A.R. Fairall* 1351 (PERTH). Some populations are variable, e.g. Yerina Springs Rd, represented by *A.S. George* 17613 *et al.* (PERTH), some plants having leaves 3–5 mm wide, others 2–3 mm wide. A collection from Eurardy Station (*Wildflower Soc. of Western Australia* EURA 67, PERTH) is placed here though its leaves are only 12–25 mm long; they are sparsely pubescent but glabrescent and smooth when mature.

e. *Calothamnus quadrifidus* subsp. *obtusus* (Benth.) A.S.George & N.Gibson, *stat. nov.*

Calothamnus quadrifidus f. *obtusus* Benth., *Fl. Austral.* 3: 180 (1867). *Type*: Murchison River, Western Australia, 18--., *A. Oldfield s.n.* (*holo*: K; *iso*: MEL 105201, MEL 105202, OXF).

Illustration. Wrigley & Fagg, *Bottlebrushes Paperbarks Tea Trees* 131 (1993) as *Calothamnus homalophyllus*.

Erect or sprawling *shrub* to 3 m tall, with lignotuber. *Bark* coarsely fibrous. *Leaves* narrowly obovate to linear, obtuse, 10–35 mm long, 1–4 mm wide, pilose or hirsute when young, later finely scabrid, pustulate, sometimes smooth. *Hypanthium* 3–3.5 mm long, tomentose in lower half becoming almost glabrous towards summit, or ± glabrous throughout, pustulate. *Sepals* glabrous except minutely ciliate margins. *Staminal bundles* 18–25 mm long. *Fruit* 6–10 mm long, glabrescent, smooth or warted. (Figure 7)

Selected specimens examined. WESTERN AUSTRALIA: track to Eagle Gorge, Kalbarri National Park, 6 Sep. 1990, *D.E. Albrecht* 4237 & *B. Fuhrer* (MEL, PERTH); Oakabella Nature Reserve, 14 June 2000, *A. Chant* 20 (PERTH); Useless Loop Rd, 12.3 km W of Overlander–Denham Rd, 13 Sep. 2004, *A.S. George* 17629, *R.K. Brummitt* & *E.G.H. Oliver* (CANB, K, MEL, NSW, PERTH); SW of Cooloomia HS, 20 Sep. 1979, *S.D. Hopper* 1410 (PERTH).

Distribution and habitat. Occurs from Tamala Station (south of Shark Bay) south to Kalbarri and the Mullewa area, in red or yellow sand, sometimes over sandstone, in kwongan, tall shrubland and low open woodland. (Figure 1)

Phenology. Flowers August–October.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Notes. From the State Barrier Fence to the Murchison River, plants are commonly glabrous except a ring of hairs at the base of the hypanthium (and the disk within the flower). Hairy and glabrous plants can occur in the same population, e.g. 8 km east of Tamala HS, *M. Peterson*, 23 August 1979 (PERTH, 3 sheets). Near Red Bluff, Kalbarri National Park, there is a population that appears to be a hybrid swarm with this and subsp. *homalophyllus* as the original parents.

f. *Calothamnus quadrifidus* subsp. *asper* (Turcz.) A.S.George & N.Gibson, *stat. et comb. nov.*

Calothamnus asper Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 22: 25 (1849) as *aspera*. *Type*: southwestern Western Australia, 184-, *J. Drummond* 4: 60 (*holo*: KW; *iso*: BM, CGE, K, LE, OXF, P).

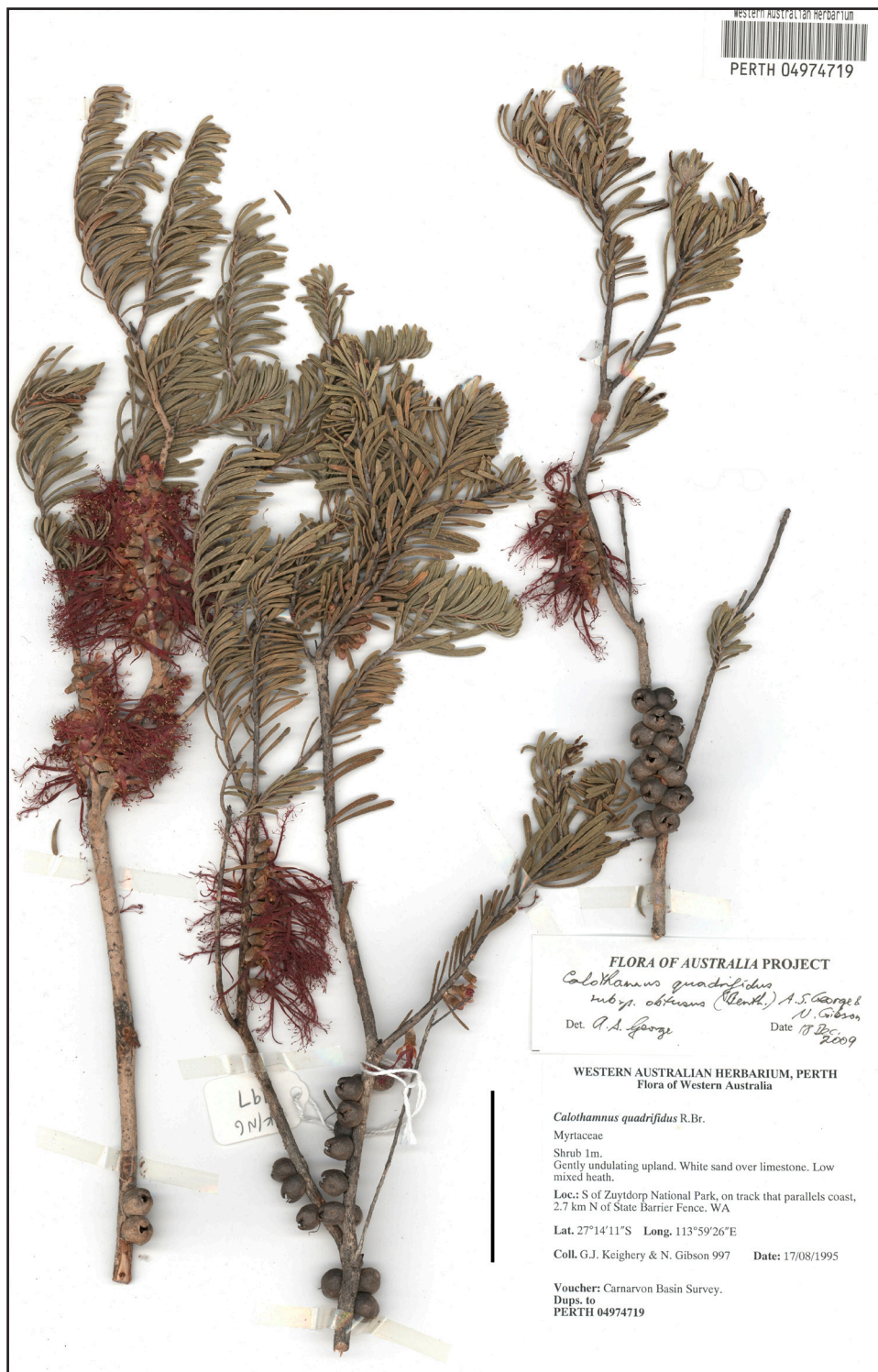


Figure 7. *Calothamnus quadrifidus* subsp. *obtusus*. South of Zuytdorp National Park, on coastal track 2.7 km north of State Barrier Fence, G.J. Keighery & N. Gibson 997 (PERTH 04974719). Scale bar = 5 cm

Erect *shrub* to 4 m, without lignotuber. *Stems* pilose, glabrescent. *Leaves* narrowly obovate or linear, acute to obtuse, shortly mucronate, 10–23 mm long, 1–2 mm wide, openly hirsute and scabrid, the long hairs wearing off. *Hypanthium* 4–6 mm long, glabrous but warted. *Staminal bundles* 23–28 mm long, deep red. *Pistil* 30–33 mm long. *Fruit* 10–14 mm long, smooth to coarsely warted, otherwise glabrous. *Seeds* 1.5–2 mm long, smooth. (Figure 8)

Selected specimens examined. WESTERN AUSTRALIA: Monks Well Gully, Wongan Hills, 17 Feb. 1984, *T.J. Hawkeswood* 159 (PERTH); NW of Wongan Hills (town), 1 Sep. 1980, *K.F. Kenneally* 7471 (PERTH).

Distribution and habitat. Confined to a small area in the Wongan Hills, on lateritic slopes or in shaly clay, in shrubland, sometimes with mallees. (Figure 1)

Phenology. Flowers August–September.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Notes. Subspecies *asper* is recognised mainly by the clearly scabrid mature leaves and usually larger fruit. Geographically it is the most restricted subspecies of *C. quadrifidus*, and morphologically the least variable, but the morphology clearly places it with this species.

g. *Calothamnus quadrifidus* subsp. *petraeus* A.S.George & N.Gibson, *subsp. nov.*

Ab subspeciebus aliis *Calothamni quadrifidi* foliis pilosis aetate scabridis, hypanthio tomentosio, sepalis tomentosio, differt.

Typus: Duladgin Rock, north of Yellowdine, Western Australia, 31° 10' S, 119° 41' E, 22 September 1969, *A.S. George* 9642 (*holo:* PERTH 02329387; *iso:* AD, CANB, K, MEL).

Erect to spreading *shrub* to 2.5 m tall, without lignotuber. *Leaves* crowded, linear, obtuse to acute, 10–23 mm long, 0.9–1.1 mm wide, pilose, remaining so when mature or glabrescent but scabrid. *Hypanthium* tomentose including sepals. *Petals* pubescent or glabrous. *Staminal bundles* 25–30 mm long. *Fruit* 10–11 mm long, at length glabrous. (Figure 9)

Selected specimens examined. WESTERN AUSTRALIA: McDermid Rock, W of Norseman, 8 Aug. 1999, *B. Archer* 1322 (MEL, NSW, PERTH); 36 miles [c. 62 km] NW of Southern Cross, 26 Nov. 1891, *R. Helms* (K); Chutawalakin Hill, NNE of Warralakin, 2 Aug. 1978, *S.D. Hopper* 1030 (PERTH); 23 km E of Karroun Hill, 1983, *P. Roberts* 233 (PERTH).

Distribution and habitat. Occurs from Karroun Hill south to Merredin, east to Yellowdine area and south-east to McDermid Rock, in granitic or quartzitic soil with tall shrubland. (Figure 1)

Phenology. Flowers August–October.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Etymology. From the Greek *petraeus* (rocky), in reference to the occurrence on rock outcrops.



Figure 8. *Calothamnus quadrifidus* subsp. *asper*: Rogers Nature Reserve, Waddington–Wongan Hills road, A.S. George 17641, R.K. Brummitt & E.G.H. Oliver (PERTH 06996477). Scale bar = 5 cm.



Figure 9. *Calothamnus quadrifidus* subsp. *petraeus*. Holotype, Duladgin Rock, north of Yellowdine, A.S. George 9642 (PERTH 02329387). Scale bar = 5 cm.

Notes. The tomentose hypanthium and sepals and the pilose (later scabrid) leaves are diagnostic. It is common in the eastern wheatbelt, especially on granite, and southwards grades into subspp. *seminudus* and *quadrifidus*. This is the 'peculiar variety [of *Calothamnus asper*] with a pubescent calyx' from near Mt Churchman, mentioned by Mueller, *Fragmenta* 10: 31 (1876).

h. *Calothamnus quadrifidus* subsp. *seminudus* A.S.George & N.Gibson, *subsp. nov.*

Ad *Calothamnus quadrifidus* subsp. *petraeus* arcte affinis, a qua hypanthio in dimidio superiore glabro, sepalis glabris praeter margines ciliatos, et petalis glabris, differt.

Typus: c. 1 km east of Digger Rocks trig on track to Hatter Hill, Western Australia, 32° 43' 34.6" S, 119° 49' 37.1" E, 14 November 2005, *N. Gibson* 4633 & *M. Byrne* (*holo:* PERTH 08133719; *iso:* CANB, MEL).

Erect to spreading *shrub* to 2 m tall, without lignotuber. *Leaves* crowded, linear but slightly broadened upwards or very narrowly obovate, obtuse to acute, usually 10–20 mm long, 0.8–1.5 mm wide, pilose, glabrescent but scabrid. *Hypanthium* 3–4 mm long, tomentose with reflexed hairs in lower third to half, glabrous above including sepals except ciliate margins. *Petals* glabrous. *Staminal bundles* 25–28 mm long. *Fruit* 8–9 mm long, smooth or slightly irregular but not warted, glabrous. (Figure 10)

Selected specimens examined. WESTERN AUSTRALIA: near Hatter Hill, 9 Dec. 1964, *C.A. Gardner* 15911 (PERTH); Bremer Range, c. 8 km SSE of Mt Glasse, 14 Sep. 1994, *N. Gibson & M. Lyons* 1849 (PERTH).

Distribution and habitat. Occurs from the Ironcaps to Digger Rock, the Bremer Range and Peak Charles, in lateritic loam, in mallee shrubland, occasionally on granite. (Figure 1)

Phenology. Flowers August–December.

Conservation status. Not listed under DEC Conservation Codes for Western Australian Flora.

Etymology. From the Latin *semi-* (half) and *nudus* (bare), in reference to the hypanthium which is glabrous in the upper half to two-thirds.

Notes. This is readily distinguished from subsp. *petraeus* by the hypanthium which is tomentose only in the lower third to half, and the sepals which are usually glabrous outside but shortly ciliate. It has a more even habit than subsp. *petraeus* and the foliage is greener. The leaves are pilose but usually soon glabrescent, and sometimes scarcely scabrid.

A population at Ninety Mile Tank (*N. Gibson* 4650–4659 & *M. Byrne*, PERTH), is growing in deep yellow sand and is variable in its indumentum, from typically hairy to having hairy but glabrescent leaves that are sometimes wider (to 1.5 mm), and a hypanthium that is glabrous except a ring of hairs at the base.

A collection from Knapp Rock (*K.M. Allan* 779, PERTH) is intermediate between this and subsp. *petraeus*. The hypanthium is tomentose throughout and the sepals are shortly tomentose in some flowers but several on the same specimen are glabrous.



Figure 10. *Calothamnus quadrifidus* subsp. *seminudus*. Holotype, c. 1 km east of Digger Rocks trig on track to Hatter Hill, N. Gibson 4633 & M. Byrne (PERTH 08133719). Scale bar = 5 cm.

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