

## Revision of *Kunzea* (Myrtaceae). 2. Subgenera *Angasomyrtus* and *Salisia* (section *Salisia*) from Western Australia and subgenera *Kunzea* and *Niviferae* (sections *Platyphyllae* and *Pallidiflorae*) from eastern Australia

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### Abstract

This contribution to a revision of the Australian species of *Kunzea* is, similarly to previous publications on western Australian groups, primarily based on the gross morphology examined on herbarium specimens and field observations. The species are, however, arranged in infrageneric groupings supported by molecular research. Descriptions and brief discussions of four subgenera and six sections are included throughout in order to provide an overall classification of the genus, although not all species are described in full detail.

Keys, descriptions and illustrations to the following 23 accepted species are provided (new taxa in bold): *K. ambigua* (Sm.) Druce, ***K. aristulata***, ***K. axillaris***, ***K. badjaensis***, *K. bracteolata* Maiden & Betche, ***K. caduca***, *K. calida* F.Muell., *K. cambagei* Maiden & Betche, *K. capitata* (Sm.) Rchb. ex Heynh. subsp. *capitata*, subsp. *seminuda*, ***K. dactylota***, *K. flavescens* C.T.White & Francis, *K. graniticola* Byrnes, ***K. juniperoides*** subsp. *juniperoides*, subsp. *pernervosa*, *K. muelleri* Benth., *K. obovata* Byrnes, ***K. occidentalis***, *K. opposita* F.Muell. var. *opposita*, var. *leichhardtii* Byrnes, *K. parvifolia* Schauer, ***K. petrophila***, *K. pomifera* F.Muell., *K. rupestris* Blakeley, ***K. sericothrix***, ***K. truncata***.

Natural putative hybrids between taxa occurring in close proximity have been examined and evaluated. No experimental artificial hybridization was performed, but as many hybrids as possible were examined in population studies. Hybrids are briefly described from cited specimens, and are reported under the first name in the hybrid formula.

**Keywords:** Myrtaceae, *Kunzea*, taxonomic revision, new species, nomenclature, Australia.

### Introduction

When Smith (1797) described *Leptospermum ambiguum* and *Metrosideros capitata* and later added *M. ericifolia* Sm. (1813), all now species of *Kunzea*, this foreshadowed the difficulties experienced in the delineation of the genus *Kunzea* from the beginning to the present. De Candolle (1828) placed these three species into a separate grouping of *Metrosideros*, all with alternate leaves, but he also replaced the first name (*L. ambiguum*) with *M. corifolia* Vent. Reichenbach (1828) introduced in the same year the genus *Kunzea*. Although he did not validly publish the genus, the name was at the time widely accepted, in contrast to *Tillospermum* by Salisbury (1814), which was completely overlooked and never used in the literature, because it was published in an obscure publication. Toelken (1981a) eventually conserved *Kunzea* Reichb. with the type species *K. capitata* (Sm.) Heynh. over the earlier unused homonym *Kunzia* Spreng. (1818) and later (Toelken 1981b) over the even earlier name *Tillospermum*.

Several additional generic names were published and used, such as *Pentagonaster* by Klotzsch (1836), *Stenospermum* by Heynhold (1841) and *Salisia* by Lindley

(1839), for some species with extreme morphology, like *K. baxteri* (Klotzsch) Schauer, *K. ambigua* (Sm.) Druce and *K. pulchella* (Lindl.) A.S.George, respectively. Other species, now included in *Kunzea*, were previously included in or transferred to other genera, such as *Agonis* (DC.) Sweet, *Baeckea* L., *Callistemon* R.Br., *Melaleuca* L. and *Metrosideros* Gaertner (cf. citations under genus). The distinguishing features for *Kunzea* changed and although the original characteristic, the capitate stigmas (cf. Flowers) repeatedly resurfaced, no single character could be found to distinguish the genus.

However, Bentham (1867) following Schauer (1844) established a wider concept, which is similar to the one presented here. He even included *K. peduncularis* F.Muell. (1855) (the oldest name for the *K. ericoides* complex in the genus *Kunzea* in preference to the earlier *Baeckea phylicoides* A.Cunn. ex Schauer, 1843, following the so-called “Kew Rule”; Nicolson 1991) into the genus, a concept which lasted for a long time. But eventually, this was challenged by Cheel (1943), Blake (1958) and Byrnes (1982), who preferred to place the latter species complex in *Leptospermum phylicoides* (A.Cunn. ex Schauer) Cheel, the oldest Australian name.

Thompson (1983) argued on the basis of the size and curved nature of the stamens and thin-walled anthers that this species complex should be placed in *Kunzea*, namely in *K. ericoides* (A.Rich.) Joy Thoms., the oldest name within the complex, which Richard (1832) published originally for a New Zealand plant. The publication of the hybrid *Kunzea sinclairii* × *Leptospermum scoparium* (Harris et al. 1992) swung arguments again for the inclusion of the *K. ericoides* complex in *Leptospermum* Forster & G. Forster, at least in New Zealand (Pettersen 2006).

Molecular research on the systematics of the *Leptospermum* suballiance by O'Brien et al. (2000) supported Thompson's concept. They also confirmed that *Kunzea* belongs into the monophyletic *Leptospermum* suballiance within the *Leptospermum* alliance of Myrtaceae, as originally proposed by Briggs and Johnson (1979) and developed in Johnson & Briggs (1983, 1984). O'Brien et al. (2000) also included the recently published *Angasomyrtus salina* (Trudgen & Keighery 1983) in *Kunzea*.

De Lange et al. (2010) provided further detailed molecular studies, specifically on the genus *Kunzea*, adopted the same delineation of the genus as Thompson (1983) and proposed an infrageneric classification, which divides the genus into four subgenera (Tab. 1). Similar to the genus, the subgenera are also not easily defined morphologically:

(1) Subgen. *Kunzea* included species with mainly pink-flowered globular inflorescences in eastern Australia.

(2) The Western Australian species, except *K. salina*, were combined into subgen. *Salisia* (Lindl.) Toelken & de Lange, which is subdivided into three sections: sect. *Salisia* (Lindl.) Benth. included large red-flowered *K. baxteri* and *K. pulchella*; while sect. *Floridae* (Toelken) Toelken & de Lange includes the floriferous pink-flowered species, but with few-flowered inflorescences and often with petals longer than stamens; and sect. *Zeanuk* Toelken (1996) retains the species with pink or yellow flowers in multi-flowered inflorescences, but now includes only Toelken's subsect. *Arborescentes* and *Globosae*.

(3) *Kunzea salina*, being without obvious affinities to other species, remains the only species in subgen. *Angasomyrtus* (Trudgen & Keighery) de Lange & Toelken.

(4) The eastern subgen. *Niviferae* Toelken & de Lange consists of usually white-flowered species with often elongate inflorescences. It is divided into three sections: sect. *Platyphyllae* Toelken & de Lange with irregular branching (cf. Branches) and globular inflorescences from mainly Queensland, but also one species from the Northern Territory; species of sect. *Niviferae* have unequally long stamens, some of which are shorter than the petals, truncate flower buds and they not only occur in south-eastern Australia but are also widespread in New Zealand; sect. *Pallidiflorae* Toelken & de Lange,

which shares regular branching from each leaf axil with sect. *Niviferae*, but is distinguished by all stamens being equally long, as well as acute flower buds, and occurs in New South Wales, eastern Victoria and Tasmania.

Detailed discussions under each of these infrageneric taxa demonstrate the variation recorded.

The species concepts, in contrast, provided fewer problems in evaluation. The fact that a number of changes and new species were published by Toelken (1996) and that more are described here must largely be attributed to more detailed exploration and discerning collecting, particularly since the 1960s.

Field studies soon, however, revealed another challenge to the identification of taxa in the form of natural putative hybrids (cf. Hybridization) between adjoining species. Hybridization is generally attributed to interference with vegetation through cultivation and urbanization, and hybrids are therefore often found, for instance, along road works, as this would have disturbed vegetation locally. However, some variation recorded on older herbarium specimens could now with field observations and more material available also be interpreted as putative hybrids. Although most putative hybrids in *Kunzea* are limited to a few plants in the majority of species populations, each one may persist for many years, as they are perennials like their putative parents. This is of particular importance in the mainly tree-like *K. ericoides* complex (Toelken, in prep.), in which a number of species produce extensive local hybrid swarms leading to a reduction of the species complex to a single species by some authors (Bentham 1867, Cheel 1943, Thompson 1983). De Lange (2014) adopts a different approach and increased the number of species from two to ten in New Zealand.

Furthermore, recognition of infraspecific taxa is obscured by extensive hybridization between, for instance, *K. capitata* subsp. *capitata* and subsp. *seminuda* (cf. Hybridization). In the case of the rare *K. juniperoides* subsp. *pernervosa* the taxon cannot be clearly delineated as in one locality extensive hybridization with *K. parvifolia* has caused all the flowers to be pink, while in other localities they are predominantly white and the occasional occurrences of pink-flowered plants might either have to be attributed to wider introgressional effects or natural variation, as it has been found in *K. badjaensis*. Too little material is available at present to make a critical judgement (cf. Typification of *K. juniperoides* subsp. *pernervosa*). An awareness of the problems concerning hybrids will hopefully create more discerning field work to fill in details or simply add to the known range of variation of hybrids and taxa.

Hybrids are also frequently mentioned in gardening publications as many of the species and hybrids of *Kunzea* are by now widely used in horticulture. Elliot & Jones (1993) in their comprehensive *Encyclopaedia of Australian Plants* have extensively described growing conditions, etc.

### Characters

**Habitats.** The majority of species of *Kunzea* grow in temperate areas particularly in south-western and eastern Australia, but in Queensland their distribution also extends into the subtropics and tropics. The occurrence of *K. petrophila* in the dry tropical environment along the Keep River in the western parts of the Northern Territory is unusual. Also, *K. pulchella* and *K. baxteri* grow in semi-arid areas of temperate Western Australia. At the other extreme, *K. muelleri* also extends the distribution of the genus into subalpine localities of New South Wales and Victoria.

While all these species grow on acid soils, *K. pomifera* prefers alkaline substrates and is usually found on sandy soils along the coasts of Victoria and South Australia. The unique *K. salina* is also found on sand dunes, but occurs only around semi-arid salt lakes north of Esperance in Western Australia.

**Habit.** Most species of *Kunzea* are shrubs, but a number of the taller shrubs, especially in sect. *Niviferae*, can develop in competition in forests into trees up to 10 m tall; in New Zealand, de Lange (2014) reports trees up to 30 m for *K. robusta*. In a small area, particularly on forest margins, one can find a range of multi-stemmed shrubs to single-stemmed trees of the same species, e.g. *K. flavescens*. Habit is not a very reliable character to distinguish species in *Kunzea*, but it is important to be aware of its variability. At the other extreme, some species, such as *K. cambagei* and *K. pomifera*, have a prostrate to decumbent habit. *Kunzea badjaensis* also usually has a decumbent habit, which is particularly low in the horticultural form registered as 'Badja Carpet', but specimens of the species have also been recorded to grow to shrubs up to 1 m tall.

Although occasionally recorded, little is known about suckering in many species, such as *K. pomifera* or *K. micrantha*, and a subsequent production of lignotubers has been recorded for *K. micrantha* subsp. *petiolata* (G. Cockerton, pers. comm.). Suckering is, for instance, thought to be important for maintaining the population of the rare *K. rupestris*. This phenomenon is also common in species of the *K. ericoides* complex, where some species even produce repeated lignotubers on often extensive underground rhizomes from which they will sucker (de Lange et al. 2010, p. 316). Such plants will freely regenerate when the aerial parts have been removed for road works.

**Branches.** The type of branching of kunzeas is not reflected in their variable habit from mainly shrubs to trees or prostrate perennials. For instance, species of the subgenera *Salisia* and *Kunzea*, as well as sect. *Platyphyllae* of subgen. *Niviferae* (except *K. petrophila*), will in every season's growth develop a few lateral branches, usually at the base of a growth flush and subsequent nodes will remain unbranched.

This irregular branching contrasts with that of species of subgen. *Angasomyrtus*, as well as sections

*Pallidiflorae* and *Niviferae* of subgen. *Niviferae*, which develop branches in the axils of all leaves at each node, although many of them (mainly the distal ones) remain short shoots, usually shorter than the subtending leaf, at least in the first year. During the next season some of these short shoots, but not all of them, will grow out into long branches and the overall branching of these species ultimately resembles that of kunzeas with irregular branching growth flushes.

While the decurrent leaf bases of most species of the first group with irregular branching are rounded and scarcely noticeable on the internodes, they have sharp-edged margins of more or less distinct flanges with grooves on either side, concurrent with the regular branching in the subgenera *Angasomyrtus* and *Niviferae*, as above.

Characteristic of the Western Australian species of the sections *Floridae* and *Zeanuk* is the slough-like shedding of large sheets of mainly the epidermis of developing branches. The upper layers split into usually long slivers on branches of the similarly pink-flowered eastern species of subgen. *Kunzea* as well as on most of the mainly white-flowered species of the subgenera *Angasomyrtus* and *Niviferae*. The subsequent development of bark of young branches (up to 8 mm in diameter) are described, because it, in contrast to that of the main stems, can be examined on herbarium specimens for identifications. Bark of older stems, useful as it might be, is only rarely represented on herbarium material, and is much less distinctive.

**Leaves.** In most species of *Kunzea* the leaves are spirally arranged (usually 3/5). De Candolle (1828) already drew attention to the alternate leaves of the three original species then placed into *Metrosideros*. However, *K. opposita* and *K. calida* with short internodes are exceptions and have opposite leaves; in *K. muelleri* the leaves are very close to one another, so that at times they too appear opposite.

A characteristic of leaves of many species of *Kunzea* are their "pinched" apices, which only appear to be acuminate to cuspidate, because their distal leaf margins are more or less strongly incurved.

The number of main veins of a leaf varies in different species and can be an important characteristic of some species, while in others, e.g. *K. capitata* subsp. *capitata*, it can be very variable.

**Inflorescence.** The usually densely clustered, apparently spike-like inflorescences of *Kunzea* are complex inflorescences described by Briggs & Johnson (1979) as a blastotelic conflorescence, or more specifically for the genus a **botryum**. This inflorescence consists of few to many part-inflorescences reduced to a single unit, usually with sessile flowers, each in the axil of a bract and subtended by two bracteoles (= pherophylls and prophylls, respectively, in Briggs & Johnson 1979). Much use is made here of the characteristic shape, size and indumentum of these bracts and bracteoles to dis-



tinguish taxa, but it must also be stressed that these characteristics may vary from the lower flowers to the distal ones on the same inflorescence, as demonstrated in many of the illustrations. The inflorescence develops directly from a resting bud covered with scales or **perules**, which differ in shape and often grade into that of the lower bracts, but these intermediates are rarely observed, because at least the upper perules are usually shed early (caducous). Occasionally one also finds rudimentary flowers in the axil of what seems to be a perule, while other perules next to them are without floral buds, so that the distinction based on size, shape or the functionality between bracts and the sterile perules cannot be used as a critical difference between the two, as observed in, for instance *K. juniperoides*. As the usually larger intermediates are commonly shed early, although usually not in *K. juniperoides*, the “retained perules” as observed on herbarium specimens, are used in descriptions. Bracts with or without a flower in their axil subtend the flower head or individual flowers.

Every inflorescence ends in a latent terminal vegetative bud or rarely also in a few leaves in species of the subgen. *Angasomyrtus* and sect. *Niviferae*. After flowering or once the fruit are shed, growth will commonly continue from the terminal bud, and only rarely from nodes below the inflorescence, as for instance, in species of sect. *Floridae* (Toelken 1996). The inflorescence is therefore usually distal, or is usually only “apparently terminal” on branches at least while flowering, as used in the descriptions to avoid confusion for the observer.

Commonly, kunzeas have dense, more or less globular inflorescences, but there are variations to this basic pattern in different groups. The majority of species belonging to subgen. *Kunzea* and sections *Floridae*, *Zeanuk*, *Platyphyllae* and *Pallidiflorae* have more or less globular inflorescences with usually scale-like chartaceous deciduous bracts and bracteoles, but in the last two sections there is a tendency for the bracts to become membranous or leaf-like, often with a green central strip. These bracts are usually dropping early (caducous: Jackson 1965), i.e. before or at flowering, while deciduous bracts of the former group are shed at the same time as the deciduous fruit. The leaf-like bracts are often associated with more elongate inflorescences with separated flowers, as distinct from dense usually globular ones, which have under exceptional environmental circumstances become more elongate mainly in sect. *Zeanuk* in Western Australia (Toelken 1996).

Elongate inflorescences with usually caducous bracts and bracteoles are, however, the norm for *K. pulchella* and *K. baxteri* from Western Australia. These two species with large, mainly red ornithophilous flowers are placed in a separate sect. *Salisia*. This seemingly unexpected placement is juxtaposed to the pink or yellow entomophilous flowers on globular inflorescences of sections *Floridae* and *Zeanuk*, representing different pollination syndromes within the subgen. *Salisia*. Even within sect. *Salisia* inflorescences differ: while the

inflorescences of *K. pulchella* are loosely racemiform with flowers more or less stalked, those of *K. baxteri* are of the bottle-brush type with sessile flowers and a terminal tuft of leaves resembling (mimicking?) closely those of species of *Callistemon*. In fact, Lindley (1839) and Mueller (1863) had mistakenly placed specimens of these species into *Callistemon*, but both species have flowers with stamens in more than one whorl, which are longer than the petals, as well as deciduous fruit typical of the genus *Kunzea*, in spite of their unusually large red flowers. *K. baxteri*, unusually for the genus, has the occasional proliferation of up to three inflorescences in succession, each with some vegetative growth in between, within a good season on cultivated plants.

The loose inflorescences with stalked flowers and often some terminal leaves of the small white-flowered species of the *K. ericoides* complex (*K.* sect. *Niviferae*; de Lange 2014) usually have membranous and caducous bracts and bracteoles, at least on the basal flowers or short axillary inflorescences. However, on the longer inflorescences, which are distal on main branches, the distal bracts are fleshy and leaf-like and are often retained after flowering similar to those in *K. pulchella*. These longer inflorescences also normally end in a few leaves and, under favourable conditions, the terminal bud at the end of a few leaves restarts growth early before fruit have matured. The inflorescence of species of sect. *Niviferae*, with flowers with long and short stamens presenting anthers at different levels and relatively short styles, suggest a different pollination syndrome. This is also indicated by the absence of hybrids with species of other groups, even though they often occur in close proximity, particularly as they hybridise in profusion within their own group. A similar comparison cannot, however, be made in the case of *K. baxteri* and *K. pulchella*, as they occur in semi-arid areas where no other species of *Kunzea* grow. Experimental hybridization has not been pursued in this study and hybrids from horticulture are not recorded here.

The inflorescences of *K. salina* in subgen. *Angasomyrtus* are also similar to those of the *K. ericoides* complex, although the inflorescence is usually reduced to few apparently axillary flowers. The elongated inflorescences on one specimen (*L.A. Craven et al.* 9098) are very similar to those of species of sect. *Niviferae*, except that the flowers are sessile or almost so.

Some elongate inflorescences are even more complex, as they consist of more or less globular inflorescences born in terminal position as well as on short axillary branches from distal nodes of last year's growth unit and, although they are usually separate units, species with small inflorescences, such as, *K. muelleri* and *K. dactylota*, often produce distally on branches larger conglomerates of conflorescences or superconflorescences (Briggs & Johnson 1979). Similar larger units have also been recorded for some species of sect. *Niviferae*.



**Flowers.** The flowers of *Kunzea* species are distinguished from those of *Leptospermum* by the stamens being arranged in more than one row and filaments, which are curved down into the free hypanthium in the buds (Thompson 1983). Once the stamens are expanded they are also usually longer than the petals even in the very much larger ornithophilous flowers of *K. pulchella* and *K. baxteri*. The exceptions are species of sect. *Floridae* (Toelken 1996), where the petals are relatively large in comparison to the stamens; and in subgen. *Angasomyrtus* and section *Niviferae*, both with unequally long sets of stamens, some of which are also shorter than the petals. In both of the latter groups the styles are also usually shorter than the stamens.

Flower colour, i.e. the colour of the petals and usually filaments, is generally species specific, except for the occasional plant with white flowers, as recorded for both the ornithophilous, usually red-flowered forms, e.g. *K. pulchella* var. *albiflora* (S.Moore) Grieve, and the entomophilous commonly pink-flowered *K. parvifolia* var. *alba* Maiden & Betcher. Such infraspecific taxa are not adopted here, because in these cases flower colour could not be linked to other distinguishing characters. The exception is the white-flowered form of *K. muelleri*, which is here raised to species level as *K. dactylota*, as it showed additional characteristics, a different habitat and distribution.

**Gynoecium.** In early diagnoses of *Kunzea*, the capitate stigma was considered the essential character to distinguish it from *Leptospermum* (Smith 1797, Reichenbach 1828, Heynhold 1840), and it is commonly observed in subgenera *Kunzea* and *Salisia*, but even there, the stigma is often flat to funnel-shaped, as is more typical of the subgenera *Angasomyrtus* and *Niviferae*. However, the variation of the shape of the stigma is not even characteristic of different groups, but may be individual to species as, for instance, the obliquely truncate stigma of *K. newbeyi* (Toelken 1996, fig. 8G). In most species the styles are about as long as the filaments, so that the stigma is at about the level of the anthers. Distinctly shorter styles are found in *K. salina* and species of sect. *Niviferae*, which also have long and shorter stamens.

The number of locules of the ovary rarely varies much and is usually characteristic of a species, while the number of ovules per locule often varies greatly with environmental conditions, particularly in species with many ovules. However, a reduction in the number of locules from 5 or 4 in the majority of species of the Western Australian subgenus *Salisia* and eastern section *Niviferae* to commonly 3 in the majority of eastern *Kunzea* species, but also the western *K. salina*, is often continued in certain species of different infrageneric groupings to 2 locules. Most of the species with only 2 locules have also a reduced number of ovules per locule, e.g. *K. eriocalyx* and *K. cambagei*, and these ovules are elongate and pendulous, while ovules are usually short and spreading in other species of the genus. The lower number of ovules per locule, as used by Bentham (1867)

to distinguish the mainly Western Australian pink-flowered species of his sect. *Eukunzea*, as opposed to sect. *Salisia*, which has numerous ovules, can, with so much more material at hand, no longer be accepted as a natural grouping.

The placentation also varies from commonly axile to apical in species with reduced numbers of ovules per locule. The style base is more or less sunk into the apex of the ovary. This is in turn surrounded by the often hairy hypanthium, which continues into the erect free hypanthium surmounted by the calyx lobes. The upper surface of the ovary is usually glabrous and only in a few species, such as forms of *K. obovata* and *K. parvifolia*, densely hairy or with few bristles next to the style in *K. cambagei*.

**Fruit.** Normally the fruits of *Kunzea* are dry capsules, which dehisce by loculicidal slits on the upper surface of the ovary similar to those of *Leptospermum*, but in contrast to most species of that genus and the similar *Callistemon* the fruit are deciduous. However, exceptions are the non-dehiscent, but dry fruit of *K. cambagei* and fleshy and dark purple to black ones of *K. pomifera*.

### Hybrids

Few of the treatments of *Kunzea* in recent floras mention or allow for natural putative hybrids, while Elliot & Jones (1993) frequently refer to hybridization in horticulture, where, admittedly, different species are often brought in close contact. Although in this paper, hybrids might appear to be reported out of proportions to their relative infrequent occurrence indicated, this is intentional in order to draw attention to possible problems in delineation or identification of taxa (cf. Toelken 1996, p. 30), particularly as they are less common in eastern than in western Australian species. Less is also known about the range of variation of individual hybrid combinations of eastern Australian species, so that they are not included in the keys to species, as was done for the western Australian ones (Toelken 1996).

Often, having examined a few hybrids in the field, similar unusual plants or specimens are quickly recognised, once the variation of the species in the area has been established. Population studies are essential in the recognition of hybrids. They are usually found where two or more species occur in close proximity, but, as there are usually only a few hybrids in an area, they might not display the complete range of variation between the putative parents.

In order to confirm hybridity of specimens (cf. Toelken 1996) pollen was stained for several hours in cotton blue in lactophenol. Hybrids are indicated by a high percentage, frequently higher than 10% of otherwise normal looking pollen grains remaining unstained or not stained very well (cf. de Lange & Murray 2004, de Lange et al. 2005). In extreme cases the pollen may show a varying number of pollen grains of an irregular shape. In some cases, as in hybrids of, for instance, *K. juniperoides* subsp. *pernervosa* × *K. parvifolia*, more

**Table 1.** Classification of *Kunzea*, listing all Australian taxa. References to detailed description of species and subspecies not discussed in this paper are given (JABG = J. Adelaide Bot. Gard.). The revision of *Kunzea* sect. *Niviferae* is currently in preparation and will be published separately.

<b>A. <i>Kunzea</i> subgen. <i>Salisia</i> (Lindl.) Toelken &amp; de Lange</b>	<b>B. <i>Kunzea</i> subgen. <i>Kunzea</i></b>
<b>A.1. <i>Kunzea</i> sect. <i>Salisia</i> (Lindl.) Benth.</b>	26. <i>K. juniperoides</i> Toelken
1. <i>K. pulchella</i> (Lindl.) A.S.George	26a. subsp. <i>juniperoides</i>
2. <i>K. baxteri</i> (Klotzsch) Schauer	26b. subsp. <i>pernervosa</i> Toelken
<b>A.2. <i>Kunzea</i> sect. <i>Floridae</i> (Toelken) Toelken &amp; de Lange</b>	27. <i>K. dactylota</i> Toelken
3. <i>K. similis</i> Toelken — JABG 17: 86	28. <i>K. muelleri</i> Benth.
3a. subsp. <i>similis</i> — Nuytsia 17: 390	29. <i>K. pomifera</i> F.Muell.
3b. subsp. <i>mediterranea</i> Toelken & G.F.Craig — Nuytsia 17: 390	30. <i>K. aristulata</i> Toelken
4. <i>K. acuminata</i> Toelken — JABG 17: 88	31. <i>K. rupestris</i> Blakeley
5. <i>K. pauciflora</i> Schauer — JABG 17: 90	32. <i>K. cambagei</i> Maiden & E.Betche
6. <i>K. preissiana</i> Schauer — JABG 17: 92	33. <i>K. capitata</i> (Sm.) Rchb. ex Heynh.
7. <i>K. acicularis</i> Toelken & G.F.Craig — Nuytsia 17: 392	33a. subsp. <i>capitata</i>
8. <i>K. jucunda</i> Diels — JABG 17: 95	33b. subsp. <i>seminuda</i> Toelken
9. <i>K. affinis</i> S.Moore — JABG 17: 98	34. <i>K. obovata</i> N.Byrnes
10. <i>K. strigosa</i> Toelken & G.F.Craig — Nuytsia 17: 394	35. <i>K. parvifolia</i> Schauer
11. <i>K. cincinnata</i> Toelken — JABG 17: 101	36. <i>K. badjaensis</i> Toelken
12. <i>K. eriocalyx</i> F.Muell. — JABG 17: 103	37. <i>K. opposita</i> F.Muell.
<b>A.3. <i>Kunzea</i> sect. <i>Zeanuk</i> Toelken</b>	37a. var. <i>opposita</i>
13. <i>K. montana</i> (Diels) Domin — JABG 17: 34	37b. var. <i>leichhardtii</i> N.Byrnes
14. <i>K. sulphurea</i> Tovey & P.Morris — JABG 17: 37	38. <i>K. calida</i> F.Muell.
15. <i>K. glabrescens</i> Toelken — JABG 17: 41	<b>C. <i>Kunzea</i> subgen. <i>Angasomyrtus</i></b>
16. <i>K. ericifolia</i> (Sm.) Rchb. ex Heynh. — JABG 17: 44	(Trudgen & Keighery) de Lange & Toelken
16a. subsp. <i>ericifolia</i> — JABG 17: 44	39. <i>K. salina</i> (Trudgen & Keighery) de Lange & Toelken
16b. subsp. <i>subulata</i> Toelken — JABG 17: 47	<b>D. <i>Kunzea</i> subgen. <i>Niviferae</i> Toelken &amp; de Lange</b>
17. <i>K. spathulata</i> Toelken — JABG 17: 48	<b>D.1. <i>Kunzea</i> sect. <i>Platyphyllae</i> Toelken &amp; de Lange</b>
18. <i>K. clavata</i> Toelken — JABG 17: 50	40. <i>K. flavescens</i> C.T.White & Francis
19. <i>K. recurva</i> Schauer — JABG 17: 55	41. <i>K. bracteolata</i> Maiden & E.Betche
20. <i>K. newbeyi</i> Toelken — JABG 17: 60	42. <i>K. graniticola</i> N.Byrnes
21. <i>K. rostrata</i> Toelken — JABG 17: 62	43. <i>K. sericothrix</i> Toelken
22. <i>K. ciliata</i> Toelken — JABG 17: 64	44. <i>K. caduca</i> Toelken
23. <i>K. praestans</i> Schauer — JABG 17: 66	45. <i>K. truncata</i> Toelken
24. <i>K. micrantha</i> Schauer — JABG 17: 69	46. <i>K. petrophila</i> Toelken
24a. subsp. <i>micrantha</i> — JABG 17: 72	<b>D2. <i>Kunzea</i> sect. <i>Pallidiflorae</i> Toelken &amp; de Lange</b>
24b. subsp. <i>petiolata</i> Toelken — JABG 17: 73	47. <i>K. occidentalis</i> Toelken
24c. subsp. <i>oligandra</i> (Turcz.) Toelken — JABG 17: 75	48. <i>K. ambigua</i> (Sm.) Druce
24d. subsp. <i>hirtiflora</i> Toelken — JABG 17: 77	49. <i>K. axillaris</i> Toelken
25. <i>K. micromera</i> Schauer — JABG 17: 78	<b>D3. <i>Kunzea</i> sect. <i>Niviferae</i> Toelken &amp; de Lange</b>
	— To be published separately.

than 50% of the pollen failed to stain properly for some specimens. As this is a reflection of the degree of compatibility of the parent species concerned, this can only be observed in some putative hybrids; in others the staining is marginal. In spite of shortcomings of the less objective method of studying abnormal morphological characters in order to establish hybrids rather than local variation, this is in most cases the only guide short of molecular examinations to draw attention to putative hybrids (cf. Toelken 1996, pp. 30, 31).

A full recombination of the characteristics of the putative parents is only found in rare localised hybrid swarms, e.g. *K. recurva* × *K. sulphurea* (Toelken 1996, p. 59) or *K. capitata* subsp. *capitata* × *K. capitata* subsp. *seminuda* along the lower Shoalhaven River. Only among species of sect. *Niviferae* (Toelken, in prep.) extensive hybrid swarms (de Lange et al. 2005, 2014) have considerably impeded recognition of species and lead to the one-species concept in this species complex referred to under different names (cf. Introduction) like *K. peduncularis* in Bentham (1867), *K. phyllicoides*

in Cheel (1943), Blake (1958), Byrnes (1982), or *K. ericoides* in Thompson (1983). De Lange et al. (2005), however, established ten species in New Zealand alone by identifying hybrids through performing a wide range of interspecific and intergeneric (with *Leptospermum scoparium*) artificial cross combinations, examining their intermediate morphology and, in complex molecular studies including *genomic in situ hybridization* (GISH), determined compatibilities and relations. The authors report that members of the New Zealand species of the *K. ericoides* complex hybridise easily, but artificial crosses failed between them and the almost indistinguishable Australian members of the complex; nor were hybrids obtained between them and Australian species of other subgenera, e.g. *K. baxteri* (subgen. *Salisia*) and *K. parvifolia* (subgen. *Kunzea*).

De Lange & Murray (2004) found that the chromosome numbers for most of the species examined are  $2n = 22$ . Few crosses of *Kunzea* species with *Leptospermum scoparium* produced viable seedlings but no flowers, presumably because some hybrids had  $2n$

= 23. The lack of hybrids between Australian species of the *K. ericoides* complex (subgen. *Niviferae* sect. *Niviferae*) and, for instance, the somewhat similar *K. ambigua* (subgen. *Niviferae* sect. *Pallidiflora*), which often grow close to one another, have usually been assumed to be due to the very much shorter style and two rows of stamens with anthers in a different position in the *K. ericoides* complex. Similarly, it seems the very different arrangement of floral parts (presume different pollination syndrome) in the flowers of the ornithophilous species, *K. baxteri* and *K. pulchella*, have prevented hybridization with other kunzeas rather than their remote habitats, as no such hybrids are mentioned in horticulture (Elliot & Jones 1993) where they are often grown close to one another. However, examinations of incompatibility of Australian taxa could be beneficial to a better understanding of relationships, in view of a recent record of a group of plants of *K. parvifolia* (subgen. *Kunzea*)  $\times$  *K. peduncularis* (sect. *Niviferae*) (Molyneux & Forrester 2016, p. 53).

In spite of this definite indication of hybridity the actual identification of the putative parents remains subjective, as it usually relies largely on a knowledge of parent species potentially present at a locality. Usually it involves only two parents and no multiple-species hybrids were encountered although compatibility does not seem to exclude this possibility. It is possible to get confused by the apparently different morphology of hybrids involving the same parent taxa, if only a few have been recorded between the only two taxa at a specific locality, because each hybrid collection represents only a small part of the range of recombination of characters of the parent species. An example of this is an interim presentation, e.g. *K. cambagei*  $\times$  *K. parvifolia* A and B, where the two hybrids could not be included in the same description as no more plants could be found even though the area was searched.

In view of the incompletely known variation of hybrids, they are presented as a hybrid formula (not nothospecies) together with a brief diagnosis and specimens examined, including related material of the putative parents, are always cited at the end of the species first in alphabetical order within the hybrid formula. A cross reference is, however, included under the second taxon in the formula. New records are encouraged in the hope of obtaining a better understanding and a wider circumscription of the potential variation of hybrids. The variation presented by one hundred year-old specimens of the subspecies of *K. capitata*, such as *A.A.Hamilton NSW123986* (Wentworth Falls) and *A.A.Hamilton NSW123987* (Lawson) can now be interpreted, branch by branch, as taxa as well as hybrids. They might also indicate that the subspecies in those days had a different distribution than at present. Natural hybrids are apparently not only due to human intervention in native vegetation, as was already recorded by J. Drummond in the 1840s for *K. montana*  $\times$  *K. recurva* in Western Australia (cf. Toelken 1996, p.31).

For general identification purposes it is necessary to remember that:

- (1) only in rare extensive hybrid swarms, such as, *K. capitata* subsp. *capitata*  $\times$  *K. capitata* subsp. *seminuda*, or among members of the *K. ericoides* complex, the variation might present a complete range of intermediates between the parent taxa;
- (2) in places with only a few hybrid plants present, they need not closely resemble one another as shown in the situation of, for instance, *K. cambagei*  $\times$  *K. parvifolia* A and B;
- (3) a change in flower colour can be indicative of hybridity, but has often also been recorded for variants of otherwise homogenous populations of species, as, for instance, *K. parviflora* var. *alba*;
- (4) perennial hybrid plants of kunzeas can at least theoretically outlast one or both putative parents at a locality, as is probably the case in *K. cambagei*  $\times$  *K. capitata* subsp. *seminuda*, since only the first parent was recorded from the immediate vicinity;
- (5) hybrids will be much more common in cultivated plants (Elliot & Jones 1993), because, in gardens, species might be brought together, which in their natural habitat would not be able to come into contact with one another.

### Taxonomy

This revisional study is based predominantly on herbarium material supported by field studies. Wherever possible hybrids were examined in situ, but once the variation of taxa had been established, others were detected among existing herbarium material and then often confirmed by additional material collected. The infrageneric classification is based on a collaborative effort between molecular evidence by de Lange's team and morphological reasoning further discussed under each of these taxa. This recently published infrageneric classification of *Kunzea* (de Lange et al. 2010) provides a basis to attempt to unite the already published parts of the revision with the present one by describing and discussing each infrageneric taxon in order to provide a better overview of the whole genus.

Although most types known were examined, a few isotypes and/or syntypes of synonyms could not be located and/or not examined in detail and are thus indicated as n.v. (non vide). Lectotypes were selected for many names in accordance with Article 9.2 (McNeill et al. 2012), but it was often difficult to discern proper duplicates (isolectotypes), especially for species described by F. Mueller, as specimens from the same locality usually did not bear the same detailed inscriptions which qualified them to be selected as the lectotype. Such specimens are indicated as "possible isolectotypes", as this may enable the identification of others, because many more duplicates than examined by the author were often distributed by F. Mueller to herbaria world-wide.



**Kunzea Rchb.**

- Consp. Regn. Veg. 175 (1828), nom. cons.: Toelken, Taxon 30: 350 (1981) & Toelken, Taxon 30: 828 (1981); Schauer in Lehm., Pl. Preiss. 123 (1844); Benth., Fl. Austral. 3: 111 (1867); Byrnes, Austrobaileya 1: 468–471 (1982); Joy Thomps., Telopea 2: 379–383 (1983); de Lange et al., Austral. Syst. Bot. 23: 316 (2010). — **Type species:** *Kunzea capitata* (Sm.) Heynh., lecto. cons.: Toelken, Taxon 30: 350 (1981).
- Tillospermum* Salisb., Monthly Rev. 75: 74 (1814). — **Type species:** *Leptospermum ambiguum* Sm.
- Pentagonaster* Klotzsch, Allg. Gartenzeitung 4: 112 (1836). — **Type species:** *Pentagonaster baxteri* Klotzsch.
- Stenospermum* Sweet, Hort. Brit. ed. 2, 209 (1830), Sweet, Hort. Brit. ed. 3, 220 (1839), nom. inval., sine descr. generico. — *Stenospermum* Sweet ex Heynh., Nomencl. Bot. Hort. 1: 787 (1841), nom. illeg., *Kunzea* in syn. — **Type species:** *Stenospermum capitatum* Sweet ex Heynh. (lecto., designated here; cf. Typification).
- Salisia* Lindl., Sketch Veg. Swan R. x (1839). — **Type species:** *Salisia pulchella* Lindl.
- Angasomyrtus* Trudgen & Keighery, Nuytsia 4(3): 435 (1983). — **Type species:** *Angasomyrtus salina* Trudgen & Keighery.
- Leptospermum* auctt. non Forster & G.Foster: Sm., Trans. Linn. Soc. London 3: 264 (1797), pro parte, quoad *L. ambiguum* Sm.; Cheel, J. & Proc. Roy. Soc. New South Wales 76: 230 (1943), pro parte, quoad *L. phyllicoides* (A.Cunn. ex Schauer) Cheel; S.T.Blake, Proc. Roy. Soc. Queensland 69: 77 (1958), pro parte, quoad *L. phyllicoides* (A.Cunn. ex Schauer) Cheel; Byrnes, Austrobaileya 1(5): 468 (1984), pro parte, quoad *L. phyllicoides* (A.Cunn. ex Schauer) Cheel.
- Metrosideros* auctt. non Gaertner: Sm., Trans. Linn. Soc. London 3: 273 (1797), pro parte, quoad *M. capitata* Sm.; Vent., Jard. Malmaison 1: 46 (1804), pro parte, quoad *M. corifolia* Vent.; Sm. in Rees, Cycl. 23: *Metrosideros* no. 16 (1813), pro parte, quoad *M. capitata* Sm., *M. ericifolia* Sm.; Hoffmanns., Verz. Pfl.-Kult. 80 (1824), pro parte, quoad *M. abietina* Hoffmanns.; Spreng., Syst. Veg., ed. 16, 2: 490, 491(1825), pro parte, quoad *M. capitata* Sm., *M. corifolia* Vent., *M. ericifolia* Sm.; DC., Prodr. 3: 225 (1828), pro parte, quoad *M. capitata* Sm., *M. corifolia* Vent., *M. ericifolia* Sm.
- Callistemon* auctt. non R.Br.: Rchb., Iconogr. Bot. Exot. 1: 59, t.84 (1827), pro parte, quoad *C. capitatus* (Sm.) Rchb.; Lindl., Edward's Bot. Reg. 24, pl. 7 (1838), pro parte, quoad *C. macrostachyum* Lindl.; F.Muell., Fragm. 3: 153 (1863), pro parte, quoad *C. haenesii* F.Muell.
- Melaleuca* auctt. non L.: Sieber, Fl. Mixta 609 (1836), pro parte, quoad *M. thymoides* Sieber nom. nud., nom. illeg., non Labill. (1806); Spreng., Syst. Veg., ed. 16, 3: 336 (1825), pro parte, quoad *M. eriocephala* Sieber ex Spreng.
- Baeckea* auct. non L.: Schauer, Repert. Bot. Syst. 2, Suppl. 1: 921 (1843), pro parte, quoad *B. phyllicoides* A.Cunn. ex Schauer.

Shrubs or trees; branches with leaf bases often becoming flanged with incurved margins. *Leaves* alternate, rarely opposite. *Inflorescences* usually apparently terminal botrya, globose to elongate, with usually sessile, rarely stalked flowers; bracts deciduous and scale-like chartaceous, rarely fleshy and ± leaf-like and then often caducous, with 1–9 main veins from the base; bracteoles in pairs, deciduous to caducous. *Flowers*

5-merous, pink to purple or white, rarely yellow or red; free hypanthium surmounting ovary. *Calyx lobes* persistent on fruit. *Petals* free and usually clawed. *Stamens* usually more than 20, in more than one series, usually longer than petals or if shorter then often some incurved. *Ovary* (2) 3 to 5-locular; placenta peltate with axile placentation and numerous spreading ovules, rarely apical with few pendulous ovules. *Fruit* usually a loculicidal capsule with apical splits, rarely indehiscent or fleshy and berry-like in *K. pomifera*, deciduous.

**Discussion.** Throughout the wide distribution of the genus in Australia and New Zealand one finds, not surprisingly, a number of extreme forms amongst the over 60 species recognised at present. While the majority of species have pink to purple, rarely white or yellow, sessile flowers densely clustered into globular inflorescences, there are also two species with large red ornithophilous flowers on elongate inflorescences, and more than 12 species, generally referred to as the *K. ericoides* group, with loosely arranged stalked flowers with unequally long stamens and usually distal leaves on racemiform inflorescences.

**Typification & nomenclature.** Concurrent with presenting a proposal (Toelken 1981a) for the conservation of *Kunzea* Rchb. (1828) against the disused homonym *Kunzia* Spreng. (1818) together with the conserved lectotype *K. capitata* (Sm.) Heynh., Mabberley (1980) drew attention to the even earlier name for the genus, *Tillospermum* Salisb. (1814). Toelken (1981b) proposed a second conservation of *Kunzea* against *Tillospermum*, which is earlier so that it automatically conserves the genus over *Kunzia* (conservation confirmed in *Taxon* 33: 299, 1984).

Although Sweet (1830, 1839) published the combination *Stenospermum capitatum*, it was invalid, because the genus name had not previously been validly published (Article 35.1, McNeill et al. 2012). The reference by Heynhold (1840) to *Kunzea* Rchb. validated the genus and species names quoted (Article 38.1, McNeill et al. 2012), but, as he cited *Kunzea* in the synonymy, *Stenospermum* becomes an illegitimate name (Article 52.1, McNeill et al. 2012). As Heynhold did not designate a type species for the genus, *Stenospermum capitatum* Sweet ex Heynh. is here selected as the type, in agreement with discussions in *Kunzea* that the capitate stigma was regarded at the time as the main distinguishing character of the genus (Reichenbach 1828, Mabberley 1980, Toelken 1981a). However, Reichenbach (1828) did not make the combinations for the four species cited under *Kunzea*.

A few species now included in the genus *Kunzea* were described in *Metrosideros* and de Candolle (1828) included them in a separate group with alternate leaves. Others were retained in the genus *Leptospermum*, and in particular species of *Kunzea* [subgen. *Niviferae*] sect. *Niviferae* were only recently placed by Thompson (1983) into *Kunzea*.

**Key to infrageneric taxa**

1. Inflorescence with 2 (–6) flowers and ending in a tuft of leaves ..... **C. *Kunzea* subgen. *Angasomyrtus***
- 1: Inflorescence with 6–∞ flowers or without terminal tuft of leaves
  2. Western Australian plants; ovary mainly with 4 or 5 locules; epidermis of young branches shed in large slough-like pieces, or flowers red and filaments 10–24 mm long ..... **A. *Kunzea* subgen. *Salisia***
  3. Filaments 10–24 mm long; hypanthium > 3.3 mm long; petals red, rarely white ..... **A.1. *K.* sect. *Salisia***
  - 3: Filaments 2–5.5 mm long; hypanthium < 3.1 mm long; petals pink to off-white
    4. Inflorescence with (1–) 3–8 (–12) flowers; stamens usually shorter than, or as long as petals ... **A.2. *K.* sect. *Floridiae***
    - 4: Inflorescence with > 10 flowers; stamens longer than petals ..... **A.3. *K.* sect. *Zeanuk***
- 2: Eastern Australian plants; ovary with 2 or 3, rarely 5 locules; epidermis of young branches shed in strips
  5. Petals pink, rarely yellow or white; inflorescence globular or rarely elongate; not branching at each node ..... **B. *Kunzea* subgen. *Kunzea***
  - 5: Petals white; inflorescence frequently elongate; often regularly branching at each node (except irregularly branching in most species of sect. *Platyphylla*) ..... **D. *Kunzea* subgen. *Niviferae***
  6. Distal young main branches irregularly branching from some nodes and these lateral branches are usually longer than the subtending leaf (except *K. petrophila*, but then with acuminate bracts); bracts usually scale-like chartaceous ..... **D.1. *K.* sect. *Platyphylla***
  - 6: Distal main branches developing lateral branches in the axil of each leaf, but some remain short shoots which are shorter or as long as subtending leaf; bracts fleshy and green and often with membranous margin
    7. Mature flower buds apically acute with erect calyx lobes; inflorescence usually without terminal leaves ..... **D.2. *K.* sect. *Pallidiflorae***
    - 7: Mature flower buds apically truncate with incurved calyx lobes; inflorescence with few to many terminal leaves ..... **D.3. *K.* sect. *Niviferae***

**A. *Kunzea* subgen. *Salisia* (Lindl.) Toelken & de Lange**

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). — *Salisia* Lindl., Sketch Veg. Swan R. x (1839). — *Kunzea* sect. *Salisia* (Lindl.) Benth., Fl. Austral. 3: 115 (1867), pro parte, quoad *K. baxteri*, *K. pulchella*. — **Type species:** *Salisia pulchella* Lindl.

Main branches with irregular growth flushes (or woody regular short shoots in *K. pulchella*); branches with raised but scarcely decurrent leaf bases not flanged, with epidermis splitting into large slough-like membranes (or if not then flowers red in sect. *Salisia*). *Leaves* with pinched apex, with 1 main vein, except 3 in *K. baxteri*. *Inflorescence* usually a globular botryum with 1–40 flowers, without terminal leaves (or elongate and with red flowers and terminal leaves in *K. baxteri* and *K. pulchella*), with growth after fruiting usually continuing terminally (or often laterally in sect. *Floridiae*); *bracts* broad and scale-like chartaceous, persistent to ± deciduous (or leaf-like, caducous with red flowers for *K. baxteri* and *K. pulchella*); *bracteoles* scale-like chartaceous, persistent or deciduous (or leaf-like, caducous with red flowers for *K. baxteri* and *K. pulchella*). *Flowers* sessile (or stalked with usually large red flowers in *K. pulchella*), with bulging and rounded to acute apex of flower buds. *Stamens* usually longer than petals (except about equally long in species of sect. *Floridiae*), erect-spreading. *Ovary* with (2–) 4 or 5 locules, each with peltate placenta with 10–∞ short spreading ovules (or 1 to few elongate and pendulous); *style* slender and as long as stamens, often much longer than the free hypanthium.

**Discussion.** As the description indicates, subgen. *Salisia* is a morphologically very diverse group, mainly due to some extremes, such as *K. baxteri* and *K. pulchella* in

sect. *Salisia*, while species of the sections *Zeanuk* and *Floridiae* form more homogeneous groups. The small-flowered kunzeas in Western Australia of the latter two sections, were segregated by Toelken (1996, in a slightly different arrangement) from similar-flowered species in eastern Australian mainly by the slough-like abscission of the epidermis on developing branches. In subgen. *Salisia*, the two large-flowered species unique to the genus, were added based on molecular evidence (de Lange et al. 2010), so that this subgenus includes all Western Australian species except for *K. salina*. The latter species is referred to the separate subgen. *Angasomyrtus*, which shows closer affinities to the eastern Australian subgenera *Kunzea* and *Niviferae*, as discussed there.

Clade A (combined rDNA ITS and ETS) in de Lange et al. (2010, fig. 1) shows strong support (BS = 91%) for separation from the eastern species and even stronger separation (BS = 100%) of sect. *Zeanuk* from sect. *Salisia* and sect. *Floridiae*. Sect. *Salisia*, including *K. baxteri* and *K. pulchella*, has always been regarded morphologically as quite distinct on account of the large, usually red ornithophilous flowers, but the two species differ so obviously by their individual inflorescences, bracts and venation of the leaves. O'Brien et al. (2000) already mentioned that the two species showed greater affinity to *K. montana* (sect. *Zeanuk*) than to the eastern Australian species. However, the terminal branches on Clade A1 (sect. *Salisia* in de Lange et al. 2010, fig. 1) of *K. pulchella*, and particularly of *K. baxteri* are remarkably long to indicate much evolutionary development in contrast to the very short branch lengths of species of the sections *Floridiae* and *Zeanuk*.

While species of sect. *Zeanuk* are found mainly west of Albany, species of sections *Floridiae* and *Salisia* occur in the south-eastern parts of Western Australia,

east of Ravensthorpe, and *K. pulchella* further inland to the north-east.

### A.1. *Kunzea* sect. *Salisia* (Lindl.) Benth.

Fl. Austral. 3: 112, 115 (1867), pro parte, quoad *K. sericea* (synonym of *K. pulchella*), *K. baxteri*. — *Salisia* Lindl., Sketch Veg. Swan R. x (1839). — **Type species:** *Salisia pulchella* Lindl.

*Pentagonaster* Klotzsch in Otto & A.Dietr., Allg. Gartenzeitung 4: 113 (1836). — *Kunzea* sect. *Pentagonaster* (Klotzsch) Kuntze in Post & Kuntze, Lex. Gen. Phan. 311 (1903), nom. illeg.: sect. *Salisia* (Lindl.) Benth. is cited in synonymy. — **Type species:** *Kunzea baxteri* (Klotzsch) Schauer.

Shrubs or trees 1.5–3 (–5) m tall, branching in seasonal growth flushes in *K. baxteri* and ± regular branching in *K. pulchella*; young branches shedding epidermis in fibrous strips. *Leaves* with 1 (–3) main veins. *Inflorescence* with (1–) 6–25 (–40) flowers, ± elongate spiciform to racemiform, usually single, apparently terminal, rarely proliferating in *K. baxteri*, or subtended by smaller globular ones on lateral short shoots in *K. pulchella*. *Flowers* sessile or stalked, red, sometimes white; *stamens* 3–5 times longer than petals; *ovary* (4–) 5-locular; ovules 40–65 per locule, spreading.

**Discussion.** The two species with very diverging morphology do not present at first sight a very homogenous grouping, and yet, they were always placed together, presumably because of their large ornithophilous flowers, unique to the genus.

Both species are usually associated with granite outcrops. *K. pulchella* occurs in the semi-arid areas of in the central south-west, while *K. baxteri* is found in south-eastern Western Australia.

#### Key to species of sect. *Salisia*

1. Leaves obovate, with 1 central vein, with lateral margins ± incurved; flowers with stalk (1–) 2.5–5.5 mm long; seed testa with many short vertical cells . . . . . **1. *K. pulchella***
- 1: Leaves linear, linear elliptic, usually with three main veins, ± flat; flowers sessile or subsessile with stalk less than 1 mm long; seed testa with few long vertical cells . . . . . **2. *K. baxteri***

#### 1. *Kunzea pulchella* (Lindl.) A.S.George

W. Austral. Naturalist 10: 32 (1966); Erickson et al., Fl. & Pl. W. Austral. 132, fig. 410 (1973); Blackall & Grieve, How to know W. Austral. Wildfl. ed. 2, 3A: 101, pl. 7 (1980); J.Green, Census Vasc. Pl. W. Austral. ed. 2, 128 (1985); C.A.Gardner, Wildfl. W. Austral. ed. 16, 97 (1986); Beard, Plantlife W. Austral. 125 (1990); Corrick & Fuhrer, Wildfl. S. W. Austral. 131 (1996). — *Salisia pulchella* Lindl., Sketch Veg. Swan R. x (1839). — **Type:** Swan River, *J.Mangles s.n.* (holo.: CGE).

*Kunzea sericea* Turcz., Bull. Soc. Imp. Natural. Moscou 20, 1: 162 (1847), non *Leptospermum sericeum* Labill.; Benth., Fl. Austral. 3: 117 (1867); Blackall & Grieve, How to know W. Austral. Wildfl. 1: 293 (1954); C.A. Gardner, Wildfl. W. Austral. 107, fig. (1959); Beard, W. Austral. Pl. 77 (1965); Morcombe, Austral. Wildfl. 102, fig. (1970). — *Kunzea sericea* var. *sericea*. S.Moore, J. Linn. Soc. Bot. 34: 192 (1899). — **Type:** Swan River,

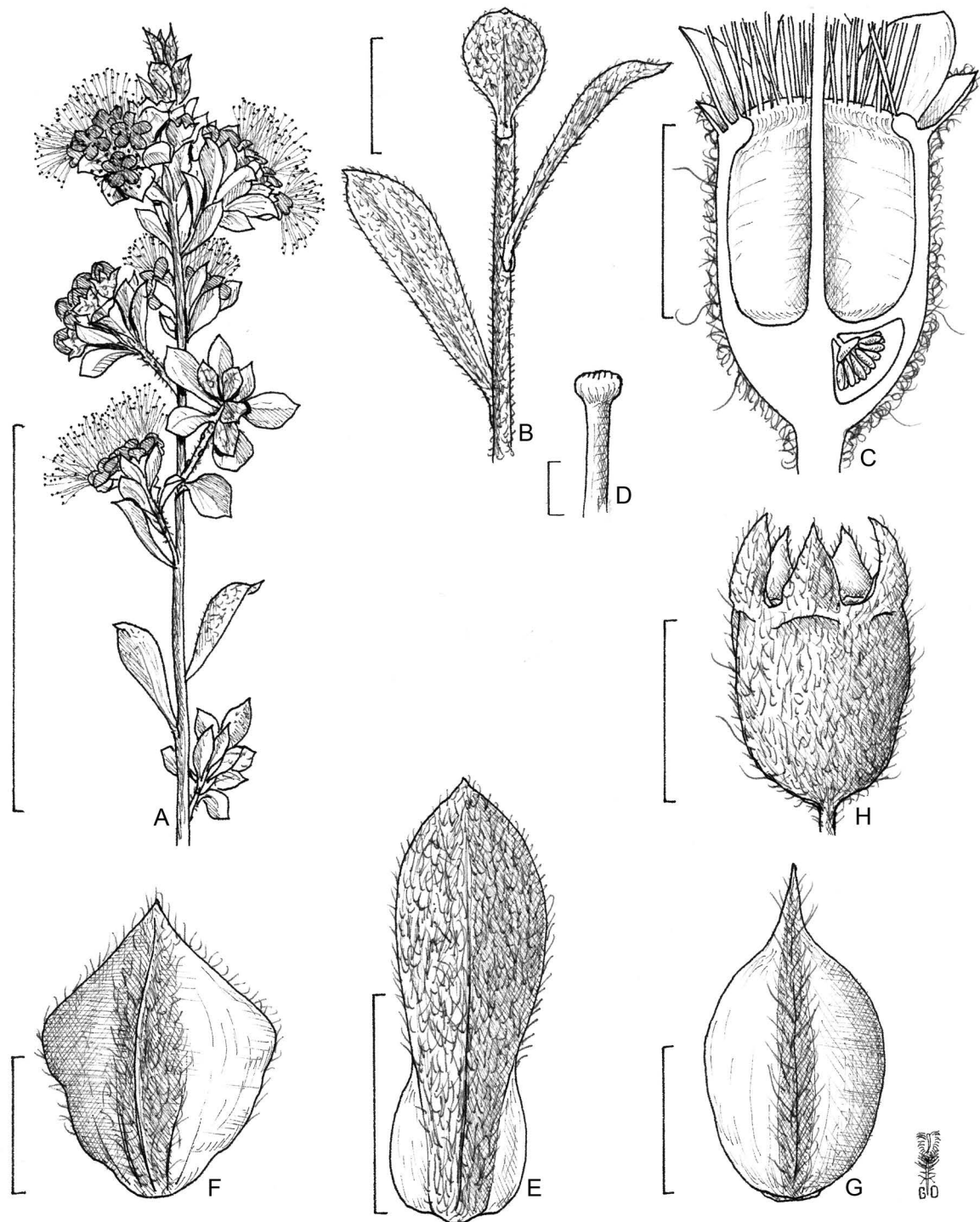
*J.Drummond 3<sup>rd</sup> coll. 40* (holo.: KW, n.v.; PERTH, photo!; possible iso.: BM, CGE, K, MEL92408, W).

*Kunzea sericea* var. *albiflora* S.Moore, J. Linn. Soc. Bot. 34: 192 (1899). — *Kunzea pulchella* var. *albiflora* (S. Moore) Grieve in Blackall & Grieve, How to know W. Austral. Wildfl. ed. 2, 3A: 101 (1980), nom. inval., sine basionym. — **Type:** Gnarlbine, *S.Moore s.n.*, ix.1895 (holo.: BM; iso.: K).

*Kunzea sericea* var. *glabra* C.A.Gardner, J. Roy. Soc. W. Austral. 9, 1: 35 (1923). — **Type:** Mt Marshall near Bencubbin, *C.A.Gardner FDH 1714* (holo.: PERTH); *C.A.Gardner 1214* (iso.: PERTH; see Typification).

Shrubs 1.5–3 (–4) m tall, spreading, often sparsely branched; *young branches* with leaf bases barely raised and no flanges visible on long shoots, pubescent to tomentose with short ± appressed hairs overtopped by fewer longer ones; *early bark* splitting longitudinally and fluted, becoming somewhat corky with uppermost layer ± irregularly peeling. *Leaves* alternate; *petiole* (0–) 0.4–0.8 (–1.8) mm long, usually ± spreading; *lamina* obovate to oblanceolate, (3.2–) 5–14 (–20) × (2.1–) 2.5–5.2 (–8.2) mm, acute to cuspidate, rarely obtuse with or without mucro, gradually tapering into indistinct petiole, flat on both surfaces but adaxially somewhat folded lengthwise and canaliculate at least distally, with one major vein but rarely visible, usually densely appressed-pubescent, rarely glabrescent. *Inflorescence* a loose elongate, rarely rounded botryum with (1–) 6–14 (–18) flowers, each on a stalk (1–) 2.5–4.5 (–5.6) mm long, terminal on main and on short lateral shoots, often, but not always, with terminal vegetative growth continuing while flowering; *perules* usually 3–5, oblong-oblanceolate to obovate, with 1 vein, leaf-like, appressed-hairy, usually caducous; *bracts* ovate to obovate, 4.5–6 (–8) × 3.1–4 mm, acute to rounded, leaf-like, with 1 main vein, appressed-hairy or with hairs only along the central ridge of both sides, ciliate, caducous; *bracteoles* in pairs, ovate to linear-lanceolate, 4.4–5 × 2.4–2.7 (–3) mm, acute to acuminate, with one central vein, ± appressed-hairy or along the central ridge, ± ciliate, caducous. *Hypanthium* (3.3–) 4–5 (–5.2) mm when flowering (free tube 2.2–3.1 mm), outside usually densely pubescent to hirsute with ± spreading long and short hairs up to the base of filaments. *Calyx lobes* triangular, (1.6–) 2.4–3.2 (–3.4), acute to acuminate as margins become ± incurved, without membranous margins, densely covered with appressed to spreading hairs on the inside and outside. *Corolla lobes* almost orbicular, sessile or almost so, (3.2–) 3.8–5 (–5.6) mm, deep red or sometimes white, often with few to many cilia along the erose margins. *Stamens* usually more than 70 in more than one row; *filaments* 10–17 mm long (3–4 times longer than corolla lobes); *anthers* broadly ellipsoidal, 0.6–0.75 mm long, each with large terminal centrifugal gland bulging on both sides of connective. *Ovary* (4) 5 locules, with style base not or scarcely sunk into the upper surface; *placenta* a broadly elliptic to orbicular stiffly fleshy disc with short attachment in the centre, with ± connate lobes each with 4 rows of





**Fig 1.** *Kunzea pulchella*: **A** flowering branch; **B** cauline leaves; **C** half flower; **D** capitate stigma; **E** perule; **F** bract; **G** bracteole; **H** fruit. — Scale bars: **A** 4 cm; **B**, **C** 2 mm; **D** 0.5 mm; **E** 5 mm; **F** 3 mm; **G** 2.5 mm; **H** 4 mm. — **A–G** *M.Crisp* 5601 (CANB); **H** *A.M.Ashby* 3619 (AD).

ovules; *ovules* 44–51 per locule, subequal, spreading to somewhat pendulous; *style* 13.8–16.4 mm long, scarcely broadened basally; *stigma* slightly broader than style, with central depression. *Fruit* a usually broadly urceolate capsule, (3.6–) 4–4.8 (–5.2) mm, with stiffly erect calyx lobes. *Seeds* scarcely angular, obconical but with distal broad side  $\pm$  oblique, 1–1.3 mm long, covered with several short (c. 2–3 times longer as broad) cells in vertical lines becoming faintly ribbed. *Flowers*:

(September) October, November (rarely to March). *Common name*: **Silky kunzea** (Blackall & Grieve 1954, Morcombe 1970); **granite kunzea** (Erickson et al. 1973, Blackall & Grieve 1980, Corrick & Fuhrer 1996). **Fig. 1.**

*Distribution and ecology.* Growing in sandy to sandy-clay soils usually over granite outcrops in open scrubland in Avon, Roe and Coolgardie districts of Western Australia.

**Conservation status.** *Kunzea pulchella* is locally common; it is not threatened (W.A. Herbarium 1998–).

**Diagnostic features.** The large usually red, sometimes white, ornithophilous flowers superficially resemble those of *K. baxteri*, but *K. pulchella* is distinguished by its obovate to oblanceolate leaves, loosely branching inflorescence with more or less stalked flowers so that the central axis is usually visible, broadly triangular calyx lobes which are shorter than the corolla, flat (not stiffly conical) apex of mature buds, and shorter filaments. Even the occasional white-flowered plants are distinct, because all parts of their flowers are bigger than in any other species of *Kunzea*.

**Variation.** The indumentum of the whole plant, but particularly of the hypanthium of this species varies from usually short-sericeous to almost glabrous, but also to tomentose or even villous on some inflorescences. Some young plants examined, as well as coppicing branches had almost glabrous leaves except for the leaf margins.

The flower colour is recorded as red or white without a range of intermediates (e.g. *P.H.Barrett 11* – white; *12* – red), but varieties based on this difference could not be accepted, because this character could not be linked to supporting characters and/or ecological or geographical differences. On a specimen with white flowers, *B.J.Lepschi 3850*, the observation “brown honeyeaters and spiny cheeked honeyeaters are feeding on the flowers” indicates that red flower colour is not a prerequisite for birds frequenting them.

Similarly, plants from the south-west of the species’ distribution area with usually marginal cilia on the often erose corolla lobes were not given taxonomic rank because they show a large range of variation in respect of these characteristic petals, and this character could not be linked with supporting characters.

**Notes.** The distinctive camptodromous veining of the leaves of this species, the rather lax inflorescence with flowers on stalks with bracteoles above their middle, and unusually short cells on the seed testa are different from the usually elongate cells of other species in the genus. This species is also unique in the genus *Kunzea* because its style is already elongated considerably in as yet unopened buds so that it often becomes curved sideways or even downwards when the flowers open.

**Typification.** Turczaninow (1847) clearly stated that the type of *K. sericea* was number 40 collected on J. Drummond’s fourth expedition, which Benth (1867) already queried, as the collector had not been to the area concerned then and points out that specimens of this species from his first and third collection trip were both numbered 40. In view of this uncertainty of whether details on the holotype specimen were wrongly transcribed, all specimens of *J.Drummond 40* examined were enumerated as possible isotypes.

Turczaninow did not refer to or intend *K. sericea* to be a new combination for *Leptospermum sericeum* Labill. (cf. Thompson 1983, p. 361) and the photograph of the holotype in PERTH leaves no doubt about them being two different species. The two species of different genera were often confused in literature, because of their similar indumentum on the leaves. Gardner (1964) clearly distinguishes the inland species, *K. sericea*, from the coastal *L. sericeum*, which “is the common plant of the islands of the Recherche Archipelago”.

The number of the type quoted in the protologue of Gardner’s *K. sericea* var. *glabra* is No 1714 of the Forestry Department Herbarium, while his personal collector’s number is 1214 (Wilson 1988). Therefore the former is cited as holotype and the latter as isotype, although they have different numbers.

#### *Selection of specimens examined (c. 100 seen)*

WESTERN AUSTRALIA: *A.M.Ashby 3619*, Mt Churchman, 7.ix.1970 (AD, W); *E.T.Bailey 349*, Wadderin Rocks, ix.1947 (PERTH); *P.H.Barrett 11 & 12*, 5 mls [8 km] SW Woolgangie, xi.1952 (PERTH – white & red flowers); *M.D.Crisp 6335*, Dingo Rock, 31.x.1979 (CANB); *P.de Rebeira 39*, NE Muckinbudin near Yadegin Hill, 16.x.1978 (PERTH); *A.Eaton MEL92788*, Youndegin, 1891 (MEL); *D.B.Foreman 1093*, Bandicoot Rd, Tutanning Wildlife Sanctuary, 19.xi.1995 (MEL); *F.Fraser NSW124253*, between Kununoppin & Mt Marshall, 1919 (NSW – white & red flowers); *C.A.Gardner & W.E.Blackall 948*, 85 mls [136 km] E Southern Cross, 11.x.1931 (PERTH); *C.A.Gardner s.n.*, Bullabulling, 13.ix.1934 (PERTH – white & red flowers); *R.Helms s.n.*, c. 32 km W Red Kangaroo Hill, 13.xi.1891 (AD, NSW, MEL); *D.L.Jones 7959 et al.*, Hospital Rock, W Menzies on Riverina Rd, 26.ix.1991 (CANB); *T.R.Lally & B.J.Lepschi 424*, Dingo Rock, 17.x.1994 (CANB); *F.Lullfitz 1739*, E Pingelly, 29.xi.1962 (PERTH); *B.J.Lepschi 3850*, Yellowdine Rock, near Yellowdine Roadhouse, 1.xii.1997 (CANB – only white flowers); *S.Moore s.n.*, between Southern Cross & Siberia, i.1895 (BM); *R.W.Purdie 6104*, Baladjie Rock Nature Res., 24.ix.2005 (CANB); *S.B.Rosier 164*, Mollerin Rock, x/xi.1959 (PERTH); *L.W.Sage 2000*, Ive Rock, 7 km SW Mt Finnerty, Jaundi Stn, 6.x.1999 (CANB); *E.M.Scrymgeour 2120*, c. 8 mls [12.8 km] N Paynes Find, 20.ix.1967 (PERTH); *P.J.Spencer 16*, Keokanie Rock, on Bodallin North Rd, 13.vi.1995 (CANB); *F.H.Vachell 2*, Kellerberrin, 1903 (K); *J.Z.Weber 5200*, Mt Churchman, 19.x.1975 (AD, PERTH); *L.C.Webster NSW147255*, Coolgardie, 1899 (NSW); *J.H.Willis MEL92684*, Wongan Hills, 17.x.1963 (MEL).

#### *Putative hybrids*

(i) *K. baxteri* × *K. pulchella*: see (2) *K. baxteri*.

#### **2. *Kunzea baxteri* (Klotsch) Schauer**

in Lehm., Pl. Preiss. 1: 123 (1844); Benth., Fl. Austral. 3: 117 (1867); Blackall & Grieve, How to know W. Austral. Wildfl. 1: 294 (1954); Beard, W. Austral. Pl. 77 (1965); Erickson et al., Fl. & Pl. W. Austral. 135, fig. 425 (1973); Blackall & Grieve, How to know W. Austral. Wildfl., ed. 2, 3A: 101, pl. 7 (1980); C.A.Gardner, Wildfl. W. Austral., ed. 16, 97 (1986); N.G.Walsh & Stajic, Census Vasc. Pl. Victoria, ed. 8, 108 (2007). — *Pentagonaster baxteri* Klotzsch in Otto & A.Dietr., Allg. Gartenzeitung 4: 115 (1836). — **Type:** King George Sound, W. Baxter (neo., designated here: K000843010).



*Callistemon macrostachyum* Lindl., Edward's Bot. Reg. 24, pl. 7 (1839). — **Type:** lecto., designated here: plate 7 (1838).

*Callistemon hainesii* F.Muell., Fragm. 3: 153 (1863). — **Type citation:** "In tractu steriliore litorali inter promontoria Cape Arid et Cape Le Grand. Maxw." — **Type:** lecto., designated here: MEL 92502; possible isolecto.: PERTH; possible syn.: MEL 92500; MEL 92503, MEL 92504; cf. Typification below.

Shrubs 3 (–5) m tall, spreading, moderately to densely branched; young branches with leaf bases scarcely raised and with indistinct flanges, pubescent to tomentose with  $\pm$  appressed hairs overtopped by scattered longer ones; *early bark* splitting longitudinally and fluted becoming corky with upper layers often irregularly flaking. *Leaves* alternate; *petiole* (0.9–) 1.1–1.7 mm long, appressed or upper third spreading; *lamina* oblong to oblong-elliptic, (6–) 14–18 (–24)  $\times$  (1.2–) 2.5–3.5 (–5) mm, obtuse to almost rounded, rarely acute, usually abruptly tapering into petiole and apex, flat above and below or with margins slightly recurved, with 3 veins from the base, sparsely to densely hairy, rarely glabrescent on both surfaces, with dense hairs in more than one row along the margin. *Inflorescence* an elongate botryum with 16–27 (–39) flowers, terminal on all branches and often continued in terminal vegetative growth while flowering; *perules* rarely more than 5, linear-lanceolate to ovate, with 1–5 (–7) veins, leaf-like, glabrous except for marginal cilia, caducous; *bracts* at base oblong to linear-lanceolate becoming broadly obovate distally, (4.5–) 5–9  $\times$  (1.2–) 2–3 (–5) mm, acute to acuminate distally, leaf-like, with (1–) 3–5 veins, pubescent outside, mainly caducous but some distal ones often persisting for some time; *bracteoles* not seen. *Hypanthium* (6.5–) 7.8–8.8 mm long when flowering (free tube 3–3.5 mm long), outside with short appressed hairs and occasionally overtopped by spreading longer hairs, inside glabrous or with few scattered hairs. *Calyx lobes* linear-triangular, 4.5–6 mm long, drawn into stiffly erect point, without membranous margins, covered with short appressed hairs outside and inside. *Corolla lobes* obovate-orbicular, shortly clawed, (3.5–) 3.8–4.7 (–5.4) mm long, deep red, with very fine hairs on claw and surrounding areas. *Stamens* (30–) 41–52, in more than one row; filaments 19–24 mm long (4–5 times longer than corolla lobes); *anther* ellipsoidal, 0.9–1.2 mm long, with subterminal gland centrifugally attached to connective. *Ovary* (4) 5-locular, with style base deeply sunk into the upper surface; placenta a broadly elliptic to orbicular, stiffly fleshy disc, with short cylindrical attachment in the middle, with connate lobes each with 4 rows of ovules; ovules 43–63 per locule, subequal but marginal ones often distinctly smaller, spreading; style 19.6–25.4 mm long, slender and scarcely broadened towards the base but often with few hairs; stigmas scarcely broader than style, with central depression. *Fruit* a cup- to urn-shaped capsule 8–9.6 mm long, with stiffly erect calyx lobes. *Seeds*  $\pm$  angular obconical to obpyramidal, 1.8–2.2 mm long, often with irregular

appendix, covered with faint vertical ridges (10–12 per side) rarely with slightly oblique connections. *Flowers:* August–October (November, March, June). *Common name:* **Baxter's kunzea** (Erikson et al. 1973, Blackall & Grieve 1980). **Fig. 2.**

*Distribution and ecology.* Growing in coarse sandy soil or laterite, often associated with granite or rarely in quartzite outcrops in dry scrub, heath vegetation or eucalyptus woodland in eastern Eyre and Roe districts of the South Western Province and sporadically naturalised near Melbourne, Victoria.

*Conservation status.* Not threatened (W.A. Herbarium 1998–); 3KC in Briggs & Leigh (1996).

*Diagnostic features.* Next to *K. pulchella*, *K. baxteri* is the only species in the genus with large red ornithophilous flowers, but they are born on a spiciform inflorescence resembling those typical of *Callistemon*. They are, however, distinguished from the latter genus by the persistent calyx lobes and deciduous fruit. The oblong leaves and sessile flowers on a stout floral axes and slender erect calyx lobes easily distinguish *K. baxteri* from *K. pulchella*.

*Variation.* For *K. baxteri* a wide range in the density of the indumentum has been recorded, particularly in respect of the leaves. As a result some whole plants may appear grey-leaved next to others with deep green leaves, as some collectors have commented.

Vegetative growth above the inflorescence usually continues at and/or after flowering, and cultivated plants have been observed to produce up to three successive inflorescences within one extended season.

*Typification.* Klotzsch's herbarium was destroyed in B (Stafleu & Cowan 1986) and no specimen of *Pentagonaster baxteri* annotated by the author could be located. He stated in the protologue that he maintained the specific epithet as used in English horticulture ("Calothamnus Baxteri H. Angl."), in honour of William Baxter, who had introduced the species to Europe from seeds he collected in Australia in the 1820s. It seems therefore appropriate to select a well preserved specimen attributed to W. Baxter at K as neotype, although this specimen had not been seen by Klotzsch.

As no specimen seems to have been preserved of *Callistemon macrostachyum* the illustration part of the protologue is selected as lectotype.

F. Mueller never wrote the name *Callistemon hainesii* on any specimens he consulted, so that it is difficult to assign a type to that species, because there are several possible specimens collected by G. Maxwell in his herbarium. The locality of none of the specimens specifically agrees with that provided in the protologue, but "shrubby plants 3 to 4 ft" in the description is found on MEL 92502. This specimen is chosen as lectotype. The hairs on a leaf and other fragments on a sheet in PERTH indicate that these could have been taken from the lectotype. The other specimens at MEL could also



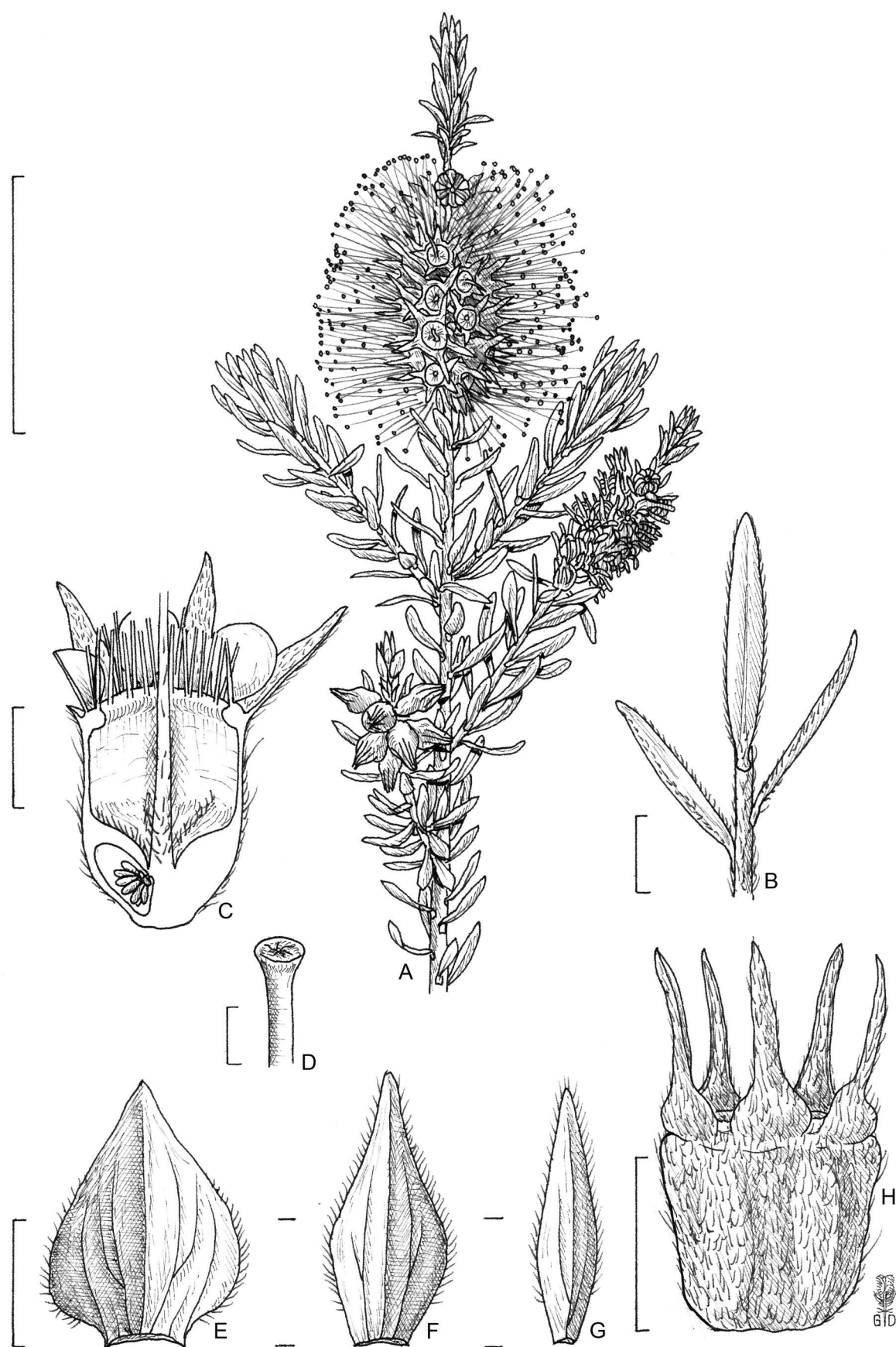


Fig. 2. *K. baxteri*: A flowering branch; B cauline leaves; C half flower; D flat-topped stigma; E perule; F, G bracts; H fruit. — Scale bars: A 5 cm; B 3.5 mm; C 4 mm; D 0.5 mm; E–G 2.5 mm; H 6 mm — A, B, F, G H.R. Toelken 7861 (AD); C–E L. Haegi 1224 (AD); H L. Haegi 2603 (AD).

be part of that collection, but differ morphologically slightly as one would expect in a population. They are, however, consecutively numbered as was often done with duplicates in MEL.

#### *Selection of specimens examined (45 seen)*

WESTERN AUSTRALIA: *T.E.H. Aplin* 2615a, Mt Boyatup, 25.x.1963 (PERTH); *M.I.H. Brooker* 3677, N Twin Peak Is., Recherche Archipelago, 24.v.1972 (CANB); *E.M. Canning* CBG35073, Mt Merrivale, 4.xi.1968 (CANB); *M.D. Crisp* 9910 & *L.G. Cook*, Tower Pk summit, Mt Ragged Ra., 10.ix.2005 (CANB); *N.N. Donner* 2645, c. 10 km ESE Howick Hill, 19.ix.1968 (AD, L, PERTH); *C.A. Gardner & W.E. Blackall* 1173, Mt Ragged, 26.x.1931 (PERTH); *L. Haegi* 1224, Condingup Pk, 6.x.1976 (AD, KW, PERTH); *R. Hnatuik* 761172, c. 58 km WNW of Pt Malcolm, 20.ix.1976 (PERTH); *G.J. & B.J. Keighery* 5213, 5 km N Dwellingup, 31.vii.2005 (CANB); *G. Maxwell* MEL92501, Israelite Bay, s.dat. (MEL); sine coll. in Herb. *F. Mueller* MEL92500, Cape le Grande, s.dat. (MEL); *M.E. Phillips* CBG10692, Mt Merrivale, 4.ix.1962 (CANB); *D.J.E. Whibley* 5439, 65 km E Esperance, 14.xi.1974 (AD, PERTH); *J.H. Willis* MEL92499, Mondrain Is., Recherche Archipelago, 13.xi.1950 (MEL, PERTH); *P.G. Wilson* 2974, c. 100 km E Esperance, 11.ix.1964 (AD, NY, PERTH).

VICTORIA: *J.H. Ross* 4146, Phillip Is., Berry Beach Rd, 1.x.2004 (MEL); *V. Stajsic* 1511, 10 km NNW Anglesea, Flaxbournes Rd, 3.iii.1996 (MEL).

#### *Putative hybrids*

*K. baxteri* × *K. pulchella* (see also Elliot & Jones 1993, p. 17)

Flowering branches are superficially similar to those of *K. baxteri* because the branching is in flushes and the stout floral axis bears sessile or subsessile flowers without obvious bracteoles. However, the whole plant has the more spreading habit of *K. pulchella*, the leaves are greyish-green, oblanceolate, though never obovate, and without marginal rows of hairs, the calyx lobes are broadly triangular and shorter than the petals, and the filaments are relatively short.

In spite of these intermediate characters it could not be established whether it is a hybrid or an interesting but unusual cultivated plant, because neither the growing conditions were fully examined nor could it be traced where the hybridization could have taken place, as in nature the two species never overlap geographically.

#### *Specimen examined*

SOUTH AUSTRALIA (cultivated): *C. Simpson* s.n., Kersbrook, 24.vi.1988 (AD) (23% abnormal pollen).

### **A.2. *Kunzea* sect. *Floridae* (Toelken) Toelken & de Lange**

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). — *Kunzea* subsect. *Floridae* Toelken, J. Adelaide Bot. Gard. 17: 82 (1996). — **Type species:** *K. affinis* S. Moore.

*Kunzea* sect. '*Eukunzea*' Benth., Fl. Austral. 3: 112 (1867), pro parte, quoad *K. ericalyx*, *K. preissiana* – nom. inval.

Low shrubs usually smaller than 2 m tall, much branched in seasonal growth flushes; young branches shedding epidermis slough-like. *Leaves* with short lateral (intralateral) veins. *Inflorescence* with (1–) 2–10

(–15) flowers, globular and without terminal leaves, clustered distally with the terminal inflorescence usually subtended by few additional ones on short shoots, vegetative growth resumes after fruiting terminally and/or laterally from below the inflorescence. *Flowers* usually sessile, pink to purple; *stamens* as long as or shorter than petals; *ovary* (2–) 5-locular.

**Discussion.** The ten Western Australian species accepted by Toelken (1996, 2007) differ mainly from the similarly pink-flowered species of sect. *Zeanuk* and subgen. *Kunzea* by their many but smaller inflorescences and relative larger petals, that are about as long as the stamens.

**Key to species and hybrids:** see Toelken (1996: 85) and Table 1 for a list of species.

### **A.3. *Kunzea* sect. *Zeanuk* Toelken**

J. Adelaide Bot. Gard. 17: 32 (1996), emend., excl. subsect. *Floridae* Toelken. — **Type species:** *K. glabrescens* Toelken.

*Kunzea* subsect. *Arborescentes* Toelken, J. Adelaide Bot. Gard. 17: 32 (1996). — **Type species:** *K. glabrescens* Toelken.

*Kunzea* subsect. *Globosae* Toelken, J. Adelaide Bot. Gard. 17: 53 (1996). — **Type species:** *K. recurva* Schauer.

*Kunzea* sect. '*Eukunzea*' Benth., Fl. Austral. 3: 112 (1867), pro parte, quoad *K. ericifolia*, *K. micrantha*, *K. micromera*, *K. recurva* – nom. inval.

Shrubs or trees 0.2–3 (–5) m tall, branching in seasonal growth flushes; young branches shedding epidermis slough-like. *Leaves* with intralateral veins ± well developed and recurved. *Inflorescence* with (10–) 15–30 (–40) flowers, globular without terminal leaves, usually single and apparently-terminal, vegetative growth continues terminally after fruiting. *Flowers* sessile, white, yellow, pink to purple; *stamens* longer than petals; *ovary* 5-locular, except for 2 or 3 (–5) in *K. micrantha*.

**Discussion.** The concept of sect. *Zeanuk* has been restricted to 13 species of the subsections *Arborescentes* and *Globosae* of Toelken (1996), while subsect. *Floridae* has been raised to an independent section. These Western Australian species have pink to purple or yellow to white globular flowering inflorescences very similar to species of subgen. *Kunzea* from eastern Australia. The two groups are not easily distinguished by a single characteristic, such as the slough-like abscission of the epidermis of mature branches. Other characters common in sect. *Zeanuk* are five locules per ovary, each with rarely up to 16 ovules in contrast to predominantly three locules (each with often up to 50 ovules) in the superficially similar flowers of subgen. *Kunzea*.

**Key to species, subspecies and hybrids:** see Toelken (1996: 33, 54) and Table 1 for a list of all species.



**B. *Kunzea* subgen. *Kunzea***

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). —

**Type species:** *K. capitata* (Reichb.) Heynh. (genus & type conserved: cf. Toelken 1981a & b).

*Kunzea* sect. *Salisia* (Lindl.) Benth., Fl. Austral. 3: 115 (1867), pro parte, excl. *K. baxteri* and *K. pulchella*.

*Kunzea* sect. '*Eukunzea*' Benth., Fl. Austral. 3: 112 (1867), pro parte, quoad *K. muelleri* – nom. inval.

Main branches with irregular growth flushes (no short shoots) from some of the axils of the leaves; branches with raised but scarcely decurrent leaf bases, not flanged, with epidermis splitting into long longitudinal ridges or strips becoming  $\pm$  corky bark often with membranous margins. *Leaves* with apex commonly pinched, with (1–) 3–9 main (intralateral) veins erect. *Inflorescence* an apparently terminal globular botryum with (2–) 5–20 flowers, without terminal leaves when flowering, with growth continuing from terminal bud after fruiting; *bracts* broad and scale-like and chartaceous, usually 3–5 veined, persistent to  $\pm$  deciduous; *bracteoles* scale-like and chartaceous, persistent or deciduous. *Flowers* sessile, mature buds with rounded apex. *Stamens* equally long, longer than petals, erect to spreading. *Ovary* with 2 or 3 (–5) locules, each with  $\pm$  peltate placenta with (6–) 10– $\infty$  short spreading ovules and/or 1 to few elongate pendulous ones in some species, e.g. *K. cambagei*; *style* slender and as long as stamens, much longer than the free hypanthium.

**Discussion.** The 13 species included in subgen. *Kunzea* from eastern Australia have very similar usually globose inflorescences with pink to purple, yellow or white flowers and are not easily distinguished from sect. *Zeanuk* (see discussion above). They are mainly restricted to the temperate areas of southern Queensland, eastern New South Wales and Victoria, except for *K. pomifera*, which extends its distribution into coastal South Australia. Unusual in the genus is also the occurrence of *K. muelleri* in subalpine regions of New South Wales and Victoria.

**26. *Kunzea juniperoides* Toelken, nom. nov.**

*Agonis ericoides* F.M.Bailey, Queensland Dept. Agric. Bot. Bull. 2: 37 (1891), non *K. ericoides* (A.Rich.) Joy Thomps. (1983). — **Type:** New South Wales, Charleys Forest, *W.Bäuerlein s.n.*, x.1886 (holo.: NSW124243).

*Kunzea* sp. B Joy Thomps. in S.W.L.Jacobs & Pickard (eds), Pl. New South Wales 166 (1981); Peter G.Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 153 (1991), pro max. parte.

Shrublets 0.15–0.6 m tall, suberect to spreading-decumbent, with wiry branches; young branches wiry-woody with leaf bases slightly raised and flanges absent, pubescent to sericeous with fine antrorse appressed hairs; early bark splitting irregularly longitudinally, peeling in irregular oblong flakes. *Leaves* alternate; *petioles* 0.2–0.4 mm long, appressed; *lamina* linear, rarely linear-elliptic, (2.5–) 3.5–8 (–12.3)  $\times$  0.4–0.6 mm, scarcely tapering into apex and petiole, straight to slightly incurved, flat to slightly concave and glabrous

above, strongly convex below and central vein visible only at the base, glabrous except for long antrorse marginal hairs or rarely sericeous with fine hairs each with a persistent base. *Inflorescence* a sessile botryum with 3–8 (–11) flowers, apparently terminal on little-branched main branches, with terminal vegetative growth continuing after flowering; *retained perules* many, few short proximal broadly ovate ones are acute grading distally into broader-ovate and cuspidate ones, 0.8–3.6 mm long, proximal ones with usually 1 vein and often glabrescent grading into distal ones with at least 5–12 main veins and  $\pm$  hairy, grading into bracts sometimes with aborted proximal flowers; *bracts* broadly ovate to distally oblong-ovate, 3.1–5.5  $\times$  2.0–4.5 mm, cuspidate, with few to many veins and a pronounced central vein continued into terminal awn, glabrous or with few marginal hairs; *bracteoles* in pairs, oblong-ob lanceolate often  $\pm$  falcate, 3.1–4  $\times$  1.1–1.6 mm, acute to obtuse, folded lengthwise, with one central vein, glabrous or with few marginal cilia. *Hypanthium* 2.8–3.4 mm long when flowering (free tube c. 2 mm long), usually strigose with antrorse appressed hairs. *Calyx lobes* triangular-ovate, 1–1.2 mm, obtuse to rounded, glabrous. *Corolla lobes* obovate to almost orbicular, usually sessile, 1.2–1.4 mm, white. *Stamens* 31–35 in more than one whorl, outer *filaments* slightly longer, 1.6–2.3 mm long; *anthers* broadly ellipsoidal, 0.4–0.5 mm long, with indistinct subterminal gland. *Ovary* 2 (–3)-locular, with style base slightly sunk into the upper surface; *placenta* an almost round disc with off-centre attachment usually on the upper third, scarcely bilobed, each lobe with 1 row of ovules; *ovules* usually 6–12 (–14) per locule, spreading, subequal; *style* 3.4–3.9 mm long, with stigma slightly capitate and scarcely compressed at apex. *Fruit* and *seeds* not seen.

**Diagnostic features.** The white (rarely pink) flowers are erect on small inflorescences surrounded by a large number of broad retained perules and bracts, distinct from all other *kunzeas*, including the superficially similar *K. dactylota* and *K. muelleri*. Their inflorescences are also borne on a peduncle-like distal branch with much elongated internodes and usually without vegetative axillary short shoots.

**Typification.** As the specific epithet of *Agonis ericoides* cannot be used in *Kunzea*, because it would become a later illegitimate homonym of the earlier *K. ericoides* (A.Rich.) Joy Thomps. (Article 53.1, McNeill et al. 2012), a new name is published here. The type specimen, *W.Bäuerlein NSW124243* as quoted by Bailey (1891) becomes the holotype of the new name.

A very similar specimen, *W.Bäuerlein 163* (MEL 92566), is probably from the same locality, although it was apparently collected one month later. It is, however, accompanied by a field description (a separate label on MEL92566, in German apparently in the collector's hand, cf. K.L.Wilson 1990): "apparently restricted, but where this plant occurs it covers the soil like a thick



**Key to species and subspecies of subgen. *Kunzea***

Hybrids are not included in the key as too little is known about them.

1. Ovary with 2 locules
  2. Petals pink; N.S.W. (ST) ..... **26b. *K. juniperoides* subsp. *pernervosa***
  - 2: Petals white to yellow
    3. Leaves linear
      4. Base of inflorescences obscured by obvious broad bracts
        5. Bracts subtending inflorescences with 1–3 veins; leaves (2.5–) 4–6 (–7.2) mm long; N.S.W. (ST) ..... **26a. *K. juniperoides* subsp. *juniperoides***
        - 5: Bracts subtending inflorescences with 4–9 veins; leaves (5.2–) 6.5–8 (–12.3) mm long; N.S.W. (ST) ..... **26b. *K. juniperoides* subsp. *pernervosa***
      - 4: Base of inflorescence with small bracts
        6. Petals white; leaves pointed and incurved; N.S.W. (ST) ..... **27. *K. dactylota***
        - 6: Petals yellow; leaves bluntly acute to obtuse and  $\pm$  straight; N.S.W. (ST, ACT), Vic. (SNOW) ..... **28. *K. muelleri***
    - 3: Leaves oblanceolate to elliptic
      7. Erect shrubs 0.6–1.5 m tall; N.S.W. (CC) ..... **31. *K. rupestris***
      - 7: Prostrate to decumbent subshrubs up to 0.3 m tall; N.S.W. (CWS?, CT, ST) ..... **32. *K. cambagei***
- 1: Ovary with 3 locules
  8. Petals pink
    9. Base of inflorescences obscured by obvious broad bracts; N.S.W. (ST) ..... **26b. *K. juniperoides* subsp. *pernervosa***
    - 9: Base of inflorescence with small bracts
      10. Leaves opposite to subopposite, linear to conical and straight erect
        11. Leaves with pronounced central vein, glabrous to sparsely hirsute
          12. Leaves (0.8–) 1–2.5 (–3.8) mm long; Qld (BN, DD, LE), N.S.W. (NC, NT, NWS) ..... **37a. *K. opposita* var. *opposita***
          - 12: Leaves (3.1–) 3.8–5.2 (–5.8) mm long; Qld (LE) ..... **37b. *K. opposita* var. *leichhardtii***
        - 11: Leaves with central vein usually not visible, sericeous; Qld (NK) ..... **38. *K. calida***
      - 10: Leaves alternate, oblanceolate to obovate and with recurved or pinched apex
        13. Leaf apex recurved and abruptly constricted with subterminal abaxial appendage; N.S.W. (CC, SC, NT, CT, ST, NWS, SWS), Vic. (GR, MID, EHL, SNOW, EG) ..... **35. *K. parvifolia***
        - 13: Leaves with recurved  $\pm$  pinched apex
          14. Decumbent shrublet covered with short appressed hairs; N.S.W. (ST) ..... **37. *K. badjaensis***
          - 14: Erect spreading shrubs covered with fine spreading hairs at least on branches
            15. Leaves flat except for pinched apex, with 3– $\infty$  main veins and with marginal tubercle; N.S.W. (NC, CC, SC, ST) ..... **33a. *K. capitata* subsp. *capitata***
            - 15: Leaves folded lengthwise and recurved apex, with 1 (–3) main veins and without marginal tubercles
              16. Ovary with spreading hairs but free hypanthium and calyx glabrous outside; N.S.W. (CT, ST) ..... **33b. *K. capitata* subsp. *seminuda***
              - 16: Ovary, free hypanthium and calyx with spreading hairs; Qld (DD, MO), N.S.W. (NT, NC) . . **34. *K. obovata***
    8. Petals white
      17. Shrubs decumbent to prostrate
        18. Shrubs prostrate; leaves obovate, with 3–7 veins; fruit fleshy and indehiscent; Vic. (LMAL, WAN), S.A. (MU, YP, SL, KI, SE) ..... **30. *K. pomifera***
        - 18: Shrubs decumbent; leaves oblanceolate, with 1 (–3) veins; fruit a dry capsule dehiscing loculicidally; N.S.W. (ST) ..... **37. *K. badjaensis***
      - 17: Erect spreading shrubs
        19. Leaf apex recurved and abruptly constricted with subterminal abaxial appendage; N.S.W. (CC, SC, NT, CT, ST, NWS, SWS), Vic. (GR, MID, EHL, SNOW, EG) ..... **35. *K. parvifolia***
        - 19: Leaves flat or recurved and with pinched apex
          20. Leaves  $\pm$  flat except for pinched apex; N.S.W. (NC, CC, SC, ST) ..... **33a. *K. capitata* subsp. *capitata***
          - 20: Leaves recurved with  $\pm$  pointed apex
            21. Calyx and hypanthium glabrous; leaves acute, glabrous except for marginal cilia; N.S.W. (CT, ST) ..... **33b. *K. capitata* subsp. *seminuda***
            - 21: Calyx and hypanthium pubescent; leaves sharply pointed, pubescent to glabrescent; N.S.W. (CT) ..... **30. *K. aristulata***

lawn but not prostrate or decumbent. Ripe fruit were not found/ 6–8 inches high.” Plants commonly found on the Pigeon House Range are altogether larger, erect shrubs up to 60 cm high, have many, usually obvious veins on the large perules and bracts and 10–12 (–14) ovules in each of the three locules. The Bäuerlein specimen is,

however, only 15 cm high and forms a thick growth, has usually 1 to 3 veins, commonly incompletely visible on the perules and bracts (cf. fig. 3) and only six ovules in each of its two to three locules per flower. A second label (not in the same handwriting) on that sheet, reads: “Braidwood District / November 1886 / William

Bäuerlen / Nro 163 / Pet. alba / 3,000ft", shows that this collection was made a month later, though presumably from the same locality. A second specimen (MEL92572) with similar basic information on a grey Baron Ferd. von Mueller label is probably a duplicate of the first specimen (MEL92566). While the above two specimens in the Melbourne Herbarium cannot be accepted as types, because of the later collecting date, the field information on them provides important information to interpret the typical subspecies, plants of which were recently rediscovered by R. Miller.

In contrast, subsp. *pernervosa* is a more robust form of the species, which is now better known, because it has recently repeatedly been recorded from the Pigeon House Range between Sassafras and Nerriga. Recognition of this subspecies is, however, complicated, as most specimens record the flower colour as white and/or pink. Some populations (H.R.Toelken 6872, 6879, 6882, 6883) examined in the field showed obvious putative hybrids (i.e. with ranges of morphological intermediates: cf. putative hybrids below) with *K. parvifolia*, which was also recorded from area. All plants of the four collections investigated, whether white- or pink-flowered, showed a high percentage of abnormal pollen, usually well over 10%. Another population (H.R.Toelken 9544) several kilometres distant also had, though predominantly white-flowered, one plant with white flowers tinged more or less pink. Although this plant showed no morphological intermediates with *K. parvifolia*, nor were any plants of that species observed in the vicinity, and the percentage abnormal pollen count was for plants examined below 10%, only the white-flowered specimen from that locality was taken as the type of the subspecies. It could not be ascertained whether the flower colour of this subspecies naturally varies from the predominant white to pink as in, for instance, *K. badjaensis*, or whether the occasional pink-flowered plants are indicative of wider introgression with *K. parvifolia* or even *K. capitata* subsp. *seminuda*, the only other species present in the area, but not observed in the immediate vicinity of type collection of subsp. *pernervosa*, H.R.Toelken 9544.

**Etymology.** The epithet "juniper-oides", Latin, "juniper-like" refers to the spreading needle-like leaves and often untidy, spreading habit resembling miniature horticultural forms of *Juniperus communis*. The more often used "juniperina", also meaning "juniper-like", was avoided here, because it is often used in connotation with colours either of the blue-green leaves or the blue-black fruit, neither of which apply to this kunzea.

#### Key to subspecies

1. Bracts subtending inflorescence with 1–3 veins; leaves (2.5–) 4–6 (–7.2) mm long; ovules per locule 6 (–8) . . . . . **26a. *K. juniperoides* subsp. *juniperoides***
- 1: Bracts subtending inflorescence with 4–12 veins; leaves (5.2–) 6.5–8 (–12.3) mm long; ovules per locule (5–) 8–12 . . . . . **26b. *K. juniperoides* subsp. *pernervosa***

#### 26a. *Kunzea juniperoides* subsp. *juniperoides*.

*Kunzea muelleri* auct. non Benth.: S.T.Blake, Proc. Roy. Soc. Queensland 69: 79 (1958); Joy Thomps. in S.W.L.Jacobs & Pickard (eds), Pl. New South Wales 166 (1981), pro parte, quoad *Agonis ericoides*.

Shrublet up to 0.2 m tall, multistemmed, with decumbent erect-spreading branches, much branched and forming dense stands. *Leaf lamina* linear, (2.5–) 4–6 (–7.2) mm long, pointed. *Retained perules* of vegetative buds 1–2 (–3) times longer than broad, obtuse to acute, with 1–3 (–5) veins, incompletely visible. *Bracts* oblong-oblancheolate, 3.1–3.4 × 2–2.5 mm. *Ovary* with 6 (–8) ovules. *Flowering*: November. **Fig. 3.**

**Distribution and ecology.** Grows in sandy soil with low heath near Braidwood, New South Wales (ST).

**Conservation status.** Known only from one small population on private property.

**Note.** While the specimen *Bäuerlen 163* is sparsely hairy, material of *J. & R.Miller s.n.* varies from scarcely to densely hairy even on the hypanthium and calyx lobes.

#### *Specimen examined*

NEW SOUTH WALES: *W.Bäuerlen 163*, [Charleys Forest,] xi.1886 (MEL92566, MEL925721); *J. & R.Miller s.n.*, near Braidwood, 8.xi.2011 (AD, NSW).

#### 26b. *Kunzea juniperoides* subsp. *pernervosa* Toelken, subsp. nov.

*A subspeciei typicae plantis majoribus ad 0.6 m, perulis bractisque pernervosis et 10–12 (–14) ovulis usque ad locule differt.*

**Type:** New South Wales, NNE Nerriga, along Tolwong Road, H.R.Toelken 9544, 22.x.2011 (holo.: AD; iso.: BRI, G, K, MEL, MO, NSW, S).

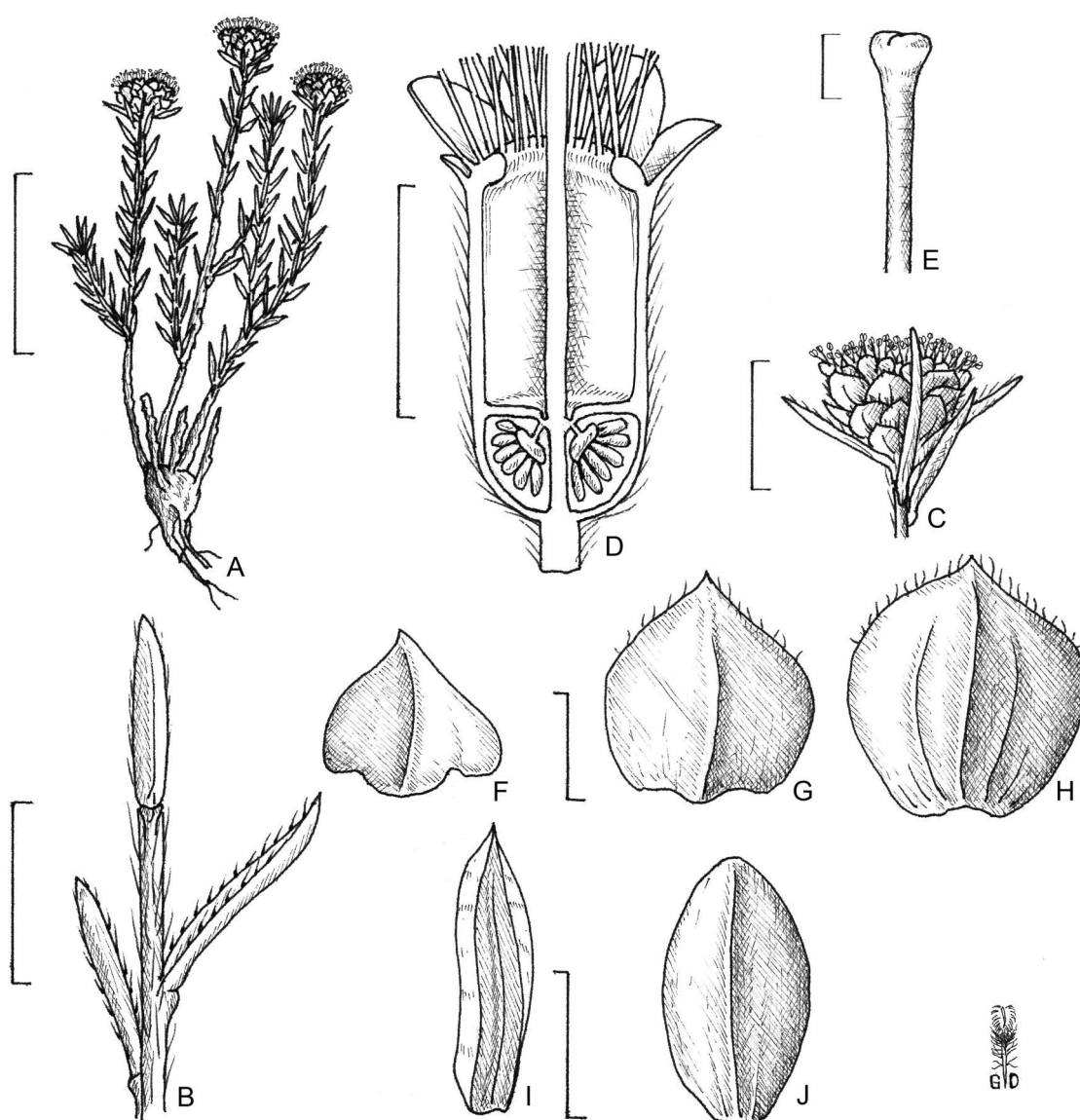
*Kunzea* sp. *B Joy Thomps.* in S.W.L.Jacobs & Pickard (eds), Pl. New South Wales 166 (1981), pro max. parte; Peter G.Wilson in G.J.Harden, Fl. New South Wales 2: 153 (1991), pro max. parte.

*Kunzea* sp. *F de Lange et al.*, Austral. Syst. Bot. 23: 311 (2010).

*Kunzea* sp. *Braidwood (Powell 371)* Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales, ed. 2, 2: 176 (2002), pro max. parte

Shrubs up to 0.6 m tall, single- or few-stemmed, with erect spreading branches, sparsely to moderately branched and interwoven into other vegetation. *Leaves* linear, (5.2–) 6.5–8 (–12.3) mm long, pointed. *Retained perules* of vegetative buds (2–) 3–6 times longer than broad, acuminate to cuspidate, with (5–) 8–12 veins well visible to the margins. *Bracts* oblong-obovate, 3.5–5.5 × 2.5–4.5 mm. *Ovary* with 10–12 (–14) ovules per locule. *Flowering*: October, November.

**Distribution and ecology.** Grows in sandy soils on gentle slopes in open patches widely scattered in woodland in scattered populations on the Pigeon House Range, New South Wales (ST) (see also Notes below).



**Fig. 3. *K. juniperoides* subsp. *juniperoides*:** A flowering plant; B cauline leaves; C inflorescence subtended by perules and/or bracts; D half flower; E capitate stigma; F perule; G, H abaxial view of proximal bracts; I abaxial view of distal bract; J bracteole. — Scale bars: A 3 cm; B 3 mm; C 10 mm; D, I, J 2 mm; E 0.5 mm; F–H 1.5 mm. — A–J W.Bäuerlen 163 (MEL92566).

**Conservation status.** Rare, populations apparently all conserved in Morton National Park.

**Note.** While the species is usually white-flowered, a few plants with more or less tinged pink petals have also been observed in areas where no hybrids with, or plants of *K. parvifolia* occur (e.g. H.R.Toelken 9544).

**Etymology.** The epithet, “pernervosa”, Latin, “very much veined” refers to the clearly visible, dense venation with many major veins often more or less raised on the perules, and particularly on the bracts of this subspecies.

**Specimens examined**

NEW SOUTH WALES: D.Black NSW642839, Shoalhaven River Trail, 9.iv.1982 (NSW); C.Burgess NBG9554, Sassafras, 13.xi.1962 (CANB); M.G.Corrick 7033, near Ettrema on

Tomrong-Braidwood road, E.Gauba NBG6222, (CANB); Pigeon House Ra., 16.xi.1951 (CANB); V. & C.Murtagh s.n., base of Quiltys Mtn, 29.x.1972 (NSW); J.M.Powell 371 & J.McGrath, 17.4 km NNE Nerriga, on Tolwong Rd, 7.xi.1975 (NSW); F.A.Rodway 12430, between Sassafras and Mt Ettrema, 16.xi.1941 (NSW); W.Underwood NSW124244, between Turpentine and Sassafras, xi.1936 (NSW).

**Putative hybrids**

***K. juniperoides* subsp. *pernervosa* × *K. parvifolia***

The prominent perules and bracts surrounding the flowers and the spreading linear leaves resemble *K. juniperoides*, but rigid and almost twiggy branches and particularly the short shoots below the apparently terminal inflorescences (not peduncle-like as in both subspecies of *K. juniperoides*) are similar to *K. parvifo-*



*lia*. The leaves are also shorter and blunt, similar to those of *K. parvifolia*, although not with an obviously recurved apex. The more or less pink petals and filaments could also be derived from *K. parvifolia*, but white and pink flowers have been recorded from another population of subsp. *pernervosa* (Toelken 9544), as well, without apparent morphological similarities to *K. capitata* subsp. *seminuda*, the only other pink-flowered species recorded from the same general area. While three collections of the latter subspecies from near the hybrid swarm show a relatively low percentage of pollen sterility (less than 10%), all white-flowered specimens examined showed a high percentage (more than 20%), so that flower colour cannot be used as a distinguishing character. It is not known how much backcrossing has occurred in these populations, in comparison to a complete range of intermediates recorded by Toelken (1996, p. 59) in a hybrid swarm between *K. recurva* and *K. sulphurea*.

**Notes.** Plants of this hybrid closest to typical *K. juniperoides* subsp. *pernervosa* are those of the collection H.R.Toelken 6875, but even they have a relatively high pollen sterility compared to specimens of *K. parvifolia*. The similar cream-flowered collections H.R.Toelken 6879 and 6881 display a much higher pollen sterility of 53%, but more field work is needed to assess the boundaries of variation of the species as compared to the effect of hybridization (cf. Typification). Furthermore the pollen sterility in all these specimens is unusually high, indicating possible environmental factors in addition to incompatibility of the two parent species.

#### *Specimens examined*

NEW SOUTH WALES: H.R.Toelken 6872 (pale pink to cream), 12.5 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 64%); H.R.Toelken 6875 (cream, possibly shade form of typical subsp. *pernervosa*), 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 20–26%); H.R.Toelken 6879 (cream), 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 53%); H.R.Toelken 6882 (pale pink to cream), 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 60–67%); H.R.Toelken 6883 (pink), 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 94%).

#### *Putative parents from area*

***K. juniperoides* subsp. *pernervosa*** (H.R.Toelken 6875, cf. note above). NEW SOUTH WALES: H.R.Toelken 6881, 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 14%).

***K. parvifolia***. NEW SOUTH WALES: H.R.Toelken 6871 (pink to mauvish-purple), 12.5 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 7%); H.R.Toelken 6873 (pink to mauvish-purple), 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 3%); H.R.Toelken 6880 (mauve rarely pink), 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD, NSW; pollen sterility 8%).

#### 27. *Kunzea dactylota* Toelken, *sp. nov.*

*A K. muelleri floribus albis, lobis calycis acuminatis, staminibus 44–47, 14–16 ovulis in quoque loculis; a K. juniperoides perulis paucis et brevioribus, foliis incurvatis et lobis calycis acuminatis differt.*

**Type:** New South Wales, Tinderry Mts, I.R.Telford 9909, 9.xii.1984 (holo.: CANB).

*Kunzea muelleri* auct. non Benth.: Peter G.Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 153 (1991).

*Kunzea sp. B* de Lange et al., Austral. Syst. Bot. 23: 311 (2010).

Spreading shrub up to 1.3 m tall; young branches with leaf bases scarcely raised and flanges absent, pubescent with antrorse, ± appressed hairs; early bark peeling in long strips but later breaking into irregular oblong flakes. *Leaves* alternate to approaching opposite when densely clustered; *petioles* 0.2–0.4 mm long, indistinct, ± appressed; *lamina* linear, (3.4–) 5.5–7.5 (–8.6) × 0.4–0.6 mm, acute and with colourless point wearing off to become bluntly acute, rarely obtuse, scarcely constricted into petiole, with margins ± laterally incurved especially towards the apex, above grooved or rarely just concave and with spreading antrorse long fine hairs, glabrescent and becoming verruculose, below strongly convex and hirsute to pubescent with spreading antrorse long fine hairs becoming appressed or wearing off. *Inflorescence* a rounded to elongate botryum with (5–) 7–10 flowers, or elongate distal clusters (superconflourescences) of apparently terminal botrya subtended by 1 to several ± subsessile smaller axillary botrya with 3–5 flowers, distally on branches, with terminal growth continuing after flowering or rarely starting while flowering; retained perules (3–) 5–7, narrowly triangular to broadly ovate or broadly oblong, (0.8–) 1–3 mm long, clasping inflorescence, with central vein continued into a point, rarely rounded with vein scarcely developed, pubescent mainly on membranous margins to glabrescent, deciduous; *bracts* linear-triangular to lanceolate, (4–) 4.5–6.5 × 1–1.5 mm, clasping, with central vein continued into apex, which is often a green and fleshy point, pubescent with ± appressed long fine antrorse hairs and marginal cilia, usually persistent; *bracteoles* in pairs, linear-lanceolate, 3.7–4 × 0.7–0.9 mm, with central vein continued into point, pubescent with membranous margins ciliate, deciduous. *Hypanthium* 3.5–4.2 mm long when flowering (free tube 1.8–2 mm long), usually shorter than bracts, without ridges, pubescent to hirsute with fine long antrorse hairs. *Calyx lobes* triangular, 1.7–2.4 mm long, unequally long, usually longer than broad, pointed and ridged towards the apex, pubescent to hirsute with fine long antrorse hairs. *Corolla lobes* broadly obovate (broader than long) to orbicular, 1.2–1.5 mm long, white. *Stamens* (38–) 44–47 in more than one whorl, *filaments* 2.8–3.3 mm long; *anthers* broadly ellipsoidal, 0.5–0.7 mm long, often with indistinct gland towards the apex. *Ovary* 2 or 3-locular, with style sunk into glabrous upper surface; *placenta* an elliptic disc with central attachment, scarcely bilobed with each lobe with 1 row of ovules; *ovules* (12–) 14–16 per locule, ± spreading; *style* 4.6–5.8 mm long, with stigma truncate, rarely small-capitate and scarcely compressed apically. *Fruit and seed* not seen. *Flowering*: November–January.

**Distribution and ecology.** Grows on gravelly slopes or in rock crevices “on a weathered hilltop pavement” in rocky montane heath with *Eucalyptus glaucescens* and *E. pauciflora* or open shrubland at high altitude on peaks of the Tinderry Ranges, but has also been recorded in a depression near Windellama, New South Wales (ST).

**Conservation status.** Conserved in Tinderry National Park where it was recorded locally “very common” (D. Walker ANU107).

**Diagnostic features.** Although this species is superficially similar to *K. muelleri*, it is readily distinguished by its verruculose leaves due to remaining tubercled bases of worn-off hairs. The glands on the epidermis of the leaves are scarcely visible as they are not as dark as in *K. muelleri*. Furthermore the apices of the leaves are incurved and the generally longer calyx lobes as well as the greater number of stamens and ovules per locule of *K. dactylota* are usually distinctive. Although the two species are not easily distinguished, molecular studies suggested to adopt species level for *K. dactylota* (de Lange et al. 2010, fig. 1).

The leaves and habit of *K. juniperoides* also resemble those of *K. dactylota*, but the former is distinguished by the compact inflorescence with many large perules clasping its base, straight erect leaves and obtuse to rounded calyx lobes.

**Variation.** Walker ANU 107 described the habit as “bush about 4 ft high”, while Telford 9909 and others refer to it as a decumbent or spreading shrub. All plants of the disjunct population in a different habitat near Windellama were decumbent and had somewhat smaller leaves and flowers, but these were well within the range of this species as distinct from *K. muelleri*. They were also not exhibiting any distinctive features to warrant infraspecific distinction.

**Etymology.** The epithet “dactyl-ota”, latinised Greek, “possessing fingers” refers to the resemblance of the linear leaves to fingers, because in this species the margins are often strongly incurved so that the lamina becomes more or less terete.

#### *Specimens examined*

NEW SOUTH WALES: M.I.H. Brooker 5484, Mt Tinderry, 17.i.1977 (CANB); R. Johnstone 2841 & G. Errington, near Windellama, 13.i.2011 (AD, NSW); D. McVean & E. Dahl ANU8629, S Tinderry Pk 21.v.1970 (CANB); R. Miller et al. 2, near Windellama, 15.xi.2011 (AD, NSW); S. Podreka 3 et al., 3.5 km SSW Tinderry Pk trig stn, 14.i.1993 (CANB, NSW); E. W. Pook CANB209261, S Tinderry Pk, 29.xi.1970 (CANB); S. Richmond 6 et al., Tinderry Ranges, 12.i.1993 (CANB); H. Thomson 842 & R. Hyland, Tinderry Ranges, 2.xii.1982 (CANB); D. Walker ANU107, Tinderry Ra., 6.i.1962 (NSW); J. H. Willis MEL92547, S Tinderry Pk, 12.i.1970 (MEL).

#### *Putative hybrid*

##### *K. dactylota* × *K. parvifolia*

While most plants of this single population of *K. dactylota* have a decumbent habit with wiry-woody

branches, a few plants on the one end are distinguished as this putative hybrid, because they have spreading rigid-woody branches up to 1.5 m tall similar to *K. parvifolia*. Furthermore the leaves ((1.6–) 2–3 (–3.8) mm long) are shorter although still oblong-lanceolate, laterally incurved and without double apex similar to *K. dactylota*. The hybrid also has white petals, but all parts of the flowers are much smaller (hypanthium & ovary 2.2–2.4 mm; free calyx lobes ovate and 0.8–1 mm long) as is typical of *K. parvifolia*.

#### *Specimens examined*

NEW SOUTH WALES: R. Miller et al. 3, near Windellama, 15.xi.2011 (AD, NSW).

#### *Putative parents from the area*

*K. dactylota*. NEW SOUTH WALES: R. Miller et al. 2, near Windellama, 15.xi.2011 (AD, NSW).

*K. parvifolia*. NEW SOUTH WALES: C. W. E. Moore 2712, between Marulan and Tallong, 16.x.1952 (NSW); L. G. Adams 1978, 9 mls [14.5 km] NNW Braidwood, 2.xi.1967 (NSW).

#### 28. *Kunzea muelleri* Benth.

Fl. Austral. 3: 113 (1867); Maiden & Betche, Census N.S.W. Pl. 154 (1916); Ewart, Fl. Victoria 864 (1931); N. T. Burb. & M. Gray, Fl. Austral. Cap. Territory 268 (1970); J. H. Willis, Handb. Pl. Victoria 2: 449 (1973); Peter G. Wilson in G. J. Harden (ed.), Fl. New South Wales 2: 153 (1991); Jeanes in N. G. Walsh & Entwisle (eds), Fl. Victoria 3: 1020 (1996). — **Type:** New South Wales, higher rocky regions of the Munyang Mountains, *F. Mueller s.n.*, (lecto., designated here: lower left branch, MEL92321). **Remaining syn.:** Munyong Mountains, *F. Mueller s.n.* (MEL92320, MEL92322, MEL92340, MEL92341); Victoria, Mt Wellington, *F. Mueller s.n.* (K 000843030, K000843031 MEL92323, MEL92324, MEL 92325, MEL92326).

*Kunzea ericifolia* F. Muell., Trans. & Proc. Victorian Inst. Advancem. Sci. 1: 123 (in preprint 1855, cf. Seberg 1986), nom. illeg., non (Sm.) Heynh. (1840); A. D. Chapman, Contr. Herb. Austral. 18: 1–3 (1976). — **Type:** same as for *K. muelleri*.

*Kunzea glabriuscula* Gand. in Bull. Soc. Bot. France 65: 26 (1918); B. G. Briggs in McGill., Contr. New South Wales Natl. Herb. 4: 345 (1973). — **Type:** Victoria, Mt Hotham, *Audas s.n.*, vi.1910 (lecto., selected by McGillivray (1973): LY, n.v., NSW, photo!). **Remaining syn.:** New South Wales, Thredbo River, Mt Kosciusko, *Maiden & Forsyth s.n.* (LY, n.v., NSW, photo!; NSW89804); in monte Kosciusko, *Walter s.n.* (LY, n.v., NSW, photo!).

*Agonis ericoides* auct. non F. M. Bailey: S. T. Blake, Proc. Roy. Soc. Queensland 69: 79 (1958), pro parte.

Spreading shrub 0.3–0.8 (–1) m tall, sometimes rooting along branches; young branches with leaf bases scarcely raised and flanges absent or almost so, pubescent with antrorse appressed hairs; early bark peeling into strips but then forming almost square flakes. *Leaves* opposite or almost so, ± 4-ranked; *petioles* 0.2–0.4 mm long, appressed; *lamina* linear, (2.1–) 2.5–4.5 (–8) × 0.3–0.6 (–0.8) mm, bluntly acute to obtuse, rarely pointed, scarcely constricted into petiole and apex, with margins usually slightly incurved especially towards the apex, above flat to ± concave and usually with spreading

antrorse hairs, below  $\pm$  strongly convex and puberulous with appressed hairs rarely glabrescent. *Inflorescence* a  $\pm$  rounded sessile botryum or often apparently terminal cluster of botrya (superconflorescence), each with (1–) 2 or 3 (–5) flowers, apparently terminal on long and short shoots, with terminal growth continuing after flowering; *retained perules* rarely more than 3, narrowly triangular-lanceolate to broadly ovate, 1–1.5 mm long, clasping to basally auriculate, with central vein continued into point, puberulous to glabrescent; *bracts* ovate to lanceolate-acuminate on upper flowers,  $3\text{--}4 \times 1.3\text{--}1.6$  mm, with stiff central vein continued into point, pubescent with long antrorse hairs; *bracteoles* in pairs, linear-lanceolate to often somewhat falcate,  $3\text{--}4 \times 1\text{--}1.5$  mm, central vein continued into point, pubescent with long antrorse hairs. *Hypanthium* 3–4 mm long when flowering (free tube 1.8–2.3 mm long) and usually shorter than bracts, without ridges, pubescent to hirsute, with fine long  $\pm$  antrorse hairs. *Calyx lobes* triangular-ovate, 1–1.6 mm long, obtuse, acute or pointed and ridged towards the apex, pubescent, rarely glabrescent, with fine antrorse hairs. *Corolla lobes* orbicular or almost so, 1.3–1.6 mm long, pale yellow to rarely off-white. *Stamens* 24–35 in more than one whorl; *filaments* 3.5–4.7 mm long; *anthers* broadly ellipsoidal, 0.5–0.7 mm long, with often indistinct gland towards the apex. *Ovary* 2-locular, with style  $\pm$  sunk into the glabrous upper surface; *placenta* a broad-elliptic disc with central attachment, scarcely bilobed, with each lobe with 1 (2) rows of ovules; *ovules* 6–10 per locule, usually spreading; style 3.7–5.8 mm long, with stigma small-capitate, scarcely compressed at apex. *Fruit* an urceolate capsule with erect calyx lobes. *Seeds* almost cylindrical but  $\pm$  angular, often somewhat crescent-shaped, 1.3–1.6 mm long, with testa  $\pm$  hard, brown and with dense vertical ribbing. *Flowering*: November–February. *Common name*: **Yellow kunzea** (Ewart 1931, Willis 1973, Jeanes 1996). **Fig. 4.**

*Distribution and ecology.* Forming often stands in boggy or seepage areas or associated with rock screes, often associated with *Eucalyptus pauciflora* and *E. triplex*, usually in areas somewhat protected from mainly frost in sub- to alpine vegetation in southern New South Wales (ST, ACT) and northern Victoria (SNOW).

*Conservation status.* Locally common and occurring in several conserved areas in Victoria and New South Wales.

*Diagnostic features.* Among species with almost terete leaves with only the base of the central vein visible near the junction of the petiole and lamina on the abaxial leaf surface, such as *K. dactylota* and *K. juniperoides*, *K. muelleri* is distinguished by its usually yellow petals, branches of short shoots are thread-like, and short bracts. The early bark is splitting at first into strips but shortly afterwards they break into almost square flakes, which is unique for species of the subgen. *Kunzea*.

*Variation.* Specimens of *K. muelleri* show an unusually wide range of variation in the size and at times also the shape of various organs, probably due to extreme ecological conditions such plants inhabit. These extreme variations may at time account for a broader concept including the similar species *K. dactylota* and *K. juniperoides*. The normal length of leaves, for instance, does not tend to exceed 6 mm, but at times they do attain a similar length to those of the *K. dactylota* (e.g. *J. Thompson 3066*), but then they are without the terminal colourless point typical of *K. dactylota*. Similarly the calyx lobes of *K. muelleri* may be pointed on some specimens and might resemble those of *K. dactylota*, but they are never as long as those.

Inflorescences on main branches often appear to be distinctly larger, but they usually include 1 or 2 (3) pairs of lateral inflorescences on short shoots from nodes subtending the central inflorescence and thus forming a dense aggregate (cf. Inflorescences).

*Typification.* *Kunzea muelleri* is here interpreted, as it was by Chapman (1976, 1991), as a new name replacing *K. ericifolia* F. Muell., non (Sm.) Heynh., so that it is not only based on the material seen by Bentham. Mueller published the species in early September 1855 (Aston 1984). It seems therefore highly likely that the collection from the Munyang Mountains in “Jan. 55” prompted the description of the species. This is supported by the fact that this collection contains flowering and fruiting material as described, while the collection from Mt Wellington (“circa 1854” according to J.H. Willis on MEL92325) consists of flowering material only. Among the five sheets of the collection from the Munyang Mountains examined, only MEL92321 refers to the higher rocky habitat mentioned in the protologue, and therefore the lower left branch on the sheet was selected as the lectotype. Although irrelevant for the selection of the lectotype, it is useful to observe that this specimen was later seen by Bentham. Mueller’s specimens annotated as “*K. ericifolia* F. Müll. Austral. felix” found in various herbaria could include duplicates of the above syntypes, but without additional information cannot be identified as such. Specimens from the Hydinger Range (e.g. MEL92327 and MEL92328, also marked as seen by Bentham), which are often included among the syntypes, do not qualify, as that locality is not mentioned in the protologue, and specimen MEL92327 states the date of collecting as “March 61”, indicating also subsequent collections by Mueller exist and these must be distinguished.

#### *Selection of specimens examined (152 seen)*

NEW SOUTH WALES: *A.M. Ashby 5481*, Schlink Pass, 28.1.1977 (AD); *W. Bäuerlen NSW124036*, Bulbrock Mtn, iii.1890 (NSW); *N.T. Burbidge 3906*, 2 mls [3.2 km] W Kiandra, 22.ii.1955 (CANB); *I. Crawford 7296*, 3.7 km W Gudgenby trig., Scabby Ra. Nature Res., 10.1.2003 (CANB); *F.E. Davies 486 & S. Walton*, Mt Black Jack, 21.i.1988 (AD, CANB, NSW); *H. Eichler 13532*, slopes of The Paralyser, 28.1.1957 (AD, E, G); *E. Gauba CBG7233*, near



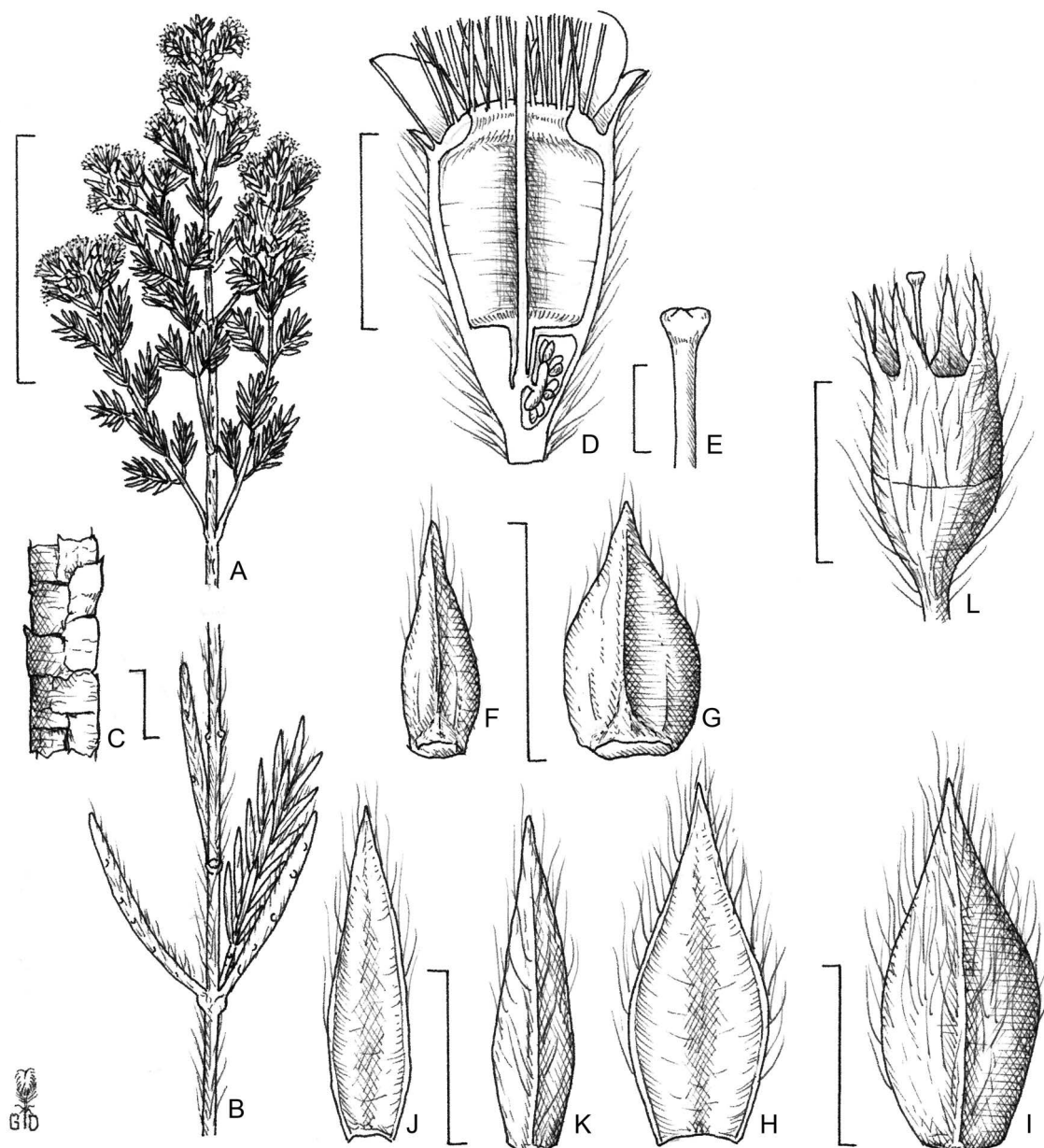


Fig. 4. *K. muelleri*: A flowering branch; B cauline leaves; C young branch displaying scaly bark; D half flower; E capitulate stigma; F, G abaxial view of perules; H adaxial view of bract; I abaxial view of bract; J adaxial view of bracteole; K abaxial view of bracteole; L fruit. — Scale bars: A 6 cm; B, C, J, K 2 mm; D 1.5 mm; E 0.5 mm; F, G 1 mm; H, I 1.5 mm; L 3 mm. — A–K J.Cullimore 236 (MEL92558); L C.Walter s.n. (MEL92574).

Mt Kosciusko, 8.i.1950 (AD, CANB); P.N.Martensz 495, The Twins near Geehi Reservoir, 8.ii.1972 (CANB, NSW); B.A.Mumbulla 1, Yaouk Pk, 9.i.1996 (AD, CANB, NSW); J.C.Newman NSW124035, Round Mtn, on the Tumut River catchment, ii.1952 (NSW); R.W.Purdie 4951, Kiandra Rd, 1.3 km from Sawyers Hill Rest House, 17.xii.2000 (NSW, CANB); H.Salasoo 3533, Khancoban to Geehi, 23.i.1969 (NSW); G.Stewart 730 et al., near Charlottes Pass, 6.ii.1985 (AD, CANB, MO); I.R.Telford 8585 & M.Parris, Sentry Box Hill, 14.i.1981 (AD, CANB, NSW, US); D. Walker ANU1237, Little Peppercorn Plain, SW Brindabella Ra., xii.1963 (CANB, MEL, NSW); A.J.Whalen 620 & J.A.Matarzyck, near Tharwa, SW Booroomba Rocks Lookout, 23.xi.2000 (CANB).

VICTORIA: A.C.Beauglehole 15426, Bogong High Plains, Wilkinson Memorial Lodge, 25.i.1966 (MEL); A.C.Beauglehole 41586, Mt Pinnibar, 24.ii.1973 (MEL); E.M.Canning

1795, Lake Catani, 15.i.1969 (CANB); L.A.Craven 1646, 2 mls [3.2 km] S Mt Feathertop, 23.xii.1969 (CANB); H.Eichler 14640, above Falls Creek Ski Village, 31.i.1958 (AD, E, G); R.Melville & K.Atkins 2641, Mt Buffalo, 30.xii.1952 (K, MEL, NSW); M.E.Phillips CBG46277, Hotham Heights, 10.i.1973 (CANB); P.S.Short 1400, Mt Buffalo, 28.1.1982 (AD, MEL); J.H.Willis MEL92545, Mt Speculation, Barry Mts, 2.i.1945 (MEL).

## 29. *Kunzea pomifera* F.Muell.

Trans. & Proc. Victorian Inst. Advancem. Sci. 1: 124 (in preprint 1855, cf. Seberg 1986); F.Muell., Hooker's J. Bot. Kew Gard. Misc. 8: 66 (1856); Miq., Ned. Kruidk. Arch. 4: 146 (1856); Benth., Fl. Austral. 3: 116 (1867); J.M.Black, Fl. S. Austral. 3: 405 (1926); Ewart, Fl. Vic-

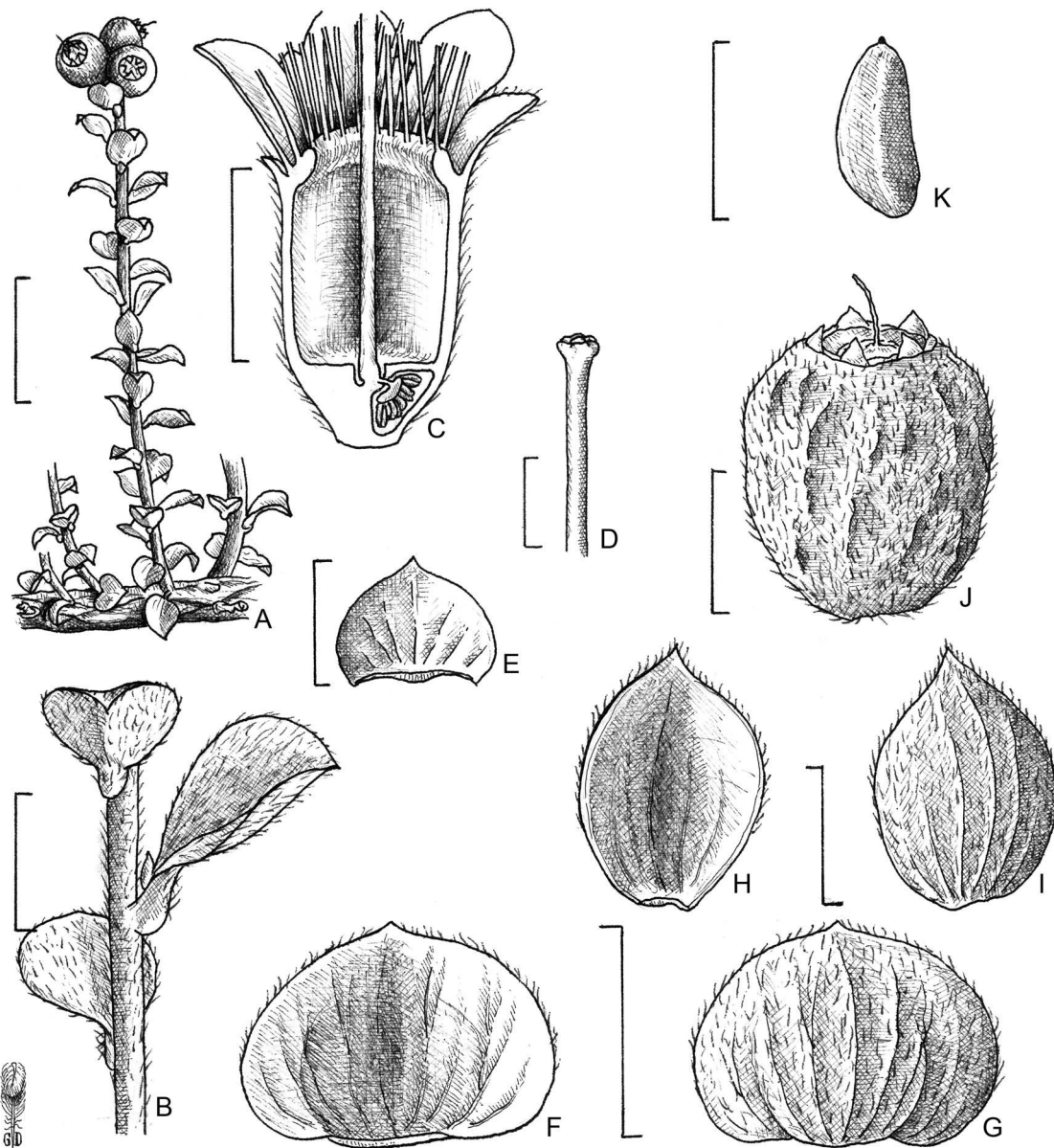


Fig. 5. A–K *K. pomifera*: A lateral fruiting branchlet from prostrate main axis; B cauline leaves; C half flower; D capitulate stigma; E abaxial view of perule; F adaxial view of bract; G abaxial view of bract; H adaxial view of bracteole; I abaxial view of bracteole; J fleshy fruit; K seed. — Scale bars: A 1 cm; B 2 mm; C 3 mm; D 0.5 mm; E, H, I 1 mm; F, G 2.5 mm; J 3 mm; K 1.5 mm. — A–K H.R. Toelken 6842 (AD).

toria 864 (1931); J.M.Black, Fl. S. Austral., ed. 2, 3: 604, fig. 802 (1952); J.H.Willis, Handb. Pl. Victoria 2: 449 (1973); Toelken in Jessop & Toelken (eds), Fl. S. Austral. 2: 932 (1986); Jeanes in N.G.Walsh & Entwistle (eds), Fl. Victoria 3: 1019 (1996). — **Type:** South Australia, Holdfast Bay, *F.Mueller s.n.*, 10.xi.1848 (lecto., designated here: MEL92432; isolecto.: dupl. ex Herb. Sonder, MEL92412); **Remaining syn.:** Rivoli Bay, *F.Mueller s.n.* (MEL92411, MEL92433–6); Gawler Town, *H.H.Behr s.n.*, 22.xi (MEL92305, MEL92413, W); Sturt River, *F.Mueller s.n.* (MEL92304:  $\beta$  *ovalifolia*) (cf. Typification). *Kunzea pomifera*  $\alpha$  *cordifolia* F.Muell. in Miq., Ned. Kruidk. Arch. 4: 147 (1856), nom. inval., sine descr. (see Typification). *Kunzea pomifera*  $\beta$  *ovalifolia* F.Muell. in Miq., Ned. Kruidk. Arch. 4: 147 (1856), nom. inval., sine descr.

Shrublets up to 0.3 m tall, decumbent or prostrate, forming patches to 3 m across, often rooting along branches or suckering; young branches with leaf bases slightly raised and scarcely visible, tomentose to puberulous with short spreading to antrorse hairs; early bark splitting into slender strips soon becoming corky but with upper layers often  $\pm$  peeling especially along the margins. *Leaves* alternate; *petiole* 0.6–1.3 mm long,  $\pm$  appressed; *lamina* ovate to broad-ovate, rarely lanceolate, elliptic or oblanceolate, (2.6–) 3–8 (–10)  $\times$  (2.1–) 3–6 (–8.3) mm, acute and somewhat recurved, often abruptly constricted into petiole, concave to cymbiform above, flat to  $\pm$  convex below, 3–5 (–7)-veined,  $\pm$  pubescent with antrorse hairs usually appressed, usually with horny, entire to dentate or



crenate margins often ciliate when young. *Inflorescence* a  $\pm$  rounded botryum with (1–) 3–8 (–15) flowers, apparently terminal mainly on lateral branches, rarely with terminal vegetative growth after flowering; *retained perules* usually numerous, broadly ovate, clasping, 3–10-veined, abruptly rounded and mucronate, rarely emarginate, glabrescent, rarely pubescent; *bracts* broadly ovate, auriculate becoming spatulate-obovate on upper flowers, 2–3.5  $\times$  2–4 mm, obtuse to rounded, 5– $\infty$ -veined, pubescent to tomentose with short antrorse hairs on thicker central part, glabrous on hyaline margins; *bracteoles* in pairs, oblong-oblancheolate to somewhat falcate, 2–3.8  $\times$  1–2 mm, central vein continued into acute or mucronate apex, pubescent to tomentose with antrorse hairs. *Hypanthium* 3–4.5 mm long when flowering (free tube 2.5–3 mm), little longer than bracts, puberulous to tomentose with antrorse hairs outside. *Calyx lobes* triangular, 1–1.5 mm long, sometimes ridged towards apex, appressed-pubescent outside, sometimes puberulous inside. *Corolla lobes* obovate-orbicular, usually clawed, (0.8–) 1–1.5 (–1.9) mm long, white to cream. *Stamens* 32–38 (–44), in more than one whorl; *filaments* 5.2–7.5 (–8.6) mm long, somewhat broadened towards the base; *anthers* broadly oblong, 0.35–0.4 mm long, with small red subterminal gland. *Ovary* 3-locular, with style slightly sunk into the glabrous upper surface; *placenta* a round disc with short off-centre attachment on upper third, scarcely bilobed, each lobe with 2 rows of ovules; *ovules* 9 or 10 (11) per locule, spreading or erect above to lower 3 or 4 pendulous and slightly longer; *style* 6.3–8 (–9.4) mm long, with stigma small-capitate, scarcely compressed at the apex. *Fruit* indehiscent, fleshy, with short incurved calyx lobes, deep red to black. *Seeds* obloid to slightly crescent-shaped, 1.3–1.5 (–2) mm long,  $\pm$  triangular in section, pale brown, smooth and shiny, with hard testa. *Flowering*: October (November); *Common name*: **Muntries** (Black 1926, Ewart 1931, Willis 1973, Toelken 1986, Jeanes 1996). **Fig. 5.**

*Distribution and ecology.* Locally common on sandy soils with or without surface limestone but often on richer soils with clay subsoils in depressions or around lakes, on coastal dunes or on inland localities associated especially with mallee heath, in heath or woodland; found from western Victoria (LMAL, WAN) connecting up with inland distributions and all along much of the coast of eastern South Australia (MU, YP, SL, KI, SE) as far north as near Tanunda and Moonta.

*Conservation status.* Not threatened and often locally common.

*Diagnostic features.* *Kunzea pomifera* vaguely resembles *K. cambagei*, which also has a decumbent habit and indehiscent, though dry fruit, but is distinguished by broader leaves, bracts and bracteoles with 3–10 veins. The deep red to black, fleshy indehiscent fruit, as well as seeds with a hard almost smooth testa of *K. pomifera* are unique in the genus.

*Variation.* Considerable variation in the size, shape and indumentum of the leaves can be observed throughout its range, but also often on one plant depending on vigorous or senescent growth. Their marginal cilia are usually appressed and wear off soon, so that their bases give the leaves a serrulate to dentate appearance.

Perules, bracts and bracteoles vary from deciduous to caducous, so that they are often not visible even in flowering material.

Immature seeds show the long vertical cells typical of *kunzea* seeds and occasionally they are also slightly ribbed, but as they mature the testa gets hard and smooth unlike seeds of any other species.

*Typification.* Seberg (1986) unravelled the little-known sequence of events of the publication of the name. *K. pomifera* was first published as a preprint of June/July 1855, but reprinted with slight alterations several times subsequently.

When Mueller (1855) described *K. pomifera*, no specimens were cited, so that typification must largely be guided by the date of publication and collections available with special reference to the locality given as “on sandy shores and on rocks at St Vincent’s Gulf and Rivoli Bay”. The species is here lectotypified on a flowering specimen from Holdfast Bay (on St Vincent Gulf), because it is accompanied by a collector’s label with the following note used in the protologue: “*K. recurva* similis differt fol. 5-nervis venosis subcordatis haud perforatis”. The date of collection is well before 1855, though the exact date could not be established, because the collector’s label states “flr.10.1848”, while the date given on the herbarium label in what seems Mueller’s handwriting as 1847. The specimens from Rivoli Bay are accepted as syntypes based on Mueller’s direct reference to it, but no collector’s date could be found on any of the sheets. While the collecting date for the specimen from Sturt River (*F. Mueller* MEL92304) is missing, the river is also flowing into the Gulf of St Vincent; neither is a full date recorded for Gawler Town, *H.H. Behr s.n.*, 22.xi. (MEL92305, MEL92413), but the collector left South Australia in 1849 (Grandison 1990), so that the specimens are all regarded as original material, as they were available to Mueller at the time of the publication of *K. pomifera*.

It appears that Miquel (1856) also described *K. pomifera* based on a specimen (U66213B) supplied by F. Mueller as he had also done for *K. pelagia* (cf. *K. ambigua*). However, judging by the information about the two variants,  $\alpha$  and  $\beta$ , for which Miquel’s protologue specifically specifies “varies”, Latin, “variant” and not a rank of variety, and without description/diagnosis except for the morphologically derived “epithet” invalidates the names in spite of Article 32.1, Note 1 (McNeill et al. 2012). If they were intended as infraspecific taxa it is not clear which of the two, or how the two differ from the typical form. It is interesting that he quoted for  $\alpha$  the specimens from Holdfast Bay and pine forest near Gawler, while for  $\beta$  specimens from Angaston, Stuart



River and Rivoli Bay. The fact that he wrote/copied most of this information on the same label, but published more detail, indicates that these localities were mentioned separately by F. Mueller. A second specimen (U66214B, “Austral. felix”) with a label by F. Mueller not in Miquel’s handwriting seem to be of a later date.

#### *Selection of specimens examined (162 seen)*

VICTORIA: *A.C.Beauglehole* 39013, Swan Lake, Portland, i.1948 (MEL); *A.C.Beauglehole* 39016, S Kaniva, x.1949 (MEL); *D.Albrecht* 4710, Swan Lake, W Mt Richmond, 14.xi.1991 (MEL); *H.E.D’Alton* NSW124245, Nhill, v.1895 (NSW); *C.French* MEL92645/6, NW Lake Albacutya, ix.1887 (MEL); *A.Morton* 463, 0.5 mls [0.8 km] SE Lake Wonga, Wyperfeld N.P., 11.xi.1979 (MEL); *T.B.Muir* 5697, Discovery Bay, NW end of Lake Bong, 27.iii.1978 (MEL); *M.E.Phillips* CBG7031, Mt Richmond N.P., 26.x. 1963 (CANB); *M.E.Phillips* CBG12287, Winniam-Goroke, 10.ix. 1961 (CANB); *M.E.Phillips* CBG19124, 18 mls [28.8 km] N Kaniva, 22.x.1966 (CANB); *J.M.Reader* MEL92651, near Jeparit, 1897 (MEL); *C.Wedding* sub *A.C.Beauglehole* 39937, Rainbow, x.1945 (MEL); *H.B.Williamson* 547, Lillimur, i.1898 (MEL92650).

SOUTH AUSTRALIA: *J.Carrick* 3500, Scorpion Spring, 26.x. 1973 (AD; E, H, L, n.v.); *J.B.Cleland* AD97225013, N Tea Tree Gully, 6.xii.1947 (AD); *K.Czornij* 211, 3 km W Tepko, 3.x.1968 (AD); *H.Eichler* 12214, Sampsons Flats, 29.ii.1956 (AD); *D.Fotheringham* & *B.Overton* NPK1 30097, 5 km SE American River, 14.xi.1989 (AD); *E.H.Ising* AD966040830, Bangham Forest, 12.xii.1934 (AD); *E.N.S.Jackson* 279, 16 km NE Lucindale, 21.xi.1959 (AD, AAU, B, NY); *M.Kenny* AD 97912065, Two Wells, 30.x.1962 (AD); *D.N.Kraehenbuehl* 1676, c. 1.6 km NE Tanunda, 8.i.1976 (AD); *B.Nordenstam* & *A.Anderberg* 1080, 6 km W Coonalpyn, 7.xi.1989 (AD, S); *M.E.Phillips* CBG16988, 23 mls [36.8 km] Bordertown to Keith, 21.x.1966 (CANB); *T.Reichstein* 861, Aldinga, xii.1969 (AD); *T.J.Smith* 859, 0.5 km N Normanville, 16.x.1967 (AD, AK); *A.G.Spooner* 5539, Carpenter Rocks, 5.xi.1977 (AD); *D.E.Symon* 8502, dunes behind Pennington Bay, 27.i.1973 (CANB, K, L, NSW); *R.Taplin* 380, Monarto C.P., 5.viii.1990 (AD); *J.G.O.Tepper* AD97225012, Coromandel Valley, s.d. (AD); *J.R.Wheeler* 1362, Vivonne Bay, 22.x.1968 (AD, NBG, NT); *D.J.E.Whibley* 9421, Cape Buffon, 12.x.1984 (AD, BRI, CBG); *L.D.Williams* 5763, Younghusband Is., 29.ix.1974 (AD); *J.Woodman* s.n., c. 10 km N Balgowan, i.1987 (AD); *J.W.Wrigley* CBG37327, 27 mls [43.2 km] Tailm Bend to Meningie, 28.xi.1968 (CANB, NSW).

### 30. *Kunzea aristulata* Toelken, *sp. nov.*

*A K. rupestre* foliis ovatis perrecurvatis aristatis, ovario trilocolato c. 50 ovulis differt; *a K. cambagei* et *K. pomifera* habitu fruticis, ovario trilocolato c. 50 ovulis differt; *K. capitata* similis sed differt foliis bracteisque aristatis vel aristulatis, calice hypanthioque distale glabro, petalis albis et stigmatibus vix capitatis.

**Type:** New South Wales, Mt Cookem, *D.H.Benson* 4470 & *D.Keith*, 21.xi.1985 (holo.: AD98753031; iso.: NSW206204, NSW364129).

*Kunzea* sp. *E* Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991); de Lange et al., Austral. Syst. Bot. 23: 311 (2010).

*Kunzea* sp. *Mt Cookem* (*Benson* 4470) Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales, ed. 2, 2: 176 (2002); Pellow et al., Fl. Sydney Region, ed. 5, 203 (2009).

Shrub to 1–2 m tall, spreading; young branches with leaf bases scarcely raised but not in form of flanges, pubescent with short antrorsely curved hairs; early bark splitting longitudinally into irregular strips with upper layers peeling from the margins. *Leaves* alternate; *petioles* 0.6–1 mm long, appressed; *lamina* ovate, (2–) 3.2–6 × 1.5–2.3 mm, ± abruptly tapering into terminal point and petiole, ± strongly recurved, usually slightly folded lengthwise and concave above along the central vein, convex below, 3–5 (–7)-veined, pubescent to glabrescent. *Inflorescence* a rounded botryum, with (3–) 7–15 (–20) flowers, apparently terminal on distal branches (no short shoots), with terminal vegetative growth after fruiting; retained perules numerous, usually broadly ovate, 2–3.8 mm long, clasping, cuspidate to rostrate-acuminate upper ones, 1–3-veined, pubescent; *bracts* broadly ovate to oblong-ovate on upper flowers, 2–2.8 × 0.9–1.2 mm, rostrate, usually 3-veined, pubescent to scarcely hirsute with spreading hairs; *bracteoles* in pairs, linear, linear-falcate, rarely linear-lanceolate, 1.8–2.2 × c. 0.4 mm, acute to pointed, with central vein, pubescent. *Hypanthium* 3.8–4.5 mm long when flowering (free tube 1–1.4 mm), irregularly angled towards the base, pubescent outside. *Calyx lobes* broadly triangular, 1.1–1.8 mm long, acute to pointed and often ridged towards the apex, puberulous to glabrescent. *Corolla lobes* obovate-orbicular, slightly clawed, 1–1.2 mm long, white. *Stamens* 50–54 in more than one whorl; *filaments* 1.9–2.3 mm long; *anthers* broadly ellipsoidal, 0.5–0.6 mm long, with red sub-terminal gland. *Ovary* 3-locular, with upper surface hairy and longer hairs next to the style base which is not or slightly inserted; *placenta* a round disc with short ± off-centre attachment, deeply lobed at least in the centre, with each lobe with 4 rows of ovules; *ovules* 47–50 per locule, spreading, of equal size; *style* 2.1–5.4 mm long, with stigma scarcely broadened, hardly compressed at the apex. *Fruit* ± urceolate but often slightly angular, with spreading calyx lobes, dehiscent or indehiscent. *Seeds* (immature) obloid-conical, c. 1 mm long, soft testa with long indistinct vertical cells. *Flowering*: October, November. **Fig. 6.**

**Distribution and ecology.** Grows often on cliff edge in open forest of *Angophora costata*, *Eucalyptus oblonga*, *E. punctata*, *E. sieberi* in restricted area north of Yerranderie, New South Wales (CT).

**Conservation status.** Very few plants of this rare species have been recorded from a conserved and very inaccessible area in the Blue Mountains National Park.

**Diagnostic features.** *Kunzea aristulata* is very similar to *K. rupestris* but easily distinguished by its ovate, usually recurved leaves terminating in a more or less awned apex. It has also a 3-locular ovary, while *K. rupestris* shares with *K. cambagei* the 2-locular ovary. It is noteworthy that *K. aristulata* is the only species in this group of three species with the style base slightly sunk into the

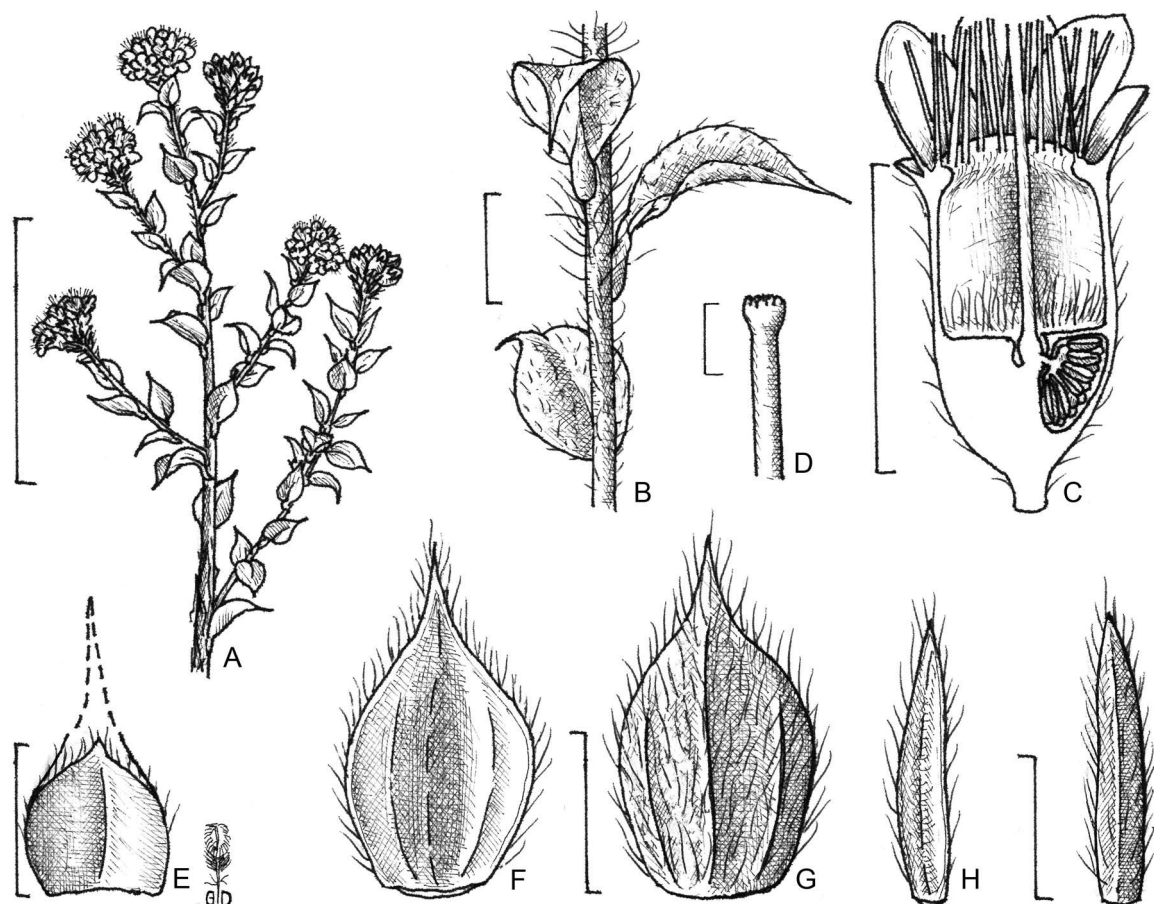


Fig. 6. *K. aristulata*: A flowering branch; B cauline leaves; C half flower; D scarcely broadened stigma; E perule variation; F abaxial view of bract; G adaxial view of bract; H abaxial view of bracteole; I adaxial view of bracteole. — Scale bars: A 3 cm; B 3 mm; C 4 mm; D 0.5 mm; E 2 mm; F, G 1.5 mm; H, I 1 mm. — A–I A. Fairly s.n. (NSW 168748).

upper surface of the ovary and the ovary is trilocular with about thirty ovules in each locule.

*Kunzea aristulata* is also superficially similar to *K. capitata*, which also has very much recurved leaves. The latter is, however, distinguished by its oblanceolate to obovate leaves, the glabrous upper surface of the ovary with a distinctly inserted style base and, most importantly, the petals and stamens are pink to purple. In *K. aristulata* the hair bases on the upper leaf margins are distinctly papillate, but such texture is usually not visible in *K. capitata*.

**Notes.** While leaves of the species are usually rigidly recurved, this is not the case on the specimen *M. Kennedy 19*, *P. Cuneo* & *A. T. Fairly*.

Fairly (*NSW664289*) comments that crushed leaves have a strong citrus smell.

**Etymology.** Although some leaves are distinctly “awned”, Latin, “*aristata*”, many are only shortly pointed, so that the diminutive, “*aristulata*”, seemed more a more appropriate epithet for the species.

#### *Specimens examined*

NEW SOUTH WALES: *M. Doherty 2*, Axehead Ra., 30.iii.1986 (NSW); *A. T. Fairly NSW257386*, Sombre Dome, Dick-

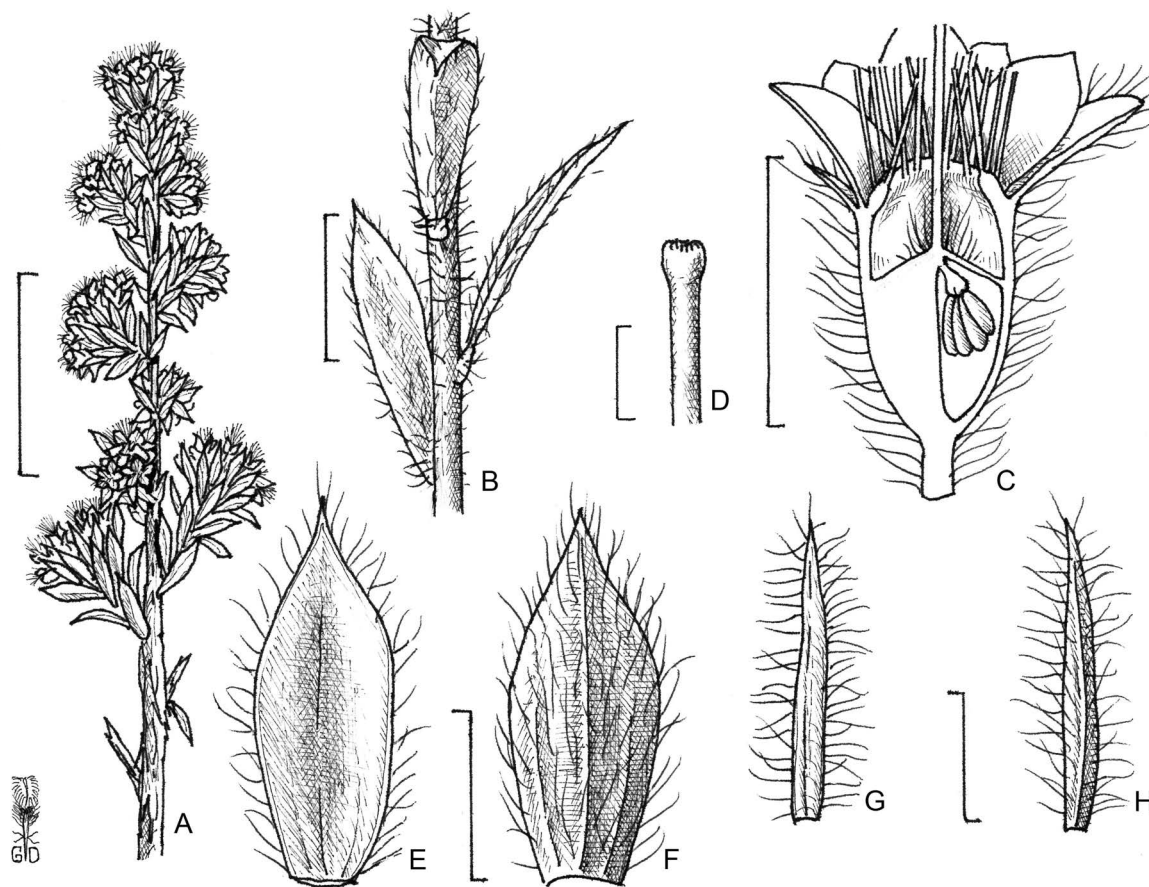
sonia Bluffs, Kanangra Walls, 8.i.1992 (NSW); *A. T. Fairly NSW168748*, Mt Cookem, 21.x.1984 (NSW); *A. T. Fairly NSW664289*, Mt Cookem, 1.ix.2001 (NSW); *W. Jones NSW265430*, Bulga Ridge, 3.xi.1992 (NSW); *M. Kennedy 19 et al.*, Mt Cookem overlooking Cocks River, 3.x.1990 (NSW).

#### 31. *Kunzea rupestris* Blakely

Proc. Linn. Soc. New South Wales 54: 683, pl. 29, 2 (1929); N.C.W. Beadle et al., Handb. Vasc. Pl. Sydney District 290 (1963); N.C.W. Beadle et al., Fl. Sydney Region, ed. 2, 344 (1972); Peter G. Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 153 (1991); Carolin & Tindale, Fl. Sydney Region, ed. 4, 396 (1993). — **Type:** New South Wales, Hornsby Plateau, near Canoelands, *D. W. C. Shires & W. F. Blakely s.n.*, 16.x.1929 (lecto., designated here: NSW 124239; isolecto.: BRI40930; K 3 sheets, MEL92309).

Spreading shrub 0.6–1.5 m tall, suckering and apparently clonal; young branches with leaf bases scarcely raised and flanges not developed, pubescent to hirsute, with fine long antrorse hairs; early bark splitting into long ± irregular strips with upper layers peeling in larger or smaller pieces. *Leaves* alternate; *petioles* 0.7–1.1 mm long, appressed; *lamina* oblanceolate, rarely linear-oblanceolate, (6.5–) 7–9.5 × 1.5–2.7 mm, acute to short-pointed, slightly recurved apex, gradually tapering





**Fig. 7. *K. rupestris*:** A flowering branch; B cauline leaves; C half flower; D scarcely broadened stigma; E adaxial view of bract; F abaxial view of bract; G adaxial view of bracteole; H abaxial view of bracteole. — Scale bars: A 3 cm; B 3 mm; C 6 mm; D 0.5 mm; E, F 1.2 mm; G, H 1 mm. — A–H D.W.C. Shiress & W.F. Blakeley s.n. (NSW124239).

into petiole, concave or slightly folded lengthwise above, convex below, hirsute to rarely villous with long antrorse hairs on both surfaces, to glabrescent mainly on upper half, with papilla-based hairs or papillae along margins. *Inflorescence* a rounded botryum with (3–) 7–19 flowers, apparently terminal on long and short shoots towards end of branches, with terminal vegetative growth continuing after fruiting; *retained perules* (3–) 5 (–7), triangular to ovate-triangular, 1.3–1.8 mm long, usually acuminate, 3-veined, hirsute to glabrescent; *bracts* oblong-ob lanceolate, 2–3.2 × 1–1.3 mm, acuminate to mucronate, 3-veined, usually villous with long antrorse hairs; *bracteoles* in pairs, linear-lanceolate to linear on upper flowers, 1.2–2 × 0.2–0.5 mm, with central vein, hirsute to pubescent. *Hypanthium* 2.4–3 mm long when flowering (free tube 1–1.2 mm), rarely ridged, hirsute. *Calyx lobes* often narrow-triangular, 1.1–1.9 mm long, acute to pointed, hirsute. *Corolla lobes* obovate to rhombic-obovate, 0.8–1.2 mm long, white or off-white, ± tinged pink. *Stamens* 25–31 in more than one whorl; *filaments* 4.2–5.4 mm long; *anthers* broadly ellipsoidal, c. 0.7 mm long, with red subterminal gland. *Ovary* 2-locular, with style base gradually tapering into raised centre of upper surface being pubescent and with a tuft of hairs above

each locule at base of style; *placenta* conical, tapering gradually central attachment, scarcely bilobed with each lobe with 2 rows of ovules; *ovules* 4 per locule, pendulous; *style* 3.8–5 mm long, slightly broadened towards the base, with stigma scarcely capitate, hardly compressed at apex. *Fruit* ± obconical but often laterally compressed, indehiscent, yellow. *Seeds* obloid-conical, c. 1 mm long, soft testa with indistinct vertical cells. *Flowering*: October (November). **Fig. 7.**

*Distribution and ecology.* Grows on shallow soil on sand stone platforms in heath, often suckering; known only from the Hornsby Plateau, New South Wales (CC).

*Conservation status.* Very rare but conserved in Marra-marra National Park. It is regarded as vulnerable in New South Wales (National Herbarium of N.S.W. 2016) and 2VCa by Briggs & Leigh (1996).

*Diagnostic features.* *Kunzea rupestris* is distinguished from the similar *K. aristulata* by its erect oblanceolate leaves, which are scarcely recurved, but also by a bilocular ovary with fewer ovules in each locule. These two species and the decumbent *K. cambagei* share the unusual characteristic of more or less bristly hairs on top of the ovary next to the style base. In addition, the



styles of these species are not, or scarcely in *K. aristulata*, sunk into the upper surface of the ovary. This is a unique feature in the genus, as hairs on the apex of the ovary have also been recorded for other species, e.g. *K. parvifolia*, but then they are short and evenly cover the whole upper surface. While the fruits are indehiscent in *K. rupestris* and *K. cambagei*, but not fleshy as in *K. pomifera*, fruits of *K. aristulata* usually dehisce as is commonly found in all other species of *Kunzea*.

**Variation.** Since the species is known only from the Maroota area not much variation has been recorded, particularly as P.G.Wilson 184 reports “plants often arising as root suckers”.

Fruits are often laterally compressed, because the ovaries are 2-locular with at the most one seed per locule developing.

**Typification.** The specimen NSW124239 with original data is here lectotypified, as the author did not designate a holotype.

#### *Specimens examined*

NEW SOUTH WALES: R.G.Coveny 17207b & T.James, South Maroota, 5.ix.1995 (CANB); R.Johnstone 2244 & A.E. Orme, 1 km along Pauls Rd, 20.xi.2007 (CANB); M.Smith s.n., 2.4 km NNE Canoelands Rd, Marramorra N.P., 11.ii.1993 (CANB); P.G.Wilson 132 & B.J.Conn, Marramorra N.P., 22.ix.1987 (AD, CANB, K, NSW); P.G.Wilson 184 et al., Marramorra N.P., 27.xi.1987 (AD, CANB; BM, BRI, K, MEL, MO, n.v.).

#### *Putative hybrids*

*K. capitata* subsp. *capitata* × *K. rupestris*: see 33a.  
*K. capitata* subsp. *capitata*.

### 32. *Kunzea cambagei* Maiden & Betche

Proc. Linn. Soc. New South Wales 38: 246 (1913); Maiden & Betche, Census N.S.W. Pl. 154 (1916); Beadle et al., Fl. Sydney Region, ed. 2, 344 (1972); Peter G.Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 153 (1991); Carolin & Tindale, Fl. Sydney Region, ed. 4, 396 (1993); Pellow et al., Fl. Sydney Region, ed. 5, 202 (2009). — **Type:** New South Wales, “Big Plain” near Mt Werong, R.H.Cambage 3175, xii.1911 (lecto., designated here: NSW; isolecto.: BRI). **Remaining syn.:** on the plateau E Mt Werong, R.H.Cambage 2258, 4.x.1909 (NSW 3 sheets).

Shrublets up to 0.3 m tall, with decumbent or prostrate branches sometimes rooting along the branches; young branches with leaf bases slightly raised but flanges not developed, ± densely sericeous with silky antrorse hairs; early bark splitting longitudinally as well as transversely, peeling in ± oblong pieces. *Leaves* alternate; *petioles* 0.4–0.7 mm long, appressed or upper third spreading; *lamina* oblanceolate, rarely elliptic, (3.5–) 4–9 × 1.2–3 mm, obtuse to rounded, rarely with slightly recurved apex, gradually tapering into petiole, flat to slightly concave above, ± convex below, usually glabrous above, ± sericeous to glabrescent with long antrorse-appressed hairs mainly below and along the margins. *Inflorescence* a rounded botryum with (3–) 5–13 (–16) flowers, apparently terminal on main branches

and below on short lateral shoots or short shoots, or apparently terminal on lateral branches to decumbent main branches, with terminal vegetative growth after fruiting; *retained perules* 2, 3 (–5), ovate to broadly ovate, 1–1.3 mm long, stem-clasping, usually 5-veined, ± densely covered with long silky hairs; *bracts* broadly ovate at base becoming oblong-elliptic on distal flowers, (1.6–) 1.8–2.4 × 2–2.8 mm, usually 3-veined, sericeous with long antrorse hair and shorter marginal cilia; *bracteoles* in pairs, oblanceolate, linear to linear-falcate, 1.2–1.9 × 0.3–0.6 mm, with central vein, sericeous. *Hypanthium* 2.6–3 mm long when flowering (free tube c. 1.3 mm), sericeous. *Calyx lobes* triangular, 0.7–0.9 mm long, acute to obtuse, sericeous. *Corolla lobes* obovate to orbicular, 1.2–1.4 mm long, white or cream. *Stamens* (20) 21–25, often apparently in one whorl; *filaments* 1.7–2.8 mm long; *anthers* broadly ellipsoidal, 0.4–0.5 mm long, with red or yellow, small subterminal gland. *Ovary* 2-locular, with style base gradually tapering into the raised conical centre of the upper surface, being pubescent and with a tuft of longer hairs on a red spot above each locule at the base of the style; *placenta* conical, tapering gradually into the attachment, scarcely bilobed with each lobe with 1 ovule; ovules 2 per locule, pendulous and elongate; *style* 3.1–4.8 mm long, with stigma scarcely capitate, hardly compressed at apex. *Fruit* ± funnel-shaped (obconical) with erect calyx lobes, indehiscent, dry. *Seeds* obloid-ellipsoid, c. 1 mm long, scarcely compressed, smooth. *Flowering:* October, November (December). **Fig. 8.**

**Distribution and ecology.** Known from moist places in heath-like vegetation, sometimes in open eucalypt woodland, associated with sandstone outcrops mainly from the southern Central Tableland (CT) of New South Wales, but has also been recorded further north from one locality near Mudgee (CWS) and to the south near Braidwood (ST).

**Conservation status.** The species is nowhere common, but is conserved in the Blue Mountain National Park (Mt Werong). It is regarded as vulnerable in New South Wales (National Herbarium of N.S.W. 2016) and 2VCa by Briggs & Leigh (1996).

**Diagnostic features.** The prostrate habit, together with the broadly conical upper surface of the ovary continuing into the style without its base being inserted into the ovary, easily distinguish *K. cambagei* from the similarly prostrate *K. pomifera*, which has in addition fleshy fruit. Unique are also, observed at least in the Medway population, the red spots each with a tuft of hairs on top of each locule next to the style. Similar tufts of hairs are, however, also found in the very similar but shrubby *K. rupestris*, but without the red spots on the upper surface of the ovary. *Kunzea cambagei* has also only two pendulous ovules per locule, a character used by Bentham (1863) to separate mainly Western Australian species into his sect. *Eukunzea*, but a reduction of locules and the number of ovules has been

shown to have developed several times and in different infrageneric groups (cf. Flowers).

**Variation.** Plants known from a single record from mountain tops south of Mudgee, which is very much further north, have not been recollected in past fifty years. This and a recent record of the species from near Braidwood are interesting extensions of distribution, particularly as the plants are indistinguishable from the main central populations.

**Typification.** The protologue enumerates two of Cambridge's collections and the one from December 1911 is here selected as the lectotype, as it was essential for the description of the species, because it represented the first flowering specimen collected.

#### *Specimens examined*

NEW SOUTH WALES: *D.Benson* 2441 & *D.Keith*, Loombah Plateau, 20.xi.1985 (AD; NSW, PERTH, n.v.); *R.Coveny* NSW 124236, SE Mt Werong, 18.ix.1967 (NSW); *T.A.James* NSW 436609, above Wombat Ck, 18.iv.1999 (NSW); *R.Johnstone* 2333 & *A.E.Orme*, Yerranderie Rd, 30 km SE Oberon at Big Plain, 21.xii.2007 (CANB, NSW); *W.B.Marsh* NSW124235, Lock Catherine coal mine, W Berrima, 29.x.1961 (NSW); *W.Martin* CBG37933, Bowral [sic], s.dat. (CANB); *R. & J.Miller* 5, near Braidwood, 8.xi.2011 (AD, NSW); *P.Ollershaw* 1802, 6.5 km E Mt Werong on road to Bindook Highlands, 21.x.1988 (AD, CANB, NSW); *L.G.Sweeney* NSW 124237, Meroo, S Mudgee, 17.x.1967 (NSW); *P.G.Wilson* 60 & *J.Highet*, Loombah Plateau, E Mt Werong, 15.i.1986 (AD; BRI, CANB, MEL, NSW, PERTH, n.v.).

#### *Putative hybrids*

##### (i) *K. cambagei* × *K. capitata* subsp. *seminuda*

The plants being described as two to three feet high immediately associate them with *K. capitata* and not with the decumbent plants of *K. cambagei*. The flat oblong-oblongate leaves, with or without scarcely pinched leaf apex, are similar to those of *K. cambagei*, but they are densely covered with long hairs, as are the branches, similar to *K. capitata* subsp. *capitata*. These hairs are appressed as in *K. cambagei* where they are, however, short and sparse. The small flowers are also reminiscent to those of *K. cambagei* and they even bear some bristles on the convex apex of the ovary, but unlike that species they usually have three locules, each with seven or eight mainly pendulous ovules (two pendulous ovules in each of two locules in *K. cambagei*). The retained perules, bracts and bracteoles are similar to those of *K. cambagei*. The fact that the leaves are flat and the flowers regularly hairy throughout, suggests that one putative parent may be *K. capitata* subsp. *capitata*, but as at present no specimens of it have been recorded from near that area, as that subspecies occurs predominantly in coastal areas, the hybrid is placed under *K. capitata* subsp. *seminuda*, until experimental evidence to refute this assumption can be provided.

#### *Specimen examined*

NEW SOUTH WALES: *S.Calneck* 9, Berrima River, s.dat. (MEL92506).

#### *Putative parents from the area*

***K. cambagei*.** NEW SOUTH WALES: *W.B.Marsh* NSW124235, Lock Catherine coal mine, W Berrima, 29.x.1961 (NSW).

***K. capitata* subsp. *seminuda*.** NEW SOUTH WALES: *C.L.Porter* 9 et al., W edge of Wanganderry Plateau, N. Wombean Caves Rd, W Mittagong, 28.xi.1994 (AD, CANB, NSW).

##### (ii) *K. cambagei* × *K. parvifolia*

No hybrid swarm but only three unusual plants outside the range of variation of *K. cambagei* are suspected putative hybrids, as they were found in the Medway population where *K. parvifolia* grew nearby. These are described as two separate entities (A, B), as they were observed, but it is possible that the two forms will in time form a continuous range of variation in a larger backcrossing hybrid swarm. Two specimens of form A combine pale pink flowers with a decumbent habit, while the third plant in a different part of the population of *K. cambagei* had pale yellow flowers and a more erect habit.

##### *K. cambagei* × *K. parvifolia* A

Shrubs with main branches decumbent and young branches covered with short appressed hairs. *Leaf lamina* linear-oblongate, (1–) 2.2–3.6 × 0.6–1.4 mm. *Bracts* ovate to broadly oblong, usually with rostrate to acuminate, often keeled apex, and with cuneate base on upper flowers; *bracteoles* narrowly spatulate to linear-oblongate. *Hypanthium* shortly tomentose outside, free tube longer than ovary. *Ovary* 2-locular, each with 8–10 ovules, upper surface hairy, style base not raised.

#### *Specimens examined*

NEW SOUTH WALES: *H.R.Toelken* 6848, near Medway, 29.x.1986 (AD, NSW); *H.R.Toelken* 6865, near Medway, 4.xi.1986 (AD, NSW)

##### *K. cambagei* × *K. parvifolia* B

Shrubs with few main branches erect and many short lateral branches particularly at the base, and young branches covered with short appressed hairs. *Leaf lamina* oblongate, (3–) 3.5–5.5 (–6) × 1.2–2 mm. *Bracts* lanceolate to oblong-lanceolate, acute, not keeled; *bracteoles* linear-falcate or rarely linear-oblongate. *Hypanthium* sericeous at the base gradually becoming pubescent below and on the calyx lobes; free tube about as long as ovary. *Ovary* 2-locular each with two ovules, with upper surface hairy, style base raised.

#### *Specimens examined*

NEW SOUTH WALES: *H.R.Toelken* 6847, near Medway, 29.x.1986 (AD, NSW).

#### *Putative parents from the associated area*

***K. cambagei*.** NEW SOUTH WALES: *H.R.Toelken* 6846, S Medway, 29.x.1986 (AD).

***K. parvifolia*.** NEW SOUTH WALES: *E.Gordon* NSW124082, Berrima, 15.xi.1961 (NSW); *H.R.Toelken* 6845, S Medway, 29.x.1986 (AD).



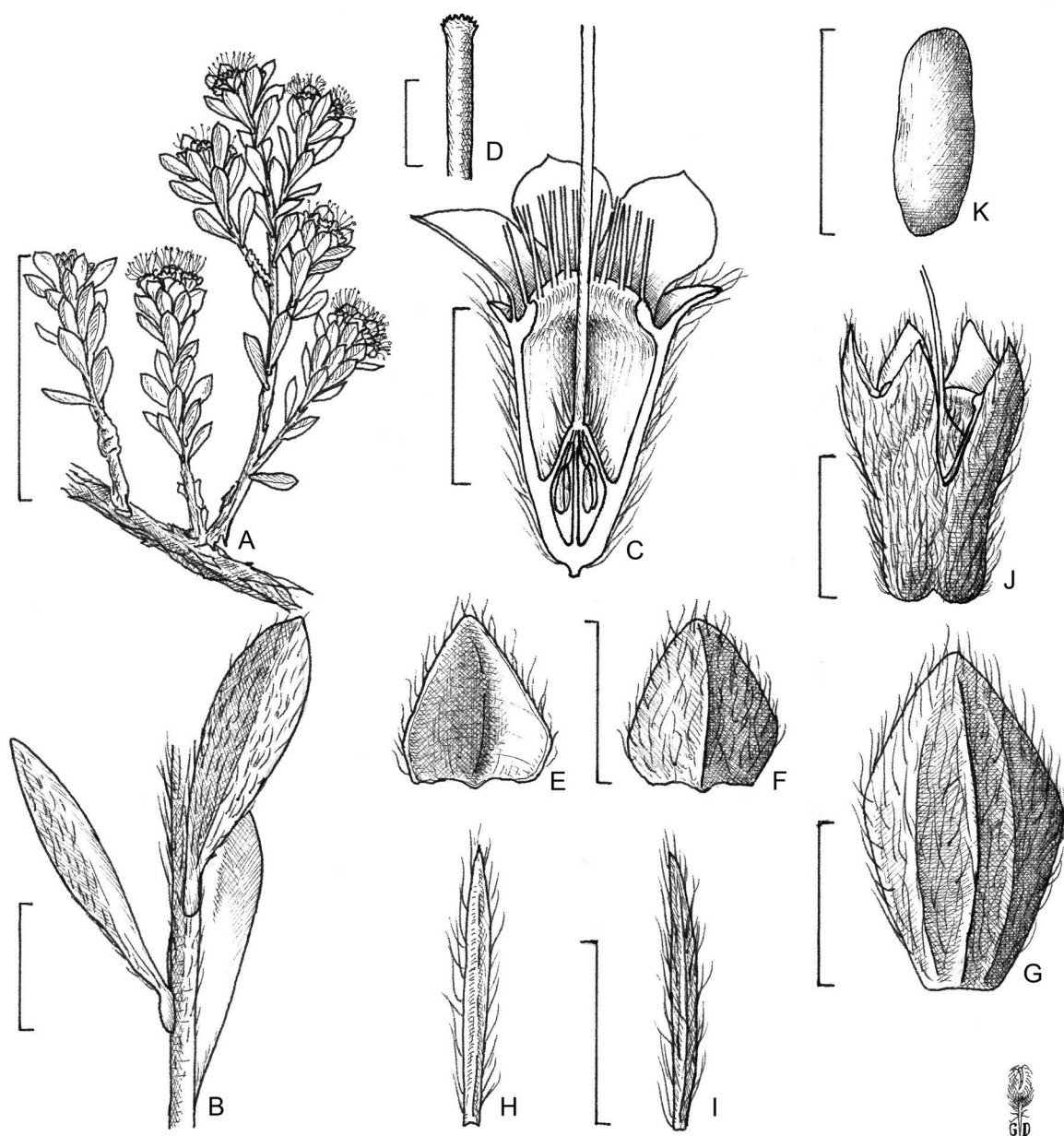


Fig. 8. *K. cambagei*: A flowering lateral branches on prostrate main branch; B cauline leaves; C half flower; D scarcely broadened stigma; E adaxial view of proximal bract; F abaxial view of proximal bract; G abaxial view of distal bract; H adaxial view of bracteole; I abaxial view of bracteole; J fruit; K seed. — Scale bars: A 3 cm; B 2 mm; C–K 1 mm. — A–K H.R.Toelken 6846 (AD).

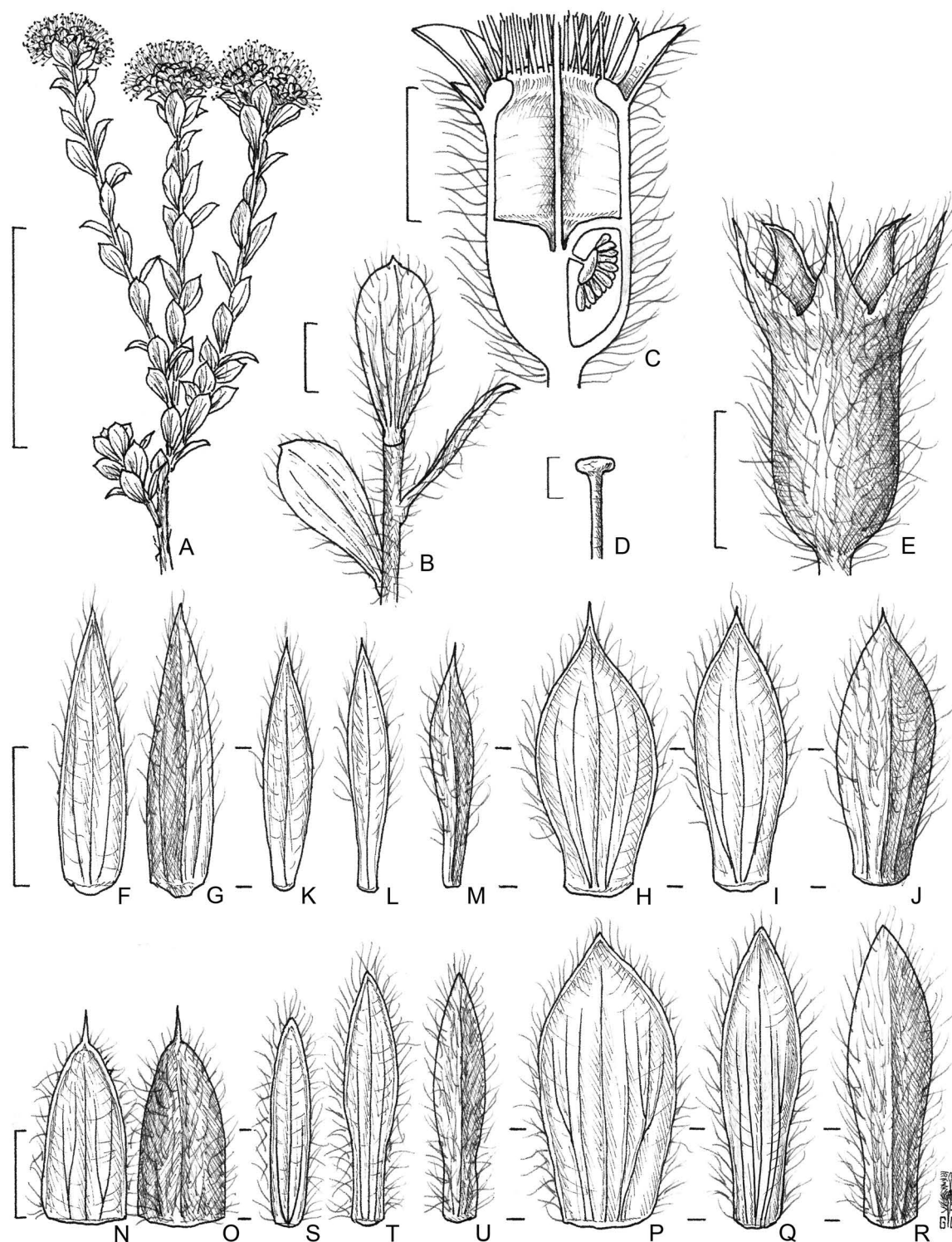
### 33. *Kunzea capitata* (Sm.) Rchb. ex Heynh.

Nomencl. Bot. Hort. 1: 337 (1840); Benth., Fl. Austral. 3: 116 (1867); N.C.W.Beadle et al., Handb. Vasc. Pl. Sydney District 290 (1963); N.C.W.Beadle, Student Fl. N.E. New South Wales 3: 477 (1976); Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991); Carolin & Tindale, Fl. Sydney Region, ed. 4, 396 (1993); Pellow et al., Fl. Sydney Region, ed. 5, 202 (2009). — *Metrosideros capitata* Sm., Trans. Linn. Soc. London 3: 273 (1797); Sm. in Rees, Cycl. 23: *Metrosideros* no. 15 (1818); DC., Prodr. 3: 225 (1828). — *Callistemon capitatus* (Sm.) Rchb., Iconogr. Bot. Exot. 1: 59, t. 84 (1827), “*Callistemma*”. — *Stenospermum capitatum* (Sm.) Sweet, Hort. Brit., ed. 2, 201 (1830), nom. inval., 3 spp. sine descrip. generico; *S. capitatum* (Sm.) Sweet ex Heynh., Nomencl. Bot. Hort.

2: 787 (1841). — **Type:** New South Wales, near Port Jackson, *J.White* (holo.: LINN-HS877/19; possible iso.: “Smith missit” in Herb. Ventenat, G00223381).

Shrubs 0.5–1.5 (–2.5) m tall, ± erect-spindly to much-branched and spreading; young branches with leaf bases slightly raised and without flanges, pilose to hirsute, rarely pubescent, with spreading, but often ± crisped long and short hairs each sometimes with basal tubercle; early bark splitting mainly longitudinally and peeling at first in long chartaceous strips but soon also break transversely into oblong pieces with ± irregular margins rarely more than one layer thick. *Leaves* alternate; *petiole* (0.2–) 0.7–1.2 (–1.6) mm long, often





**Fig. 9.** *K. capitata* subsp. *capitata*: **A–M** northern form: **A** flowering branch; **B** cauline leaves; **C** half flower; **D** capitate stigma; **E** fruit; **F** adaxial view of perule; **G** adaxial view of perule; **H** adaxial view of proximal bract; **I** adaxial view of distal bract; **J** abaxial view of distal bract; **K, L** adaxial view of bracteoles; **M** abaxial view of bracteole. **N–U** southern form: **N** adaxial view of perule; **O** abaxial view of perule; **P** adaxial view of proximal bract; **Q** adaxial view of distal bract; **R** abaxial view of bract; **S, T** adaxial view of bracteoles; **U** abaxial view of bracteole. — Scale bars: **A** 5 cm; **B** 3 mm; **C** 2.5 mm; **D** 1.5 mm; **E** 3.5 mm; **F–M** 1.5 mm; **N–U** 1.3 mm. — **A–D, F–M** J.J. Fletcher NSW123953; **E** F.A. Rodway NSW123967; **N–U** R.H. Cambage 1415 (NSW).

appressed; *lamina* oblanceolate to oblong-obovate or narrowly to broadly elliptic, rarely linear-oblanceolate, (2.1–) 4.5–9.5 (–14.4) × (1.2–) 2–4.5 (–7.5) mm, ± ab-

ruptly constricted into recurved acute apex, usually gradually tapering into petiole, flat and erect to spreading with only the apex recurved, or folded length-

wise and recurving from at least the middle, above flat to furrowed and usually glabrous or rarely with a few hairs, below flat or convex and  $\pm$  hairy, 3–5 (–9)-veined, with marginal cilia often with  $\pm$  developed persistent tubercles. *Inflorescence* a rounded botryum, sometimes in clusters with up to 3 sessile lateral ones subtending the distal one, often half-hidden by leaves below, each with (3–) 7–15 (–24) flowers, apparently terminal mainly on major branches, often also on short shoots along distal branches but separate from the main inflorescence, with terminal growth usually after flowering; *retained perules* 2 or 3 (–5), linear-triangular to triangular, (1.2–) 1.4–2 mm long, (1–) 3 (–5)-veined, pilose to hirsute or with spreading crisped hairs mainly towards the apex; *bracts* oblong-elliptic to oblong-oblongate, (2.3–) 2.6–3.5 (–3.8)  $\times$  0.4–1.2 (–1.6) mm, acute, acuminate, cuspidate to rarely obtuse, (1–) 3–5 (–9) veined, pilose to hirsute,  $\pm$  glabrous towards the base; *bracteoles* in pairs, linear, linear-elliptic, sometimes falcate, (1.4–) 1.6–2.3  $\times$  0.2–0.4 mm, hirsute. *Hypanthium* 2.4–3.2 mm long when flowering (free tube 1.1–1.6 mm long), hirsute to pubescent, or with glabrous free tube, with spreading or crisped hair on the ovary. *Calyx lobes* narrow-triangular, (1.1–) 1.3–1.8 (–2.2) mm long, acute or pointed and ridged, hirsute to glabrous. Corolla lobes broadly obovate to oblong-obovate or almost orbicular, 1.2–1.6 mm long, scarcely erose, purplish-pink, rarely pink or white. *Stamens* (39–) 45–65 (–75), in more than one whorl; *filaments* (2.6–) 3–4.5 (–5.8) mm long; *anthers* broadly ellipsoidal, 0.4–0.7 mm long, with small subterminal gland. *Ovary* 3-locular, with style base slightly sunk into the upper surface of ovary; *placenta* a broadly elliptic disc with short central attachment, scarcely bilobed, with each lobe with usually 4 rows of ovules; *ovules* 39–54 per locule, spreading, subequal; *style* 4–5.5 (–6.2) mm long, with stigma small capitate, scarcely compressed at apex. *Fruit* elongate urceolate, with erect calyx lobes. *Seeds*  $\pm$  angular obovoid, 0.5–0.65 mm, with few vertical ridges and some transverse ones joining them.

*Diagnostic features.* *Kunzea capitata* is very variable with a number of local forms, of which only the subsp. *seminuda* is formally segregated here on the basis of its folded leaves without marginal tubercles and glabrous free hypanthium and calyx lobes. Most of the specimens of *K. capitata* subsp. *capitata* with more or less flat leaves are easily distinguished from other kunzeas by their prominent and often more than three veins (up to 9) visible on the abaxial leaf surface. *Kunzea parvifolia* and *K. obovata* have similar folded leaves to subsp. *seminuda*, but the first species has smaller leaves with a double-pointed apex. *Kunzea obovata* differs from *K. capitata* subsp. *seminuda* by its hairy hypanthium and usually some hairs on the upper surface of the ovary surrounding the style insertion. The leaves of *K. badjaensis* are also somewhat similar, but the decumbent plants have short and more or less appressed hairs on branches and leaves.

*Variation.* In contrast to Bentham (1867), who described *Kunzea capitata* var. *glabrescens* from “between Port Jackson and Sydney” based on plants with “calyx glabrous or nearly so”, it was found that the density of the indumentum on different parts of this species varies considerably. More material now available showed that his delimitation could not be supported by additional characters and, most importantly, was geographically and edaphically inseparable from the typical variety. The more or less appressed oblanceolate leaves show that it is also not a hybrid with *K. ambigua*, as such specimens also show a decreasing indumentum on the free hypanthium and calyx lobes (cf. *K. ambigua*: putative hybrids).

However, the absence of hairs on the free hypanthium and calyx lobes is also observed on plants from the Central and Southern Tableland, and, as they differ from populations of the coastal plants (NC, CC, SC), they are here described as subsp. *seminuda*. In addition to this character, namely the absence of hairs on older flowers (often common to both subspecies), the segregation of subsp. *seminuda* is also based on its characteristically folded and spreading cauline leaves ( $\pm$  flat except for “pinched” recurved apex and erect to often approaching appressed leaves of subsp. *capitata*), which are usually glabrous, except for marginal hairs without basal tubercles ( $\pm$  hairy at least abaxially and with obvious marginal cilia with basal tubercles in subsp. *capitata*). In herbarium specimens the main veins of the leaves are usually not or only scarcely visible, while they are more or less pronounced in subsp. *capitata*. The full range of variation is discussed in detail under each of the two subspecies.

### Key to subspecies

Local intermediates between the two subspecies are attributed to hybridization at the interface of their distributions (cf. Putative hybrids under *K. capitata* subsp. *capitata*).

1. Leaves flat except for recurved “pinched” apex, with marginal tubercles; free hypanthium and calyx outside with spreading hairs to glabrescent ..... **33a. *K. capitata* subsp. *capitata***
- 1: Leaves folded lengthwise and recurved in the upper third, without marginal tubercles; free hypanthium and calyx outside glabrous .... **33b. *K. capitata* subsp. *seminuda***

### 33a. *Kunzea capitata* subsp. *capitata*.

Benth., Fl. Austral. 3: 116 (1867); Maiden & Betche, Census N.S.W. Pl. 154 (1916), emended.

*Melaleuca thymoides* Sieber, Fl. Mixta 609 (1836), nom. nud., nom. illeg., non Labill. (1806) (cf. Sieber 609 in MEL92427, MEL92428, MEL92429).

*Melaleuca eriocephala* Sieber ex Spreng., Syst. Veg. 3: 336 (1825). — **Type:** New South Wales, F.W.Sieber, Fl. Nov. Holl. 322 (lecto., designated here: W340039; isolecto.: K000843020 (right hand side), MEL92427, MEL92430, MEL92520, W177967, W340038, W343372, W).

*Kunzea schaueri* Lehm. ex Schauer in Lehm., Pl. Preiss. 1: 124 (1844), nom. illeg., with *Metrosideros capitata* in synonymy. — **Type:** Nov. Holland, F.W.Sieber s.n. (lecto., designated here: W ex. Herb. Endl.). **Remaining syn.:** Nov. Holl., King George’s Sound, F.L.Bauer s.n.



(W); Australasia orient., *K.K.A. von Hügel* 40 (W); South Head road, *K.K.A. von Hügel* 97 (W); South Head road, *K.K.A. von Hügel* 259 (W); Australasia NSW, *K.K.A. von Hügel s.n.* (W) (cf. Typification).

*Kunzea hirsuta* Turcz., Bull. Soc. Imp. Naturalistes Moscou 35(2): 326 (1862). — **Type:** “Nowa Hollandia”, *J.Brogden s.n.* (holo.: KW, n.v.; photo.: PERTH).

*Kunzea capitata* var. *glabrescens* Benth., Fl. Austral. 3: 116 (1867); Maiden & Betche, Census N.S.W. Pl. 154 (1916). — **Type:** New South Wales, between Port Jackson and Sydney, *R.Brown [J.J.Bennett 4659]*. (lecto., designated here: BM; isolecto.: K000843021, cf. Typification).

Spreading shrubs up to 2.5 m tall, usually with few to many stems. *Leaves* elliptic-oblong, rarely oblong-lanceolate, (3.8–) 7–10 (–14.4) × (1.2–) 2.5–4.5 (–7.5) mm, flat and erect except for “pinched” recurved apex, with 3–5 (–9) main veins usually visible, above glabrous or rarely with few hairs, below hirsute but soon wearing off, with marginal cilia each with persistent basal tubercle. *Calyx lobes* acuminate to acute, about once to twice longer than broad, and as well as free hypanthium and ovary covered with silky spreading hairs usually > 1 mm long. *Flowering:* September–November (December). **Fig. 9.**

*Distribution and ecology.* Grows on sandy soils usually of old coastal dunes but often associated with temporarily swampy areas and recorded mainly from heath (rarely on forest floor) along the coast and the adjoining foot hills of eastern New South Wales (NC, CC, SC, ST).

*Conservation status.* The subspecies is widespread and locally common.

*Variation.* The variation of *K. capitata* subsp. *capitata* can be divided vaguely into three forms and extreme specimens of each of these are usually easily recognised, but they ultimately grade seamlessly into one another. In contrast to subsp. *seminuda*, the first two forms of subsp. *capitata* can neither morphologically nor geographically or edapically be clearly separated.

(1) North of Sydney the often spindly shrubs are multi-stemmed and have erect flat leaves with only the “pinched” apex, which is acute to usually cuspidate and more or less recurved (fig. 9B). The three to five main veins from the short petiole are more or less visible and marginal tubercles, with or without their hairs, are usually arranged in one row. Leaves are, in contrast to those of subsp. *seminuda*, usually hairy on the abaxial surface and margins, but occasionally very hairy specimens exhibit also hairs on the adaxial surface (e.g. *J.L. Boorman NSW123928*).

The flowers of this northern form of subsp. *capitata* are subtended by long acute lanceolate-triangular retained perules, oblanceolate bracts and linear-elliptic bracteoles (fig. 9K–M). The densely hairy flowers have pointed calyx lobes, which are up to almost twice as long as broad, and, as they are often more sparsely hairy and being more exposed than the basis of the flower, are

more likely to become glabrescent sine the hairs wear off above sooner (e.g. *M.F.Day CANB102354* or *T. Reichstein AD966071683*).

These specimens resemble the specimen *R.Brown [J.J.Bennett 4659]*, the type of *K. capitata* var. *glabrescens* Benth., which also has glabrescent rather than glabrous calyx lobes. However, three specimens from Parramatta in MEL deserve more attention, as they were examined by Benthams (signed) and might have swayed his decision to describe the above variety, although they were not cited by Benthams (1867). The specimen *W.Woolls MEL92512* is typical *K. capitata* with densely hairy calyx; on *MEL92513* the calyx is glabrescent, and *W.Woolls MEL92517* has glabrous upper flowers and agrees in all its characters with *K. capitata* subsp. *seminuda*. However, subsp. *seminuda* has never again been recorded so close to Sydney, so that it is here assumed that the locality Parramatta is a reference to W. Woolls’ residence (Home et al. 1998) rather than to the provenance of the specimens. Unusual are also specimens from near Morisset (*H.C.Dorman NSW 123979*) and Coffs Harbour (*C.T.White 7427*), which are almost completely glabrous including the flowers, but the flat and more or less strongly veined leaves readily identify them as *K. capitata* subsp. *capitata*. Some glabrous plants with particularly small leaves (c. 4 mm long) have usually marginal tubercles (e.g. *H.Spencer NE9523*) or occasionally no tubercles (e.g. *H.A.Edwards NE9528*).

(2) Plants growing mainly on old dunes from Manly south to Currarong, just north of Jervis Bay, and again further south at Ulludulla are shrubby, much more robust and have usually much broader, often truncate leaves (up to 7.5 mm broad) with marginal tubercles not arranged in rows. Some plants (e.g. *H.Deane NSW 123956*) exhibit these broad leaves at the base and the distal leaves are smaller and especially narrower and therefore resemble those of northern populations. Their similar hairy flowers have often pale pink to white petals (e.g. *R.H.Cambage 4115, 4128*, Ulladulla) and are subtended by ovate-triangular retained perules with usually cuspidate apex, obovate to oblanceolate bracts and bracteoles. All of these perules and bracts as well as the leaves have usually many pronounced main veins (fig. 9N–U). In spite of these distinctive feature the first two forms merge seamlessly and without evidence of hybridization in and around Sydney.

(3) A pronounced change in the local variation can be noticed along the lower Shoalhaven River and the Clyde River, and especially in the vicinity of the Beecroft Peninsula, where the two subspecies come naturally into contact with one another, so that an extensive hybrid population as well as presumed introgression (cf. putative hybrids below) was observed. For instance, all plants examined at Bundanoon (*Toelken 9558*) have glabrous calyx lobes and hypanthium and glabrous leaves, which are more or less folded



and with one scarcely visible central vein (typical of subsp. *seminuda*), while a more eastern population at Carrington Falls (see *K. capitata* subsp. *capitata* × *K. capitata* subsp. *seminuda*) shows the wide range of variation of all these characteristics expected in hybrids of the two subspecies. Some populations from this area show an unexpected large range of variation and identification of the two subspecies and their hybrids becomes very difficult, presumably because of additional introgression. The phenomenon is further complicated by additional local hybridization between the two subspecies and *K. parvifolia* and *K. ambigua* (cf. putative hybrids below).

**Typification.** *Kunzea capitata* was lectotypified as the type of the genus (Toelken 1981), because of the obvious capitate stigma as cited by Reichenbach (1828). The type specimen of *K. capitata* (in LINN) is a broad-leaved specimen from the south-central parts of the distribution of the species. The hypanthium as well as the calyx are densely hairy. A possible isotype inscribed “Smith missit” is located in Herb. Ventenat (G). No lectotypes were selected for *K. capitata* and *K. ambigua* as it cannot be assessed, whether the specimens sent by Smith to Ventenat were authentic duplicates, particularly as it had become fashionable in Europe to grow Australian plants from early exploration of the new continent (Morley & Toelken 1983, p. 14).

*Melaleuca thymoides* was used without description by Sieber for the specimens of *Fl. Mixta* 609 and, as he provided no indications that he was referring to the species of that name by Labilliere (1806), it is an illegitimate later homonym apart from the fact that it was never published.

*Melaleuca eriocephala* remains an enigma because Sprengel (1826) places it into his group “Foliis oppositis verticillatisque”, but neither of these characters apply to any of the specimens of Sieber 322 or any other Sieber collection of *Kunzea* examined. Nor is the brief description sufficiently detailed to identify the species, but could apply to Sieber 322 except for the grouping. The only connection to this collection is the cited epithet in the protologue “eriocephala Sieb.”, a name Sieber seems to have used for that particular collection, as many specimens were annotated subsequently with that name. However, the collector’s number is not cited in the protologue. As no specimen of the type collection could be traced in B, where a major part of Sprengel’s personal collection was later sold to (Staffleu & Cowan 1986), it must be assumed that the holotype was destroyed. None of the duplicates of the specimen Sieber 322 examined bear any indication that Sprengel had referred to them, nor was a specimen found that bore the name *Melaleuca eriocephala* in Sieber’s hand as indicated in the protologue. Consequently, with all duplicate specimens being similarly devoid of references to any wordings in the protologue, the specimen W340039 is preferred as lectotype, because it is accompanied by a small label (“NH/ 322. Callistemon capitatus Rbch”) in

a handwriting similar to other Sieber specimens. The branch on the left is designated as the lectotype.

In the protologue of *K. schaueri* three collectors, “Ferd. Bauer! Sieber! Hügel!” are cited and in W six unnumbered specimens of these, annotated as *K. schaueri*, are accepted here as syntypes, particularly as the annotation is written in a distinctive style, similar to other specimens described by Schauer. With everything being equal the specimen, which most closely agrees with the protologue, with leaves obviously 5-veined and “obovato-oblongis cuneatisve” is a Sieber specimen (ex Herb. Endlicher), of which the right hand branch was selected as the lectotype. It is, however, interesting that all these specimens were originally inscribed “*K. smithii*”, which is obviously indicating that Schauer was not aware of Heynhold’s combination of *Metrosideros capitata* in *Kunzea*. As the description in Schauer (1844) is very similar to those of other species of that particular group of species, it becomes evident that Schauer had presumably intended to publish this species as “*K. smithii*”, but Lehmann edited it, with or without Schauer’s agreement, to *K. schaueri*. Authorship of the species should therefore be cited as “Lehm. ex Schauer in Lehm.” as suggested by Chapman (1991).

A photograph of the holotype of *K. hirsuta* examined by the author was sufficiently clear to be able to identify *K. capitata* subsp. *capitata*.

As no specimen of the type collection *R. Brown [Bennett 4659]* examined by Bentham was annotated by him as *K. capitata* var. *glabrescens*, the specimen at BM is here lectotypified, as he would have consulted this material. A specimen of this collection at K is a duplicate, which was according to the label only distributed and incorporated there in 1877 and thus much later than Bentham (1867) published this part of *Flora Australiensis*. As the specimen agrees in all respects with the protologue, it is considered an isolectotype.

#### *Selection of specimens examined (c. 170 seen)*

Many specimens from ST and SC are also cited associated with hybrids: *K. capitata* subsp. *capitata* × subsp. *seminuda*, in order to show the range and number of putative hybrids in that area.

NEW SOUTH WALES: *J. Armstrong* 11, 1.2 mls [1.9 km] from light house to Arakoon, 25.viii.1972 (NSW); *J. Armstrong* 1165 & *J.M. Powell*, Crowdy Bay N.P., 29.ix.1977 (NSW); *Beckler* MEL92515 & 92516, Hastings River, s.dat. (MEL); *W. Best* NSW123977, Hastings River, viii.1901 (NSW); *W.F. Blakely* NSW123925, Maroota, 14.ix.1929 (NSW); *W. Bäuerlen* 414, Shoalhaven, i.1884 (MEL); *J.L. Boorman* NSW123928, Morrisset, ix.1907 (NSW); *J.L. Boorman* NSW123973, Coff’s Harbour, ix.1909 (NSW); *R. Brown [Bennett 4657]*, Georges River, 1803 (MEL 92511); *R.H. Cabbage* 1415, Milton, 4.xii.1902 (NSW); *R.H. Cabbage* 4115, old racecourse at Ulladulla, 7.xi.1914 (NSW); *R.H. Cabbage* 4128, Ulladulla, 9.xi.1914 (NSW); *A. Cameron* NSW123980, Broomes Head, x.1966 (NSW); *E. Cheel* NSW123920, Cronulla, x.1910 (NSW); *C.C. Connolly* NSW123976, Port Stephens, x.1905 (NSW); *M. Craig* CBG12596, Kariiong, 6.ix.1965 (CANB); *P. Croucher* CBG20233, Dobroid Pt, 27.x.1960 (CANB); *H.C. Dorman* NSW123979, Old Wyce Rd, Morrisset, 30.x.1962

(NSW); *H.A. Edwards* NE9528, Smoky Cape, viii.1947 (NE); *M. Evans* 2718, near Carrington Water Falls, 16.xi.1967 (AD); A, BISH, BO, CANB, CHR, E, L, LE, NSW, US, n.v.); *J.J. Fletcher* NSW123954, Narrabeen, 8.x.1887 (NSW); *R.H. Goode* 41b, Kuring-gai Chase, 27.x.1954 (NSW); *R.H. Goode* 507, Captain Cooks Pt, Kurnell, 11.xi.1961 (NSW); *W.H. Harvey* NSW123982, Port Jackson district, c. 1850 (NSW); *P. Hind* 5336 *et al.*, Llandilo Rd, Castlereagh S.F., 7.x.1987 (AD; HO, NSW, n.v.); *R. Lemberg* NSW123924, North Head, viii.1937 (NSW); *E.J. McBarron* 20377, The Basin, Georges River, 3.i.1972 (NSW); *Rev. Canon Michael* 1987, Dee Why, 1929 (NSW); *A. Morrison* 5/145, N.P., Sydney, 3.x.1896 (AD); *M. Parris* 9791, c. 5 km SSW Ulladulla, adjacent to Dolphin Point Village, 21.x.1990 (CANB); *M.E. Phillips* CBG18856, near Diamond Head, 23.ix.1966 (CANB); *J.M. Powell* 1095 & *J. Armstrong*, Crowdy Bay N.P., 29.ix.1977 (NSW); *J. Pulley* 815, Yarramundi, 28.ix.1971 (CANB); *T. Reichstein* AD966071683, N.P., Sydney, 5.x.1961 (AD); *J.F. Roberts* MEL92753, Watsons Bay, 1886 (MEL); *F.A. Rodway* NSW123966, Cambewarra, 29.i.1939 (NSW); *R. Siegert* MEL92726, Port Jackson, 1884 (MEL); *H. Spencer* NE9523, Woy Woy, Gosford Rd, 10.ix.1960 (NE); *I.R. Telford* 3645, Carrington Water Falls, 12.xi.1973 (CANB); *sine coll.* NSW123941, Manly, ix.1903 (NSW); *C.T. White* 7427, Coff's Harbour, 6.x.1930 (BRI).

#### Putative hybrids

(i) *K. ambigua* × *K. capitata* subsp. *capitata*: see 48. *K. ambigua*

(ii) *K. capitata* subsp. *capitata* × *K. capitata* subsp. *seminuda*

As subsp. *seminuda* does not show much variation and occurs in a smaller, less disturbed environment, it is more easily defined, so that the discussion is here viewed from its perspective to measure change believed to be due to hybridization and/or subsequent introgression with a very variable *K. capitata* subsp. *capitata*. There is evidence, through mainly a few old specimens, for direct hybridization on the Kings Tableland (see also variation: *K. capitata* subsp. *seminuda*) and putative hybrids and wider introgression in the vicinity of Wentworth Falls by a range of characters such as flat leaves, with hairs abaxially and/or marginal tubercles as well as the occurrence of hairs on the hypanthium and calyx lobes of the flowers (e.g. *A.A. Hamilton* NSW123986).

Similar hybrid swarms, especially from Carrington Falls, have also been recorded among the southern collections, although typical subsp. *seminuda* is much less frequently known from the Southern Tableland (ST), as most of the specimens show a varying degree of hybridization and/or introgression, because the two subspecies often occur in adjoining but usually different habitats on the foot hills (cf. variation: subsp. *seminuda*). Although *K. capitata* subsp. *capitata* usually occurs in coastal localities especially on old sand dunes, a number of inland specimens (e.g. *I. Olsen* 2873, northern Budawang Range; *T. & J. Whaite* 2945, S Sassafras on Clyde River) seem to indicate that subsp. *capitata* has migrated up the rivers and must be identified as such. These specimens show varying numbers of characters typical of the subsp. *capitata*.

The two localities, near Carrington Falls and south of Sassafras to Tianjara Falls, from where several collections record such a wide range of variation that hybrid swarms are presumed to occur there, because they include specimens showing a full range of characters between the subspecies. Identification of the subspecies and hybrid here remains arbitrary, as no recessive/dominant character in either of the two subspecies could be discerned on which sharp divisions between the taxa could be based, as was previously used to distinguish the putative parents from the putative hybrid *K. recurva* × *K. sulphurea* (Toelken 1996, p. 59). However, specimens of *K. capitata* subsp. *seminuda* have slightly broader leaves with few veins showing at the base in the south-east as compared to their counterparts on the Central Tableland. Furthermore it is important to note that *K. capitata* subsp. *capitata* now also established itself on inland localities away from sand dunes by what must be interpreted as “introgressive adaptation”.

#### Specimens examined

NEW SOUTH WALES: *M.P. Austin* & *J. Duggan* 16, c. 12 km S Sassafras, 9.xii.1972 (CANB); *M.P. Austen* 203, 14 km SE Nerriga, 26.vi.1973 (CANB); *B.G. Briggs* & *D.F. Blaxall* 74, 4 mls [6.4 km] SSE Sassafras, 7.xii.1968 (NSW); *B.G. Briggs* NSW123997, 1.5 mls [2.4 km] SW Tianjara Falls, 23.xii.1961 (NSW); *E.F. Constable* NSW52388, Pt Perpendicular, Jervis Bay, 8.x.1960 (NSW); *E. Gauba* CBG7229, Jervis Bay, 21.x.1951 (CANB); *E. Gauba* CBG9534, Pigeon House Ra., 2.xi.1951 (CANB); *P. Gilmour* 5317, Brooks Plateau near Tallowa Dam, 23.xi.1985 (CANB); *E. Gordon* NSW123999A, Barren Grounds, xi.1961 (NSW); *E. Gordon* NSW123400, 3 mls [4.8 km] SE Carrington Falls, 4.xii.1961 (NSW); *A.A. Hamilton* NSW123985, Medlow Bath, Leura, xi.1914 (NSW); *A.A. Hamilton* NSW123986A, Wentworth Falls, i.1915 (NSW); *A.M. Lyne* 779 & *J. Lyne*, c. 1 km NE Corang Pk, 11.vii.1992 (AD); *J.M. Maiden* NSW123929, Box Pt to Kangaroo River, x.1893 (NSW); *L. McDougall* 26 & *J. Steer*, junction of fire road 1 & 1E, Avon Dam, 9.xii.1986 (NSW); *C. Moore* MEL92455 & MEL92521, Blue Mts, s.dat. (MEL); *M.E. Phillips* CBG12691, Jervis Bay, 18.x.1961 (CANB); *J. Pulley* & *I.R. Telford* CBG52056, The Castle, 17.vi.1971 (CANB); *F.A. Rodway* 3181, Sassafras Falls, 27.xi.1932 (NSW); *R.J. Rudd* 153, Jervis Bay, 20 m NE front gate of Australian National Botanic Gardens Annexe, 18.x.1991 (CANB); *D.W. Shoobridge* CBG13105, 23 mls [36.8 km] from Nerriga, 28.x.1962 (CANB); *D.W. Shoobridge* CBG13817, near Sussex Inlet, 24.ix.1964 (CANB); *J. Sturgess* NSW123969, The Castle, iv.1944 (NSW); *I.R. Telford* 9597, Ettrema Gorge, 13.xi.1983 (CANB); *I.R. Telford* 9609, Monolith Valley, xii.1983 (CANB).

#### Putative parents from the area

*K. capitata* subsp. *capitata*. NEW SOUTH WALES: *M.P. Austen* 202, c. 10 km SSE Sassafras, 28.vi.1973 (CANB); *M.P. Austen* 204, c. 11 km SSE Sassafras, 28.vi.1973 (CANB); *M. Evans* 2718, Carrington Falls, 16.xi.1967 (AD, CANB); *A.A. Hamilton* NSW123987, Lawson, i.1915 (NSW) (with some hairs on hypanthium and calyx); *T.G. Hartley* 14314, near Mt Tianjara, 25.iii.1975 (CANB); *I. Olsen* 2873, N Budawang Ra., 1.xi.1975 (NSW); *F.A. Rodway* NSW123964, Pacific City, 3.ix.1930 (NSW); *F.A. Rodway* 14608, Sassafras, 30 mls [48 km] SW Nowra, 9.ix.1947 (NSW); *F.A. Rodway* NSW123967, West Cambewarra Rd, 22.viii.1931 (NSW); *D.W. Shoobridge*



CBG13596, Sussex Inlet Rd, 24.ix.1964 (CANB); I.R.Telford 3645, Carrington Falls, 12.xi.1973 (CANB); T. & J.Whaite 2948, 10 mls [16 km] S Sassafras, 23.x.1965 (NSW).

***K. capitata* subsp. *seminuda*.** NEW SOUTH WALES: B.G. Briggs NSW123970, 3 mls [4.8 km] W Sassafras, 25. xii.1961 (NSW); C.Dunlop 190, Tianjara Falls, 9.xi.1968 (CANB); E.Gauba CBG7228, Jervis Bay, 14.vii.1950 (CANB); E.Gauba CBG7231, Pigeon Hose Ra., 16.xi.1951 (CANB, NE); Gordon NSW123999B, Barren Grounds, xi.1961 (NSW); A.A.Hamilton NSW123986B, Wentworth Falls, i.1915 (NSW); A.H.Lyne 378 et al., Beecroft Penin., 27.viii.1991 (CANB); A.H.Lyne 779 & J.Lyne, above Corang Arch, c. 1 km NE Corang Pk, 11.vii.1992 (CANB); I.Olsen 1971, 2 mls [3.2 km] S Sassafras, 24.iii.1974 (NSW); I.Olsen 2787, near Ettrema Ck, 8.viii.1976 (NSW); J.Pickard 1705, 12.9 km ESE Nerriga, 6.ix.1971 (NSW); F.A.Rodway 12382, Tomerong, 30.x.1941 (NSW).

(iii) ***K. capitata* subsp. *capitata* × *K. rupestris***

The pale pink flowers and trilocular ovary of the hybrid are similar to *K. capitata*, but the plants are spreading shrubs, have papillae based hairs on the leaf margins, linear bracteoles, and some short hairs on the upper surface of the ovary, which has few ovules (8–14) per locule, more reminiscent of *K. rupestris*.

*Specimens examined*

NEW SOUTH WALES: G.Butler 1566, 4.3 km N Canoelands turnoff, 8.xi.1989 (CANB); A.E.Orme 178 & R.D.Coveny, c. 0.9 km along Paulls Rd from Windsor, 27.x.2001 (NSW); P.G. Wilson 134 & B.J.Conn, 2 km S South Maroota, 22.ix.1987 (AD, K, NSW).

*Putative parents from associated area*

***K. capitata* subsp. *capitata*.** NEW SOUTH WALES: P.G.Wilson 133 & B.J.Conn, 2 km S South Maroota, 22.ix.1987 (AD, K, NSW).

***K. rupestris*.** NEW SOUTH WALES: G.Butler 1573 & A.M. Lyne, 4.3 km N Canoelands turnoff, 8.xi.1989 (CANB); P.G. Wilson 132 & B.J.Conn, 2 km S South Maroota, 22.ix.1987 (CANB, K, NSW).

**33b. *Kunzea capitata* subsp. *seminuda* Toelken, subsp. nov.**

*A subspecie typica foliis plicatis lobisque calycis et hypanthiis discretis glabris; a K. similis lobis calycis et hypanthiis discretis glabris ovariisque trilocularibus quoque 8–10 ovulis differt.*

**Type:** New South Wales, Wishing Well, Morton National Park, H.R.Toelken 9558, 27.x.2011 (holo.: AD; iso.: NSW).

*Kunzea capitata* auct. non (Sm.) Rehb. ex Heynh: Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991), pro parte.

Erect shrub to 1.5 m tall, often spindly with one or few stems. *Leaves* oblanceolate rarely linear-oblan- ceolate, (3.8–) 5–7 (–7.8) × (1.6–) 1.8–2 (–3.5) mm, folded lengthwise and with ± recurved upper third, with scarcely visible 3 (–5) veins, above and below glabrous or rarely with few spreading hairs below but wearing off soon, often with marginal cilia usually without basal tubercles. *Calyx lobes* acuminate and about twice longer than broad, glabrous as also the free hypanthium (rarely

with scattered hairs); ovary with crisped or straight hairs up to 1 mm long. *Flowering:* October, November. **Fig. 10.**

*Distribution and ecology.* Usually associated with sandstone outcrops and often growing on shallow soil on rock platforms; recorded from open areas in woodland to forest, or in heath-like scrub on the Central and Southern Tablelands of New South Wales (CT, ST).

*Conservation status.* Widespread but rarely common in several conserved areas, such as Blue Mountains and Morton National Parks.

*Diagnostic features.* The spreading folded spatulate leaves of subsp. *seminuda* are similar to those of *K. obovata*, but the latter species is distinguished by its hirsute hypanthium and calyx lobes, the pubescent to puberulous upper surface of the ovary with the free hypanthium and the broader bracts, while the bracteoles are narrower and almost stalked. *K. parvifolia* has also similar features but is in all respects smaller, the leaves are up to 3.2 mm long and their double apex is not obviously recurved. The epithet of the Western Australian *K. similis* was adopted by Toelken (1996) and Toelken & Craig (2007) in observing its close resemblance to *K. capitata*, especially subsp. *seminuda*, as it also shares with it a single central vein of the leaves. The subspecies is, however, distinguished by glabrous calyx lobes and free hypanthium, as well as 8–10 ovules per locule.

*Variation.* The subsp. *seminuda* exhibits little variation in the Blue Mountains and, although leaves are usually narrower than those of the subsp. *capitata*, in one specimen from the upper Lachlan River (*A.Dulhunty* MEL92768) they are up to 3.5 mm broad. Similarly, a few plants were examined with some hairs on their abaxial leaf surfaces, particularly those below the inflorescence (*C.Burgess* CBG33393, Wentworth Falls; *C.Burgess* CBG32449, Kings Tableland). In the case of *C.Burgess* CBG36186, also from Kings Tableland, even the free hypanthium and the calyx are covered with few shorter hairs although the plant otherwise agrees in all other characters with *K. capitata* subsp. *seminuda*.

Two collections, *A.A.Hamilton* NSW123986 (Wentworth Falls) and especially *A.A.Hamilton* NSW123987 (Lawson), each contains two different elements, one of which is not only very hairy but also shows close resemblance to subsp. *capitata* and the other exhibits an intermediate mixture of characters of the two subspecies. Since the two specimens of each collection were probably collected in close proximity of one another they seem to indicate a few hybrids in that area, but no specimens of typical subsp. *capitata* have been seen from the Blue Mountains.

Only few specimens of typical subsp. *seminuda* were examined from the Southern Tableland and South Coast regions, while most of the specimens known from that area exhibit varying numbers of characters of, or are



identifiable as subsp. *capitata*, as the two subspecies often occur in adjoining areas. For instance, only the latter subspecies occurs on deep sandy soils on dunes in the vicinity of Currarong, Ulladulla, south of Bee-croft Peninsula, where usually subsp. *seminuda* and putative hybrids prevail. In addition the river valleys of the Shoalhaven and the Clyde River seem to have provided a congenial environment for the coastal subsp. *capitata* and with it introgressional forms between the two subspecies to extend their distribution inland, as the following well collected example localities indicate. Detailed population studies in the area are needed to evaluate the full extent of hybridization.

*Note.* The subsp. *seminuda* is not synonymous with the var. *glabrescens* Benth (1867), although both were characterised by a similar glabrescent or glabrous calyx among other characters. They are based on different populations and different types.

*Etymology.* As the free hypanthium and calyx lobes are glabrous and only the lower half of the hypanthium is covered with long spreading hairs the epithet “semi-nuda”, Latin, “half-naked” seemed fitting.

#### *Specimens examined.*

More specimens from ST and SC are also cited under hybrids: *C. capitata* subsp. *capitata* × subsp. *seminuda*, in order to show the range of hybridization in those areas.

NEW SOUTH WALES: *W.F.Blakely* NSW123992, Wentworth Falls, 12.xi.1938 (NSW); *J.W.Boorman* NSW123994, Lithgow Water Works, i.1914 (NSW); *C.Burgess* CBG32449, Kings Tableland, 19.xi.1969 (CANB); *C.Burgess* CBG33393, Wentworth Falls, 19.xi.1969 (AD); *C.Burgess* CBG36186, Kings Tableland, 19.xi.1970 (BRI, CANB); *R.H.Cabbage* NSW123990, Leura, xii.1906 (NSW); *J.H.Camfield* NSW123989, Katoomba, xi.1908 (NSW); *L.Carne* NSW123996, Lawson, xi.1908 (NSW); *R.H.Goode* 535, near Sublime Pt, Leura, 4.xii.1961 (NSW); *J.Gregson* NSW123991, Mt Wilson, xi.1896 (NSW); *J.Gregson* NSW123995, Mt Tomah, i.1898 (NSW); *A.A.Hamilton* NSW123984, Mt Victoria, i.1915 (NSW); *V.Scarth-Johnson* 135, near Bell, xii.1969 (NSW); *M.J.Taylor* 306 & *R.G.Coveny*, near start of Golden Stairs Track, Katoomba, 23.x.1984 (AD).

#### *Putative hybrids*

(i) *K. ambigua* × *K. capitata* subsp. *seminuda*: see 48. *K. ambigua*

(ii) *K. cambagei* × *K. capitata* subsp. *seminuda*: see 32. *K. cambagei*

(iii) *K. capitata* subsp. *capitata* × *K. capitata* subsp. *seminuda*: see 33a. *K. capitata* subsp. *capitata*

(iv) *K. capitata* subsp. *seminuda* × *K. parvifolia*

The following examples from New South Wales are here evaluated individually, as they differ slightly, possibly because of local variation, although they exhibit characteristics of both putative parents.

CT: One of the below listed Constable collection “B” has much smaller leaves, short and broad calyx lobes and the whole plant, including the hypanthium and

calyx lobes, is covered with short more or less appressed hairs, as they are found in *K. parvifolia*. Furthermore the few flowers in each inflorescence are characteristically directed upwards. However, the characteristic double-apex of leaves of *K. parvifolia* was not observed, so that this specimen, though very similar to *K. parvifolia*, is assumed to be a hybrid *K. capitata* subsp. *seminuda* as represented by Constable specimen “A”.

ST: The hybrid (*B.G.Briggs* & *D.F.Blaxell* 85) is not only recognised by white flowers, but the whole plant has short spreading hairs particularly on and below the inflorescence, it has smaller leaves and few-flowered inflorescences similar to *K. parvifolia*. The specimen does not show the characteristic double-apex of leaves, typical of *K. parvifolia*, and is therefore interpreted as a hybrid. The other pale-pink-flowered specimen from the same locality (*B.G.Briggs* & *D.F.Blaxell* 84) is closest to the subsp. *seminuda* in all its characters, including the absence of marginal tubercles of the leaves. The third, more robust specimen from the area (*B.G.Briggs* & *D.F.Blaxell* 83), has the typical marginal tubercles and exhibits at least three clear longitudinal veins, indicating that it forms part of the introgressional population associated with *K. capitata* subsp. *capitata* × subsp. *seminuda*, which is widespread in the area. It is therefore possible that this population includes triple-hybrids.

#### *Specimen examined*

NEW SOUTH WALES: *B.G.Briggs* & *D.F.Blaxell* 84A, 1 mile [1.6 km] S Sassafras, 6.xii.1968 (NSW); *E.F.Constable* B, Blackheath, 26.xi.1946 (NSW); *A.A.Hamilton* NSW123988, Medlow Bath, xi.1914 (NSW); *H.R.Toelken* 6860, c. 35 km WSW Nowra airport to Nerriga, 30.x.1986 (AD) (flower buds immature); *H.R.Toelken* 6878, 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD).

#### *Putative parents from the area*

*K. capitata* subsp. *seminuda*. NEW SOUTH WALES: *B.G.Briggs* & *D.F.Blaxell* 84B, 1 mile [1.6 km] S Sassafras, 6.xii.1968 (NSW); *E.F.Constable* A, Blackheath, 26.xi.1946 (NSW); *H.R.Toelken* 6859, c. 35 km WSW Nowra airport to Nerriga, 30.x.1986 (AD) (flower buds immature); *H.R.Toelken* 6884, 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD).

*K. parvifolia*. NEW SOUTH WALES: *W.Forsyth* & *A.A.Hamilton* NSW124084, Badgerys Crossing to Nowra, ix.1899 (NSW); *R.Pullen* 2223, Bulee Ridge, 25.ix.1960 (NSW); *R.Story* 7878, 15 mls [24 km] NNE Braidwood, 13.4.1967 (NSW); *H.R.Toelken* 6858, c. 35 km WSW Nowra airport to Nerriga, 30.x.1986 (AD) (flower buds immature); *H.R.Toelken* 6880, 13.4 km Nerriga to Sassafras, 11.xi.1986 (AD); *W.Underwood* NSW124094, between Turpentine and Sassafras, xi.1936 (NSW).

#### 34. *Kunzea obovata* Byrnes

*Austrobaileya* 1: 469 (1982); T.D.Stanley in T.D.Stanley & E.M.Ross (eds), Fl. S.E. Queensland 2: 133 (1986); Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991); A.R.Bean in R.J.F.Henderson (ed.), Queensland Pl. 133 (1997). — **Type:** Queensland, Cottonvale-Amiens road, *Byrnes* 3932 (holo.: BRI247872; iso.: CANB378161, K000843051, L9495, NSW639626, PERTH1636626).

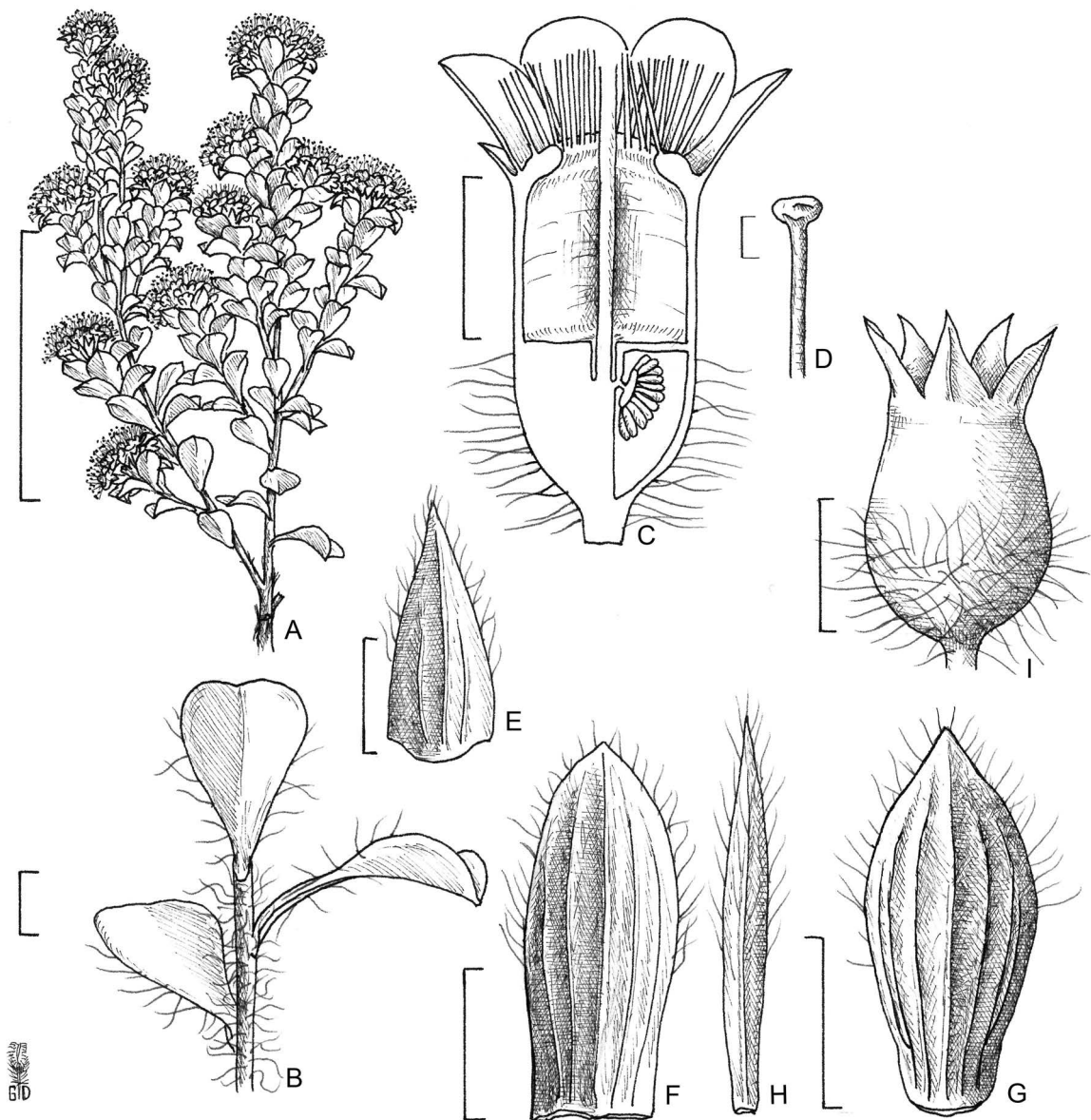
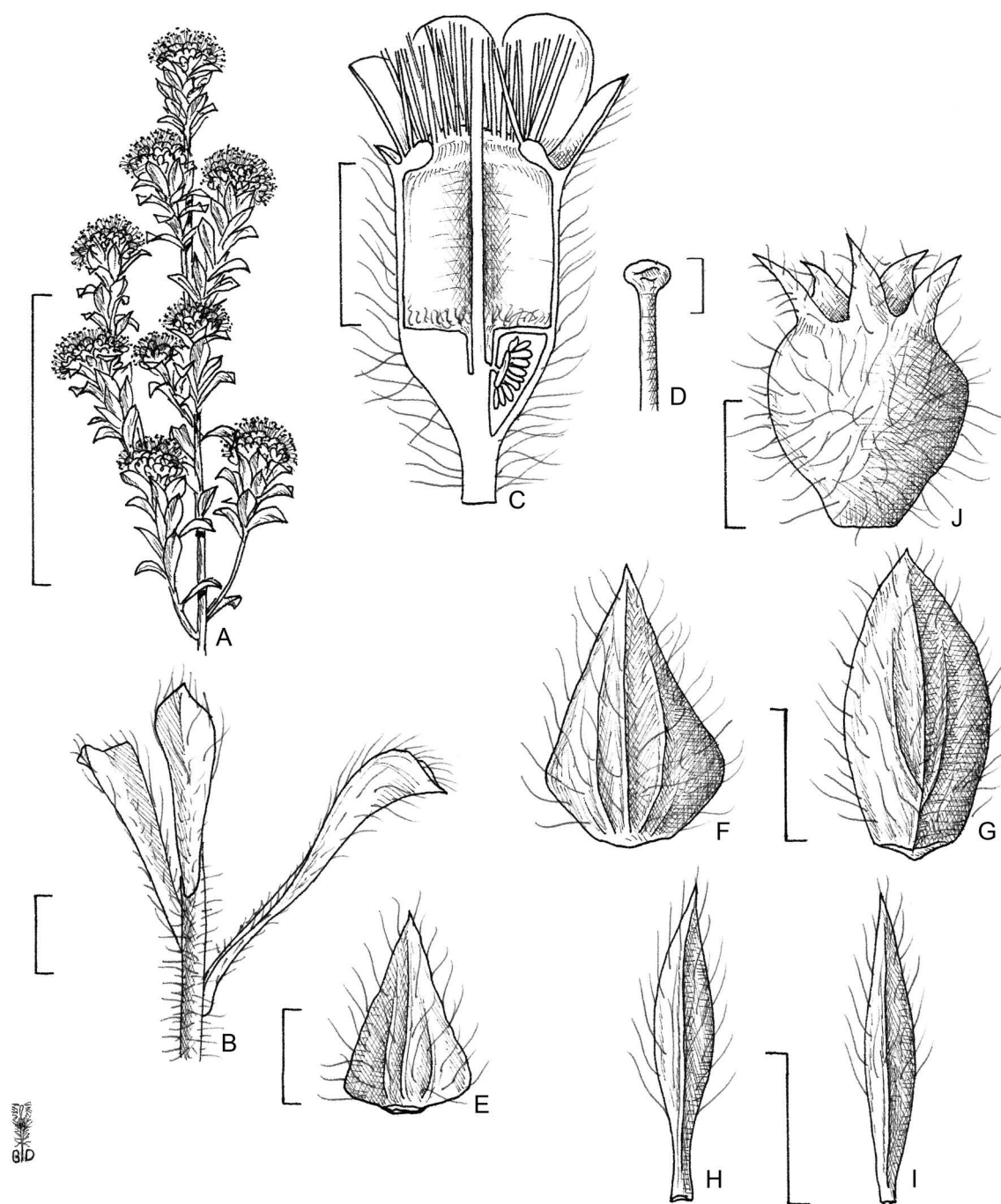


Fig. 10. *K. capitata* subsp. *seminuda*: A flowering branch; B cauline leaves; C half flower; D capitulate stigma; E abaxial view of perule; F abaxial view of proximal bract; G abaxial view of distal bract; H abaxial view of bracteole; I fruit. — Scale bars: A 4 cm; B 1 mm; C 2.5 mm; D 1.5 mm; E 1.5 mm; F–H 2 mm; I 2.5 mm. — A–H H.R.Toelken 6867 (AD); I A.A.Hamilton NSW123984.

Shrubs (0.5–) 1.5–2.5 (–3) m tall, with many spreading branches; young branches with leaf bases slightly raised but not flanged, hirsute, pilose, rarely pubescent, with  $\pm$  spreading long hairs over fewer shorter ones; early bark splitting mainly longitudinally, peeling in slender membranous pieces with irregular to straight margins. *Leaves* alternate; *petiole* (0.3–) 0.6–1 mm long, usually appressed; *lamina* oblanceolate to linear-oblanceolate, rarely oblong-elliptic, (1.8–) 3–8 (–9.6)  $\times$  (0.6–) 1.2–1.5 (–1.8) mm,  $\pm$  abruptly constricted into a recurved acute apex, gradually tapering into petiole, above folded lengthwise and concave, especially towards the apex,  $\pm$  convex and often with raised main vein below, sparsely hirsute usually glabrescent but with shorter hairs above, hairs spreading to appressed, with

marginal cilia each with a broad persistent tubercle. *Inflorescence* a rounded botryum, often with clusters of spreading leaves below, with (4–) 6–18 (–25) flowers, apparently terminal on all branches, with vegetative growth after fruiting often continuing not terminally; *retained perules* (0–) 3–8, narrow-triangular rarely ovate or oblong-ovate, 1.2–1.9 mm long, with 1 (–3) veins, with spreading hairs, especially upper ones often caducous; *bracts* ovate, oblong-ovate, rarely oblong-lanceolate or oblong-obovate, (2.2–) 2.5–3.5 (–4.2)  $\times$  (1.2–) 1.6–2 (–2.5) mm, usually rostrate, with (1–) 3 veins, pilose; *bracteoles* in pairs, linear-oblanceolate to -elliptic, sometimes falcate, 1.3–1.8  $\times$  0.3–0.8 (–1.2) mm, with central main vein, pilose. *Hypanthium* 2–2.8 (–3.1) mm long when flowering (free tube 0.9–1.6





**Fig 11. *K. obovata*:** A flowering branch; B cauline leaves; C half flower; D capitate stigma; E abaxial view of perule; F abaxial view of proximal bract; G abaxial view of distal bract; H abaxial view of proximal bracteole; I abaxial view of distal bracteole; J fruit. — Scale bars: A 4 cm; B, F, G 1 mm; C, H, I, J 1.5 mm; D, E 0.5 mm. — A–I K.A.W. Williams 75106 (BRI); J R.W. Jessup & M. Gray 79 (BRI).

mm), pilose to hirsute, with spreading hairs 0.3–0.6 mm long. *Calyx lobes* usually narrow-triangular, 1.4–1.8 mm long, pointed and ridged towards the apex, pilose to sparsely so. *Corolla lobes* obovate rarely orbicular and shortly clawed, 1.5–2.2 mm long,  $\pm$  erose, deep-purplish to rarely pink. *Stamens* 37–50 in more than one whorl; *filaments* 2.8–4.7 mm long; *anthers* broadly ellipsoidal, 4.5–6 mm long, with red subterminal gland. *Ovary* 3-locular, with style somewhat sunk into the hairy upper surface; *placenta* a broad-elliptic

disc with short central attachment, scarcely bilobed, with each lobe with usually 2 rows of ovules; *ovules* 25–45 per locule, spreading, subequal; *style* 3.8–5.6 mm long, with stigma small-capitate, scarcely compressed at the apex. *Fruit* an urceolate capsule with erect calyx lobes. *Seeds* (immature) angular-cylindrical with blunt ends, often somewhat crescent-shaped, with testa brown and with dense vertical ribbing, rarely confluent. *Flowering*: September–November (December).

**Fig. 11.**



**Distribution and ecology.** Grows in sandy soils usually associated with granite boulders in dry sclerophyll forest or shallow skeletal soil on granite in southern Queensland (DD, MO) and northern New South Wales (NT, NC).

**Conservation status.** Locally common and conserved in several parks, for instance, Girraween and Boonoo Boonoo National Park.

**Diagnostic features.** Although very similar to *K. parvifolia*, the obovate to usually oblanceolate leaves of *K. obovata* have, in contrast to that species, a distinctly recurved apex, and the hypanthium and calyx lobes are pilose with spreading hairs 0.3–0.6 mm long, while in *K. parvifolia* they are very short and  $\pm$  appressed, if at all present. Similar short appressed hairs are also typical of *K. badjaensis*, another species resembling *K. obovata*, but it has a more or less decumbent habit.

**Variation.** The leaves are oblanceolate, linear-oblanceolate or rarely obovate as the specific epithet indicates. However, some lower leaves, and especially those subtending lateral branches off long shoots, often become broader to oblong-elliptic and with scarcely recurved apex. These characteristics, as well as the long spreading hairs on the hypanthium and calyx lobes, are found throughout the species, even in all plants examined from between Torrington and Emmaville, which are usually smaller in all respects so that they are often interpreted as intermediates between *K. obovata* and *K. parvifolia*. No real intermediates have as yet been recorded from this area, and only one individual has been found near Howell (see also *K. parvifolia*, variation 3), which is possibly a hybrid.

Throughout the range of the species the density of the indumentum varies much, as in *K. parvifolia*, but unlike that species the hairs are always more or less spreading.

Although terminal vegetative growth from the apex of the infructescence is usually found in this species, some specimens, e.g. *R.G.Coveny 16568* & *A.J.Whalen* (AD), show a “pseudodichotomy” particularly of lateral branches due to branching from below the previous season’s inflorescence. In this particular specimen (probably a senescent plant) this unusual lateral growth is repeated several times on lateral branches while terminal growth is prevalent on terminal actively growing branches.

#### *Selection of specimens examined (44 seen)*

QUEENSLAND: *A.R.Bean 6364* & *P.I.Forster*, Bald Rock Ck, 4.ix.1993 (NSW); *T.J.Bowen BRI274347*, Bapaume-Pozieres road, 30.x.1956 (BRI); *N.B.Byrnes 3928*, Cottonvale to Amiens, 9.x.1979 (BRI, NSW); *M.S.Clemens BRI274346*, near Ballandean, x.1944 (BRI); *S.L.Everist 8121*, near Passchendaele, 16 km N Stanthorpe, 13.x.1968 (BRI, NSW); *M.T.Mathieson 470*, Passchendaele S.F., via Goldfields Rd, 5.ix.2009 (BRI); *L.Pedley 1465*, Fletcher, 8 mls [12.8 km] SW Stanthorpe, 29.x.1963 (BRI); *J.Staer NSW147309*, Wallangarra, x.1911 (NSW); *I.R.Telford 3191*, Bald Rock Ck, 10 mls [16 km] N Wallangarra, 26.ix.1973 (A, CANB, L, K);

*I.R.Telford 12354* & *S.Donaldson*, summit plateau of Mt Maroon, 19.viii.1996 (CANB); *K.A.W. Williams 75106*, 6 km W Thulimbah, 7.x.1975 (BRI).

NEW SOUTH WALES: *A.R.Bean 6581*, 30.6 km Ashford to Emmaville, 22.ix.1993 (NSW); *J.L.Boorman NSW124107*, Barren Mtn, Deer Vale, xi.1913 (NSW); *J.L.Boorman NSW124108*, Emmaville, x.1901 (NSW); *R.G.Coveny 2250*, 5 mls [8 km] N Deepwater on New England Hwy, 3.x.1969 (BRI, NSW); *R.G.Coveny 16568* & *A.J.Whalen*, 0.6 km from Boonoo Boonoo Falls, 14.x.1993 (AD; BRI, CANB, HO, K, L, MO, n.v.); *P.Gilmour 7818*, Carrai Ck, W Kempsey, 11.ix.1997 (NSW); *G.J.Harden & D.W.Harden s.n.*, Torrington, x.1992 (AD, NSW); *J.T.Hunter 3419*, Flagg Ra., N Bendemeer, 5.viii.1995 (NSW); *R.Johnstone 2169* & *A.E.Orme*, c. 15.5 km Emmaville to Ashford, 7.xi.2007 (NSW); *M.E.Phillips CBG18145*, 3 mls [4.8 km] Torrington to Tent Hill, 19.ix.1966 (CANB); *J.B.Williams NE37011*, c. 16 km WSW Dorrigo, xii.1967 (NE); *J.B.Williams NE37015*, Bolivia Ra., 19.xi.1966 (NE); *J.B.Williams & H.J.Wissmann NE37014*, near Mt Slow, SE Glen Innes, 21.x.1966 (NE); *H.J.Wissmann NE37170*, 55 km E Armidale, ix.1974 (NE); *H.J.Wissmann NE37012*, c. 9.6 km E Baldersleigh, 12.xii.1967 (NE).

#### *Putative hybrids*

(i) *K. bracteolata*  $\times$  *K. obovata*: see 41. *K. bracteolata*.

(ii) *K. obovata*  $\times$  *K. parvifolia*

This specimen consists of three separate branchlets all with acute leaves with no obvious double apex. The length of the hairs on the hypanthium, although somewhat immature, fall on the two left-hand branchlets into the range of *K. obovata*, while they are much shorter on the right-hand branchlet. The leaves are, however, oblong-elliptic to -lanceolate and with  $\pm$  appressed hairs which is reminiscent to those of *K. parvifolia*.

This only specimen with somewhat intermediate characters is highlighted here to draw attention to it, although there is no evidence for hybridisation and this could be an odd variant (cf. *L. Wheeler 121* in variations 3, *K. parvifolia*), particularly as *K. obovata* has not been recorded so far west.

#### *Specimen examined*

NEW SOUTH WALES: *J.B.Williams NE37029*, 3 mls [4.8 km] Howell to Copeton, 6.ix.1966 (NE).

#### *Putative parents from the area*

***K. obovata*.** NEW SOUTH WALES: *R.Johnstone 2169* & *A.E.Orme*, c. 15.5 km Emmaville to Ashford, 7.xi.2007 (NSW); *J.B.Williams & H.J.Wissmann NE37014*, near Mt Slow, SE Glen Innes, 21.x.1966 (NE).

***K. parvifolia*.** NEW SOUTH WALES: *J.B.Williams NE37024*, 3 km Howell to Copeton, 20.ii.1966 (NE); *J.B.Williams NSW124101*, 2 mls [3.2 km] E Howell to Tingha, 22.i.1967 (NSW).

(iii) *K. obovata*  $\times$  *K. opposita* var. *opposita*

Bracts are ovate to oblong-ovate, all leaves are more or less flat or often folded lengthwise and at least upper short leaves have recurved apices as observed in depauperate specimens of *K. obovata*, e.g. *L.W.Jessup & M.Gray BRI274349* with all leaves oblanceolate and older ones usually even more recurved. But the lower

leaves are elliptic to oblong-lanceolate and more or less appressed, more like *K. opposita*.

Since only a single branch of this putative hybrid was found in among a number of typical specimens of *K. obovata* in the population collection McKie 216, among granite boulders at Backwater, hybrids forming between these two species seem highly likely.

#### *Specimens examined*

NEW SOUTH WALES: *E.N. McKie 216B*, Backwater, 3.xi.1930 (NSW).

#### *Putative parents from the area*

***K. obovata***. NEW SOUTH WALES: *E.N. McKie 216A*, Backwater, 3.xi.1930 (NSW); *I.R. Telford 1405*, Pheasant Mt., NE of Backwater, 1.ix.1969 (CANB).

***K. opposita* var. *opposita***. NEW SOUTH WALES: *E.N. McKie BRI1274327*, Guyra, s. dat. (BRI).

### 35. *Kunzea parvifolia* Schauer in Lehm.

Pl. Preiss. 1: 124 (1844); Benth., Fl. Austral. 3: 115 (1867); Ewart, Fl. Victoria 865 (1931); N.C.W. Beadle et al., Handb. Vasc. Pl. Sydney District 290 (1963); Cockrane et al., Fl. & Pl. Victoria, t. 207 (1968); N.T. Burb., Fl. Austral. Cap. Terr. 267, fig. 266 (1970); J.H. Willis, Handb. Pl. Victoria 2: 450 (1973); N.C.W. Beadle, Student Fl. N.E. New South Wales 3: 477 (1976); N.C.W. Beadle et al., Fl. Sydney Region, ed. 3, 344 (1988); Peter G. Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 153 (1991); Carolin & Tindale, Fl. Sydney Region, ed. 4, 396 (1993); Jeanes in N.G. Walsh & Entwistle (eds), Fl. Victoria 3: 1020 (1996); Pellow et al., Fl. Sydney Region, ed. 5, 202 (2009). — *K. parvifolia* var. *parvifolia* Maiden & Betche, Proc. Linn. Soc. New South Wales 38: 246 (1913). — **Type**: New South Wales, Argyle, *K.K.A. von Hügel s.n.* (lecto., designated here: W).

*Kunzea parvifolia* var. *alba* Maiden & Betche, Proc. Linn. Soc. New South Wales 38: 246 (1913); Census N.S.W. Pl. 153 (1916). — **Type**: New South Wales, Rockley, *J.L. Boorman s.n.*, xi.1906 (lecto., designated here: NSW124073). **Remaining syn.**: near Braidwood, *R.H. Cambage s.n.*, xi.1908 (NSW, n.v.).

Shrubs 0.5–1.2 (–2) m tall, with many spreading branches; young branches with leaf bases somewhat raised but not flanged, ± densely pubescent with mainly long hairs appressed to slightly spreading; early bark scarcely fluted, peeling in membranous slender pieces or strips with irregular margins. *Leaves* alternate to subopposite; *petioles* 0.2–0.4 (–0.6) mm, appressed; *lamina* narrow-elliptic to linear-oblongate, rarely linear-lanceolate, (0.8–) 1.5–3.2 (–3.4) × (0.6–) 0.8–1 (–1.3) mm, obtuse to truncate, rarely acute becoming obtuse, ± abruptly constricted into a recurved apex terminating usually in an apparent subterminal abaxial point (double-pointed apex), ± gradually tapering into petiole, concave to shallow-canaliculate above, convex and often with ridged main vein below; puberulous to pubescent or glabrescent with appressed hairs, or appressed when young to often somewhat spreading later. *Inflorescence* a rounded botryum but flowers often erect with leaves below ± appressed at the base, with (1–) 3–8 (–11) flowers, apparently terminal on

long shoots and especially common on short shoots, with terminal vegetative growth continuing after fruiting; *retained perules* 0–4, ovate rarely oblong-ovate, with 1–3 veins, ± hairy; *bracts* ovate, oblong-elliptic to oblong-obovate, (1.5–) 2.5–3.5 × 0.8–1.5 mm, cuspidate rarely acuminate, with 3–5-veins, with few to many, appressed to spreading hairs; *bracteoles* in pairs, ovate on lower flowers to sometimes linear-lanceolate and ± falcate on upper one, (0.8–) 1.5–2.6 (–3) × 0.4–1.2 mm, with one central vein, usually appressed-pubescent and ± ciliolate. *Hypanthium* 1.6–2.6 mm long when flowering (free tube 0.7–1.5 mm long), glabrous or glabrescent with appressed hairs rarely with slightly spreading hairs up to 0.3 mm long. *Calyx lobes* triangular-ovate, 0.7–1 mm long, acute to pointed (often double-pointed), glabrous or with short hairs. *Corolla lobes* obovate-orbicular, scarcely clawed, 1.3–1.8 (–2.2) mm long, ± erose, pink to mauve or rarely white. *Stamens* 33–38 in more than one whorl; *filaments* 2.1–3.4 mm long; *anthers* broadly ellipsoidal, 0.28–0.35 mm long with red subterminal gland. *Ovary* 3-locular, with style not or scarcely sunk into the usually ± hairy upper surface; *placenta* a broad-elliptic disc with short central attachment, scarcely bilobed with each lobe with usually 2 rows of ovules; *ovules* (12–) 20–30 (–35) per locule, spreading, subequal; *style* 2.5–3.5 mm long, with stigma small-capitate, scarcely compressed at the apex. *Fruit* an urceolate capsule with erect calyx lobes. *Seeds* obloid-ellipsoidal, 0.6–0.7 mm long, with ± blunt ends and coarse vertical ridges. *Flowering*: (September–) October–November (–January). **Common name**: **Crimson kunzea** (Ewart 1931); **violet kunzea** (Willis 1973, Jeanes 1996). **Fig. 12.**

**Distribution and ecology.** Grows often on seepage areas or sometimes on shallow acid soil mainly on granite or sandstone shelves in heath, or open patches usually in dry sclerophyll forest or often common in deforested areas; found in New South Wales (CC, SC, NT, CT, ST, NWS, CWS, SWS) and Victoria (GR, MID, EHL, SNOW, EG).

**Conservation status.** Locally common and known from several conserved areas, e.g. Morton National Park, Grampians National Park.

**Diagnostic features.** Although some forms of *K. parvifolia* are very similar to *K. obovata* (cf. variation, below) it can be identified by one or more of the following characteristics:

The usually linear leaves of *K. parvifolia* are commonly up to 3.2 mm, or rarely up to 4 mm long, but the apex does not usually appear obviously recurved, because a distal abaxial ridge continues in line with the central vein to form an abaxial subterminal appendage or double-pointed apex of the leaves (cf. fig. 12B), which is usually visible in young leaves and particularly on leaves below the inflorescences. The leaves are often more or less appressed to the branches and clasping the base of the inflorescence, but in cultivated plants



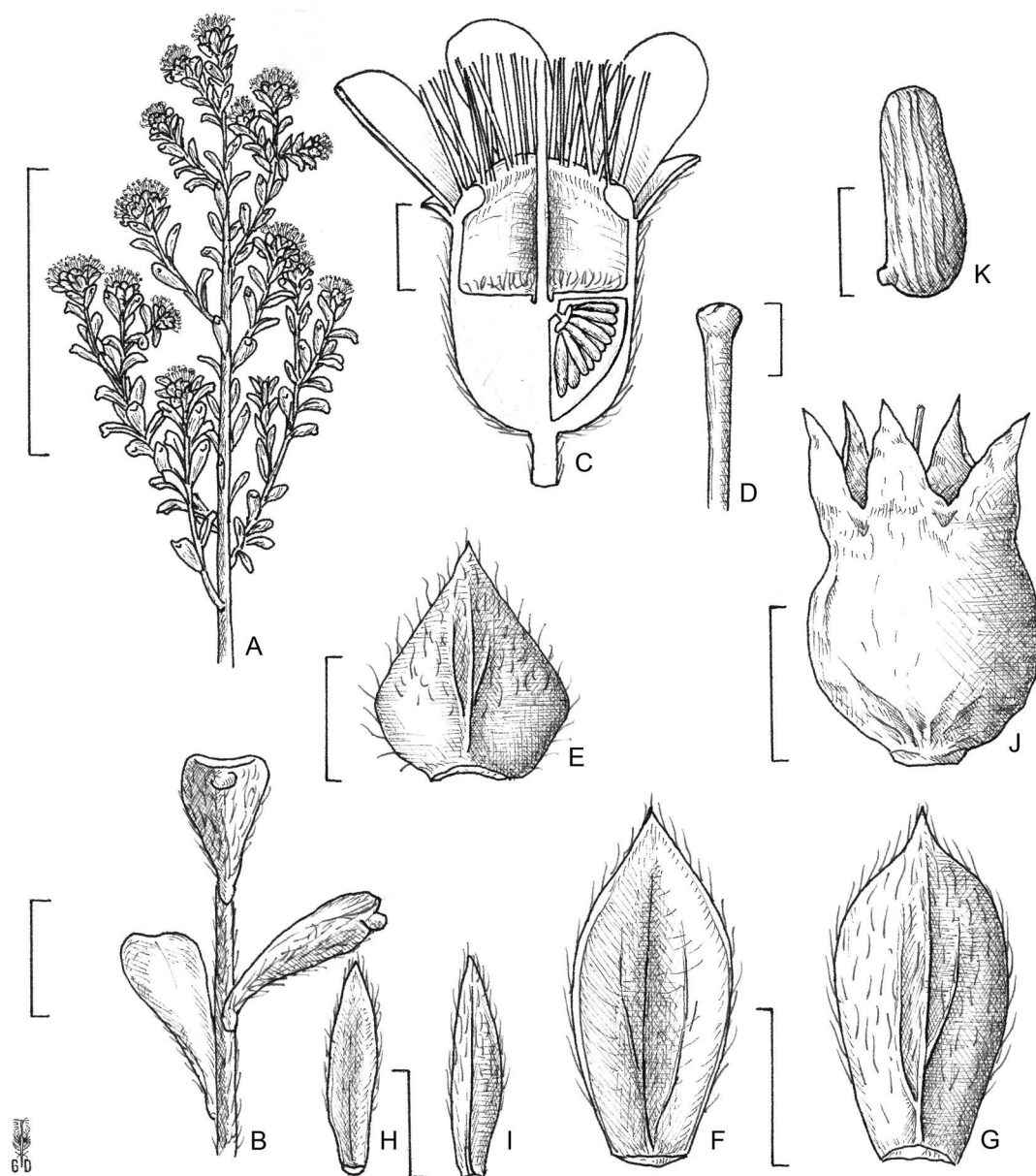


Fig. 12. *K. parvifolia*: A flowering branch; B cauline leaves showing subterminal abaxial appendage; C half flower; D capitate stigma; E abaxial view of perule; F adaxial view of bract; G abaxial view of bract; H adaxial view of bracteole; I abaxial view of bracteole; J fruit; K seed. — Scale bars: A 5 cm; B, C, F–I 1 mm; D, E 0.5 mm; J 1.5 mm; K 0.25 mm. — A–I H.R. Toelken 6845 (AD); J, K A.K. Fitzhenry (NSW).

they are usually spreading and recurved even below the inflorescences, similar to those of *K. obovata*. The hypanthium and usually also the calyx lobes of *K. parvifolia* are glabrous, or glabrescent or, if with spreading hairs, then individual hairs are shorter than 0.3 mm long, in comparison to those of *K. obovata*, which are often longer than 1 mm.

**Variation.** The local variation and this widespread species must be studied in detail to understand delimitation accepted here. Throughout the range of the species the size of the bracts and bracteoles relative to the hypanthium may vary much between populations and within the same population. Also, the leaves show a large range of variation, but usually they are  $\pm$  oblong and erect

with a double apex (fig. 12B). The leaves are often very different on fast growing juvenile plants than on older plants, which are distinguished by having an intricate branching system reminiscent to species of sect. *Floridae*, except that in *K. parvifolia* the distinction between long shoots and short shoots is not as well developed as in extreme cases in the *Floridae*, e.g. *K. preissiana*.

(1) Specimens (including the type) from the Central and Southern Tablelands and coasts of New South Wales as well as the adjoining parts of north-eastern Victoria differ from *K. obovata* in their short oblong leaves with subterminal appendage and leaves clasping the base of the inflorescence, and hypanthium and calyx lobes are usually glabrescent with short appressed hairs. The fre-

quent absence of hairs on the upper surface of the ovary from populations near Berrima and southwards into the Shoalhaven River valley is unusual. From this area several specimens with white petals have been recorded and described in the past as var. *alba*, but, as with white-flowered specimens from other species, this character could not be linked with other characters, so that this variety was reduced to synonymy. An exception was however made for some specimens from between Junee and Cootamundra, which show extreme local variation examined and are here referred to a hybrid swarm of *K. occidentalis* × *K. parvifolia* (cf. *K. occidentalis*: hybrids).

(2) Some plants of *K. parvifolia* growing on the Tinderry Mountains do not have a well developed double apex of the leaves (e.g. *E.M. Canning* 3327), but the oblong-obovate leaves are dorsiventrally flattened, i.e. they cannot be confused with those of nearby *K. badjaensis*. The absence of the double-apex is often observed on the usually relatively small leaves of plants growing at high altitude.

(3) *K. parvifolia* occurs in a number of often isolated localities mainly on the western slopes of the Great Dividing Range from the Grampians in the south-west to near Inverell in the north-east. In contrast to the previous variant, the leaves are usually narrow-oblong and often ± densely covered with fine appressed hairs, which are often not fully appressed on young leaves. The leaves have usually a well developed subterminal appendage or double apex typical of the species, except in extreme northern parts between Howell and Inverell (cf. diagnostic features of *K. opposita* discussing possible introgression between the two species in that area). Although the leaves are often slightly oblanceolate in this northern area, their apices are rarely acute nor distinctly recurved. The dense, usually ± appressed tomentum of the leaves throughout most of this western range of the species stands in direct contrast to the glabrescent leaves with few spreading hairs in plants of *K. obovata* from nearby Emmaville to Torrington and further north. The long spreading hairs on the perules and bracts may be misleading, particularly on immature inflorescences, but all such specimens investigated had shorter hairs on the hypanthium and calyx, unlike those in *K. obovata*. The superficial resemblance of the form from south of Inverell to that of *K. obovata* north of Emmaville seem to be a parallel development rather than clonal, judging by these differences. Nor was a wide range of variation in either population found to indicate hybridization between these somewhat similar species. However, one specimen, *J.B. Williams* NE37029, 3 km Howell to Copeton, indicates that occasional intermediates/hybrids with *K. obovata* might occur, because it has oblong-elliptic leaves with many appressed hairs and an acute apex, and the hairs on the hypanthium are of intermediate length. In other places the two species were recorded apparently together without any

intermediates as, for instance, at Black Ck, Guyra (*E.N. McKie* NSW124110A: *K. obovata*; NSW124110B: *K. parvifolia*). The distinction between the two species is further complicated by a putative hybrid *K. obovata* × *K. opposita* (cf. *K. obovata*: hybrids) from Backwater (*E.N. McKie* 216).

An odd specimen (*J.H. Willis* MEL92608, Pine Mt near Walwa), well away from the above distribution of *K. obovata*, has pointed leaves with the marginal ridge scarcely developed (no distinct double-apex) reminiscent to leaves of *K. obovata*. It is, however, accepted as *K. parvifolia*, as the leaves are oblong-elliptic to oblong-lanceolate with short ± appressed hairs, and with short spreading hairs on the hypanthium.

(4) The long spreading hairs on the whole plant and especially on the hypanthium and calyx of plants from Mt Buffalo (Victoria) are similar to those of *K. obovata*, except that the leaves are usually much smaller and flat, as well as the typical subterminal appendage is usually present, but, like in the case of plants from the Tinderry mountains, it is often not well developed. Although these plants have unusually short and broadly oblong-obovate leaves, they are more oblong at lower altitude, e.g. Eurobin Falls (*Robbins* MEL524665).

The variation shown by some pink-flowered specimens recorded from between Junee and Cootamundra (NSW) may be interpreted as hybrids between *K. occidentalis*, a plant rarely recorded from that area, and *K. parvifolia* (cf. putative hybrids of 47. *K. occidentalis*).

*Notes.* *Kunzea obovata*, like *K. badjaensis*, was once considered part of the variable *K. parvifolia*, and the present delimitation and characterisation of the latter species have been slightly emended (cf. *K. parvifolia*, variations).

*Typification.* The sheet of a Hügel collection in W, annotated in a similar handwriting as other species described by Schauer and agreeing with the protologue, is selected as lectotype of *K. parvifolia*.

As the one syntype of *K. parvifolia* var. *alba* (*R.H. Cambage*, near Braidwood, xi.1908) could not be traced, the specimen *J.L. Boorman*, Rockley, xi.1906, which conforms with the protologue, has been selected as lectotype.

#### *Selection of specimens examined (308 seen)*

NEW SOUTH WALES: *R.H. Anderson* NSW64412, Tooma, 12 mls [19.2 km] S Tumbarumba, xi.1938 (MEL, NSW); *W.A.W. de Beuzeville* NSW124080, Bombay, Shoalhaven River, 16.ii.1932 (NSW); *P. Beesley* 519 et al., 27.5 km NNW Boorowa, 30.x.1985 (AD); *B.G. Briggs* 914, 2 mls [3.2 km] W Timor Rock, Warrumbungles, 24.x.1966 (NSW); *B.G. Briggs* 1588, near Tolwong, Nerriga, 28.1.1968 (NSW); *J.D. Briggs* 2284, 1 km S railway crossing at Alleena, 19.x.1987 (CANB); *R.H. Cambage* 2113, E Biddon Rd, Gulgandra, 15.x.1904 (NSW); *R.H. Cambage* 2997, Tharwa Rd, Queanbeyan, 6.xi.1911 (NSW); *E.M. Canning* 3327, 6.7 mls [10.7 km] from Michelago to Little Tinderry Hmsd, 7.xii.1972 (CANB); *A.D. Chapman* 1564, Lees Pinch, 13 km NW Bylong, 2.x.1979 (AD); *R.J. Chinnock* 7777 & *J. Briggs*,



1 km S Alleena, 13.x.1987 (AD); *W.F. Clark* NSW124113, Boyd Ck, Kanangra district, xii.1966 (NSW); *L. Costermans* NSW168924, W Lithgow, xi.1973 (NSW); *R. Coveny* 12391 *et al.*, Limestone Ck, 6.7 km Moredun Rd from Tenterden to Tingha, 13.xii.1987 (AD); *L.A. Craven* 645, 4 mls [6.4 km] NE Nerriga, 13.x.1965 (MEL; B, BH, CHR, E, G, K, L, NSW, P, US, n.v.); *I. Crawford* 6618, 0.8 km S Lake Bethunga dam wall, 28.x.2001 (CANB); *A. Floyd* 16, near Inverell, 30.x.1956 (NSW); *W. Forsyth* NSW124074, Bombala Hill, i.1910 (NSW); *M. Gray* 2354, Gilgai, 8.xii.1953 (NE); *G.J. Harden* NE38912, Mt Naman, 20.viii.1975 (NE); *B. Kennedy* NSW124096, Trinkey S.F., 50 km SW Gunnedah, x.1977 (NSW); *P. Lindsay* NSW124079, Talbingo, 26.x.1978 (NSW); *J.H. Maiden* NSW124083, Barbers Ck, i.1898 (NSW); *E.N. McKie* 2325, Kings Gap, near Bundarra, 14.x.1940 (NSW); *H.S. McKie* 11724, Black Mtn, ACT, 8.xi.1964 (NSW); *B.J. Lepschi* 6360 & *A.N. Schmidt-Lebuhn*, c. 11.5 km SE Koorawatha, 11.xi.2010 (CANB); *Monagan* NSW124093, near Nowra Hill, ix.1945 (NSW); *A. Morris* 2232, between Gulgong & Dubbo, 5.viii.1928 (NSW); *I. Olsen* 1938, Uriarra Crossing, Swamp Ck, 27.ii.1974 (NSW); *M. Parris* 9182 & *N. Fisher*, Tingaringi Fire Trail, Kosciusko N.P., 15.ii.1987 (AD); *R.W. Purdie* 6277, Black Mtn Nature Res., 20.x.2006 (CANB); *R.W. Purdie* 7035, Ironmungy Nature Res., 30.xii.2008 (CANB); *Ralph* NSW124112, Oberon, Wells Rd, s.dat. (NSW); *R. Schodde* 3145, Gibraltar Ck area, 14.xi.1962 (AD, MEL, NE, NSW); *D.W. Shoobridge* CBG13564, near Gilgandra, 3.x.1964 (AD); *C. Stafford* NSW124103, Merriwa, 1.xii.1945 (NSW); *J.B. Williams* NE10395, Dunley Vale, NW Guyra, x.1959 (NE); *J.B. Williams* NE37024, 3 km Howell to Copeton, 20.ii.1966 (NE); *J.B. Williams* NE37028, N Bundarra on road to Inverell, 22.i.1967 (NE); *J.B. Williams* NSW124101, 2 mls [3.2 km] E Howell to Tingha, 22.i.1967 (NSW); *P.G. Wilson* 49 & *J. Highet*, Goonoo S.F., Dubbo, 2.x.1983 (AD); *E.K. Winterhalter* NE9524, 51 km E Gilgandra, ix.1958 (NE); *C.A. Winters* NSW124106, Cootamundra to Bethunga Rd, 31.x.1951 (NSW).

VICTORIA: *J. Ackland* 169, 1 mile [1.6 km] N Bundarra River crossing, 23.xi.1964 (MEL); *D.E. Albrecht* 3593, Wermatong track, c. 7 km NE Mt Burrowa, 22.x.1987 (AD, MEL); *A.C. Beauglehole* 36857, Mt Sister, 20.ii.1971 (MEL); *M.G. Corrick* 5720, Mt William Rd, Grampians, 20.xi.1976 (MEL); *H.M. Jolly* 18 *et al.*, 6.3 km W Whitfield, 13.x.1996 (NE, CANB); *R.A. Keble* MEL92599, Walwa, 15.x.1951 (MEL); *A. Meebold* 21713, Glenn Wiles, xii.1936 (NSW); *R. Melville* 3034 & *N. Wakefield*, Wulgulmerang, 21.i.1953 (MEL, NSW); *F. Mueller* MEL92592, Mt Buffalo Ra., 8.iii.1853 (MEL); *F. Mueller* MEL92612, Mt Hotham, 1893 (MEL); *A.E. Orchard* 2772, 4 km E Mt Seldom Seen, c. 10 km SW Wulgulmerang, 16.xii.1970 (AD); *S.T.W. Parfett* 268, 4 km N Zumsteins, 17.x.1999 (MEL, CANB); *F. Robbins* sub *A.C. Beauglehole* 38734, Eurobin Falls, 15.i.1951 (MEL); *R.V. Smith* 73/30, Cudgewa Bluff, 21.xi.1973 (MEL, NSW); *J.H. Willis* MEL92608, SW slopes of Pine Mtn, 17.xi.1964 (MEL); *J.H. Willis* MEL92611, Black Ra. Grampians, 2.i.1948 (MEL).

#### Putative hybrids

(i) *K. ambigua* × *K. parvifolia*: see 48. *K. ambigua*

(ii) *K. capitata* subsp. *capitata* × *K. parvifolia*: see 33a. *K. capitata* subsp. *capitata*

(iii) *K. juniperoides* subsp. *pernervosa* × *K. parvifolia*: see 26b. *K. juniperoides* subsp. *pernervosa*

(vi) *K. occidentalis* × *K. parvifolia*: see 47. *K. occidentalis*

(v) *K. obovata* × *K. parvifolia*: see 34. *K. obovata*

(vi) *K. parvifolia* × *K. peduncularis* (Molyneux & Forrester 2016, p. 53)

#### 36. *Kunzea badjaensis* Toelken, sp. nov.

*K. capitata* subsp. *seminudae* similis sed habitu decumbenti et pilis brevis adpressus in ramis, foliis et floribus; a *K. obovata* habitu decumbenti, pilis adpressis in foliis floribusque et sine pilis in apice ovariis; a *K. parvifolia* habitu decumbenti, foliis magnis et perulis brevioribus differt.

**Type:** New South Wales, 4 km SE Wadbilliga Trig., I.R. Telford 12025, 20.1.1994 (holo.: AD99426049; iso.: CANB (CBG9400401); BISH, MEL, NSW, n.v.).

*Kunzea* sp. C Joy Thomps. in S.W.L. Jacobs & Pickard (ed.), Pl. New South Wales 166 (1981); Peter G. Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 152 (1991); de Lange *et al.*, Austral. Syst. Bot. 23: 311 (2010).

*Kunzea* sp. *Wadbilliga* (Rodd 6168) Peter G. Wilson in G.J. Harden (ed.), Fl. New South Wales, ed. 2, 2: 176 (2002).

Shrubs 0.2–0.5 (–1) m tall, with decumbent branches rarely ascending; young branches with leaf bases slightly raised but flanges absent to scarcely visible, pubescent to glabrescent with short hairs ± appressed; early bark scarcely fluted, peeling in membranous oblong pieces with ± straight margins. *Leaves* alternate; *petiole* (0.3–) 0.5–1.2 mm long, appressed; *lamina* oblanceolate to obovate, (1.5–) 2.5–5 (–6) × (0.8–) 1.4–2.5 (–4.1) mm, acute to obtuse, rarely truncate and ± abruptly constricted into a recurved apex, gradually tapering into petiole, concave to shallow-canaliculate above, convex and often with ridged main vein below, puberulous with short hairs ± appressed below and on the margins. *Inflorescence* a rounded botryum with (1–) 3–6 (–10) flowers, apparently terminal on long shoot but mainly on short shoots, with terminal vegetative growth often continuing while flowering or fruiting; *retained perules* 2–5, narrow-triangular to rarely broad-triangular, with 1–3 veins, usually appressed-pubescent; *bracts* ovate to oblong-elliptic, (1.7–) 2–3.5 × 1.2–2.2 mm, 3-veined, ciliate, tomentose to puberulous on upper half and glabrous below; *bracteoles* in pairs oblong-lanceolate to elliptic, (1.2–) 1.5–3 × 0.6–0.8 mm, with one central vein, tomentose to puberulous on upper half and glabrous below. *Hypanthium* 2.6–3.5 mm long when flowering (free tube 1.5–1.9 mm), tomentose to glabrescent with short appressed hairs often coiled. *Calyx lobes* triangular to narrow-triangular, 0.9–1.3 mm long, usually pointed, glabrescent to rarely tomentose and often with marginal cilia. *Corolla lobes* obovate, 1.2–1.5 mm long, scarcely erose, white, pink or mauve. *Stamens* (28–) 32–37, in more than one whorl; *filaments* 3.2–3.6 mm long; *anthers* broadly ellipsoidal, 0.5–0.6 mm long, with subterminal gland. *Ovary* 3-locular, with style slightly sunk into the sometimes ± hairy surface; *placenta* a fleshy round disc with short central attachment, scarcely bilobed with each lobe with 2 rows of ovules; *ovules* 16–20 per locule, spreading to erect above but lower 4 or 5 pendulous and often slightly longer; *style* 3.7–3.8 mm long, with stigma small-cap-

tate, scarcely compressed at the apex. *Fruit* an urceolate capsule with erect calyx lobes. *Seeds* not seen. *Flowering*: (November) December–January. **Fig. 13.**

*Distribution and ecology.* Grows on clay soil or often on shallow skeletal soil on acidic rocks such as sandstone, locally common in heathland with, for instance *Allocasuarina nana* and *Banksia canei*, or as understory to open woodland, but known only from a few, often widely separated localities, mainly in the Kybean Range of New South Wales (ST).

*Conservation status.* Locally common (e.g. *R.G.Coveny* 5962) but known only from few populations, most of which occur in Deua and Wadbilliga National Parks.

*Diagnostic features.* The leaves of this species are obovate or rarely oblanceolate as in *K. obovata*, but unlike that species they have indistinctly recurved apices, which are usually obtuse to cuspidate even when young. *Kunzea badjaensis* is best distinguished from the latter by its short appressed hairs on the hypanthium and calyx, if at all present, and its decumbent habit. The decumbent habit will also immediately distinguish it from *K. parvifolia*, which has commonly oblong, almost flat leaves with a double apex.

*Variation.* Plants from Badja Hill and the northern parts of the distribution area are decumbent, have white petals, larger and almost glabrous leaves, and usually no hairs on the apex of the ovary. These would seem quite distinct from the ascending plants from the Tuross River area, which have pink to purple petals, shorter tomentulose leaves and usually a tomentose apex to the ovary if it were not for two collections from near Wadbilliga trig (*I.R. Telford* 8582, 12021). The latter plants also have a spreading habit together with pink flowers and glabrescent intermediate leaves and few hairs on the apex of the ovary.

*Note.* A white-flowered form with a decumbent habit is registered as *Kunzea* ‘Badja Carpet’ and used as a ground cover in horticulture (Elliot & Jones 1993).

#### *Specimens examined*

NEW SOUTH WALES: *D.Binns* 605 *et al.*, S Dampier Trig., 18.xii.1982 (NSW); *B.G.Briggs* NSW120222, Tuross Falls, 26.iv.1968 (CANB, NSW); *J.D.Briggs* & *M.Parris* 2080, 300 m W Kydra Trig., 28.x.1986 (CANB); *J.D.Briggs* & *P.H. Weston* 1817, bluff 2.4 km N Wadbilliga Trig., 27.iii.1985 (CANB); *J.D.Briggs* & *P.H.Weston* 1843, 2 km SW Dampier Trig., Deua N.P., 28.iii.1983 (CANB, MEL); *R.G. Coveny* 5962 & *A.N.Rodd*, 2 km S Dampier Trig., 14.i.1975 (NSW); *M.D.Crisp* 2393a & *D.J.Cummings*, E of Big Badja Hill, 1.xii.1976 (CANB); *D.J.Cummings* 49 & *M.D.Crisp*, Big Badja Hill Trig. Pt. 2.xii.1976 (CANB); *E.Gauba* CBG11473, Mt Badja, 6.i.1950 (CANB, MEL); *J.Liney* 2050, Tuross Falls, 8.xii.2003 (CANB); *I.Olsen* 2374, N end of Wadbilliga Mtn plateau, 13.x.1974 (NSW); *A.E.Orme* 608 & *J.Whyte*, c. 50 m E Throsby Mtn Trig. 17.ii.2006 (NSW); *A.N.Rodd* 6168, Razorback Fire Trail, 25.i.1991 (NSW); *H.Streimann* CBG52917, Big Badja Mtn, 16.i.1974 (CANB, NSW); *I.R. Telford* 10118, Tuross Falls, 17.xi.1985 (AD, CANB, NSW); *I.R.Telford* 12021, Razorback Fire Trail, 1 km SW Wadbilliga

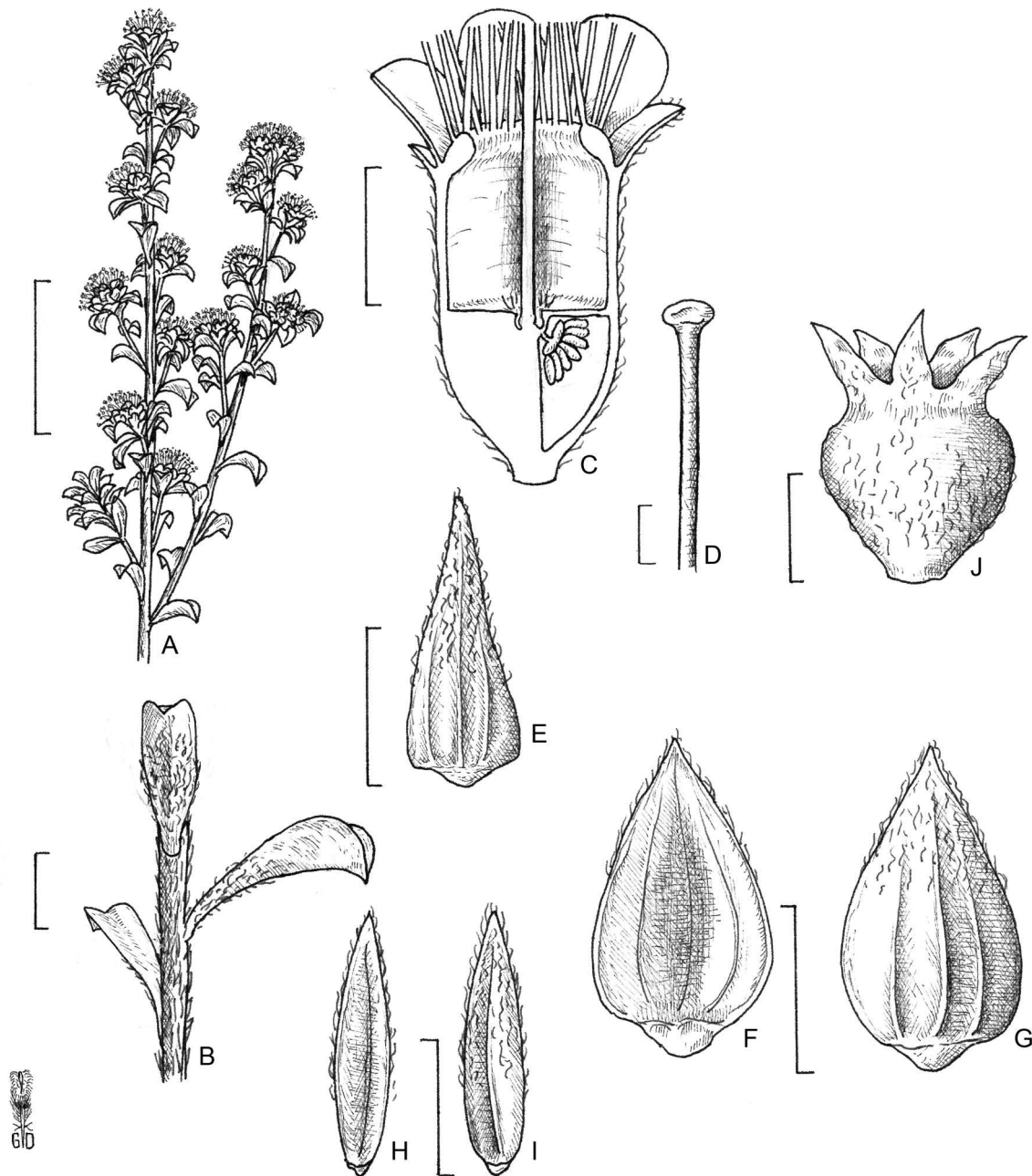
Trig., 20.i.1994 (AD, CANB, NSW); *I.R.Telford* 8582 & *N.Ollerenshaw*, 4 km SW Wadbilliga Trig., 9.xii.1980 (AD, CANB, NSW); *M.D.Tindale* 4011 *et al.*, Kydra Reefs fire trail, 17.i.1972 (NSW); *J.H.Willis* MEL92637, Kydra Pks, 11.i.1970 (MEL).

#### **37. *Kunzea opposita* F.Muell.**

Fragm. 6: 24 (1867); Maiden & Betche, Proc. Linn. Soc. New South Wales 30: 364 (1905); Census N.S.W. Pl. 154 (1916); N.C.W.Beadle, Student Fl. N.E. New South Wales 3: 477 (1976); Byrnes, *Austrobaileya* 1(5): 468 (1982); T.D.Stanley in T.D.Stanley & E.M.Ross (eds), Fl. S.E. Queensland 2: 133, fig 18A (1986); Peter G.Wilson (1991) in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991); A.R.Bean in R.J.F.Henderson (ed.), Queensland Pl. 133 (1997). — **Type:** New South Wales, granite rocks near Timbarra, *C.Stuart* s.n., Nov. (lecto., designated here: MEL82191; isolecto.: MEL82193). **Remaining syn.**: Tablelands, *C.Stuart* 288, Dec. (MEL82192, MEL92825); New England, *C.Stuart* (K000843016, K000843017, MEL 92823, cf. Typification).

Shrubs 0.5–1.5 (–2.5) m tall, often spindly-branched; young branches with scarcely raised leaf bases and flanges usually absent, glabrous to hirsute with antrorse, often crisped hairs; early bark splitting in long longitudinal strips with almost membranous margins ± peeling to sometimes becoming corky. *Leaves* opposite to subopposite, rarely alternate; *petioles* 0–0.3 mm long, appressed; *lamina* lanceolate to linear-lanceolate, 1–2.5 (–5.5) × 0.7–1.1 mm, obtuse to rarely acute, usually gradually tapering into apex, abruptly constricted at the base, straight or loosely appressed, with margins incurved and ± furrowed above, strongly convex below, glabrous rarely puberulous below. *Inflorescence* a rounded botryum with (3–) 5–9 (–14) spreading flowers, apparently terminal to main and predominantly to shorter lateral branches, with vegetative growth usually continued laterally from below the inflorescence; *retained perules* up to 5, but often absent or with leaf-like fleshy apex, narrowly triangular-lanceolate to -ovate, 1.2–1.8 mm long, with clasping base, with central vein continued into point (often with well developed straight lateral veins), sericeous, puberulous to glabrescent; *bracts* ovate to elliptic-lanceolate above, (1.6–) 2.2–2.8 (–3.2) × (0.8–) 1–2 (–2.4) mm, acuminate and sometimes fleshy apex, with pronounced central vein and usually 2 lateral ones, hirsute to glabrous or with marginal hairs; *bracteoles* in pairs, linear-lanceolate, linear-elliptic to -oblanceolate and usually somewhat falcate, (0.7–) 1–1.5 (–1.8) × (0.4–) 0.5–0.9 (–1.3) mm, with pronounced central vein continued into acuminate or acute apex, hirsute to glabrous but often with marginal hairs. *Hypanthium* 3.2–3.6 mm long when flowering (free tube 1.5–1.8 mm long), becoming slightly angular, pubescent to hirsute, rarely glabrous. *Calyx lobes* triangular-ovate, (0.5–) 0.7–1 (–1.2) mm long, acute, ± ridged towards the apex, hirsute to glabrous with spreading antrorse hairs. *Corolla lobes* oblong-obovate to broadly obovate, 1.2–1.4 mm long, pink. *Stamens* (36–) 40–50 in more than one





**Fig. 13. *K. badjaensis*:** **A** flowering branch; **B** cauline leaves; **C** half flower; **D** capitate stigma; **E** abaxial view of perule; **F** adaxial view of bract; **G** abaxial view of bract; **H** adaxial view of bracteole; **I** abaxial view of bracteole; **J** fruit. — Scale bars: **A** 5 cm; **B** 1 mm; **C, D, J** 2 mm; **E–I** 1.1 mm. — **A–I** D.Binns 605 (NSW); **J** B.G.Briggs NSW120222.

whorl, *filaments* 3.1–4.6 mm long; *anthers* broadly ellipsoidal, 0.3–0.45 mm long, with red subterminal gland. *Ovary* 3 (4)-locular, with style somewhat sunk into the upper surface, which varies from glabrous to hairy or hairy only along the sutures; *placenta* an almost round thick disk with short attachment just below the centre, scarcely lobed, each lobe with 3 (4) rows of ovules; *ovules* 21–76 per locule, subequal, spreading; *style* 4.2–5.6 mm long; stigma moderately capitate, scarcely compressed apically. *Fruit* an urceolate capsule with spreading to slightly incurved calyx lobes. *Seeds*

angular cylindrical, c. 0.5 mm long; testa hard with dense vertical rugose ribbing.

**Diagnostic features.** The opposite or subopposite leaves of *K. opposita* and *K. calida* may be confused with the very densely clustered ones of *K. juniperoides*, *K. muelleri* and *K. dactylota*, but those of the former two are deeply furrowed to rolled and especially the bracts and bracteoles have membranous margins, while leaves of the latter three species are slightly grooved above and the bracts and bracteoles scale-like chartaceous. *Kunzea calida* is very similar to *K. opposita* var. *leich-*

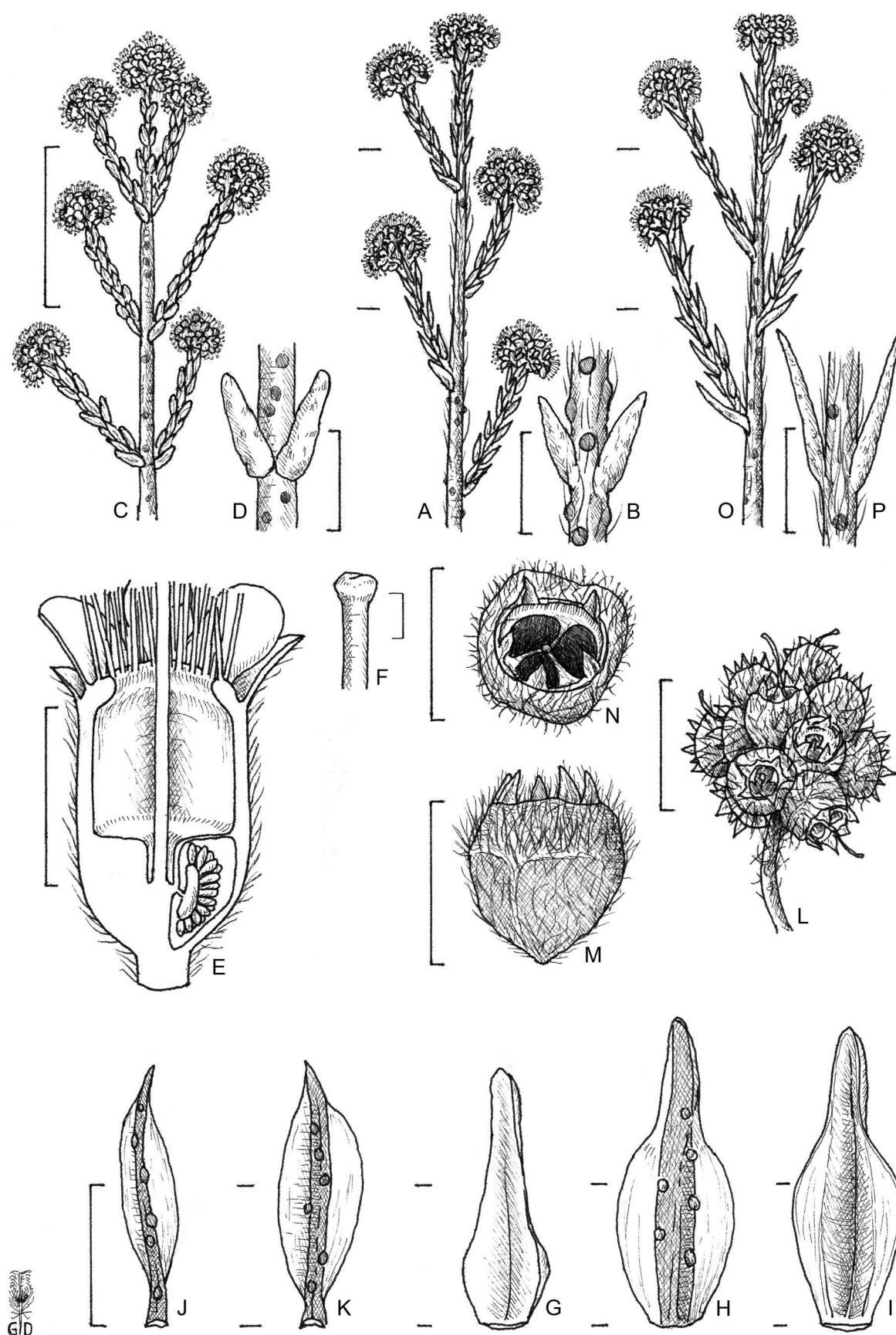


Fig. 14. A–N *K. opposita* var. *opposita*: A–B, E–N NSW form: A flowering branch, B cauline leaves pointed. C–D Qld form: C flowering branch, D cauline leaves blunt and  $\pm$  amplexicaule; E half flower; F capitate stigma. G adaxial view of perule; H adaxial view of bract; I abaxial view of bract; J, K ab-



*hardtii* (see Variation, below), but is distinguished by its linear conduplicate leaves, and the longer bracts and bracteoles.

The fine spreading lateral branches around the more robust main branches resemble the habit of *K. parvifolia* and it has often been confused, particularly in Queensland, with that species (Byrnes 1982), but is distinguished from *K. opposita* by its linear-oblongate to oblanceolate leaves with an abaxial ridge ending in a more or less developed subterminal point or double apex. These leaves are always spirally arranged, while they are usually opposite to subopposite in *K. opposita*. However, records from near Howell (New South Wales) of a form with spirally arranged leaves with more or less recurved apex are distinctly lanceolate as compared with oblanceolate or oblong in *K. parvifolia* from that area (cf. variation 3 of *K. parvifolia*). Both these species are so variable that hybridization or introgression would be very difficult to recognise and could only be assessed in detailed population studies. No distinct putative hybrids between the two species have here been recognised in spite of the unaccountable range of variation in north-eastern New South Wales.

The much intricately branched habit and the lateral branching, commonly from below the inflorescence rather than from the terminal bud, is reminiscent of the growth in species of sect. *Zeanuk* subsect. *Floridiae* (Toelken 1996) except that the epidermis of the latter branches peels slough-like, seeds are  $\pm$  smooth and petals are usually relatively larger to the stamens.

**Typification.** On two of the several sheets of C. Stuart's collections of *K. opposita* in MEL the type locality Timbarra is mentioned and, as sheet MEL82191 is accompanied by a collector's label, it is selected here as lectotype. The second sheet MEL82193 with only one of the blue handwritten labels of Mueller's herbarium contains four branches is regarded as isolectotype. It seems, however, that C. Stuart collected the species at least twice during that stay in New England, as, for instance, MEL82192 bears a collector's label with "288/ fl. Red/ Highest granite rocks/ Tableland/ (Dec)". This specimen was collected in December while sheet MEL 82191 was in November. As these specimens other than the lectotype and its duplicate also bear the same Mueller labels of the time it is highly likely that he had consulted them, as well. They are therefore accepted as syntypes. Specimens annotated as types and sent to K by F. Mueller lack detail to identify them correctly.

#### Key to varieties

1. Leaf lamina (0.8–) 1–2.5 (–3.8) mm long; hairs on branches 0.3–1 mm long . . . . . **37a. *Kunzea opposita* var. *opposita***
- 1: Leaf lamina (3.1–) 3.8–5.2 (–5.8) mm long; hairs on branches longer than 1 mm . . . . . **37b. *Kunzea opposita* var. *leichhardtii***

#### 37a. *Kunzea opposita* Byrnes var. *opposita*

Austrobaileya 1: 468 (1982); A.R.Bean in R.J.F.Henderson, Queensland Pl.:133 (1997).

Young branches pubescent, glabrescent, rarely shortly sericeous with hairs 0.3–1 mm long. *Leaves* subopposite to opposite, rarely alternate, with lamina (0.8–) 1–2.5 (–3.8) mm long. *Flowering*: (August) September–November. **Fig. 14A–N.**

**Distribution and ecology.** Grows mainly in sandy soil usually associated with granite or sandstone rocks in open forest to woodland or exposed cliffs; recorded from often widely separated localities in south-eastern Queensland (BN, DD, LE) and northern New South Wales (NC, NT, NWS).

**Conservation status.** Widespread, locally frequent and conserved in several parks.

**Variation.** Plants of this typical subspecies from different areas show a wide diversity in indumentum, varying from glabrous to sericeous, which may vary on different parts of the plants from different areas. Interesting is that plants from the Nandewar Range are usually distinguished by a hairy upper surface of the ovary or sometimes specimens from north of these mountains have hairs on both sides of the sutures along which the capsules dehisce. This unusual character has also been observed in *K. parvifolia* and *K. occidentalis* from this area, but was, as in *K. opposita*, usually absent in other populations.

The leaves vary from opposite, more or less appressed to almost amplexicaul with rounded apices (cf. fig. 14D) on the Northern Tableland of New South Wales, while northwards in much of Queensland they are becoming more often subopposite to alternate with usually more or less spreading pointed apices (cf. fig. 14B). In the northern areas of the distribution of the species a definite increase in the length of the leaves is observed of which those of var. *leichhardtii* (cf. fig. 14P) are extremes. Intermediate leaf sizes, such as (1.6–) 2–3 (–3.8) mm in *P.I.Forster 11667* & *P.Machin* (Headwaters of Pariagara Ck, 7 km W Bringalily Forestry lookout fire tower) and (1.7–) 2.2–3.1 (–3.4) mm in *Story & Yapp 307* (Planet Ck, c. 30 mls NE Rolleston), indicate that var. *leichhardtii* is possibly the extreme within a stepped cline and therefore the status quo is retained, i.e. the taxon is only recognised at variety level. However, *K. calida*, which is also very similar to var. *leichhardtii*, is for lack of evidence and due to the rarity of both taxa, retained as a separate species.

Considerable variation in the shape and size of the bract and bracteoles and in their tomentum has also been recorded. Unusual in this species are the large and often bulging oil glands on the branches. In some forms they are more clustered than in others (cf. fig. 14).

axial view of bracteoles; L infructescence; M fruit in side view; N dehiscent fruit from above. O, P *K. opposita* var. *leichhardtii*: O flowering branch; P cauline leaves. — Scale bars: A, C, O 15 mm; B, D, M, N, P 2.5 mm; E 2 mm; F 0.5 mm; G–K 1 mm; L 5 mm. — A, B, E, F R.H.Cabbage 2418 (NSW); C, D D.O'Grady NSW124127; G–K U.Johnson 6/74 (BRI); L–N J.H.Maiden & J.L.Boorman NSW124128; O, P R.J.Henderson 972 (BRI).

*Selection of specimens examined (64 seen)*

QUEENSLAND: *A.R.Bean* 12565, c. 6 km ESE Brovinia, 9.xi.1997 (AD, BRI); *R.C.Beasley* BRI274329, near Gili-gul, 22.ix.1941 (BRI); *L.A.Craven* 9959 & *Matarczyk*, 3.1 km W Amiens P.O., 16.x.1997 (CANB); *P.I.Forster* 11667 & *P.Machin*, Headwaters of Pariagara Ck, 7 km W of Brangily Forest Lookout fire tower, 26.ix.1992 (AD, BRI); *P.I.Forster* 29600 & *D.A.Halford*, Badgery Holding, Wondul Ra., 7.xi.2003 (AD, CANB); *C.E.Hubbard* 5110, Wandoan near Gurulmundi, 17.xi.1930 (BRI); *K.McArthur* BRI49200, Tara, ix.1958 (BRI); *M.E.Phillips* CBG15665, Gurulmundi, 24.viii.1961 (BRI, CANB); *M.M.Richardson* 258, *et al.*, 5.5 km Gurulmundi Siding to Woleebie, 20.ix.1988 (AD, CANB); *E.J.Rider* 40, Gulera, 8.x.1968 (BRI); *Story & Yapp* 307, Planet Ck, c. 30 mls [48 km] NE Rolleston, 30.ix.1962 (BRI, CANB, K, MEL); *S.R.Stevens* BRI41129, Barakula NW Chinchilla, 21.x.1957 (BRI); *I.R.Telford* 8880, 13 km Cecil Plains to Millmerran, 10.xi.1982 (AD, CANB, MEL); *C.T.White* s.n., Inglewood, xi.1922 (BRI274333, NSW124132); *P.G.Wilson* 1572 & *G.Towler*, 35.3 km S Wandoan, 18.iv.2002 (CANB, NSW).

NEW SOUTH WALES: *E.F.Constable* 7067, Big Spirabo Mtn, 22.viii.1966 (BRI, K, NSW); *L.M.Copeland* 3475, 15 km S Inverell along road to Bundarra, 10.xii.2002 (CANB, NSW); *R.G.Coveney* 12729 *et al.*, towards Dawson Springs, Mt Kaputar N.P., 25.viii.1987 (AD, NSW; BRI, CANB, HO, MEL, PERTH, n.v.); *R.H.Cambage* 2418, Mt Lindsay, xi.1909 (BRI, NSW); *E.N.McKie* BRI274327, Guyra, s.dat. (BRI); *J.H.Maiden* & *J.L.Boorman* NSW124128, Howell, viii.1905 (K, NSW); *M.Melvaine* NSW124130, 20 mls [32 km] W Uralla, 4.ii.1968 (NSW); *R.D.O'Grady* NSW24127, near Ramornie, 18.ix.1965 (NSW); *W.Schofield* NE36989, Mt Dowe, Nandewar Ra., 1.iii.1965 (NE, NSW); *W.R.Weiley* NSW124122, Copmanhurst, ix.1959 (NSW); *J.B.Williams* NE36984, 13 km E Tingha, 21.xii.1971 (NE); *H.J.Wissmann* NE36992, near Gilgai, x.1971 (NE).

*Putative hybrid*

(i) *K. obovata* × *K. opposita* var. *opposita*: see 37. *K. obovata*.

(ii) *K. occidentalis* × *K. opposita* var. *opposita*: see 47. *K. occidentalis*.

**37b. *Kunzea opposita* var. *leichhardtii* Byrnes**

Austrobaileya 1: 470 (1982); A.R.Bean in R.J.F.Henderson, Queensland Pl. 133 (1997). — **Type:** Queensland, Blackdown Tableland, c. 35 km SE Blackwater, *R.J.Henderson* 972, *L.Durrington* & *P.Sharpe*, ix.1971 (holo.: BRI 182140; iso.: CANB307507, MEL92581, NSW).

Young branches sericeous, with hairs commonly at least 1 mm long. *Leaves* alternate, subopposite or rarely opposite, with lamina (3.1–) 3.8–5.2 (–5.8) mm long. *Flowering:* August, September. **Fig. 14O, P.**

*Distribution and ecology.* Grows on shallow sandy soil on sandstone in open *Eucalyptus-Angophora* forest and known only from the Blackdown Tableland, Queensland (LE).

*Conservation status.* The frequency of this variety is unknown, but it was recorded from and it is conserved in Blackdown Tableland National Park.

*Variation.* The second collection of this variety examined (*C.H.Gittins* 900) showed a wider range of variation of the leaf length (3.1–5.8 mm long) than represented in the protologue.

*Specimens examined*

QUEENSLAND: *C.H.Gittins* 900, Third Ck, Blackdown Tableland, viii.1964 (BRI, NSW).

**38. *Kunzea calida* F.Muell.**

Fragm. 6: 23 (1867); F.M.Bailey, Syn. Queensland Fl. 168 (1883); Queensland Fl. 2: 592 (1900); Byrnes, Austrobaileya 1(5): 470 (1982); A.R.Bean in R.J.F. Henderson (ed.), Queensland Pl. 133 (1997). — **Type:** Queensland, Newcastle Range, at sources of the Flinders River, *J.Sutherland* s.n. (lecto., designated here: MEL 560102; isoleccto.: K000843018).

Additional measurements and information obtained from a cultivated specimen (*A.Griinke* s.n. based on seeds from *E.J.Thompson* 338 & *H.A.Dillewaard*) is presented in square brackets.

Spreading shrubs to 1.5 m tall; young branches with scarcely raised leaf bases and flanges absent, sericeous with mainly ± appressed long silky antrorse hairs but also some often coiled shorter ones; early bark flaking into shortly oblong to almost square membranous flakes with irregular margins. *Leaves* opposite, subopposite [alternate on long shoots]; *petioles* 0–0.2 [–0.5] mm long, appressed; *lamina* linear-lanceolate to linear-ob-lanceolate but usually rolled and linear, (2.9–) 3.5–7.9 [–15.6] × 0.45–0.6 [–1.6] mm, erect, obtuse to usually rounded, scarcely constricted towards the apex and base, above concave to ± rolled, below usually strongly convex with central vein not visible, sericeous on both sides. *Inflorescence* a ± rounded botryum with 3–12 flowers, apparently terminal to main branches and some short shoots subtending these, with vegetative growth continuing from the terminal bud and/or from below the inflorescence after flowering; *retained perules* 0–3, linear-lanceolate, 1.5–1.7 mm long, with scarcely visible central vein to the apex, hirsute; *bracts* lanceolate to linear-lanceolate, 4.3–6.2 [–8.4] × 1.1–1.7 mm, with acuminate apex on lower flowers to linear leaves with sheathing base on upper flowers, with 1 vein but often obscured by central ridge, hirsute with long spreading antrorse hairs; *bracteoles* in pairs, linear-elliptic rarely -oblanceolate, often somewhat falcate, 2.8–3.5 (–3.7) × 2.2–3.6 mm, with pronounced central ridge above the central vein, hirsute with spreading hairs. *Hypanthium* 3.4–3.6 [–4] mm long when flowering (free tube 1.2–1.4 mm long), almost globular or slightly angular, hirsute with long spreading antrorse hairs over few often coiled shorter ones. *Calyx lobes* triangular, 1.2–1.5 mm long, acute to acuminate because the margins are ± incurved, hirsute with spreading antrorse hairs rarely glabrescent. *Corolla lobes* obovate to oblong-obovate, 0.9–1.2 mm long, pinkish-purple. *Stamens* 50–64 in more than one whorl; *filaments* c. 3.5 mm long; *anthers* broadly ellipsoidal, 0.35–4 mm long, with ± distinct subterminal



gland. *Ovary* 3-locular, with style  $\pm$  sunk into the upper surface being glabrous to hairy along the sutures; *placenta* an almost round disk with short central attachment, scarcely lobed, each lobe with 3 or 4 rows of ovules; *ovules* 35–42 per locule, spreading; *style* 5.2–7.8 mm long, with stigma capitate, scarcely compressed at the apex. *Fruit* an almost spherical capsule, with calyx  $\pm$  recurved to 90° of the central axis. *Seeds* few per locule maturing, cylindrical to somewhat crescent-shaped, terete to slightly angular-terete; testa soft, pale brown, finely scalariform-rugose. *Flowering*: September.

*Distribution and ecology*. “On top of mountain, in flat rocky open area” of the Mount Stewart Ranges, Queensland (NK).

*Conservation status*. A very rare species and although a few plants of this species were found in 1991/92, they could not be relocated recently. An endangered species on schedule 2 in Queensland (Bostock & Holland 2015) or 3K in Briggs & Leigh (1996).

*Diagnostic features*. The leaves of *K. calida* are rolled and thus appear to be terete unlike the more conical leaves with furrowed upper surface of *K. opposita* var. *opposita*. The leaves are, however, similar to those in *K. opposita* var. *leichhardtii* except that they are usually even longer and densely hairy (sericeous).

*Variation*. The collections examined are very similar except that the sutures along the upper surface of the ovary are hairy in the type specimen while they are glabrous on the specimen *E.J.Thompson 338* & *H.A.Dillewaard*. The leaves of a specimen cultivated by Mr Allen Griinke from seeds of the latter collection are about twice as long and very distinct from those of *K. opposita* var. *leichhardtii*.

*Note*. A specimen without date or collector, consisting of only one inflorescence, but with No 22 (MEL556943), is correctly identified as this species, except that the provenance is given as “Pentland Hill/ Flinders & Burdakin [rivers]”.

*Typification*. The type specimen of *K. calida* in Mueller’s herbarium (MEL56102), with one of his typical blue labels, is accompanied by a minute packet of the same blue paper, in which numerous immature seeds (“gemmulis”) are wrapped, as described by Mueller (1867). As the author did not designate a holotype this specimen is selected as lectotype.

#### *Specimens examined*

QUEENSLAND: *A.Griinke ex E.J.Thompson 338* & *H.A.Dillewaard*, cultivated 2002 (AD); *E.J.Thompson 338* & *H.A.Dillewaard*, Mt Stewart Ranges, 22.ix.1991 (BRI); *E.J.Thompson CHA199* & *P.R.Sharpe*, 9.5 km W Hmsd, 83 km SW Charters Towers, 30.viii.1992 (AD, CANB, MEL; A, BISH, DNA, K, KEP, L, MBA, NSW, NY, PERTH, PNH, PR, PRE, SAN, SAR, n.v.).

### **C. *Kunzea* subgen. *Angasomyrtus* (Trudgen & Keighery) de Lange & Toelken**

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). — *Angasomyrtus* Trudgen & Keighery, Nuytsia 4(3): 435, fig. 1 (1983). — **Type species**: *Kunzea salina* (Trudgen & Keighery) de Lange & Toelken.

Main branches with short branches (sometimes short shoots) in the axil of all leaves; branches with raised decurrent leaf bases, but not flanged, with epidermis splitting into long longitudinal ridges, becoming corky bark. *Inflorescence* an elongate botryum with 2 or 3 (–6) flowers continued terminally into  $\pm$  vegetative growth before, while and after flowering; *bracts* fleshy leaf-like, caducous; bracteoles thin membranous, caducous. *Flowers* sessile, mature buds pointed. *Stamens* unequally long, shorter than petals, incurved. *Ovary* with 2 or 3 (–4) locules, each with peltate placenta with 4 or 5 pendulous elongate ovules; *style* short and scarcely longer than free tube of hypanthium.

*Discussion*. In spite of the obvious similarity of this species to *Kunzea*, it shows no close resemblance to any of the existing species, so that it was first described as the monotypic genus *Angasomyrtus* (Trudgen & Keighery 1983). Even the unusual feature of opposite leaves in *K. opposita*, could not be compared to those of *K. salina*, as it combines them with axillary short shoots in many leaf axils. Furthermore *K. salina* was described with monads instead of the typical globose botrya and two whorls of stamens of different length. This last characteristic is shared with species of *K. ericoides* complex (= *Kunzea* subgen. *Niviferae* sect. *Niviferae*) and additional material (*L.A.Craven et al. 9098*) confirmed that the inflorescence, originally described as a monad was a seasonally reduced botryum with leaf-like caducous bracts and bracteoles as well as terminal growth concurrent with flowering. However, *K. salina*, unlike the *K. ericoides* complex, has a pointed conical apex to flower buds, lacks a funnel-shaped stigma and well developed flanged decurrent leaf bases. Even under favourable conditions it usually produces only one short shoot in the axil of one of the opposite leaves (*L.A.Craven et al. 9098*).

Resulting from molecular research by O’Brien et al. (2000), *Angasomyrtus* was placed into *Kunzea*. In their detailed molecular study of the genus *Kunzea* de Lange et al. (2010) established it as a separate subgenus next to subgen. *Kunzea* in central position.

### **39. *Kunzea salina* (Trudgen & Keighery) de Lange & Toelken**

in de Lange et al., Austral. Syst. Bot. 23: 318 (2010). — *Angasomyrtus salina* Trudgen & Keighery, Nuytsia 4(3): 435, fig. 1 (1983). — **Type**: Western Australia, S Truslove on reserve 27983, *A.Hopkins 77/27* & *M.E.Trudgen*, 8.ii.1977 (holo.: PERTH, n.v.; iso.: CANB; NSW, K, n.v.).

Low shrubs up to 0.4 m tall and spreading to 2 m across, much-branched; branches with raised decurrent leaf bases rarely flanged, shortly sericeous to pubescent;

early bark splitting into long longitudinal strips, becoming corky ridges, not peeling. *Leaves* opposite, but often  $\pm$  shifted by unequal branching in the axils; *petiole* 0.4–1 mm long,  $\pm$  appressed; *lamina* linear-oblongate to linear-elliptic, (2.6–) 3.5–6 (–7.3)  $\times$  (0.5–) 0.8–1.3 (–1.8) mm, acute to obtuse, often becoming rounded, gradually tapering into petiole, straight erect,  $\pm$  furrowed above, usually strongly convex below, puberulous above and on margins, soon glabrescent. *Inflorescence* a botryum with 2 (–6) sessile flowers, at base of new shoots developing above the perules, with vegetative growth continuing above it; *retained perules* 3–5, ovate-triangular at base to narrowly oblong or elliptic higher up, (0.8–) 1.5–3 mm long, blunt to rounded apex, slightly fleshy (veins not visible) with membranous margins, sericeous especially on margins, caducous to deciduous; *bracts* linear-elliptic, (2.8–) 3.3–4  $\times$  1–1.4 mm,  $\pm$  fleshy with veins not visible, puberulous to glabrescent, caducous to deciduous; *bracteoles* in pairs, linear-oblongate, rarely linear-lanceolate, 1.3–1.5  $\times$  0.3–0.6 mm, acute to pointed,  $\pm$  fleshy with veins not visible, sericeous, usually caducous. *Hypanthium* 2.7–3 mm long when flowering (free tube c. 0.4 mm long), sericeous to pubescent. *Calyx lobes* ovate-triangular, 0.5–0.7 mm long, acute to pointed, puberulous to glabrous but usually with marginal cilia when young. *Corolla* lobes broadly obovate to suborbicular, about twice the size of calyx lobes, pale pink to white. *Stamens* 16–19 in two whorls; *filaments* terete, unequally long, curved introrse; *anthers* broadly ellipsoidal, 2–2.5 mm long,

with bold terminal gland. *Ovary* 2 or 3 (–4)-locular, with style slightly sunk into the upper surface, glabrous above; *placenta* a rounded peltate disc, scarcely lobed and with 4 or 5 subequal pendulous ovules; *styles* 1–1.2 mm long, broadened towards the base, with truncate, scarcely broadened stigma. *Fruit* an urceolate capsule with erect to spreading calyx lobes. *Seeds* angular cylindrical, 1–1.2 mm long; testa with fine vertical ribs. *Flowering*: November–February, but variable with season. **Fig. Nuytsia 4: 437, fig. 1.**

*Distribution and ecology.* The species grows in a rare habitat, a combination of “white sand dunes over clay at the margins of small playa lakes” with *Tecticornia uniflora* to *Melaleuca/Eucalyptus* shrubland communities (Trudgen & Keighery 1983).

*Conservation status.* *Kunzea salina* is a “rare species of restricted habitat and restricted range” which is conserved in Truslove Reserve (Trudgen & Keighery 1983); it is listed as a Priority 3 species (poorly-known) by the Western Australian Herbarium (1998–).

*Variation.* Although *K. salina* develops obvious buds or branches in most leaf axils, as it is commonly observed on species of sections *Pallidiflorae* and *Niviferae*, these are often not short shoots, since some will develop into long branches. In addition, the opposite leaves, which are unusual in the genus, but also found in, for instance, *K. opposita*, are frequently pushed out of position by developing axillary branches.

#### Key to species of sections *Platyphylla* and *Pallidiflorae* of subgen. *Niviferae*

1. Seasonal growth flush above infructescence develops at few nodes; axillary branches of varying length
  2. Flower buds truncate; leaves linear and glabrous, 11.6–17.3 mm long; Qld (NK) ..... 45. *K. truncata*
  - 2: Flower buds acute-conical; leaves oblanceolate to elliptic and pubescent to puberulous, rarely up to 12 mm long
    3. Bracts broader or about as broad as long
      4. Calyx glabrous or almost so; Qld (DD), N.S.W. (NT) ..... 41. *K. bracteolata*
      - 4: Calyx covered with long silky hairs; Qld (SK) ..... 43. *K. sericothrix*
    - 3: Bracts usually twice longer than broad
      5. Hypanthium and calyx pubescent to puberulous; bracts and bracteoles deciduous, rarely persisting on upper fruits; Qld (BN, DD, MO, PC, WB) ..... 40. *K. flavescens*
      - 5: Hypanthium and calyx glabrous; bracts and bracteoles caducous
        6. Branches below the inflorescence with few short appressed hairs mainly between flanges; abaxial leaf glands not extending to margins; Qld (NK) ..... 42. *K. graniticola*
        - 6: Branches below the inflorescence pubescent to hirsute; abaxial leaf glands extending close to margins; Qld (PC) ..... 44. *K. caduca*
- 1: Seasonal growth flush above infructescence develops at all nodes of axillary branches, but they remain often only short shoots as long or shorter than subtending leaf
  7. Flower buds with acute-conical apex; style 3–8.4 mm long; stamens subequally long (except in *K. petrophila*)
    8. Bracts acuminate; plants densely hirsute with long spreading hairs; N.T. (VR) ..... 46. *K. petrophila*
    - 8: Bracts acute to obtuse or rarely emarginate; plants pubescent, shortly hirsute to glabrescent
      9. Bracts similar to leaves and persistent; branches glabrous or almost so; N.S.W. (NC) ..... 49. *K. axillaris*
      - 9: Bracts scale-like; branches shortly hirsute, pubescent to glabrescent
        10. Branches puberulous to glabrescent, then developing white flanges; N.S.W. (NWS, CWS, NWP) ..... 47. *K. occidentalis*
        - 10: Branches shortly hirsute to pubescent, rarely glabrescent obscuring usually grey flanges; NSW (CC, SC, CT, ST), Vic. (EG, GPL, PROM), Tas. (FI, NE, EC) ..... 48. *K. ambigua*
  - 7: Flower buds truncate; style 1.5–2.5 mm long; stamens unequally long (Qld, N.S.W., Vic., New Zealand)
    - ..... *K. ericoides* complex (= *Kunzea* sect. *Niviferae*; in prep.)



*Specimen examined*

WESTERN AUSTRALIA: *L.A. Craven et al.* 9098, at junction of Lagoon and Kendall Roads, Scaddan, 10.xi.1992 (AD).

**D. *Kunzea* subgen. *Niviferae* Toelken & de Lange**

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). —

**Type species:** *K. peduncularis* F.Muell.

*Kunzea* sect. '*Eukunzea*' Benth., Fl. Austral. 3: 112 (1867), pro parte, quoad *K. corifolia* (synonym of *K. ambigua*), *K. peduncularis* – nom. inval..

Main branches usually regularly branching with short shoots in the axils of all leaves, except irregular growth in growth flushes and rarely short shoots in most species of sect. *Platyphyllae*; branches with raised, usually flanged decurrent leaf bases except in some species of sect. *Platyphyllae*; epidermis of branches splitting into long longitudinal ridges becoming  $\pm$  corky or with  $\pm$  peeling bark. *Inflorescence* a  $\pm$  elongated botryum with (3–) 6– $\infty$  stalked or sessile flowers without or usually with few to many terminal leaves, but if botrya are  $\pm$  globose then with (1–) 3–24 mainly sessile flowers without terminal leaves or only few in most species of sect. *Platyphyllae*, growth after flowering terminal; *bracts* and *bracteoles*  $\pm$  fleshy leaf-like to membranous and caducous, or deciduous and  $\pm$  scale-like chartaceous mainly in species of sect. *Platyphyllae*. *Flowers* stalked or sessile, mature buds acute-conical (in species of sections *Platyphylla* and *Pallidiflorae*) to truncate (mainly in species of sect. *Niviferae*). *Stamens* erect, as long as and/or longer than petals, often unequally long with shorter ones, mainly shorter than petals and  $\pm$  incurved in species of sect. *Niviferae*. *Ovary* 3–5 locules, each with peltate placenta with usually more than 20 short spreading ovules; *style* as long as stamens, or shorter and rarely scarcely longer than the calyx lobes in species of sect. *Niviferae*.

*Discussion.* The subgenus is divided into three sections: *Platyphyllae*, *Pallidiflorae* and *Niviferae*. Only the first two sections are described in detail in this paper, sect. *Niviferae* is currently under revision and will be published separately.

A morphologically very variable group. Species of sect. *Platyphyllae* share with species of subgen. *Kunzea* a number of characters, such as the globular inflorescence, scale-like bracts and bracteoles, which are persistent to deciduous, and irregular growth in growth flushes. The species of sect. *Pallidiflorae* show much more similarity to species of sect. *Niviferae*, particularly as *K. axillaris* has not only an elongate inflorescence with often some terminal leaves, but also stalked flowers in contrast to *K. ambigua* and *K. occidentalis* (sect. *Pallidiflorae*). Species of sect. *Pallidiflorae* differ, however, from those of sect. *Niviferae* by their subequal long erect stamens, acute-conical apices of mature flower buds and a long style placing the stigma at about the level of the anthers.

The molecular support (de Lange et al. 2010, fig. 1) for the separation of clade B (subgen. *Kunzea*) and

clade C (subgen. *Niviferae*) is only moderate (BS = 84%). It is also noteworthy that on clade C the terminal branches of species of sect. *Platyphyllae*, especially of *K. graniticola* and *K. caduca*, are unusually long, in comparison to the very short branches of species of the sections *Pallidiflorae* and *Niviferae*.

Species of sect. *Platyphyllae* occur predominantly on the Great Divide in Queensland, but *K. bracteolata* also enters into northern New South Wales and *K. petrophila* occurs very locally in the dry parts of the Northern Territory. *Kunzea ambigua*, the most widespread species of sect. *Pallidiflorae*, shows a distribution from coastal ranges of central New South Wales southwards through eastern Victoria into Tasmania. Sect. *Niviferae* has largest number of species, with six in Australia and ten recorded from the North and South Island of New Zealand (de Lange 2014). The Australian species are distributed from southern Queensland southwards mainly along the southern ranges of the Great Divide into eastern Victoria.

**D.1. *Kunzea* sect. *Platyphyllae* Toelken & de Lange**

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). —

**Type species:** *K. flavescens* C.T.White & Francis.

Distal main branches few and irregularly branching, rarely regularly branching from each node in *K. petrophila* and these new branches are usually longer than the subtending leaf or ending in flowers; leaf base not flanged. *Inflorescence* globose, rarely spiciform; mature flower buds acute-conical, rarely truncate in *K. truncata*, rarely obtuse with subequal calyx lobes; bracts and bracteoles usually scale-like and deciduous, rarely membranous and caducous; stamens subequal and erect-spreading, longer than petals but subequal to style; petals white.

*Discussion.* A heterogeneous group of species with more or less flat straight leaves, or leaves scarcely folded and/or recurved in *K. bracteolata* and *K. flavescens*, but without “pinched apex” as commonly found in the somewhat similar species of subgen. *Kunzea*. They are mainly based in Queensland with *K. bracteolata* extending into northern New South Wales, and *K. petrophila* occurring only in the Northern Territory. The latter differs in having regular growth with short shoots developing in all leaf axils, as is typical to species in sections *Pallidiflorae* and *Niviferae*. Also, the decurrent leaf bases develop into flanges with incurved margins. *Kunzea petrophila* also shows much variation of the inflorescence, as both globular and elongate ones may be found on the same branch, but, in contrast to *K. ciliata* (Toelken 1996, p. 66), the elongate inflorescences, which are often subtended by small globular ones, do not seem to be environmentally induced. *Kunzea petrophila* is morphologically not easily placed (cf. Diagnostic features of species), especially as it produces, similar to *K. caduca* and *K. truncata*, stamens of two different lengths, a character typical of species of sect. *Nivifera*,

but molecular evidence places *K. truncata* and *K. petrophila* as sister taxa clearly into this section. *Kunzea truncata* is also unusual in this section, because it has truncate mature buds, which resemble those of species of sect. *Niviferae*, but the inflorescences of the two sections differ.

#### 40. *Kunzea flavescens* C.T.White & Francis

Proc. Roy. Soc. Queensland 33: 155 (1922); Byrnes, *Austrobaileya* 1(5): 468 (1982); T.D.Stanley in T.D.Stanley & E.M.Ross (eds), *Fl. S.E. Queensland* 2: 132 (1986); A.R.Bean in R.J.F.Henderson (ed.), *Queensland Pl.* 133 (1997). — **Type:** Queensland, Crows Nest, *F.H.Kenny s.n.*, xi.1921 (lecto., designated here: BRI-AQ278373; isolecto.: K000800998, MEL92306, MEL92307, NSW).

Spreading shrubs or trees rarely up to 7 m tall; young branches with leaf bases scarcely raised and flanges rarely well developed, pubescent, rarely hirsute, with  $\pm$  spreading antrorse hairs; early bark repeatedly longitudinally splitting, corky and not peeling or rarely with papery margins. *Leaves* alternate; *petioles* 0.5–0.9 mm long, appressed; *lamina* oblong-oblancheolate, rarely oblong-elliptic, 4–7 (–7.8)  $\times$  (1.2–) 2–2.5 (–3.1) mm, cuspidate to acuminate, rarely acute, gradually tapering into petiole, erect-spreading, above flat to slightly concave, with or without obvious glands, below scarcely convex, with usually > 60 oil glands, which are usually absent close to the margins, pubescent to puberulous mainly above, rarely glabrescent but with marginal short antrorse, usually appressed hairs at least when young. *Inflorescence* a rounded to slightly elongated botryum with 8–15  $\pm$  spreading flowers, apparently terminal on main branches and short lateral shoots below the apex; with terminal vegetative growth continuing after flowering; *retained perules* 2–8, narrowly triangular to rarely ovate, 0.6–1.2 mm long, acute, with or without mucro, 1 (–3)-veined, usually glabrous; *bracts* ovate to broadly elliptic, 3.3–3.8  $\times$  1.8–2.2 mm, cuspidate to acute on upper flowers, 3 (–5)-veined, glabrous or with few hairs mainly along the central ridge and with  $\pm$  marginal cilia; *bracteoles* in pairs, broadly ovate to ovate, 2.5–3.2  $\times$  2–3 mm, obtuse, truncate or emarginate, 1 (–3)-veined, with scattered hairs and  $\pm$  developed marginal cilia. *Hypanthium* 3–3.5 mm long when flowering (free tube c. 1.3 mm long), longer than bracts,  $\pm$  ridged, pubescent with spreading short antrorse hairs. *Calyx lobes* narrowly triangular, 1.4–1.8 mm long, acute, somewhat ridged, puberulous to glabrous with short antrorse hairs at least on the margins. *Corolla lobes* oblong-obovate, 1.4–1.7 mm long, white or cream. *Stamens* c. 50, in several rows; *filaments* 2.2–3.5 mm long; *anthers* broadly ellipsoidal, c. 0.45 mm long, with pronounced subterminal gland. *Ovary* 3-locular, with style usually deeply sunk into upper surface; *placenta* an oblong-elliptic disc with short off-centre attachment in lower third, scarcely divided into two lobes, each with 4 rows of ovules; *ovules* 39–45 per locule, spreading; *style* 3.8–5 mm long with stigma broadly capitate, slightly compressed at apex. *Fruit* a cylindric-urceolate capsule,

4.5–5 mm long, with erect-spreading calyx lobes. *Seeds* irregular obpyramidal to angular cylindrical, often slightly curved, c. 0.6 mm long; testa hard, dark brownish-red, with vertical rugulose scalariform ribs. *Flowering:* Mainly September, October. **Fig. 15.**

**Distribution & ecology.** Grows on granite or sandstone in open eucalypt forest, sometimes locally common but usually locally restricted in south-eastern Queensland (BN, DD, MO, PC, WB).

**Conservation status.** For a long time this species was known from a single area near Crows Nest, but, although it is now known from a number of localities, it still has a restricted occurrence, including Mt Walsh National Park. (3RC in Briggs & Leigh 1996).

**Diagnostic features.** *Kunzea flavescens* is similar to *K. bracteolata* but distinguished by distinctly spreading leaves (at c. 90° to branches),  $\pm$  hairy calyx lobes, and rounded to emarginate apices of bracts.

**Variation.** The indumentum on leaves varies considerably in density and especially the length of the long hairs on plants from different localities. The distinctive antrorse marginal hairs vary little and are usually the last to wear off. Furthermore the hairs on the hypanthium and particularly the calyx also vary considerably and at times are already glabrescent at flowering (e.g. *W.H. Pilkington BRI501590*).

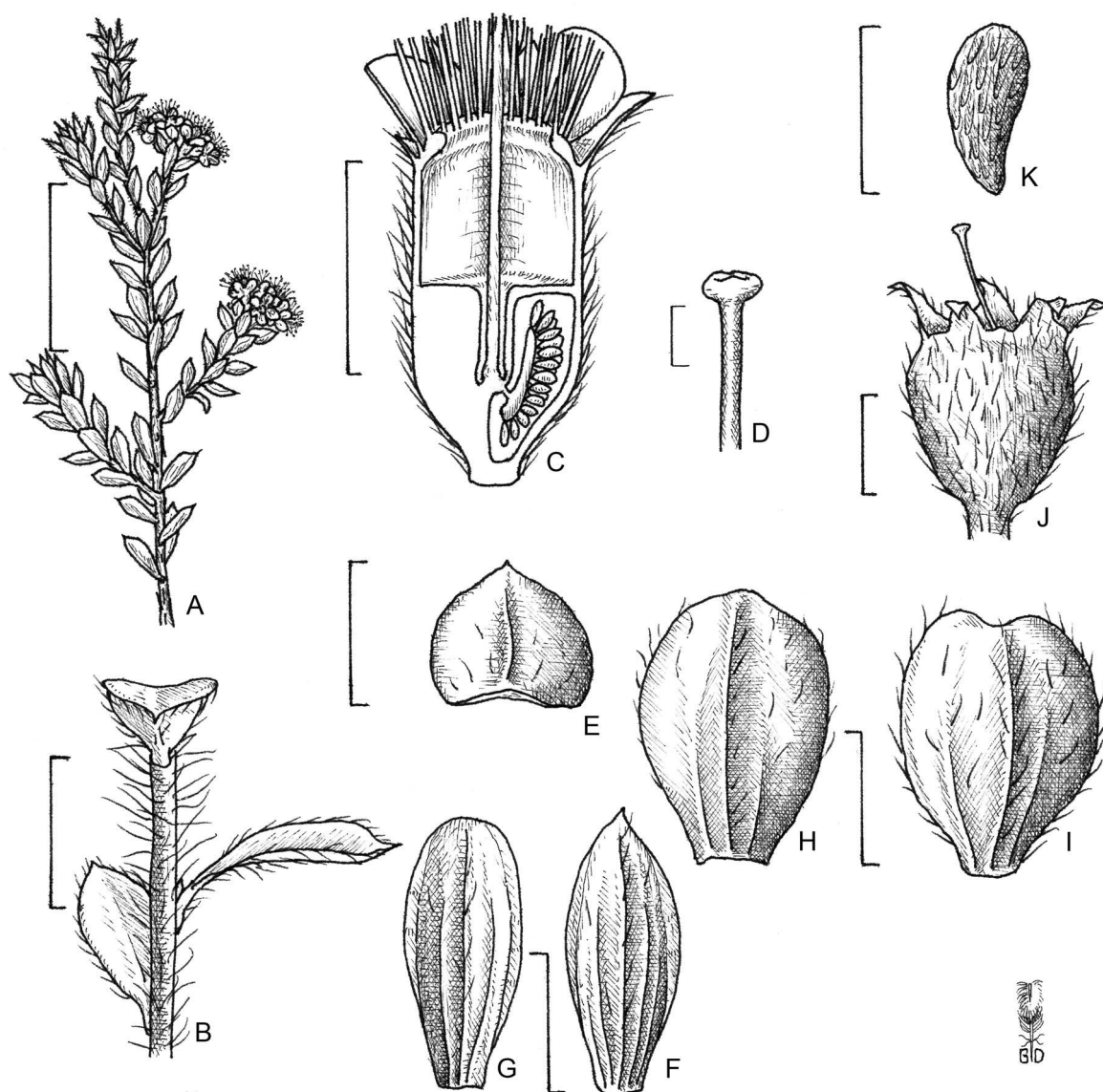
**Notes.** The number of ovules per locule was erroneously described in the protologue as “with a single ovule in each cell”, but this was corrected by Byrnes (1982). The species resembles more closely *K. bracteolata* than *K. cambagei* as claimed by the original author.

**Typification.** Since no holotype was designated in the protologue the specimen in BRI, which is accompanied by the collector’s label, is selected as a lectotype.

#### *Specimens examined*

QUEENSLAND: *A.R.Bean* 7701, Mt Walsh N.P., 21.vi.1994 (BRI); *A.R.Bean* 8540, Warro S.F., 6.iv.1995 (BRI); *A.R.Bean* 14431, near Monto, E Scrubby Dam, 11.xii.1998 (BRI, MEL); *A.R.Bean* 19616, S.F. 132, Allies Ck, S Mundubbera, 26.xi.2002 (BRI); *L.J.Brass s.n.*, Crows Nest, iv.1924 (CANB); *L.A.Craven* 9975 & *J.A.Matarczyk*, Mt Walsh, near Biggenden, 18.x.1997 (CANB); *W.Curtis BRI546315*, sandstone plateau, Plunkett S.F., 23.viii.1992 (BRI); *L.Durrington* 621, 3 km E Crows Nest, 3.iv.1972 (BRI, K); *P.I.Forster* 5761, Beeron Holding, 5 km W Toondahra Hmsd, 9.ix.1989 (BRI, MEL, MO, BISH); *P.I.Forster* 31083, Beeron Holding, SSW Mundubbera, 26.ix.2008 (BRI); *P.Grimshaw* G553 & *L.M.Grimshaw*, Wivenhoe View Estate, 22.iii.1994 (BRI); *R.Johnstone* 470, Biggenden Bluff, 27.vii.1994 (NSW); *T.E.Lanham BRI75099*, Crows Nest, 25.i.1967 (BRI); *M.E.Phillips* CBG25309, Crows Nest, 12.viii.1963 (CANB); *W.H.Pilkington BRI501590*, Goomburra Valley on Dalrymple Ck, 23.x.1990 (BRI); *J.W.Randall BRI188170*, Mt Walsh N.P., 3.ix.1973 (BRI); *I.R.Telford* 5313, Mt Walsh, S Biggenden, 28.iv.1977 (CANB); *I.R.Telford* 11851 & *J.Nightingale*, Crows Nest Ck, 4.xi.1993 (AD, CANB, BRI, MEL, NSW, n.v.); *T.Tyson-Donely* 242, Bloodwood Ck, 17.xii.2006 (BRI);





**Fig. 15. *K. flavescens*:** A flowering branch; B cauline leaves; C half flower; D saucer-shaped stigma; E abaxial view of perule; F abaxial view of proximal bract; G abaxial view of distal bract; H abaxial view of proximal bracteole; I abaxial view of the distal bracteole; J fruit; K seed. — Scale bars: A 2.5 cm; B, C 2.5 mm; D–I 1.5 mm; J 2 mm; K 0.5 mm. — A–I C.T.White 7317 (BRI); J, K L.Durrington 621 (BRI).

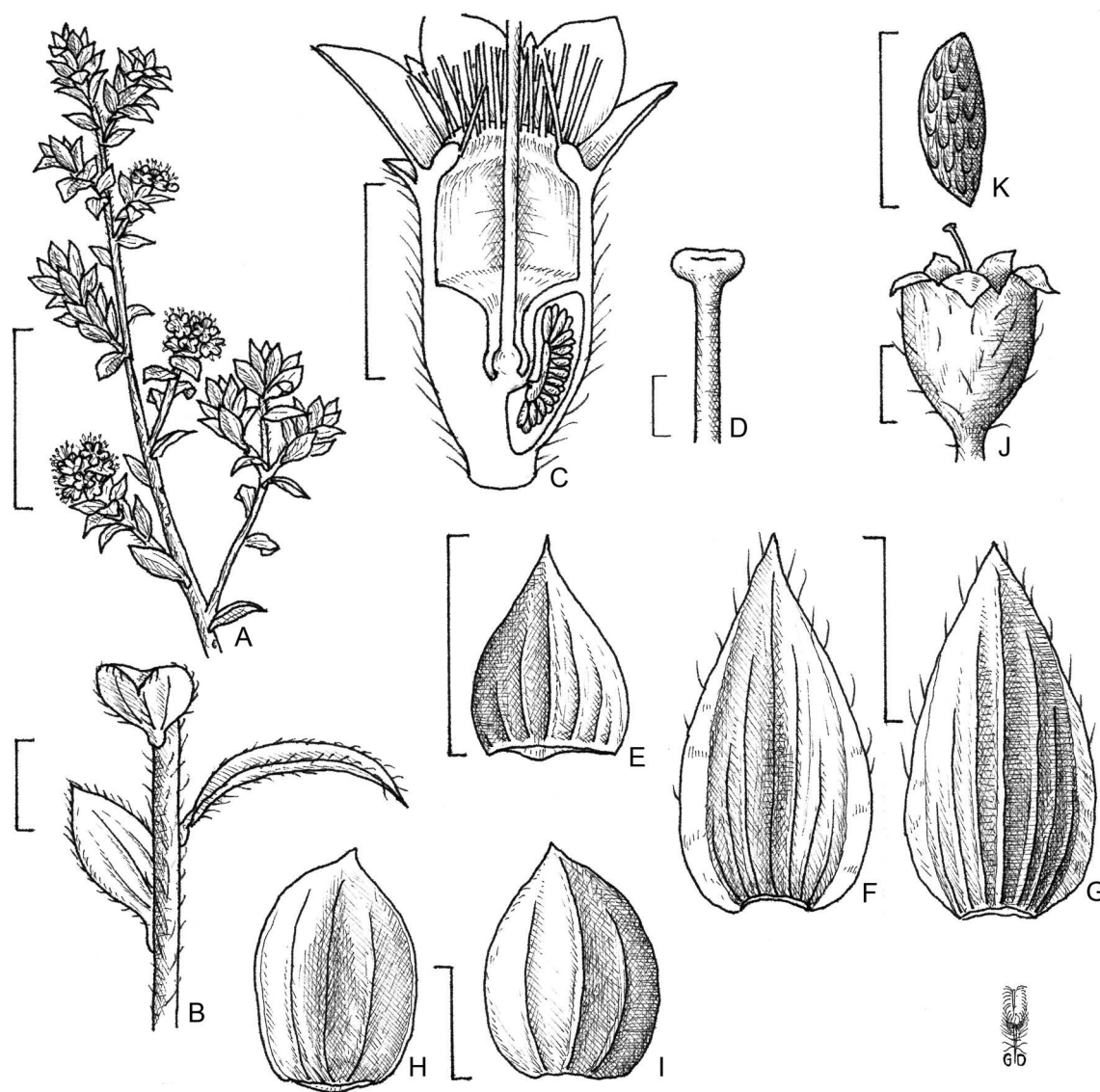
C.T.White 7317, Biggenden Bluff, 13.x.1930 (BRI, K); C.T. White BRI273811, Crows Nest, x.1921 (BRI, NSW).

#### 41. *Kunzea bracteolata* Maiden & Betche

Proc. Linn. Soc. New South Wales 30: 363 (1905); Maiden & Betche, Census N.S.W. Pl. 154 (1916); N.C.W.Beadle, Student Fl. N.E. New South Wales 3: 477 (1976); Byrnes, *Austrobaileya* 1(5): 469 (1982); T.D.Stanley in T.D.Stanley & E.M.Ross (eds), Fl. S.E. Queensland 2: 133 (1986); Peter G.Wilson (1991) in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991); A.R.Bean in R.J.F. Henderson (ed.), Queensland Pl.: 133 (1997). — **Type:** Queensland, Wallangarra, *J.L.Boorman s.n.*, xi.1904 (lecto., designated here: NSW10607; isolecto.: BM, K000 843007, MEL92329).

Shrubs 1–2 (–3) m tall, erect; young branches with leaf bases somewhat raised and slightly decurrent but

not flanged, pubescent to tomentose with short antrorse hairs; early bark splitting into slender longitudinal pieces, ± fibrous but becoming indistinct corky ridges. *Leaves* alternate; *petiole* 0.6–1 mm long, appressed; *lamina* elliptic to oblong-ob lanceolate, rarely linear-lanceolate, (2.6–) 4–9 (–11) × (0.9–) 1.5–3.5 (–4.5) mm, acute to pointed, gradually or sometimes abruptly tapering into petiole, erect to recurved, above slightly concave, below slightly convex, with ∞ fine oil glands usually right to the ± horny margins, glabrous or puberulous with antrorse hairs at least along the margins. *Inflorescence* a rounded botryum with 6–12 (–18) flowers, apparently terminal on short and long branches, with terminal growth often at fruiting; *retained perules* few or absent, lanceolate to broadly ovate, 1.3–2.4 mm, 1–3-veined, with marginal cilia and sometimes



**Fig. 16. *K. bracteolata*:** A flowering branch; B cauline leaves; C half flower; D saucer-shaped stigma; E abaxial view of perule; F adaxial view of bract; G abaxial view of bract; H adaxial view of bracteole; I abaxial view of bracteole; J fruit; K seed. — Scale bars: A 3 cm; B 2 mm; C 3 mm; D, E, H, I 1.5 mm; F, G 2.5 mm; J 2 mm; K 1 mm. — A–I F.D.Hockings BRI113086; J, K J.B.Williams NSW124238.

with few hairs mainly along the central vein; *bracts* broadly ovate and subauriculate basally, ovate on upper flowers, 4–5 × 4–4.5 mm, with 3–5 veins usually raised, with stiff central vein continued into acuminate to cuspidate apex, glabrous except for ± cilia along hyaline margins; *bracteoles* in pairs, obliquely ovate, 3.2–4 × 2.5–3 mm, obtuse to cuspidate, 1–3-veined, glabrous or with few marginal cilia. *Hypanthium* 3–4.2 mm long when flowering (free tube c. 2 mm long), about as long as bracts, often ridged, glabrous. *Calyx lobes* triangular, 1.5–1.8 (–2) mm long, apex acute to pointed and ± recurved, ridged to keeled, glabrous. *Corolla lobes* oblong-obovate to obovate, 1.8–2 mm long, cream. *Stamens* usually > 50, in more than one whorl, *filaments* 2.3–3.5 mm long; *anthers* broadly ellipsoidal, 0.4–0.55 mm long, with red subterminal

gland. *Ovary* 3 (4)-locular, with style deeply sunk into the upper surface; *placenta* an elliptic disc with short off-centre attachment on lower third, scarcely divided into 2 lobes each with 3 or 4 rows of ovules; *ovules* 48–63 per locule, equal, spreading; *style* 5–5.8 mm long, with stigma broadly flat-capitate, with marked central depression. *Fruit* an urceolate to cup-shaped capsule, 4–4.5 mm long, with recurved calyx lobes. *Seeds* angular-cylindrical to obpyramidal, c. 1 mm long; testa firm, dark reddish-brown, vertically ribbed and rarely with oblique connections. *Flowering*: (October) November, December. **Fig. 16.**

*Distribution and ecology.* The species usually grows on skeletal sandy soil on granite rocks in heath-like vegetation often under eucalypt woodland in Queensland (DD) and northern New South Wales (NT).



**Conservation status.** Locally frequent and conserved in several National Parks. (3RC in Briggs & Leigh 1996).

**Diagnostic features.** Distinguished from other species in this section by its broadly ovate bracts with 3 to 5 distinctly raised veins, ridged to keeled pointed calyx lobes, and  $\pm$  horny margins of the leaves. These broad bracts as well as the bracteoles are deciduous at the fruiting stage, unlike the caducous ones of the very similar *K. caduca* and *K. truncata*.

**Variation.** The indumentum on the branches can vary occasionally, even on the same plant, from usually pubescent to hirsute or glabrescent.

**Typification.** Several specimens of the collection, “J.L. Boorman; Nov.’04”, exist, as cited in the protologue of *K. bracteolata*. As the authors did not designate a holotype, the sheet *J.L.Boorman NSW10607*, which is accompanied by Boorman’s collector’s information used in the protologue, is selected as the lectotype. The sheet (MEL92329) consists of three branchlets, which might have been derived from the lower branch of the lectotype.

#### *Specimens examined*

QUEENSLAND: *A.R.Bean* 7155, 4 km E Wyberba, 7.xii.1993 (NSW); *S.T.Blake* 23678, near Wyberba and Wallangarra, 2.xi.1971 (BRI); *T.J.Bowen* BRI5774, Amiens, 6.xi.1956 (BRI); *M.S.Clemens* BRI273795, near Ballandean, x.1944 (BRI); *C.W.Frazier & Hazlitt* NE36957, 400 m from Mountain View, Amiens, 6.x.1966 (NE); *F.D.Hockings* BRI31420, Wyberba, 1961 (BRI); *F.D.Hockings* BRI113086, Mt Norman, 6.xii.1970 (BRI); *W.J.F.McDonald* BRI223925, top of Slip Rock, 11.xi.1974 (BRI); *L.Pedley* 1490, Amiens, 30.x.1963 (BRI, CANB); *T.L.Ryan* 54, 1.6 km SE Mt Norman, 1.xii.1970 (BRI); *I.R.Telford* 1506, Mt Norman, 9.v.1970 (CANB, NSW); *I.R.Telford* 2594, 2 mls [3.2 km] NE Wallangarra, 29.xi.1970 (BRI, CANB, NSW); *I.R.Telford* 3126, Mt Norman, 25.ix.1973 (CANB).

NEW SOUTH WALES: *A.R.Bean* 8239, 14 km N Torrington, 28.i.1995 (NSW); *J.P.Burgess* NSW124234, 40 mls [64 km] E Glen Innes, 4.xii.1960 (NSW); *S.C.Clemesha* NSW746210, Granite picnic area, Washpool N.P., 15.xi.1998 (NSW); *L.A.Copeland* 2716, 100 m ENE Granite Pk, 10 km W Tenterfield, 18.x.2005 (CANB, NSW); *I.R.Telford* 2638, Warah Trig., NE Glen Innes, 27.xi.1970 (AD, CANB); *I.R.Telford* 5176, Bald Rock, 24.v.1977 (CANB); *J.B.Williams* NSW124233, 36 mls [57.6 km] E Glen Innes, vi.1954 (NSW); *J.B.Williams* NSW124238, 6 mls [9.6 km] N Torrington, 17.xii.1966 (NE, NSW); *J.B.Williams* 587 & *K.Winterhalder*, 42 mls [67.2 km] E Glen Innes, 5.x.1958 (NE, NSW); *P.G.Wilson* 1686 & *A.E.Orme*, c. 64.4 km E Glen Innes on Gwydir Hwy, 4.v.2005 (NSW); *H.J.Wissmann* NE36854, Bald Rock, 12.xi.1967 (NE).

#### *Putative hybrids*

##### *K. bracteolata* $\times$ *K. obovata*

The specimens have the less branched and more erect habit, stiffly erect, linear-oblongate to elliptic-oblongate erect leaves, and white petals of *K. bracteolata*. The bracts have 3 obvious veins and are covered like the hypanthium with long spreading hairs as is typical of *K. obovata*, which seem to occur nearby

as the collector commented that “pink-flowered bushes of this species occurred nearby”.

#### *Specimens examined*

QUEENSLAND: *M.E.Phillips* CBG35788, Myall Park (cultivated), Stanthorpe, 9.ix.1963 (CANB).

NEW SOUTH WALES: *J.B.Williams* NE37010, Boonoo Boonoo Falls, 6.x.1966 (NE).

#### *Putative parents from the area*

*K. bracteolata*. NEW SOUTH WALES: *I.R.Telford* 5176, Bald Rock, 24.v.1977 (CANB); *H.J.Wissmann* NE36854, Bald Rock, 12.xi.1967 (NE).

*K. obovata*. NEW SOUTH WALES: *J.C.Morrow* BRI31347, above Boonoo Boonoo Falls, 16.x.1960 (BRI); *M.E.Phillips* CBG16413, Boonoo Boonoo Falls, 21.ix.1966 (CANB, BRI).

#### 42. *Kunzea graniticola* Byrnes

Austrobaileya 1(5): 468 (1982); A.R.Bean in R.J.F.Henderson (ed.), Queensland Pl. 133 (1997). — **Type:** Queensland, 16 km N Ingham, *R.Smith* 8a, 22.viii.1975 (holo.: BRI 197154; iso.: CANB378169).

Shrubs or small trees 2–3 (–4) m tall; young branches with scarcely raised leaf bases but with well developed flanges with incurved lateral margins, glabrous to puberulous or rarely pubescent mainly below inflorescences, with short  $\pm$  appressed hairs particularly between flanges; early bark repeatedly splitting longitudinally with scarcely fibrous margins, usually corky and not peeling. *Leaves* alternate; *petiole* 0.2–0.5 mm long, flat, appressed; *lamina* linear-oblongate to -elliptic, (4–) 6–9 (–12)  $\times$  1–1.2 mm, acute, gradually tapering into petiole, with erect or scarcely recurved apex, above  $\pm$  concave, without obvious glands, below convex and with 25–55 oil glands mainly along the central vein, glabrous, rarely with short marginal cilia when young. *Inflorescence* a rounded to slightly elongate botryum with (1–) 3–8 flowers, apparently terminal on all branches, with terminal growth after fruiting; *retained perules* rarely more than 3, elliptic to oblanceolate, 0.5–0.7 mm long, 1-veined, glabrous, lower persistent but upper ones caducous; *bracts* oblong-oblongate, 1.8–2.1  $\times$  0.8–1.1 mm, obtuse, 3-veined, glabrous or with some cilia; *bracteoles* in pairs, oblong-oblongate, 1.5–1.8  $\times$  0.6–1 mm, acute to obtuse, 1–3-veined, ciliolate to glabrous. *Hypanthium* 3.5–4 mm long when flowering (free tube 2–2.2 mm long), rarely ridged, glabrous. *Calyx lobes* usually broadly triangular, 1–1.5 mm long, acute, scarcely ridged towards the apex, glabrous. *Corolla lobes* broadly obovate, 1.8–2.2 mm, white to cream. *Stamens* 80 or more in several rows; *filaments* 3.6–4.2 mm long; *anthers* broadly ellipsoidal, 0.3–0.45 mm long, with short connective and prominent subterminal gland. *Ovary* 3-locular, with style somewhat sunk into the upper surface; *placenta* a narrowly oblong-elliptic disc with short central attachment, scarcely bilobed, each lobe with 2 rows of ovules; *ovules* 26–35 per locule, spreading; style 3.8–4.7 mm long; stigma broadly flat-capitate, scarcely compressed at apex. *Fruit* and *seed* not seen. *Flowering:* August, September. **Fig. 17.**

**Distribution and ecology.** Growing on often steep rocky slopes or on river banks usually associated with granite, but also recorded from sandstone, in open eucalypt forest; restricted to near Cardwell and Hinchinbrook Island, Queensland (NK).

**Conservation status.** The species is conserved to Hinchinbrook Island National Park. (2RC in Briggs & Leigh 1996).

**Diagnostic features.** The linear-oblongolate to linear-elliptic leaves and the whole plant of *K. graniticola* are glabrous, in contrast to plants of other species of this section, except for *K. truncata*. *K. truncata* has longer leaves (11.3–17.6 mm) with abaxially numerous fine oil glands extending to the margins of the leaves, while in *K. graniticola* they are larger and restricted to along the central vein.

**Variation.** While the margins of the leaves of plants from Hinchinbrook Island are sharply edged, those from plants on the mainland are sharply edged only towards the base.

#### *Specimens examined*

QUEENSLAND: *S.T. Blake* 18852, Zoe Bay, Hinchinbrook Is., 21.viii.1951 (BRI); *N.B. Byrnes* 3919, Five Mile Ck, S Cardwell, 8.viii.1979 (BRI); *B. Jackes* BRI181844, Waterfall Ck, Cardwell Ra., 25.viii.1974 (BRI); *J. Donohue* 6, Waterfall Ck, Cardwell Ra., 25.viii.1973 (BRI); *J. Kemp* TH2555, c. 2 km NW Mt Diamantina, Hinchinbrook Is., 4.xii.2000 (CANB); *I.R. Telford* 12151 & *S. Donaldson*, lower E slopes of Bishop Pk, 2.viii.1996 (CANB); *I.R. Telford* 13016 & *J.J. Bruhl*, E of spur of Bishop Pk, 12.xi.2006 (AD, NSW); *A.G. & M.G. Thorsborne* 297, c. 8 km S Cardwell, 22.ix.1976 (BRI); *A.G. & M.G. Thorsborne* BRI63027, Mt Bowen, Hinchinbrook Is., 25.viii.1966 (BRI); *C. Warrian* 7051, Hinchinbrook Is., 28.x.1986 (BRI); *K.A.W. Williams* 77234, Five Mile Ck, S Cardwell, 21.ix.1977 (BRI).

#### 43. *Kunzea sericothrix* Toelken, *sp. nov.*

*A K. bracteolata perulis linearo-triangularibus et pilis sericeis longissimis in ramis, foliis inflorescentiis differt.*

**Type:** Queensland, Dick's Tableland, Eungella National Park, *A.R. Bean* 3672, 3.ix.1991 (holo.: BRI508278).

*Kunzea* sp. (*Dicks Tableland A.R. Bean* 3672) *A.R. Bean* in *R.J.F. Henderson* (ed.), *Queensland Pl.* 133 (1997).

*Kunzea* sp. *L. de Lange et al.*, *Austral. Syst. Bot.* 23: 311 (2010).

Shrub up to 0.5 m; young branches with leaf bases scarcely raised and without decurrent flanges, hirsute to sericeous with long antrorse hairs  $\pm$  appressed; early bark splitting into slender longitudinal pieces with  $\pm$  peeling margins. *Leaves* alternate; *petioles* 0–0.4 mm long, appressed; *lamina* linear-elliptic to -lanceolate, 5.3–6.5 (–8.2)  $\times$  1.2–2.0 mm, acute to pointed, gradually tapering into indistinct petiole, erect with somewhat recurved apex, above flat to concave or  $\pm$  cymbiform, below  $\pm$  convex, with glands not obvious, sericeous with long appressed antrorse hairs on both surfaces. *Inflorescence* a rounded botryum with 5–8 (–10) flowers, apparently terminal on main branches and short

lateral shoots below it, with terminal growth not seen; *retained perules* 0–3, compressed-ovate, with base often shorter than oblong-triangular acumen, 3–3.5 mm long, 3–5-veined, sericeous; *bracts* broadly ovate with cuspidate to acuminate apex, 3.6–4  $\times$  4–4.3 mm, (3–) 5-veined with often raised veins, sericeous; *bracteoles* in pairs, oblong-ovate, 3.2–4  $\times$  2.2–2.5 mm, cuspidate to mucronate, 1–3-veined, sericeous. (Flower buds were immature, i.e. information measurements provided are provisional). *Hypanthium* longer than calyx (free tube slightly longer than ovary), sericeous. *Calyx lobes* triangular, 0.6–0.7 mm long, pointed, ridged, sericeous. *Corolla lobes* broadly elliptic to almost orbicular, 1.3–1.5 mm long. *Stamens* c. 40, in more than one whorl; *filaments* 0.9–1.8 mm long; *anthers* broadly ellipsoidal, 0.45 mm long, with subterminal gland. *Ovary* 2, 3-locular, with style deeply sunk into the upper surface; *placenta* an elliptic disc with short attachment in lower third; scarcely divided into 2 lobes each with 3 rows of ovules; *ovules* more than 45 per locule, equal, spreading; *style* 3.8–4 mm, broadened towards the base, with stigma flat-capitate, with slight central depression. *Fruit and seed* not seen. *Flowering:* September.

**Distribution and ecology.** Known only from type collection “in rocky watercourse, with *Callistemon viminalis* and *Leptospermum polygalifolium*” on the Dicks Tableland, Queensland (SK).

**Conservation status.** The type collection states “rare at site” in Eungella National Park. Nevertheless it is regarded as endangered in schedule 2 in Queensland (Bostock & Holland 2015).

**Diagnostic features.** *Kunzea sericothrix* is distinguished from all other species in this section by the combination of its linear leaves and long silky hairs on all parts of the plant, especially the hypanthium and calyx, and the perules with a short compressed-ovate base abruptly continued into a long oblong-triangular acumen. Although the long hairs of *K. flavescens* are usually more or less spreading (hirsute) a few specimens were observed with more adpressed hairs (sericeous), but in all cases the leaves were broader.

**Etymology.** The epithet “serico-thrix”, Greek, “silky hair” refers the rather long fine hairs all over the plant.

#### 44. *Kunzea caduca* Toelken, *sp. nov.*

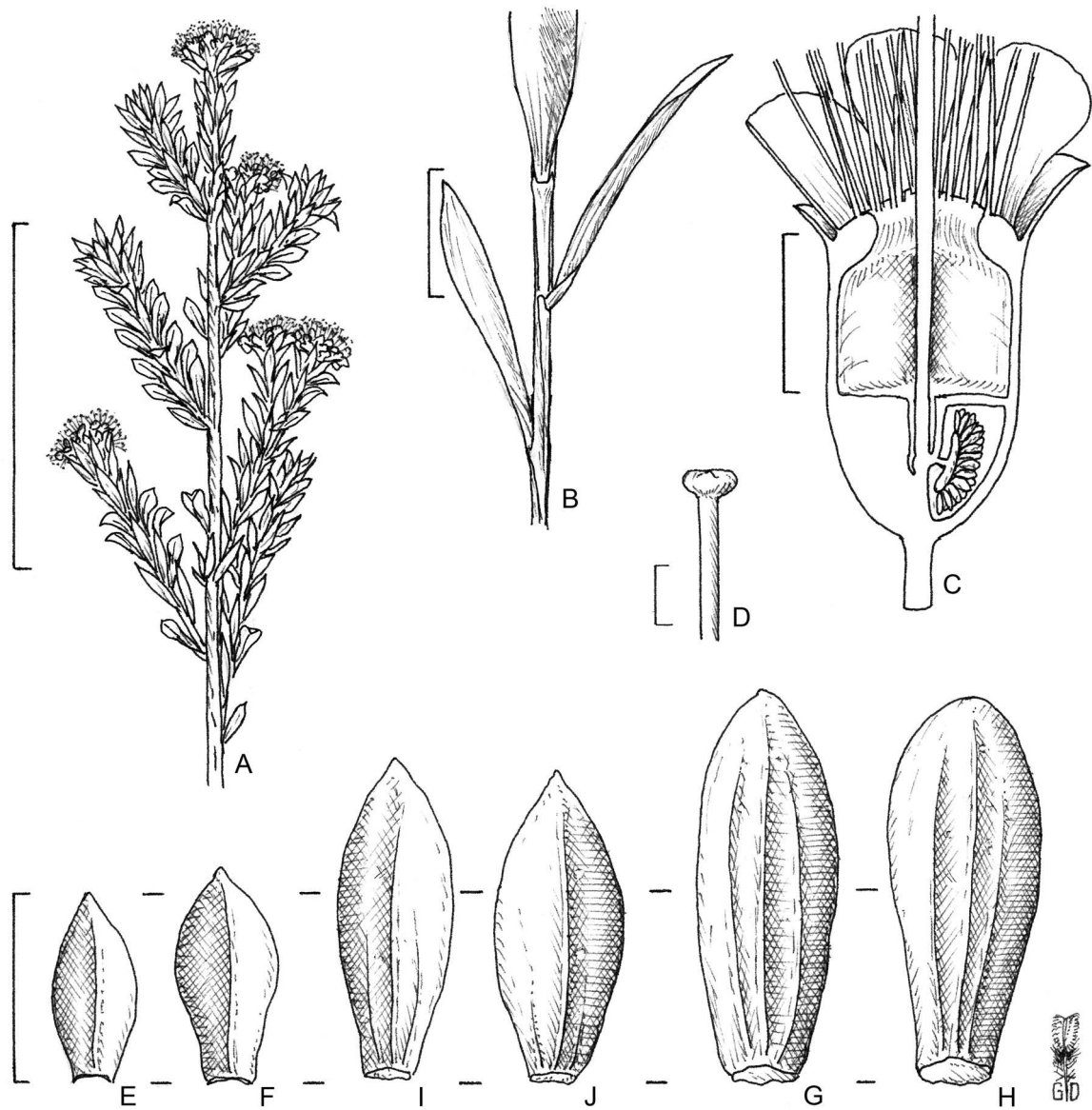
*A K. graniticola et K. truncata ramis puberulis rare pubescentibus et foliorum basibus indistincte complanatis; affinis K. flavescens sed bracteis bracteolisque caducis, ramis puberulis, hypanthiis glabris et obconicis in pedicello usque ad 1.4 mm longo differt.*

**Type:** Queensland, Mt Maria, *J. Brushe* JB247, 2.x.1995 (holo.: BRI 584365; iso.: NSW).

*Kunzea flavescens* auct. non C.T. White & Francis: *A.R. Bean* in *R.J.F. Henderson* (ed.), *Queensland Pl.* 133 (1997).

*Kunzea* sp. *K. de Lange et al.*, *Austral. Syst. Bot.* 23: 311 (2010).

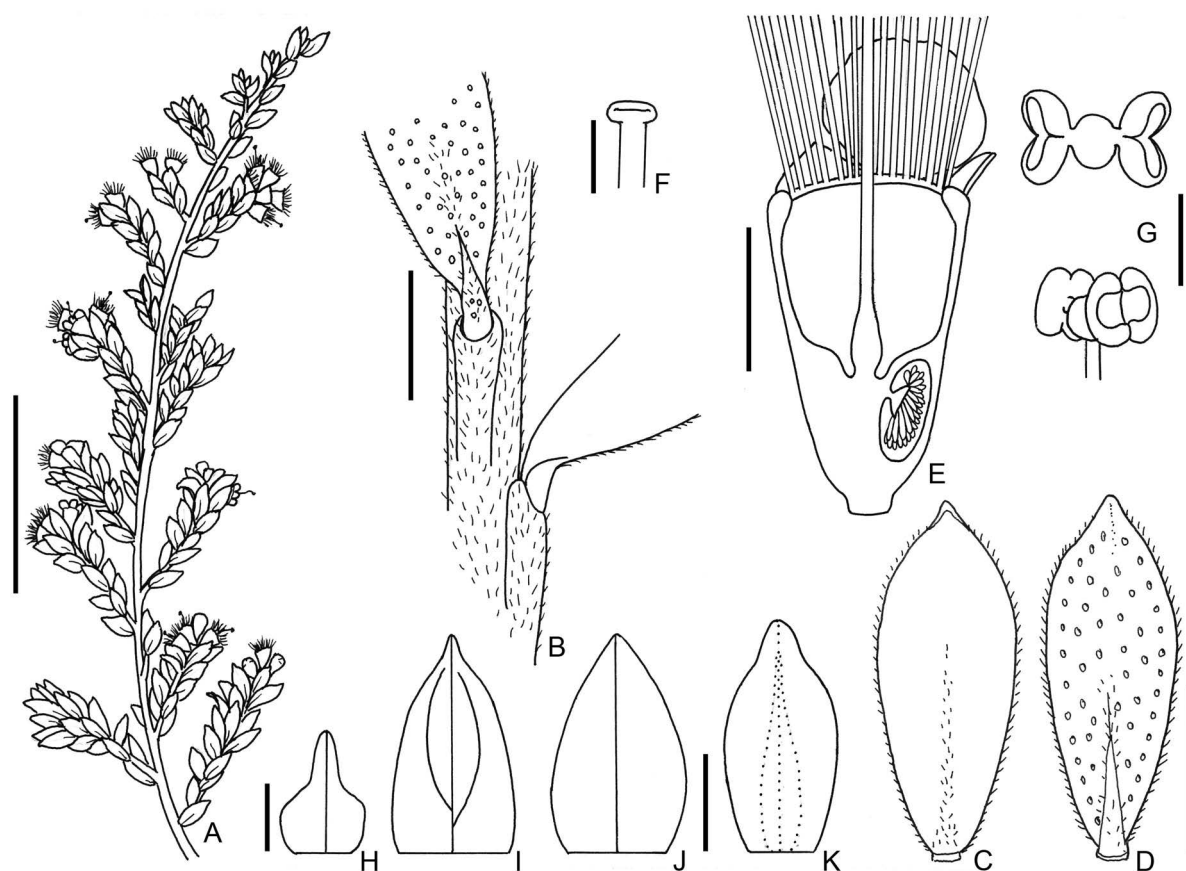




**Fig. 17. *K. graniticola*:** A flowering branch; B cauline leaves; C half flower; D saucer-shaped stigma; E, F abaxial view of perules; G adaxial view of bract; H abaxial view of bract; I adaxial view of bracteole; J abaxial view of bracteole. — Scale bars: A 5 cm; B, C 2 mm; D 1.5 mm; E–J 1 mm. — A, B K.A.W. Williams 77234 (BRI); C–J R. Smith 8A (BRI).

Spreading, often low shrubs up to 3 m tall; young branches with scarcely raised decurrent leaf bases in the form of  $\pm$  well developed flanges each with incurved lateral margins at least at the base of leaf, pubescent to hirsute below and on inflorescences, with long and short spreading hairs; early bark repeatedly splitting longitudinally without fibrous margins, becoming corky. *Leaves* alternate; *petiole* 0.2–0.6 mm long, flat, appressed; *lamina* linear-oblongate to narrowly elliptic-oblongate, (3.8–) 5–9 (–10.8)  $\times$  (1.1–) 1.4–2 (–2.5) mm, acute, gradually tapering into petiole, erect to rarely with scarcely recurved apex, above flat to  $\pm$  concave, below convex and with  $> 60$  coarse glands but rarely extending close to the margins, glabrous or glabrescent with few minute hairs at the abaxial base and often along its central vein and margins.

*Inflorescence* a  $\pm$  rounded botryum with (1–) 3–8 flowers, each with a short pedicel up to 1.4 mm long, apparently terminal on all branches, with terminal vegetative growth after fruiting; *retained perules* rarely more than 3, with compressed triangular-ovate base surmounted by acumen up to equal length, 0.45–0.8 mm long, 1-veined (often dark brown), glabrous, caducous but lowermost often retained; *bracts* ovate to oblong-ovate, 1.0–1.3  $\times$  0.8–1.2 mm, pointed to cuspidate,  $\pm$  incurved, 1–3-veined, scale-like chartaceous, glabrous to puberulous and/or with some short cilia; *bracteoles* oblong-ovate, 1.1–1.8  $\times$  0.8–1 mm, obtuse rarely acute, 1-veined, membranous, ciliate to glabrous. *Hypanthium* 3.5–4.1 mm long when flowering (free tube 2–2.2 mm long), obconical, rarely ridged, glabrous. *Calyx lobes* broadly triangular-ovate, 0.6–0.8 mm long, acute,



**Fig. 18.** *K. caduca*: **A** flowering branch; **B** young branch with flanged decurrent leaf bases; **C** adaxial leaf surface without glands; **D** abaxial leaf surface with many glands but not close to the margins; **E** half flower; **F** saucer-shaped stigma; **G** anthers with lobes pushed apart by broad connective and gland; **H** abaxial view of perule; **I** adaxial view of bract; **J** abaxial view of bract; **K** adaxial view of bracteole. — Scale bars: **A** 3 cm; **B** 2 mm; **C**, **D** 4 mm; **E** 2 mm; **F**, **G** 0.5 mm; **H** 0.25 mm; **I–K** 0.5 mm. — **A–K** J.Brushe 247 (BRI).

± ridged towards the apex, glabrous. *Corolla lobes* broadly obovate to oblong-obovate, 1.3–1.6 mm, entire to erose, white to cream. *Stamens* 48–56, in several rows; *filaments* 0.8–2.5 mm long, unequally long, with outer ones up to twice as long as inner ones; *anthers* broadly ellipsoidal, 0.3–0.4 mm long, twice as broad as long when dehiscent, with red subterminal gland. *Ovary* 3-locular, with style base somewhat sunk into the upper surface; *placenta* an oblong-elliptic disc with short central attachment, scarcely bilobed, each lobe with 3 or 4 rows of ovules; *ovules* 34–40 per locule, spreading or the lower ones pendulous and slightly longer; *style* 3.8–4.4 mm long, with stigma broadly flat-capitate, scarcely compressed in the apex. *Fruit* a ± cup-shaped capsule, slightly flared below the calyx lobes, 3.1–3.5 mm long, with erect but slightly incurved calyx lobes. *Seed* irregularly pyramidal, c. 1 mm long, dark brown, with scalariform vertical ridges. *Flowering*: August, September. **Fig. 18.**

**Distribution and ecology.** Growing on steep hills or mountains on black sandy loam with acid intrusive rocks; forming an often sparse mid stratum which is dominated by *K. caduca* and *Xanthorrhoea latifolia* subsp. *latifolia* in low open woodland/shrubland dominated by *Eucalyptus exserta*, other eucalypts and

*Lophostemon confertus*; known only from one locality in Queensland (PC).

**Conservation status.** At present the species is known only from few localities but it is conserved in Mt Castle Tower National Park.

**Diagnostic features.** *Kunzea caduca* superficially resembles *K. graniticola*, but is distinguished by short scattered hairs on branches and fewer stamens (more than 80 in *K. graniticola*), which are of different lengths. Stamens of different length on the same flower are also encountered in *K. truncata* and *K. petrophila* in sect. *Platyphylla* and it is a common feature of species of sect. *Niviferae*. The short hairs and short leaves distinguish *K. caduca* from *K. truncata*, while *K. petrophila* differs by linear leaves and being covered with long spreading hairs. Furthermore, *K. caduca* differs from *K. flavescens* by few short hairs along branches (puberulous) and the glabrous hypanthium (both hirsute in *K. flavescens*), bracts and bracteoles that are caducous and unequally long stamens.

**Notes.** The filaments of the stamens vary somewhat and the shortest ones are centripetally placed. This condition was also observed in *K. truncata* and *K. graniticola*, except that in these cases the length difference of indivi-



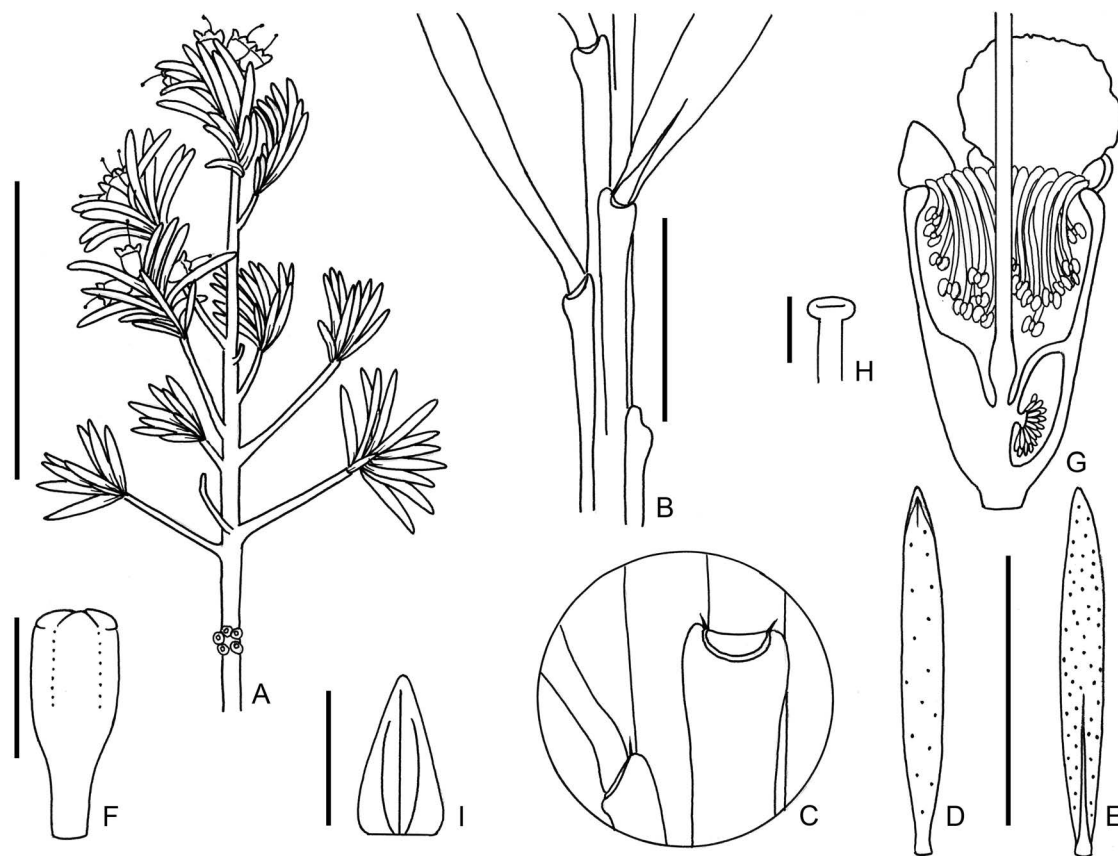


Fig. 19. *K. truncata*: A flowering branch; B young branch with flanged decurrent leaf bases (C close-up); D adaxial leaf surface with few glands; E abaxial leaf surface with many glands with some close to the margin; F truncate mature flower bud; G half flower; H saucer-shaped stigma; I abaxial view of perule. — Scale bars: A 3 cm; B 5 mm; C, D 10 mm; E 4 mm; F 2 mm; G 0.5 mm; H 2 mm. — A–H R.J. Cumming 11309 (BRI).

dual filaments was not so obvious and might relate to the progressive maturing (from the outside to the inside) of the anthers together with some additional final expansion and stretching of the filaments as sometimes observed in *K. ambigua*. More field observations are needed.

In *K. caduca* the connective and the gland are both reddish-brown in dried specimens, so that it is difficult to discern one from the other. Once the anthers are dehiscent the shell of each theca (with two opposite pollen sacs) remains wing-like expanded on opposite sides of the large, almost round gland-connective-sphere. The latter seems to dominate the whole anther, making it broader than long, because the two lateral thecae, each with two functional pollen sacs, are very much shorter than those of *K. graniticola* and *K. truncata*. The anthers of *K. caduca* are very short and, in spite of its obvious nature, the gland-connective sphere is only marginally larger than in *K. graniticola*.

**Typification.** The description was predominantly based on *J. Brushe JB247*, which is here selected as the holotype, although the fruiting specimen, *A.R.Bean 6998* (paratype), was also consulted and there are more widely distributed duplicates available of this specimen.

**Etymology.** The epithet “*caduca*”, Latin, “dropping off

early” refers to the bracts and bracteoles, which are shed usually well before anthesis.

#### *Specimens examined*

QUEENSLAND: *A.R.Bean 6998*, Mt Maria, 18. xi.1993 (AD, BRI; K, MEL); *P.I.Forster 16339*, E slopes of Many Peaks Ra., Mt Castle Tower N.P., 20.xi.1995 (MEL).

#### 45. *Kunzea truncata* Toelken, *sp. nov.*

*A K. caduca* et *K. graniticola* ramis glabris foliisque longioribus et glandulis parvioribus foliorum in paginis abaxillaribus et adaxillaribus differt.

**Type:** Queensland, Yamanie National Park, *R.J. Cumming 11309*, 27.viii.1991 (holo.: BRI 540676).

*Kunzea* sp. (*Herbert River R.J. Cumming 11309*) *A.R.Bean* in *R.J.F.Henderson* (ed.), *Queensland Pl.* 133 (1997).

*Kunzea* sp. *K.A.Williams*, *Native Pl. Queensland* 4: 244 (1999).

Sparse shrub to 1 m tall; young branches with scarcely raised leaf bases but flanges clearly demarcated by recessed lateral margins, glabrous except rarely with scattered short hairs or papillae between the flanges; early bark mainly splitting into long longitudinal membranous flakes, but soon becoming thick and corky. *Leaves* alternate; *petiole* 0–0.2 mm long, appressed, later spreading; *lamina* linear to linear-elliptic, 11.6–17.3 × 0.9–1.3 mm, acute, gradually tapering into a

petiole, erect-spreading, above flat to slightly concave, below  $\pm$  convex, with many fine oil glands extending to the margins, glabrous. *Inflorescence* a rounded to flat-topped botryum with 5–9 flowers, apparently terminal on all branches, with terminal vegetative growth after fruiting; *retained perules* 2–5, ovate-triangular, 2–2.5 mm long, obtuse to pointed, (1–) 3-veined, glabrous, rarely with marginal hair at the apex; *bracts* ovate, 10–12.3  $\times$  0.4–0.6 mm, acute, 1 (–3)-veined, glabrous, leaf-like, upper ones or all caducous (not seen); *bracteoles* caducous (not seen but scars present). *Hypanthium* 3.9–4.2 mm long when flowering (free tube c. 2 mm long), obconical, glabrous. *Calyx lobes* triangular, 1.4–1.6 mm long, pointed, glabrous. *Corolla lobes* compressed obovate-orbicular, c. 4 mm long (immature), white. *Stamens* more than 50 in more than one whorl; *filaments* 1.1–2.7 mm long (immature), centrifugal ones almost twice as long as centripetal ones, but unknown whether both are erect; *anthers* ellipsoidal, c. 0.4–0.45 mm long, with subterminal gland. *Ovary* 3-locular, with style base somewhat sunk into the glabrous upper surface; *placenta* a broadly elliptic disc with a short central attachment, scarcely lobed, each lobe with 3 (4) rows of ovules; *ovules* 18–22 per locule, spreading to pendulous with lower ones slightly longer; *style* c. 8 mm long after flowering, with stigma flat-capitate with depression in the middle. *Fruit* and *seeds* not seen. *Flowering*: August. **Fig. 19.**

*Distribution and ecology.* Known only from the type locality where it has been recorded from “cracks in rocks along creek”, near Herbert River, Queensland (NK).

*Conservation status.* R.J. Cumming commented on the type collection: “Uncommon, about thirty plants present in a very small area” of Yamanie National Park so that it listed as Endangered in Queensland (Bostock & Holland 2015).

*Diagnostic features.* Although *K. truncata* resembles in its irregular branching other species in sect. *Platyphyllae*, especially the very similar *K. graniticola*, it differs by having long and short stamens, which it shares with *K. petrophila*. Those two are, however, obviously distinct because the branches and flowers of *K. petrophila* are hirsute to woolly, while plants of *K. truncata* are glabrous. The latter species has also, unlike other species of sect. *Platyphyllae*, truncate mature flower buds, normally only found in species of sect. *Niviferae*, which in turn also have elongate inflorescences with terminal leaves and a regular growth pattern with short shoots at all nodes of distal branches.

*Etymology.* Although *K. truncata* is similar to other species in this section, the unusual presence of its flat-topped flower buds earned it the epithet “truncata”, Latin, “truncate, ending very abruptly as if cut straight across”.

#### 46. *Kunzea petrophila* Toelken, sp. nov.

*A speciebus aliis sectionis Platyphyllarum ramis principalibus distalibus brachyblasto vegetativo in quoque nodo, tomento hirsuto vel lanato in ramis et hypanthiis; a speciebus sectionis Pallidiflorarum tomento hirsuto vel lanato in ramis et hypanthiis, bracteis et bracteolis brevis chartaceis deciduis differt.*

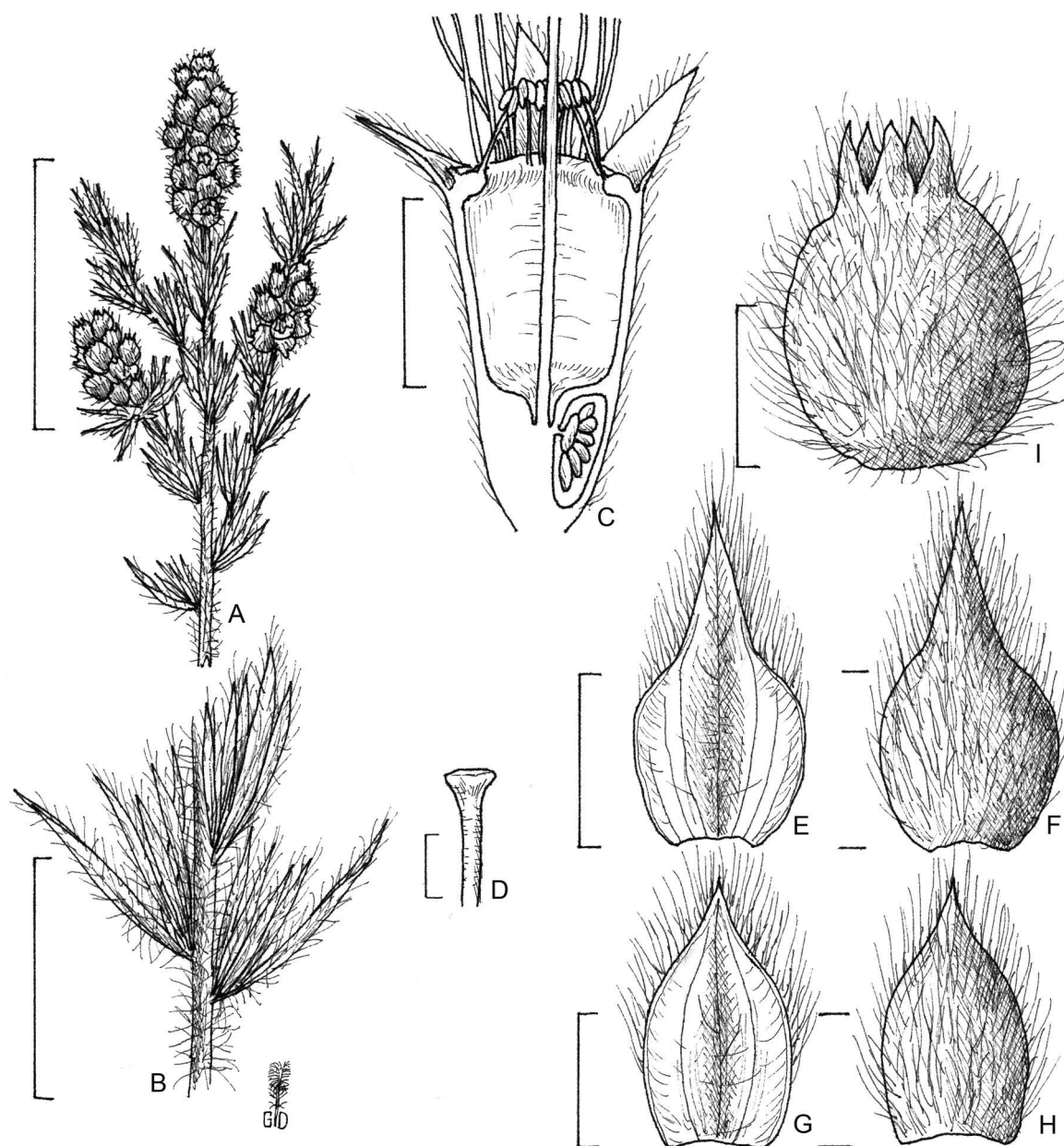
**Type:** Northern Territory, along Keep River, c. 30 km E Kunanurra, P.A.Fryxell, L.A.Craven & J.McD. Stewart 4868, 20.vi.1985 (holo.: CANB377035; iso.: BRI415817, NSW; G, n.v.).

*Kunzea* sp. (Keep River; Sivertsen 739) J.D.Briggs & J.H. Leigh, Rare Threat. Austral. Pl. 117 (1996).

*Kunzea* sp. M de Lange et al., Austral. Syst. Bot. 23: 311 (2010).

Spreading or decumbent shrub up to 2 m tall; young branches with scarcely raised leaf bases and flanges  $\pm$  visible, hirsute to woolly, rarely pubescent with  $\pm$  spreading fine antrorse hairs; early bark splitting into longitudinal strips,  $\pm$  corky but usually with membranous margins. *Leaves* alternate; *petiole* absent; *lamina* linear-lanceolate to linear-oblongate, 6–9.5 (–11)  $\times$  0.9–1.2 mm, pointed, gradually tapering into the base, erect-spreading, flat to slightly concave above, slightly convex below and with at least one vein visible, hirsute to pubescent or sericeous with spreading to appressed fine antrorse hairs, rarely glabrescent. *Inflorescence* either apparently terminal usually on main branches forming elongate to almost globular botrya with 10–18 sessile flowers without terminal growth and not subtended by additional inflorescences on axillary short shoots; or on short shoots developing elongate botrya with (3–) 5–16 (–24) sessile flowers and frequently continuing into terminal vegetative growth and subtended by few globular inflorescences (2–5 flowers); *retained perules* (2–) 5–8, linear-lanceolate to linear-elliptic or ovate, 1.9–5 mm long, acute to pointed, usually 1-veined, hirsute to woolly, chartaceous to leaf-like; *bracts* broadly ovate becoming  $\pm$  pointed on upper flowers, sometimes leaf-like but with  $\pm$  broadened base, 3.6–4  $\times$  2.8–3.4 mm, acute to acuminate, usually 3-veined, hirsute to woolly outside, with few long antrorse hairs also on the inside, deciduous, rarely leaf-like and persistent towards the apex of the inflorescence; *bracteoles* in pairs, ovate to lanceolate, 3–3.3  $\times$  1.2–2 mm, acute to acuminate, 3–5 (–7)-veined, hirsute outside, with few to many long antrorse hairs also on the inside, deciduous. *Hypanthium* 2.8–3 mm long when flowering (free tube 1.2–1.6 mm long), cup-shaped, hirsute. *Calyx lobes* triangular, 1–1.4 mm long, pointed, pubescent to hirsute with antrorse hairs on outside and appressed hairs on the inside. *Corolla lobes* obovate-orbicular, 1–1.3 mm long, minutely ciliate, cream. *Stamens* 40–46 in more than one whorl; *filaments* 0.6–1.3 mm long, antepetalous ones about twice longer than anteseptalous ones; *anther* 0.3–0.4 mm long, recurving, with distinct subterminal gland. *Ovary* 3-locular, with narrow style base somewhat sunk into the upper surface; *placenta* a broadly elliptic disc with short central attachment, scarcely bilobed,





**Fig. 20.** *K. petrophila*: **A** fruiting branch; **B** short shoots in axils of cauline leaves; **C** half flower with long and short stamens; **D** ± funnel-shaped stigma; **E** adaxial view of distal bract; **F** abaxial view of distal bract; **G** adaxial view of bracteole; **H** abaxial view of bracteole; **I** fruit. — Scale bars: **A** 4 cm; **B** 1 cm; **C** 1 mm; **D** 0.5 mm; **E, F, I** 2 mm; **G, H** 1.25 mm. — **A–I** P.A. Fryxell et al. 4868 (CANB).

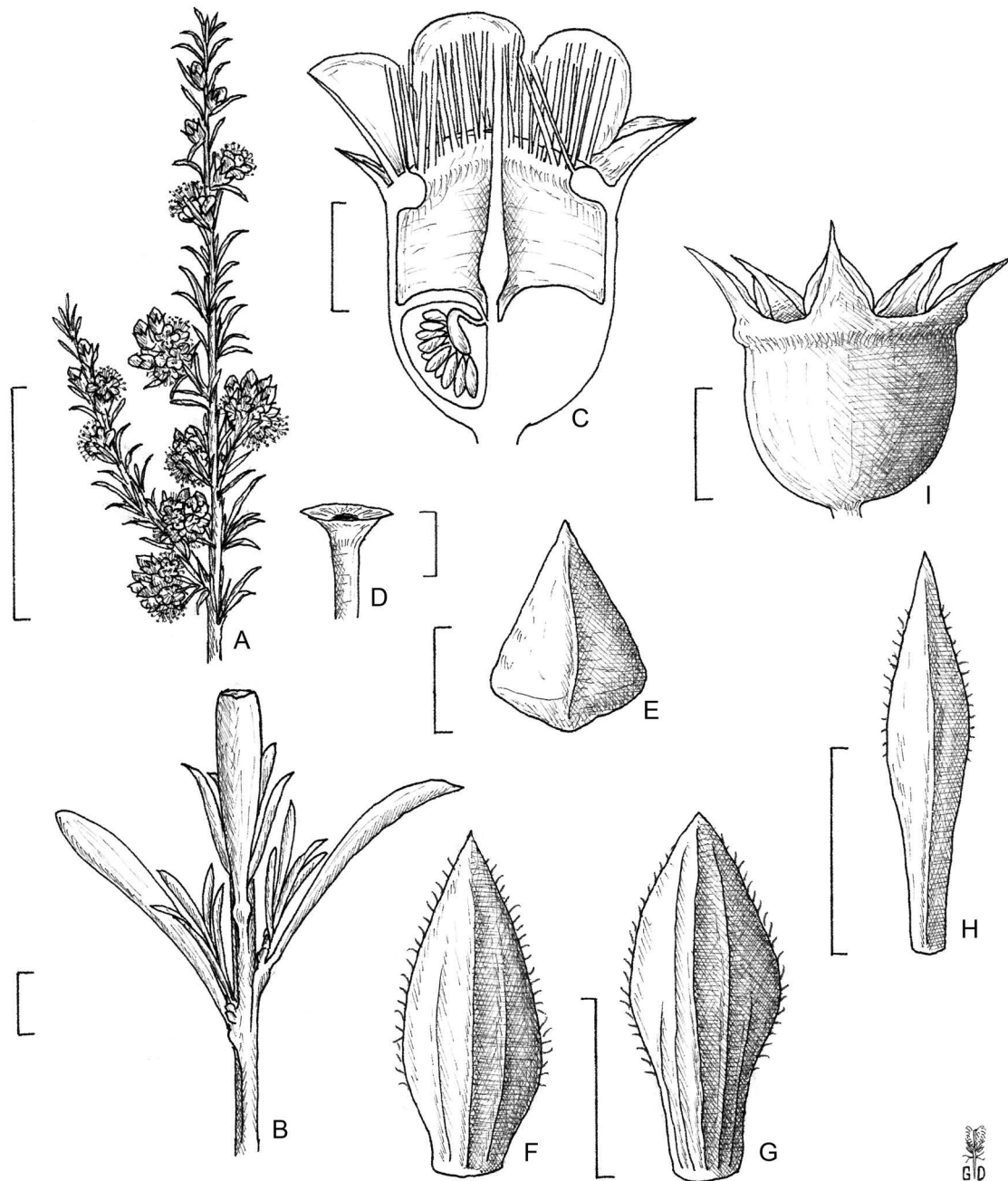
with each lobe bearing 4 rows of ovules; *ovules* 45–51 per locule, subequal, spreading; *style* 5.8–6.4 mm long, with stigma broadened, somewhat compressed at apex. *Fruit* an urceolate capsule with erect calyx lobes. *Seeds* irregularly angular cylindrical, ± curved, finely vertically ribbed with few oblique connections. *Flowering*: On four specimens collected in June there were mainly old fruit. **Fig. 20.**

*Distribution and ecology.* Found on sand in sheltered crevices on sandstone cliffs along the Keep River, Northern Territory (VR).

*Conservation status.* Recorded as locally common on

sandstone cliffs in the Keep River National Park; listed as Near Threatened in the Northern Territory (N.T. Herbarium 2015–). (2RC in Briggs & Leigh 1996).

*Diagnostic features.* *Kunzea petrophila* is similar to species of sect. *Platyphyllae*, as it has globular to sometimes elongate inflorescences with deciduous broad chartaceous bracts, but is distinguished by its regular growth habit with short shoots in the axils of all leaves on the distal main branches. The latter characteristic is typical of the sections *Pallidiflorae* and *Niviferae*, but this species is distinguished from species of both these sections by its hirsute to almost woolly (curled



**Fig. 21. *K. occidentalis*:** A flowering branch; B short shoots in axils of cauline leaves; C half flower; D funnel-shaped stigma; E abaxial view of perule; F abaxial view of proximal bract; G abaxial view of distal bract; H abaxial view of bracteole; I fruit. — Scale bars: A 5 cm; B, F, G, I 1.5 mm; C, H 1 mm; D, E 0.25 mm. — A–D G.J.Harden NE38781; E–H C.W.Frazier NE37032; I D.F.Mackay NE42326.

or twisted) tomentum on branches and flowers. The species is, however, unusual to both these sections because it produces stamens of two sizes (not in sect. *Pallidiflorae*), and they are unlike those of flowers of species of sect. *Niviferae*, as none of the shorter stamens remain incurved, and because the apex of mature flower buds is not truncate but acute-conical in *K. petrophila*. Furthermore it differs from sect. *Niviferae* by its sessile flowers in dense inflorescences with or without terminal leaves, and bracts and bracteoles are usually broad-

based and scale-like chartaceous. The species is placed into sect. *Platyphyllae* based on molecular evidence. *Kunzea petrophila* is an unusual species as it shares the feature of hairs on the inside of the calyx lobes only with *K. baxteri*; it also grows well out of the mainly temperate to subtropical range of the genus.

A recent collection from western Queensland, which vegetatively resembles this species, might be *K. petrophila*, but could not be examined in detail.

*Variation.* Young leaves are usually covered with long



fine hairs, but these often become more appressed to sericeous; they are often glabrescent as the hairs on leaves wear off easily. The characteristic hirsute to woolly tomentum of the species applies mainly to the branches and flowers.

In younger flowers the hypanthium is often more obconical as in the very similar *K. truncata*, but in the fruiting stage they are typically cup-shaped.

**Etymology.** As the species is recorded as locally common on sandstone cliffs the epithet “petro-phila”, Greek, “rock-loving” seems appropriate.

#### *Specimens examined*

NORTHERN TERRITORY: *I.D.Cowie* 7720, Keep River N.P., 31.v.1998 (DNA); *J.L.Egan* 5047, Gurrandalng area, 9.vi.1995 (AD, DNA); *J.L.Egan* 5051, Keep River, Gurrandalng area, 9.vi.1995 (AD, DNA); *J.L.Egan* 5100 & *A.Bowley*, Keep River, S Jarrnara, 16.vi.1995 (AD, DNA, MEL).

### D.2. *Kunzea* sect. *Pallidiflorae* Toelken & de Lange

in de Lange et al., Austral. Syst. Bot. 23: 317 (2010). —

**Type species:** *K. ambigua* (Sm.) Druce.

*Kunzea* sect. ‘*Eukunzea*’ Benth., Fl. Austral. 3: 112 (1867), nom. inval., pro parte, quoad *K. corifolia* (synonym of *K. ambigua*).

Distal main branches with vegetative short shoots at each node shorter than or as long as subtending leaf; leaf bases becoming flanges. *Inflorescence* spiciform to racemiform in *K. axillaris*, without terminal leaves, except sometimes in *K. axillaris*; mature flower buds pointed with erect, usually unequal calyx lobes; bracts and bracteoles scale-like and deciduous; petals white; *stamens* subequal, erect, longer than petals and about as long as the style.

**Discussion.** The three species included in this section resemble species of sect. *Niviferae* closely, because, for instance, the distal branches develop short shoots in the axils of all leaves and only some of these will continue growing in the next year; their decurrent leaf bases are more or less flanged and bracts and bracteoles are scale-like. They are, however, easily distinguished by their acute mature buds and erect long styles.

While the inflorescences of *K. ambigua* and *K. occidentalis* have sessile or subsessile flowers and usually continue terminal growth only after fruiting, flowers of *K. axillaris* are stalked and always develop from the beginning some leaves above the flowers, which is similar to species in sect. *Niviferae*.

#### 47. *Kunzea occidentalis* Toelken, *sp. nov.*

*Kunzeae ambiguae similis sed folia (16–) 20–40 (–48) glandulibus in paginis abaxialibus, foliorum basibus albidis spongiosis in ramis junioribus et fructibus > 3.2 mm in diametro differt.*

**Type:** New South Wales, Waa Gorge, Mt Kaputar National Park, *R.Coveny* 9030 & *S.K.Roy*, 2.xi.1976 (holo.: NSW; iso.: K, L, n.v.).

*Kunzea* aff. *ambigua* auct. non (Sm.) Druce: N.C.W.Beadle, Student Fl. N.E. New South Wales 3: 477 (1976).

*Kunzea* sp. *D.Joy* Thomps. in S.W.L.Jacobs & Pickard (eds), Pl. New South Wales 166 (1981); Peter G.Wilson in G.J. Harden (ed.), Fl. New South Wales 2: 154 (1991); de Lange et al., Austral. Syst. Bot. 23: 311 (2010).

*Kunzea* sp. *Mt Kaputar* (*E.N.S.Jackson* 2246) Peter G. Wilson in G.J.Harden (ed.), Fl. New South Wales, ed. 2, 2: 177 (2002).

Spreading shrubs 1.2–2.5 m, rarely up to 6 m tall; young branches with raised leaf bases in the form of decurrent flanges of cream spongy tissue, puberulous, rarely pubescent with short and a few longer hairs but usually soon becoming glabrous; early bark repeatedly splitting longitudinally into long irregular strips, becoming corky and usually not peeling. *Leaves* alternate; *petiole* 0–0.7 (–1.2) mm long, appressed, but with at least apex  $\pm$  spreading; *lamina* narrowly elliptic-oblongate to linear-elliptic, (2.6–) 4–6.5 (–8.4)  $\times$  0.75–1 (–1.3) mm, obtuse to rounded, rarely acute, gradually tapering into petiole, straight and  $\pm$  recurved from the upper petiole, above concave to  $\pm$  folded lengthwise, usually convex below and with (16–) 20–40 (–48) glands irregularly arranged, puberulous to glabrescent and usually with appressed marginal hairs. *Inflorescence* a slightly elongate to globose botryum with (1–) 3–6 (–8) flowers, with “pedicel” 0.2–0.4 mm long, apparently terminal on long shoots and with similar or more abbreviated ones on lateral short shoots below them, usually without terminal vegetative growth when flowering; *retained perules* triangular to oblong-triangular, 0.15–0.5 mm, often acute, puberulous to glabrescent with marginal cilia; *bracts* ovate-elliptic to oblanceolate-elliptic on upper flowers, 1.7–2.2  $\times$  c. 1 mm, acute to obtuse, 3 (–5)-veined, fleshy with narrow hyaline margins, usually glabrous except for marginal cilia, deciduous; *bracteoles* in pairs, linear-oblongate to -spatulate, rarely obliquely so, 1.8–2  $\times$  0.4–0.7 mm, acute, with pronounced central ridge and hyaline margins, glabrous except for some marginal cilia, caducous. *Hypanthium* 3.2–4.1 mm long when flowering (free tube c. 1.8 mm long), not ridged, glabrous to rarely pubescent. *Calyx lobes* ovate-triangular but often appear linear-triangular because of incurved margins, 1.1–1.5 mm long, acute to pointed, scarcely ridged, glabrous, rarely puberulous. *Corolla lobes* broadly obovate to almost orbicular, 1.9–3.1 mm long, often erose, white. *Stamens* 48–60 in more than one whorl; *filaments* 2–4.8 mm long, often unequally long; *anthers* with large subterminal gland. *Ovary* 3 or 4-locular, with style distinctly sunk into the upper surface; *placenta* a fleshy elliptic disc with short apical attachment, scarcely divided into 2 lobes, each with 4 rows of ovules; *ovules* 49–58 per locule, spreading but  $\pm$  curved downwards; *style* 3.8–5.6 mm long, with stigma usually a scarcely broadened thick disc with central depression. *Fruit* a cup-shaped capsule, 2.9–3.5  $\times$  3.2–3.8 mm, often broader than long, with erect calyx lobes slightly recurving towards the apex. *Seeds* irregular-angularly pyramidal to -cylindrical,  $\pm$  curved, vertically scalariform-ribbed. *Flowering:* October, November. **Fig. 21.**

**Distribution and ecology.** Found on rocky slopes or often on ridges usually in heath or scrub with scattered eucalypts on mainly western slopes of the Great Divide in New South Wales (NWS, CWS, NWP).

**Conservation status.** Locally common and conserved in, for instance, Warrumbungle and Mt Kaputar National Park.

**Diagnostic features.** *Kunzea occidentalis* is very similar to *K. ambigua* and isolated populations have different distinguishing features or combination of characters. However, the number of usually dark glands on the abaxial leaf surface of leaves is (16–) 20–40 (–48) as opposed to more than 50 in *K. ambigua*. If these glands include distinctly smaller ones then they will be in groups of (1–) 3 (–5), or in a row closest to the leaf margins in *K. ambigua*. Similar numbers of glands were observed on longer and straight leaves, comparable to those of *K. ambigua*.

Commonly, the pale cream shiny flanges of the branches develop a white spongy tissue and are well visible, because they are more or less glabrous, except for some very short hairs. Young branches of *K. ambigua* sometimes also become silvery-grey when they are slightly older, but then the flanges are already more or less split and scarcely recognisable. None of these flanges also develop the spongy tissue typical of *K. occidentalis*. The typical densely hairy branches of *K. ambigua* are observed particularly higher up on the same or other actively growing branches of that species. Although the central axis of the inflorescence of *K. occidentalis* is more or less densely hairy and this tomentum often only gradually decreases below the inflorescences, young branches of this species cannot be confused with those of *K. ambigua*, because they are glabrescent.

In addition, fruits of *K. occidentalis*, if present, are usually broader than 3.2 mm, but immature material may be intermediate, e.g. *J.R.Hoskins* 173. The apex of the leaves tends to be obtuse to rounded. Inflorescences, particularly the lateral ones on short shoots, tend to be short and more or less globular, and the terminal inflorescences with flowers in the axil of leaf-like bracts have rarely more than seven flowers in comparison to the commonly much longer ones found in *K. ambigua*.

**Variation.** *Kunzea occidentalis* is a remarkably uniform species considering its wide, often disjunct distribution. Separate populations with usually individual characteristics occur often in widely separated localities mainly on the western slopes of the Great Divide. The most obvious variant is a densely hairy form recorded from the northern Nandewar Ranges. Another one from the Hunter Valley (e.g. *Hoskins* 173), has more delicate branches similar to *K. ambigua* and is described as a tree up to 6 m tall. The corky bark and very obtuse leaf apices suggest, however, that it is *K. occidentalis*.

The development of the inflorescences on distal main branches varies considerably. The inflorescences, apparently terminal to main branches, are usually, unlike

those of *K. ambigua*, short and more or less rounded and at times reduced to a few flowers. Rarely, the distal inflorescence is not at all developed and in those cases, the lateral inflorescences on short shoots have only 1–3 flowers. However, if this is the case, many short shoots develop, each with few-flowered inflorescences (e.g. *C.W.Frazier* NE37032).

**Etymology.** While most species of *Kunzea* in eastern Australia are found on or on the eastern side of the Great Divide this species occurs on rocky outcrops mainly west of the mountains. The epithet, “occidentalis”, Latin, “western” refers to its more western distribution, particularly in comparison to the very similar *K. ambigua*.

#### *Selection of specimens examined (44 examined)*

NEW SOUTH WALES: *L.Abrahams* 472, Cobar district, x.1910 (NSW); *D.F.Blaxall* 679, Rays Ck, c. 14 km E “Gid-giegolambo”, 76 km N Cobar C.P., 15.xi.1971 (NSW); *B.G. Briggs* 6234 & *L.A.S.Johnson*, SE slopes of Siding Spring Mtn, 9.xi.1975 (NSW); *E.F.Constable* 4546, Mulgoon Stn, top of Gunderbooka Ra., 35 mls [56 km] S Bourke, 16.x.1963 (BRI, NSW); *M.D.Crisp* 3615, Burrumbuckle Rock, 8.xi.1977 (CANB); *J.M.Curran* MEL92796, Cobar, 1887 (MEL); *J.W. Dwyer* NSW124216, Trungley Rd near Barmedman, iv.1914 (NSW); *C.W.Frazier* NE37035, Mt Kaputar, 1.x.1961 (NE); *G.J.Harden* NE38781, Warrumbungle, 26.x.1974 (NE); *J.R.Hosking* 173, between Hollydeen and Sandy Hollow, 10.x.1985 (NSW); *E.N.S.Jackson* 2246, Mt Kaputar, 30.x.1972 (AD); *L.A.S.Johnson* & *E.F.Constable* NSW20489, Tooraweenah Ck, Warrumbungle Ra., 18.iv.1952 (NSW); *R.Johnstone* 1774 & *A.E.Orme*, summit of Mt Woorut, 12.i.2006 (NSW); *A.M.Lyne* 189, 11 km W Mt Kaputar, 27.ix.1990 (AD, CANB); *A.M.Lyne* 1302 & *J.Lyne*, walking track to the Governor, Nandewar Ra., 8.iii.1994 (AD, CANB, NSW); *D.F.Mackay* NE42326A, Hawks Nest Cliffs, Deriah S.F., 12.ii.1985 (NE); *R.O.Makinson* 1250 & *B.Harrison*, on Nuada Saddle, Warrumbungle Ra., 30.xi.1992 (AD, CANB); *A.Mitchell* NSW124220, Buggajool Forest, Barmedman, vi.1974 (NSW); *B.Muffet* CBG53091, 34 km from Narrabri on Mt Kaputar Rd, 24.viii.1973 (CANB); *W.E.Mulham* W1003, near Yathong, vi.1977 (NSW); *M.E.Phillips* CBG22569, between Camp Pincham & Camp Wimbelong, Warrumbungle Ra., 28.viii.1961 (CANB); *R.W.Purdie* 6862, Mary Gilmore Way, E Barmedman, 7.x.2008 (CANB, NSW); *R.Story* 6762, Giants Ck, 2 mls [3.2 km] NW Sandy Hollow, 6.x.1959 (CANB); *H.Streimann* 621, Mt Woonut, Warrumbungle Ra., 7.xii.1973 (CANB; A, K, L, n. v.); *E.H.F.Swain* 40, Terrengee, N Nandewar Ra., xi.1914 (NSW); *J.T.Waterhouse* NSW124222, Siding Spring Mt, Mt Woonut, 9.xi.1962 (NSW); *T. Werner* NSW124231, “Yathong”, 30 mls [48.6 km] NNE Roto, 29.x.1969 (NSW); *J.B.Williams* NE32812, Canyon Camp, Warrumbungle Ra., 30.x.1971 (NE); *P.G.Wilson* 1478 & *W. Cherry*, Mt Grenfell, 13.i.2000 (AD, NSW).

#### *Putative hybrids*

##### (i) *K. occidentalis* × *K. opposita*

At first sight the specimen appears to represent a depauperate branch of *K. occidentalis*, because of its cream young branches with some flanges on long shoots, but they are not as clearly developed as in that species. Characteristic typical of that species are also the narrow erect, and usually unequally long calyx lobes



in the bud. The upper leaves are linear, scarcely fleshy and folded lengthwise as in *K. occidentalis*, but all leaves are unusually short ((2.2–) 3–4 (–4.8) mm long), subsessile and upper leaves are often subopposite to opposite, similar to those of *K. opposita*. Lower leaves on long shoots tend to be linear-lanceolate, the many inflorescences are few-flowered and rounded and with deciduous bracts as in *K. opposita*.

No open flowers were available to test pollen sterility or whether the dominance of pink petals, as shown in the hybrid, would be enough to confirm that it is not a hybrid with *K. parvifolia*. This hybrid of *K. opposita*, though very similar, is distinguished from the latter by its lanceolate leaves without subterminal point.

#### *Specimen examined*

NEW SOUTH WALES: *G.J.Harden NE38940*, Yalludunida Crater, Mt Kaputar N.P., 10.xi.1976 (NE).

#### *Putative parents from the general area*

***K. occidentalis***. NEW SOUTH WALES: *A.M.Lyne 189*, 11 km W Mt Kaputar, 27.ix.1990 (AD, CANB); *A.M.Lyne 1302* & *J. Lyne*, walking track to the Governor, Nandewar Ra., 8.iii.1994 (AD, CANB, NSW).

***K. opposita***. NEW SOUTH WALES: *G.J.Harden NE38941*, Yalludunida Crater, Mt Kaputar N.P., 10.xi.1976 (NE).

#### (ii) *K. occidentalis* × *K. parvifolia* A

One immediately associates this hybrid with *K. occidentalis*, because of its similar erect habit, cream young branches, as well as most of the leaves being erect and having a terminal point, while only a few of them show the subterminal bulge typical of *K. parvifolia*. In addition, the branching in growth flushes, the absence of not clearly demarcated flanges, the presence of scale-like chartaceous deciduous bracts and bracteoles as well as pink flowers are reminiscent of *K. parvifolia*.

#### *Specimens examined*

NEW SOUTH WALES: *G.W.Althofer MEL92482*, Warrumbungle Ra., 6.x.1946 (MEL: pollen sterility 26%, NSW 124224).

#### *Putative parents from the general area*

***K. occidentalis***. NEW SOUTH WALES: *G.W.Althofer MEL 92490*, Warrumbungle Ra., 6.x.1946 (MEL: pollen sterility 1%, NSW124226).

***K. parvifolia***. NEW SOUTH WALES: *B.G.Briggs 914*, 2 mls [3.2 km] W Timor Rock, Warrumbungles, 24.x.1966 (NSW).

#### (iii) *K. occidentalis* × *K. parvifolia* B

Two pairs of specimens have been recorded of white to pink-flowered forms growing between the normally purple-flowered *K. parvifolia* on the road between Juneë and Cootamundra. These plants resemble that species in its habit with irregular growth flushes, the absence of flanges, small linear leaves with subterminal point, and small globose inflorescences each with few flowers and each ovary with five locules, but the leaves are longer ((3.6–) 4–5 mm long), the lateral branches are short and the solitary inflorescence as well as the caducous bracts and pale pink flowers are reminiscent of *K. occidentalis*.

The high percentage of sterile pollen and the fact that many of these grains are malformed also indicate their hybrid nature. However, the latter species has not yet been recorded from the same area, though occurs in an area just north of it. This and the more delicate habit of these plants might indicate that in this case *K. parvifolia* was the maternal parent, while in *K. occidentalis* × *K. parvifolia* A it was *K. occidentalis*.

#### *Specimens examined*

NEW SOUTH WALES: *D.W.Shoobridge CBG23504*, 22 mls [35.2 km] Juneë to Cootamundra, 11.xi.1966 (CANB) (pollen sterility 76%); *A.Mitchell NSW147311* (pollen sterility 38%) & *A.Mitchell NSW147312* (pollen sterility 48%), 11 mls [17.6 km] Cootamundra to Juneë, xi.1962, (NSW).

#### *Putative parents from the area*

***K. parvifolia***. NEW SOUTH WALES: *D.W.Shoobridge CBG 23503*, 22 mls [35.2 km] Juneë to Cootamundra, 11.xi.1966 (CANB) (pollen sterility 2%); *A.Mitchell NSW147310*, 11 mls [17.6 km] Cootamundra to Juneë, xi.1962, (NSW) (pollen sterility 9%).

***K. occidentalis***. NEW SOUTH WALES: *J.W.Dwyer NSW 124219*, Temora, x.1913 (NSW).

### 48. *Kunzea ambigua* (Sm.) Druce

Bot. Exch. Club Soc. Brit. Isles Rep. 1916, Suppl. 2: 629 (1917); Snelling, Bot. Mag. 150, t. 9032 (1924); Ewart, Fl. Victoria 865 (1931), pro parte; W.A.Curtis, Student Fl. Tasmania 199 (1956); N.C.W.Beadle et al., Handb. Vasc. Pl. Sydney District 291 (1963); Cockrane et al., Fl. & Pl. Victoria t. 207 (1968); N.T.Burb., Fl. Austral. Cap. Territory fig. 266 (1970); J.H.Willis, Handb. Pl. Victoria 2: 450 (1973), pro parte; W.A.Curtis, Student Fl. Tasmania, ed. 2, 1: 202 (1975); Joy Thomps. in S.W.L.Jacobs & Pickard (eds), Pl. New South Wales 166 (1981); Peter G.Wilson in G.J.Harden (ed.), Fl. New South Wales 2: 153 (1991); Jeanes in N.G.Walsh & Entwisle (eds.), Fl. Victoria 3: 1020 (1996); Pellow et al., Fl. Sydney Region, ed. 5, 202 (2009). — *Leptospermum ambiguum* Sm., Trans. Linn. Soc. London 3: 264 (1797); Cheel, J. & Proc. Roy. Soc. New South Wales 76: 230 (1943). — **Type:** ex hort. G.Hibbert (holo.: LINN-HS878/19 on microfiche!; possible iso.: “Smith missit” in Herb. Ventenat in G00223382!; cf. Typification).

*Metrosideros corifolia* Vent., Jard. Malmaison 1: 46, pl. 46 (1804). — *Stenospermum corifolium* (Vent.) Sweet ex Heynh., Nomencl. Bot. Hort. 2: 787 (1841); Sweet, Hort. Brit., ed. 2, 209 (1830), nom. inval., 3 spp. sine descriptione generico. — *Kunzea corifolia* (Vent.) Heynh., Nomencl. Bot. Hort. 2: 338 (1841); Schauer in Lehm., Pl. Preiss. 1: 124 (1844); Benth., Fl. Austral. 3: 115 (1867). — **Type:** “Originaire de la Nouvelle Hollande”, type specimen not located: lecto., designated here: Vent., Jard. Malmaison 1, pl. 46 (cf. Typification).

*Metrosideros abietina* Hoffmanns., Verz. Pfl.-Kult. 80 (1824), nom. nud. & inval. (*M. corifolia* in synonymy); Heynh., Nomencl. Bot. Hort. 1: 338 (1840), nom. inval. (in synonymy of *K. corifolia*).

*Kunzea pelagia* F.Muell. ex Miq., Ned. Kruidk. Arch. 4: 145 (1856). — **Type:** Tasmania, [C.Stuart, Schouten Is.] ex Herb. F.Mueller (lecto., designated here: U66215B; isolecto.: MEL92330; MEL92336; MEL92421; cf. Typification).

Spreading, rarely decumbent shrubs to erect trees, 1–2.5 (–4) m tall; young branches with slightly raised leaf bases in the form of decurrent flanges but  $\pm$  obscured by tomentum, pubescent to hirsute with short and longer hairs usually spreading at about right angles; early bark repeatedly splitting longitudinally into irregular elongate pieces with peeling margins. *Leaves* alternate; *petiole* 0–0.8 mm long, appressed to  $\pm$  spreading at least at the apex; *lamina* linear-elliptic to elliptic-oblongate, (3.7–) 5–10 (–12.6)  $\times$  (0.5–) 0.7–1.4 (–1.9) mm, acute and slightly recurved, rarely obtuse, gradually tapering into petiole, straight and  $\pm$  recurved from upper petiole, above flat becoming concave to cymbiform when dried,  $\pm$  convex below and with (50–) 55–90 (–115) glands including rows of distinctly smaller ones lining the leaf margins, hirsute, pubescent or puberulous but commonly becoming glabrous with or without appressed marginal hairs. *Inflorescence* racemose (often with terminal vegetative growth), or globular (normally without terminal vegetative growth when flowering) botrya with (1–) 5–16 (–23) flowers, commonly with a “pedicel” 0–0.8 mm long, elongate ones distal on long shoot with elongate or globose ones on short shoots below them; *retained perules* 3–5, triangular to oblong-triangular, 0.5–0.8 mm, rarely leaf-like and longer,  $\pm$  obtuse, pubescent, puberulous to glabrous except usually with marginal cilia; *bracts* leaf-like, lanceolate to oblong-elliptic on upper flowers, rarely to broadly ovate, (1.6–) 2–3  $\times$  0.35–0.8 (–2.1) mm, obtuse or acute, 3-veined, usually glabrous except for marginal cilia and some hairs along the central vein, caducous to deciduous or rarely persistent mainly on upper flowers; *bracteoles* oblong-lanceolate to -elliptic, (0.8–) 1–2.5 (–3.1)  $\times$  (0.2–) 0.3–0.6 (–0.8) mm, acute, 1-veined, glabrous except for some marginal cilia, caducous. *Hypanthium* (2.1–) 2.2–2.5 (–2.8) mm when flowering (free tube 1–1.5 mm long), 2–3.4 mm in diameter, cup-shaped, not ridged, pubescent or puberulous, rarely hirsute. *Calyx lobes* ovate-triangular to almost triangular, (0.9–) 1.3–2 (–2.3) mm long, usually unequally long, acute to pointed, scarcely ridged, glabrous, rarely pubescent. *Corolla lobes* broadly obovate to almost orbicular, (1.5–) 1.8–2.5 (–3.2) mm long, often erose, white. *Stamens* 45–73, in more than one whorl; *filaments* 3.8–6 mm long and often  $\pm$  unequally long; *anthers* broadly ellipsoidal, 0.5–0.55 mm long, with large subterminal gland. *Ovary* 3 (4)-locular, with style base distinctly sunk into the upper surface; *placenta* a fleshy elliptic disc with short central attachment, scarcely divided into 2 lobes, each with 3 to 4 rows of ovules; *ovules* 34–52 (–70) per locule, subequal, spreading, but  $\pm$  curved downwards; *style* up to 8.4 mm long when fruiting, with stigma often much broadened, disc- to funnel-shaped with distinct central depression. *Fruit* a cup-shaped capsule, 2.9–3.5 mm long, with  $\pm$  recurved calyx lobes. *Seeds* irregularly cylindrical,  $\pm$  curved, vertically scalariform-ribbed with few oblique connections. *Flowering*: (October) November–January, but flowers, mainly on

proliferations, have been recorded throughout the year. *Common Names*: **Tick bush** (Beedle et al. 1963, Carolin & Tindale 1993, Wilson 1991); **white kunzea** (Ewart 1931, Willis 1973, Jeanes 1996). **Fig. 22.**

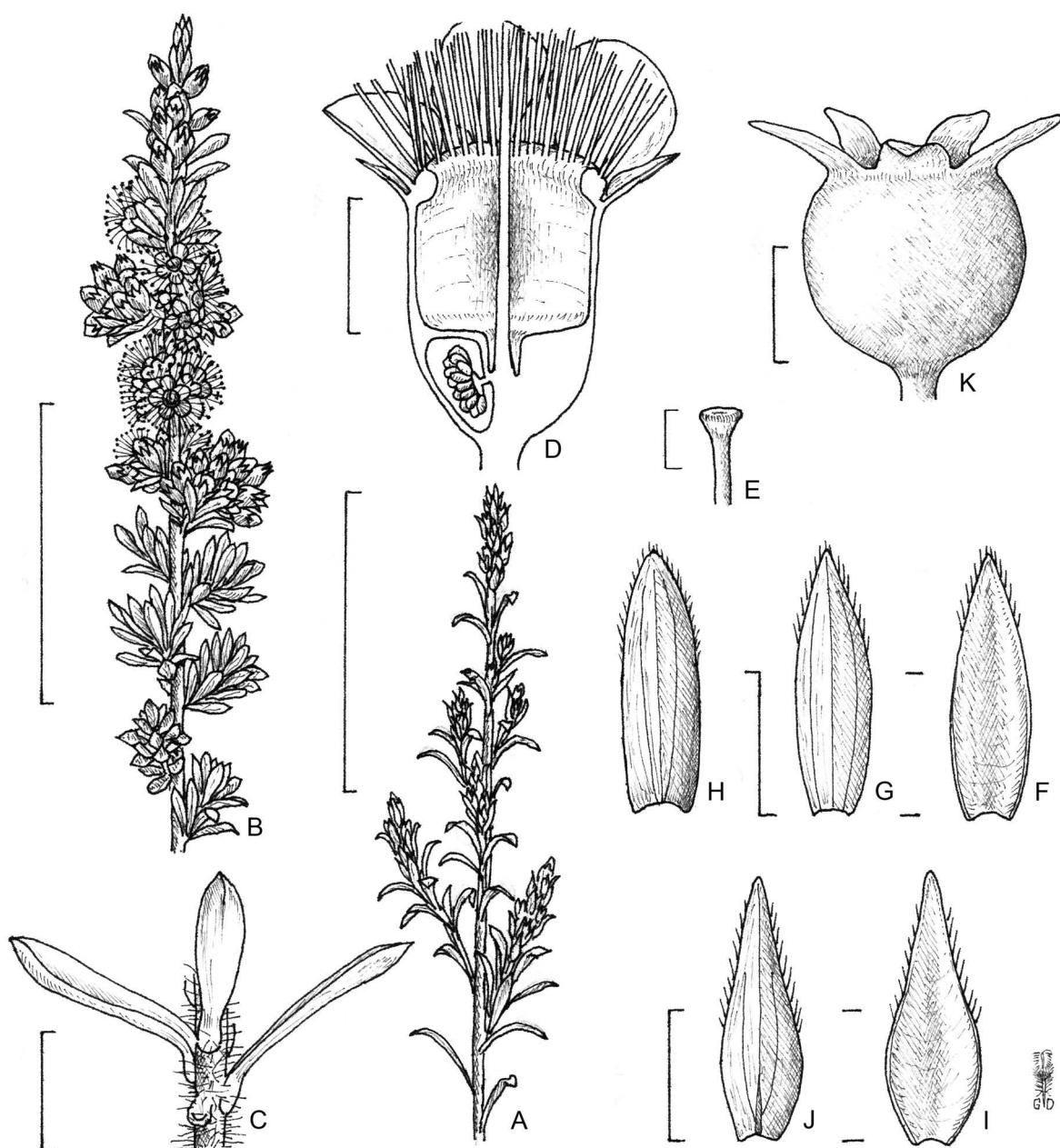
*Distribution and ecology.* Recorded often from a wide range of soils in sclerophyll forest, but also often recorded from rock outcrops in heath; individual plants are sometimes recorded from swampy areas. Occurs in New South Wales chiefly south of the Sydney area (CC, SC, CT, ST), Victoria (EG, GPL, PROM) and north-eastern Tasmania (FI, NE, EC) including many islands of the Bass Strait; marginally naturalised in South Australia (SL) and New Zealand.

*Conservation status.* A widespread species occurring locally common also in conserved areas.

*Diagnostic features.* While the very similar *K. occidentalis* (see also under its Diagnostic features) occurs mainly on the western slopes of the Great Divide, *K. ambigua* is found on the eastern slopes and especially on the coastal foothills. Although not always visible on all leaves, the darker glands on the abaxial leaf surface tend to be smaller than those of *K. occidentalis*. They number (50–) 55–90 (–115) and usually a row of distinctly smaller glands lines the leaf margins. There is a gradual increase southward with the highest number of glands recorded from Wilsons Promontory and north-eastern Tasmania (e.g. St Helens, *T.E. Burns* 195). Numbers higher than 100 have also been recorded from the North Coast of New South Wales, but here the glands are much less clearly visible and often obscured by hairs. The pale cream spongy flanges and usually broader fruit (more than 3.2 mm), diagnostic of *K. occidentalis*, are not observed in *K. ambigua*, except for somewhat thicker fruit but of different texture on some specimens from Wilsons Promontory and northern Tasmania. Neither of these characters are found in *K. axillaris*. On specimens of *K. axillaris* the stalked flowers are in the axils of distal leaves, but, although they appear to be axillary, they bear caducous bracteoles (or usually only their scars are observed on each flower stalk). This shows that these are foliose botrya with very much elongated internodes obvious between flowers unlike the more compact inflorescences of *K. ambigua* and *K. occidentalis*. In addition, the central axis of the inflorescences of the latter two species is densely hairy in contrast to the glabrous branches of *K. axillaris*.

*Variation.* Much local variation has been recorded for *K. ambigua* with regards to its globose to cylindrical or even elongate inflorescences (e.g. *E. Gauba* CBG7043), but then only an occasional terminal inflorescence on main branches, while all the other inflorescences, especially lateral ones, are globose or almost so. The flowers may vary from hirsute, pilose to glabrous or with pilose hypanthium and glabrous calyx, but none of this variation could be linked with other characters. This species can, however, be more or less divided into





**Fig. 22. *K. ambigua*:** A branch in bud showing bracts; B flowering branch; C cauline leaves; D half flower; E funnel-shaped stigma; F adaxial view of proximal bract; G abaxial view of proximal bract; H abaxial view of distal bract; I adaxial view of bracteole; J abaxial view of bracteole; K fruit. — Scale bars: A 4 cm; B 5 cm; C 4 mm; D, K 1.5 mm; E 0.5 mm; F, G, H 2 mm; I, J 2.5 mm. — A *H.R. Toelken* 7860 (AD); B–K *H.R. Toelken* 6852 (AD).

three major forms, but no clear infraspecific taxa could be delimited:

(1) The typical form occurs near Genoa, Victoria northwards to just north of Sydney, and can usually be distinguished by the rather loose arrangement of the more or less elongate inflorescences at the ends of major branches, and leaves which are usually narrower than 1 mm. The hypanthium is 2–2.2 mm in diameter, while the glabrous calyx lobes (rarely with a few hairs) are (1.3–) 1.5–2.3 mm long, pointed and usually without membranous margins.

To the south, both the second and third forms are represented by an array of different variants in several more or less geographically isolated populations, but all of them are usually recognisable by their wand-like distal compound inflorescences with the lower lateral inflorescences being more or less round and sessile. The leaves are generally more than 1 mm broad.

(2) The second, at times very distinct form occurs in north-eastern Tasmania roughly between St Helens and Bicheno. The hypanthium is 2–2.3 mm in diameter, and its dense indumentum also covers the calyx lobes,

which are 1–1.3 mm long, rounded (as are leaves) and with narrow membranous margins. The bracts are very short and broad and sometimes broader than long. This form was described by Miquel (1856) as *K. pelagia*.

(3) Another form refers to plants from Wilsons Promontory and surrounding areas, which have a hypanthium 2.8–3.4 mm in diameter, the calyx lobes are usually glabrous, 1.5–2.2 mm long, pointed, commonly ridged and with narrow membranous margins becoming broader towards the base.

Additional forms recorded mainly from the islands in the Bass Strait, but also from mainland Tasmania, show a range of variation and their recombination of the characteristics of above forms rendered the three extremes indistinguishable, especially as there is no present evidence of direct hybridization.

**Typification.** A type of Ventenat's *Metrosideros corifolia* could not be located in G, where most of his specimens are now deposited (Stafleu & Cowan 1986, p. 700). The plate 46 is therefore selected as the lectotype.

A probable isotype specimen of *K. ambigua*, which J.E. Smith sent to Ventenat (inscribed "Smith missit – in herb. Ventenat.") was examined and identified at G by the author.

Although the combination *Stenospermum corifolium* (Sm.) Sweet was effectively published, it is invalid, because the genus with the two species had not previously been described (Article 35.1, McNeill et al. 2012).

Miquel (1856) did not designate a holotype when he described *K. pelagia*. As he did not cite a collector or locality for the specimen, it is obvious that he did not see the duplicate specimens now in MEL. The specimen in U is therefore lectotypified and three similar specimens in MEL are accepted as duplicates (isotypes). Firstly, MEL92421, a fragment inscribed "ex Herb MEL" also refers to C. Stuart, who apparently collected the type, even though this was not mentioned in the protologue. Secondly, MEL 92330, which gives the locality of this restricted form as: "This sp. given me from Schouten Island East Coast of VDL", and it seems that this part of the label could have been written by C. Stuart, who collected in Tasmania between 1842 to 1857 and sent much of his material to F. Mueller (Buchanan 1990). The third specimen with no provenance (MEL92336) has a label in F. Mueller's handwriting, which merely states: "This does not agree with the description of *M. coriifolia* in G. Don in the calyx hairy tomentose in this specimen. It is there described as smoothish, but is nevertheless the same plant." Since Mueller considered it to be the same species, it could be assumed that his statement on the specimen could have influenced Bentham (1867), who had examined the latter two specimens and merely subsumed *K. pelagia* under *K. corifolia*.

#### *Selection of specimens examined (c. 150 seen)*

NEW SOUTH WALES: *W.F. Blakely* NSW124166, Kendalls Glen, Gosford, 16.x.1926 (NSW); *J.L. Boorman & E. Cheel* NSW124169, Bents Basin, Nepean River, ix.1913 (NSW);

*A.K. Brooks* 28, 3.5 km S Helensburg, 21.vi.1988 (AD, NSW); *L. Carne* NSW124203, Lawson, xi.1908 (NSW); *E.F. Constable* 4326, Narrabarba, W Disaster Bay, 14.viii.1963 (NSW); *R. Coveny* 3389, Picton Lakes, 5 mls [8 km] SW Picton, 1.xii.1970 (NSW); *L.A. Craven* 669, 4 mls [6.4 km] NE Nerriga, 24.xi.1965 (NSW, CANB; B, BH, CHR, G, K, L, US, n.v.); *N.C. Ford* NSW124172, Newport, 15.viii.1945 (NSW); *E. Gauba* CBG7043, Pigeon House Ra., 9.i.1952 (BRI, CANB, NE); *R.D. Hoogland* 11698, Tianjara Falls, 26.xi.1969 (CANB, NSW; A, K, L, n.v.); *L.A.S. Johnson* NSW124134, 2 mls [3.2 km] E Leumeah, 6.xi.1948 (NSW); *E.J. McBarron* 8553, Veterinary Research Stn, Glenfield, 30.xi.1963 (NSW); *K. McDougall* 717, beside Green Cape Rd near junction with Bull Ck Forest Rd, 9.xii.1999 (CANB); *D. McGillivray* 662, Ulladulla, 31.x.1957 (NSW); *A.M. Lyne* 1474, Mt Imlay, i.ix.1994 (CANB); *A.M. Lyne* 1553, Tallong, 11.i.1995 (AD, CANB); *J.H. Maiden* NSW124171, Greenbrook, xi.1914 (NSW); *R. Melville & N. Wakefield* 2903, upper Genoa River, 15.i.1953 (MEL); *R. Pullen* 4193, near Nelligen Bridge, E of Clyde River, 22.xi.1966 (CANB, NSW); *F.A. Rodway* NSW 124193, Kangaroo Valley, 28.xi.1929 (NSW); *F.W. Sieber* 324, Nov. Holl., s.dat. (MEL); *J.R. Telford* 3602, Jingera Rock, Egan Pk, 8 km SSE Wyndham, 29.x.1973 (CANB).

VICTORIA: *B.J. Conn* 2710 & *J.L. Porter*, 25.8 km S Bendoc on Bonang Hwy, 12.xii.1987 (CANB, NSW); *L.A.S. Johnson* NSW124215, Tidal River, Wilsons Promontory, 13.i.1967 (NSW); *A.H.S. Lucas* NSW124213, Wilsons Promontory, i.1885 (NSW); *K. Macfarlane* 255, W end of Mt Oberon car park 11.xii.1996 (AD, CANB); *F. Mueller* MEL92474, Genoa River, ix.1860 (MEL); *MEL92335 & 92477*, granite near shores of Corner inlet, v.1853 (MEL); *B. Nordenstam & A. Anderberg* 1203, 8 km S Fish Ck towards Wilson Promontory, 11.xi.1989 (AD); *M.E. Phillips* CBG21131, Squeaky Bay to Leonard Pt, Wilsons Promontory, 21.xi.1961 (CANB, NE); *C. Walters* NSW124212, Gippsland, xi.1897 (NSW).

TASMANIA: *M.I.H. Brooker* 5886, Mt Strzelecki walking track, Flinders Is., 12.vi.1978 (CANB, HO, NSW); *N.T. Burbidge* 3064, between Branhholm & Derby, 10.i.1949 (CANB, HO); *T.E. Burns* 195, St Helens, 24.xii.1959 (NSW); *R.C. Gunn* 488/1842, Allott, 18.xi.1842 (NSW); *J.H. Hemsley* 6565, Cape Mistaken, Maria Is., 1.ii.1969 (HO, NSW); *R. Johnston* MEL92479, Kings Is. (MEL); *C.E. Lord* CANB7074, Lady Barron Is., xii.1928 (CANB); *E. MacLaine* MEL92496, Clarks Is., 1889 (MEL); *J. Milligan* 1165, Bicheno, (HO, MEL); *M.E. Phillips* CBG36943, 2 mls [3.2 km] from Herrick to Moorina, 7.xii.1965 (CANB); *F.A. Rodway* 2647, Freycinet Penin., xii.1937 (NSW); *A. Smith* MEL92495, Mt Munro, 1891 (MEL); *J.S. Whinray* 897, Woody Is., 28.viii.1975 (AD); *J.S. Whinray* 8985, Cape Barren Is., s.dat. (AD, CANB; HO, NSW, n.v.); *J.S. Whinray* 9394, Flinders Is. S.F., Saddle at Head of Badger Gully, 7.i.1991 (AD, CANB; NSW, HO, n.v.); *C. Wilhelmi* MEL92478, Glenlynn Tasmania Islands (MEL).

SOUTH AUSTRALIA: *C.J. Brodie* 3884 & *P.J. Lang*, Belair N.P., 2.xii.2011 (AD); *H. Goldney* 3, 474 Ackland Hill Rd, Coromandel East, 10.i.2012 (AD).

NEW ZEALAND: *R. Mason & A.E. Esker* 11515, Ngataki, roadside, 26.xi.1970 (CANB).

#### *Putative hybrids*

All specimens examined of both hybrids mentioned below lack the regular branching of long shoots and well-formed flanges, both characteristics typical of sect. *Pallidiflorae*.



**(i) *K. ambigua* × *K. capitata* subsp. *capitata***

This hybrid is even more variable than one of the putative parents, *K. capitata* subsp. *capitata*, but is usually recognised in the field by its white or pale pink flowers, oblong-elliptic to -oblanceolate leaves with ± tubercled margins. Herbarium specimens are easily identified by the combination of linear-elliptic ± flat leaves without obvious veins and a more or less developed constriction between the free hypanthium and the ovary, as well as usually a decreasing density of the tomentum from the ovary to the calyx lobes.

A many-stemmed shrub with spreading branches, elliptic-oblanceolate leaves and ± narrowly elliptic bracts and bracteoles, also reminiscent to those of *K. ambigua*. The few veins are usually not visible (except in *H. Deane* NSW147329). Below the distal inflorescences there are usually several short shoots terminating in inflorescences, similar to *K. ambigua*. They are ± globose and very rarely elongated as is usual in *K. ambigua*. The leaves are often broader (1.2–2.3 mm) than in that species and often with a “pinched” apex; branching occurs in growth flushes and short shoots often do not occur regularly at each node; bracts and bracteoles are membranous to chartaceous and deciduous (rarely in typical subsp. *capitata*) at flowering; a constriction between the free hypanthium and the ovary as well as a decreasing density of the indumentum from the ovary to the free hypanthium and calyx lobes are characters found in *K. capitata*. In addition the petals and filaments vary from pale to intense pink and rarely white as in *K. ambigua*. Usually a high percentage of pollen abnormalities indicate hybridity.

*Selection of specimens examined (18 examined, but many of them were without precise locality)*

NEW SOUTH WALES: *S.C. Burnell* NSW147326, Manly side of Middle Harbour, xi.1905 (NSW); *J.F. Camfield* NSW147325, Spit Rd, Middle Harbour, xi.1897 (NSW); *H. Deane* NSW147329, Manly, x.1884 (NSW); *E.P. Elliott* NSW147319, s.loc., 22.x.1916 (NSW); *D. Ellison* NSW147313, near Currarong tip, 18.xi.1979 (NSW); *W. Farley* NSW147330, Dee Why Headland, 12.x.1964 (NSW); *M. Fuller* 7071, North Bridge, x.1927 (CANB); *K. Mills* NSW168747, Bollereng Ck, W Tomerong, 29.xi.1984 (NSW); *H.R. Toelken* 6851, 4 km NW Currarong, 30.x.1986 (AD, NSW) (pollen sterility 68–71%); *H.R. Toelken* 6855, 9.7 km SW Nowra airport on road to Nerriga, 30.x.1986 (AD, NSW) (pollen sterility 55–67%); *H.R. Toelken* 6856, 9.7 km SW Nowra airport on road to Nerriga, 30.x.1986 (AD, NSW) (pollen sterility 58–68%).

***Putative parents from associated area***

***K. ambigua*.** NEW SOUTH WALES: *H.R. Toelken* 6849, 4 km NW Currarong, 30.x.1986 (AD, NSW) (pollen sterility 5%); *H.R. Toelken* 6852, 9.7 km SW Nowra airport on road to Nerriga, 30.x.1986 (AD, NSW) (pollen sterility 4%).

***K. capitata* subsp. *capitata*.** NEW SOUTH WALES: *H.R. Toelken* 6850, 4 km NW Currarong, 30.x.1986 (AD, NSW) (pollen sterility 4%); *H.R. Toelken* 6854, 9.7 km SW Nowra airport on road to Nerriga, 30.x.1986 (AD, NSW) (pollen sterility 2%).

**(ii) *K. ambigua* × *K. capitata* subsp. *seminuda***

The leaves are elliptic-obovate, somewhat folded lengthwise and with slightly recurved apex resembling those of *K. capitata* subsp. *seminuda*, but unlike those their apices are pointed. The calyx lobes, which are glabrous as in the subsp. *seminuda*, are, however, similarly pointed and reminiscent to those of *K. ambigua*. Also the regular branching from all distal nodes is typical of the latter species.

***Specimens examined***

NEW SOUTH WALES: *M. Kempster* 6, Beecroft Penin., Long Beach South Rd, 100 m from Lighthouse Rd, 28.x.1999 (CANB).

***Putative parents from associated area***

***K. ambigua*.** NEW SOUTH WALES: *E. Gauba* CBG 7042, forest near Nowra, 21.x.1951 (CANB); *J.M. Powell* 374 & *J. McGrath*, near Tomerong, 7.xi.1975 (NSW).

***K. capitata* subsp. *seminuda*.** NEW SOUTH WALES: *R.L. Rudd* 153 & *M. McLeod*, 20 mls [32 km] NE of front gate of Australian National Botanical Gardens Annexe, Jervis Bay, 18.x.1991 (AD).

**49. *Kunzea axillaris* Toelken, sp. nov.**

*A speciebus aliis sectionis Pallidiflorarum hujus calycis lobis latis brevis (ad 0.5 mm longis) inflorescentiisque tantum elongatis distalibus et bracteis foliiformibus differt.*

**Type:** New South Wales, Mt Cairncross, *T. & J. Whaite* 3537, 7.iii.1981 (holo.: AD98831018; iso.: NSW).

*Kunzea* sp. *A Joy* Thomps. in *S.W.L. Jacobs & Pickard* (eds), *Pl. New South Wales* 166 (1981); *Peter G. Wilson* in *G.J. Harden* (ed.), *Fl. New South Wales* 154 (1991); *de Lange et al.*, *Austral. Syst. Bot.* 23: 311 (2010).

*Kunzea* sp. *Middle Brother* (*P.G. Wilson* 505) *Peter G. Wilson* in *G.J. Harden* (ed.), *Fl. New South Wales*, ed. 2, 2: 177 (2002).

Erect shrub or tree 2.5–6 (–8) m tall; young branches with raised leaf bases ± decurrent, but not forming flanges, pubescent to tomentose with short and longer spreading antrorse hairs; early bark splitting into corky longitudinal strips with scarcely peeling margins. *Leaves* alternate; *petiole* 0.4–0.7 mm long, appressed; *lamina* linear-elliptic to linear, (3–) 4–6 × 0.5–0.8 mm, acute to pointed, gradually tapering into petiole, straight to slightly recurving, flat to slightly furrowed above, strongly convex below, glabrous except for often appressed antrorse marginal hairs. *Inflorescence* a raceme-like botryum with (1–) 3–5 (–7) flowers, each with a “pedicel” (0.8–) 1–1.5 (–2.4) mm long, distal on branches, with terminal vegetative growth usually continuing while flowering; *retained perules* 2, 3 or absent below inflorescence, narrowly triangular to triangular-elliptic, 0.5–0.8 mm, 1–3-veined, puberulous to glabrous with marginal hairs; *bracts* similar to leaves, persistent; *bracteoles* leaf-like but more delicate, caducous (usually only scars seen on pedicels). *Hypanthium* 2.5–2.8 mm long when flowering (free tube 1–1.2 mm long), obconical, not ridged, glabrous. *Calyx lobes* ovate-triangular, 0.4–0.55 mm long, acute, rarely

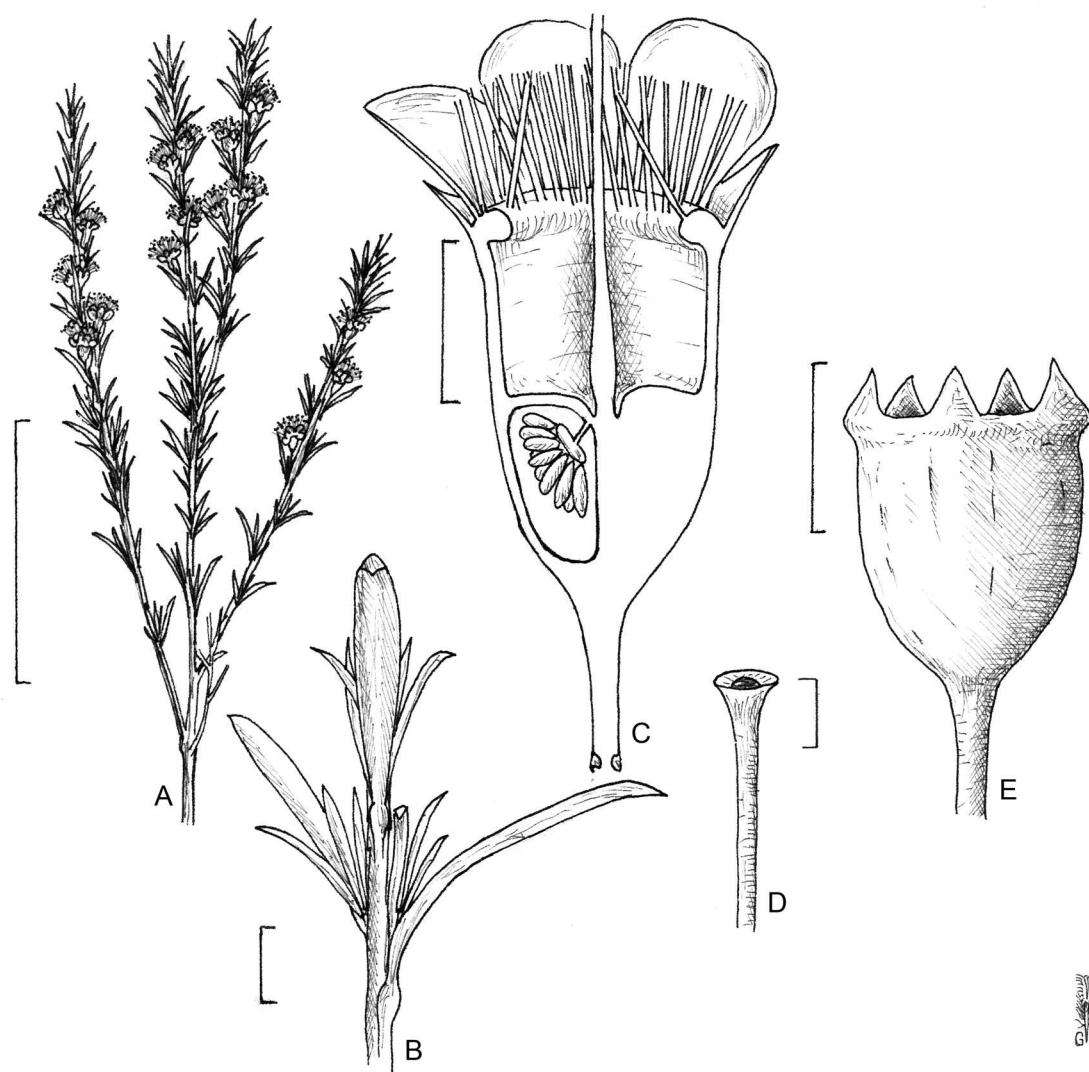


Fig. 23. *K. axillaris*: A flowering branch; B short shoots in axils of cauline leaves; C half flower; D funnel-shaped stigma; E fruit. — Scale bars: A 3 cm; B, C, E 1 mm; D 0.5 mm. — A–D L.Frazer NSW124240; E A.G.Floyd NE35790.

obtuse, scarcely ridged, glabrous. *Corolla lobes* broadly obovate, obovate-orbicular, 1–1.2 mm long, white. *Stamens* 30–35 in more than one whorl; *filaments* 2.5–3 mm long; *anthers* ellipsoidal, 0.3–0.4 mm long, with small subterminal gland. *Ovary* 3-locular, with style base slightly sunk into upper surface; *placenta* a narrow-elliptic disc with short central attachment, scarcely divided into 2 lobes, each with 2 rows of ovules; *ovules* 23–25 per locule, subequal, spreading; *style* 3.5–4 mm long when fruiting, with stigma disc to funnel-shaped with distinct central depression. *Fruit* a cup-shaped capsule, 2–2.2 mm long, with erect but slightly incurved calyx lobes. *Seeds* not seen. *Flowering*: January. **Fig. 23.**

**Distribution and ecology.** Recorded from wet sclerophyll eucalyptus forest (e.g. *E. agglomerata*) on various soils but mainly around granite or conglomerate outcrops on slopes of ranges between Taree and Kempsey, New South Wales (NC).

**Conservation status.** Poorly known species recorded from a few localities in State Forests (2K).

**Diagnostic feature.** Distinguished from other species by short, broad calyx lobes, obconical hypanthium, and elongated (raceme-like) leafy inflorescences with terminal vegetative growth, which are typical of species of sect. *Niviferae*. However, *K. axillaris* is placed here, because it differs from species of the latter section by its filaments being all long and erect-spreading, as well as by its long style placing the stigma at the same level as the fully expanded stamens.

**Notes.** The flowers of this species have, like in *K. truncata*, an obconical hypanthium, which does not become cup-shaped even in the fruiting stage.

**Etymology.** The epithet “axillaris”, Latin, “axillary” refers to the flowers, which appear to be single in the axils of leaves (=leaf-like bracts), but on closer examination one finds the scars of two bracteoles subtending each



flower, which makes the inflorescence a leafy botryum as is commonly found in sect. *Niviferae*.

#### *Specimens examined*

NEW SOUTH WALES: *D.Binns* 170, Mt Cairncross, 6.viii.1987 (CANB); *D.Binns* 301, Bottlebrush Rd, Kerewong S.F., 1.iii.1988 (CANB, NSW); *J.J.Bruhl* 1843 & *I.R.Telford*, c. 10 km SW Wavehope, Broken Bago S.F., 12.vi.1999 (AD, CANB, NSW); *P.Burgess* NSW124241, Burrawan S.F., 24.x.1961 (NSW); *E.Cheel* NSW124242, Upper Landsdown, 6.v.1925 (NSW); *A.G.Floyd* 917, Middle Brother, 27.iv.1978 (NE, NSW); *L.Frazer* NSW124240, Comboyne, 7.i.1935 (NSW); *S.J.Griffith* NE66481A, Manning River valley, Wyuma, Killabakh Ck, 29.i.1994 (CANB); *R.Johnstone* 2012 & *A.E.Orme*, 80 m NW TV tower, Middle Brother, 28.iii.2007 (AD, NSW; K, NE, n.v.); *P.Richards* 815, Forest Hut Rd, Middle Brother, 15.x.1997 (NSW; BRI, MEL, n.v.); *P.G.Wilson* 505, Middle Brother Lookout, 28.i.1990 (AD, NSW; BRI, MO, n.v.).

### D.3. *Kunzea* sect. *Niviferae* Toelken & de Lange

in de Lange et al. Austral. Syst. Bot. 23: 317 (2010). —

**Type species:** *K. peduncularis* F.Muell.

*Kunzea* sect. '*Eukunzea*' Benth., Fl. Austral. 3: 112 (1867), pro parte, quoad *K. peduncularis* — nom. inval. *Leptospermum* auctt. non Forster & G.Forster: A.Rich., Essai Fl. Nouv. Zél. 338 (1832), pro parte, quoad *L. ericoides*; Cheel, J. & Proc. Roy. Soc. New South Wales 76: 230 (1943), pro parte, quoad *L. phyllicoides* (A.Cunn. ex Schauer) Cheel; S.T.Blake, Proc. Roy. Soc. Queensland 69: 77 (1958), pro parte, quoad *L. phyllicoides* (A.Cunn. ex Schauer) Cheel; Byrnes, Austrobaileya 1(5): 468 (1983), pro parte, quoad *L. phyllicoides* (A.Cunn. ex Schauer) Cheel.

*BaECKia* auct. non L.: Schauer, Repert. Bot. Syst. 2, Suppl. 1: 921 (1843), pro parte, quoad *B. phyllicoides* A.Cunn. ex Schauer.

Distal main branches with vegetative short shoots at each node shorter or as long as subtending leaves, leaf bases becoming decurrent flanges. *Inflorescence* racemiform and usually with terminal leaves; bracts ± fleshy and leaf-like; petals white; *stamens* unequal, erect-spreading or some incurved, with usually antepetalous ones longer and antesealous ones shorter than petals, and style usually shorter than all filaments.

**Discussion.** Following Recommendation 22A.1., *Kunzea* sect. *Niviferae* was given the same name as the subgenus (McNeill et al. 2012). It includes 10 species in New Zealand (de Lange 2014) and 6 in Australia, which were only recently re-identified as kunzeas (Thompson 1983), a decision confirmed by molecular studies by O'Brien et al. (2000) and de Lange et al. (2010). They were for many years before that retained in *Leptospermum*, because of their close resemblance to some of the species of that genus.

The loose inflorescence with usually stalked flowers, the usually caducous leaf-like bracts and particularly the short often partially incurved stamens, as well as the short styles, about as long as the calyx lobes, are characteristics of this section. Some of these characters, but never the full complement, are shared with other

members of subgen. *Nivifera*, and have been discussed there.

Species to be published separately (Toelken, in prep.).

### Species excluded

Thompson (1989) already transferred *K. brachyandra* F.Muell. and *K. podantha* F.Muell. to *Leptospermum brachyandrum* (F.Muell.) Druce (p. 353) and *L. oligandrum* Turcz. (p. 350), respectively. For *Metrosideros sororia* Endl. (p. 105) and *Tetrastoma verrucosa* Turcz. (p. 106) see Toelken (1996).

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