A taxonomic revision of *Macarthuria* (Molluginaceae) in Western Australia

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Abstract

Lepschi, B.J. A taxonomic revision of *Macarthuria* (Molluginaceae) in Western Australia. Nuytsia 11 (1): 37-54 (1996). The genus *Macarthuria* (Molluginaceae) in Western Australia is revised, and six species are recognized. A key and distribution maps are provided, along with illustrations of selected species. *Macarthuria keigheryi* Lepschi and *M. vertex* Lepschi are described as new, and the name *Macarthuria australis* Hügel ex Endl. is neotypified.

Introduction

The endemic Australian genus *Macarthuria* Hügel ex Endl. consists of approximately ten species, five of which are endemic to the south-west of Western Australia, with the remainder occurring in northern and eastern Australia. Of the species indigenous to Western Australia, two are unnamed, and four (including one of the undescribed taxa) are regarded as rare or threatened. This paper provides formal names for the undescribed taxa and reviews the taxonomy of all species known to occur in Western Australia.

Three named species (*M. complanata* E.M. Ross, *M. ephedroides* C.T. White and *M. neocambrica* F. Muell.) and two unnamed species (one of which is newly described here as *M. vertex* Lepschi) occur in eastern and northern Australia. The taxa endemic to eastern Australia are not treated further in this paper, other than in regard to their relationships to Western Australian species.

Macarthuria has variously been included in Aizoaceae (e.g. Mabberley 1987, Stanley & Ross 1983), Molluginaceae (e.g. Beadle *et al.* 1982, Eckardt 1964) or subfamily Molluginoideae within Aizoaceae (e.g. Jacobs & Highett 1990, Prakash 1967). Recent studies on the Aizoaceae *s.l.* (e.g. Bittrich 1988, Endress & Bittrich 1993) have favoured recognition of Molluginaceae, and this is followed here. Research on generic relationships within Molluginaceae has been summarized by Endress & Bittrich (1993) who suggest the Afro-Asian genus *Limeum* L. as the closest relative of *Macarthuria*.

Taxonomic history

Macarthuria was described by S.L. Endlicher in 1837 (Endlicher 1837) to accommodate a single species, *M. australis*, the type of the genus. Steudel (1845), working with material collected by L. Preiss, described *M. foliosa* (synonymous with *M. australis*), with *M. apetala* added by Harvey (1855) and *M. neocambrica* by Mueller (1865). Mueller was apparently also aware of an additional taxon to which he applied the manuscript name *M. apetala* var. *rigidor*, but it was not until 1982 that this plant was formally described as *M. intricata* (Keighery 1982). Three other species have been recognized in recent times, *viz: M. ephedroides* (White 1946), *M. georgeana* (Keighery 1983) and *M. complanata* (Ross 1984).

Materials and methods

This study is based on examination of herbarium collections from BRI, CANB (including CBG), DNA and PERTH, with selected material from K, KPBG, LD, MEL and TCD. All measurements were made from dried specimens, reconstituted in the case of reproductive organs. Terminology for indumentum follows Hewson (1988).

Notes on morphology

Shape and size of leaves varies greatly depending on the stage of growth of the plant. Seedlings, plants regenerating from the rootstock following fire or other disturbance and plants producing new growth at the beginning of the growing season all have larger leaves at the base of the plant (occasionally in a false rosette), and on new stems. These basal leaves are often withered at anthesis and are gradually lost, with the plant producing reduced leaves further up the stems. Basal leaves have been seen in all species treated in this study, except *M. georgeana* and *M. intricata*, and are included in the descriptions. Such leaves have also been seen in the eastern Australian species *M. complanata*, *M. neocambrica* and an unnamed taxon from northern Queensland, but in *M. neocambrica* the basal leaves are usually persistent (in a false rosette), as are the variously developed cauline leaves.

Seedling plants of *M. apetala* (at least the 'southern variant' of this species) and *M. vertex* may flower and fruit when quite young, and with their basal leaves still present are superficially similar to the predominantly herbaceous *M. neocambrica* (see above). The more usual case for these species would appear to be a period of active vegetative growth, followed by flowering and fruiting once the plant is established.

For this study filament lengths are measured from the base of the point of divergence from the staminal ring to the filament apex.

Taxonomic treatment

Macarthuria Hügel ex Endl.

Endlicher (1837: 11). *Type: Macarthuria australis* Hügel ex Endl.

Perennial *herbs, subshrubs* or *shrubs* to 1.5(2) m tall, glabrous or rarely hairy. *Stems* rigid, terete, rarely intricate, flattened or winged. *Leaves* mostly cauline, rarely also basal, alternate, becoming progressively reduced further up the stem, occasionally all reduced to scales. *Inflorescence* cymose, sometimes open and dichotomous, 1-many-flowered, inserted laterally or terminally on the branches, flowers pedicellate. *Sepals* 5, free, in two whorls. *Petals* 5, white to cream, free, or absent. *Stamens* 8, inserted on a staminal ring. *Ovary* 3-locular, with 1-3 ovules per locule. *Style* branches 3, stigma at apex of each. *Fruit* a loculicidal capsule. *Seeds* ± reniform to almost ellipsoid, dark, seed coat often sculpted, arillate.

Distribution. Ten or more species endemic to Australia, of which five are endemic to south-western Western Australia, the remainder occurring from the Kimberley region eastwards to the Northern Territory and Queensland, and south to northern New South Wales.

Etymology. After Sir William Macarthur, 1800-1882, horticulturalist and agriculturalist (Baines 1981).

Key to species of *Macarthuria* in Western Australia

Note: the inner whorl of sepals could be misinterpreted as petals; flowers with petals have ten perianth parts (five sepals, five petals), apetalous flowers only five perianth parts (five sepals). Care should also be taken when examining over-mature flowers and young fruits, as the petals may have been shed.

1 Flowers 1-6 in cymes at the apex of the ultimate inflorescence branchlets (rarely some borne laterally as well). Kimberley region of Western Australia and monsoonal Northern Territory ..... **M. vertex**

1: Flowers 1-many in generally ± condensed cymes borne laterally and occasionally terminally as well, on the main stems (if flowers consistently 1 or 2, then always lateral). South-western Western Australia 2

2 Plant hairy ..... **M. keigheryi**

2: Plant glabrous (very rarely some small papillae may occur in *M. apetala*) 3

3 Petals always present, conspicuous, 2-4 mm long 4

4 Stems distinctly verrucose, rusty brown or glaucous; all leaves reduced to appressed, triangular scales; cymes consistently 1- or 2-flowered, ovary with 1 ovule per locule ..... **M. georgeana**

4: Stems smooth, green; leaves variously developed, but never all reduced to appressed triangular scales; cymes 1-many-flowered, ovary with 2-3 ovules per locule ..... **M. australis**

3: Petals generally absent (occasionally produced in *M. apetala*); when present, inconspicuous, 0.7-1.8 mm long 5

5 Intricately branched shrub; all leaves reduced to appressed triangular scales. Shark Bay to Kalbarri ..... **M. intricata**

5: Erect, little-branched subshrub, not intricate; leaves often small, but never all reduced to appressed triangular scales. Eneabba to Esperance ..... **M. apetala**

1. Macarthuria apetala Harv. (Harvey 1855: 55). *Type:* W[estern] Australia, *J. Drummond s.n.* (*holo*: TCD (photo BRI, PERTH)).

Erect *subshrub* to 30 cm tall, glabrous or rarely with some poorly developed papillae on vegetative parts. *Stems* terete, wiry or more or less stout, greenish to red-brown, often glaucous when dried. *Leaves* present mainly towards the base of the stems and on young growth, becoming progressively reduced further up the stems, sessile to obscurely petiolate; lamina narrowly to linear-obovate, or narrowly elliptic to linear, 1.2-30 mm long, 0.3-3 mm broad; base very narrowly cuneate to attenuate; apex acute to narrowly acute or very shortly acuminate. *Inflorescence* of 1-20 flowers in generally somewhat condensed cymes, inserted laterally (or rarely terminally) on the stems. *Bracts* broadly triangular to triangular, 0.5-1.5 mm long, herbaceous with a narrow scarious margin, brown. *Pedicels* 1-3 mm long. *Sepals* elliptic to broadly elliptic, 1.3-2.3 mm long, herbaceous (inner 2 less strongly so), with a narrow scarious margin. *Petals* usually absent; if present, narrowly to very narrowly obovate to very narrowly elliptic or (rarely) obovate, 0.7-1.8 mm long, base attenuate, not clawed. *Staminal ring* about half as long as ovary; free filaments 0.3-1.2 mm long; anthers 0.3-0.5 mm long. *Ovary* 1-1.3 mm long, with 1 ovule per locule; style branches 0.2-0.5 mm long. *Fruit* ovoid to more or less globular, 1.5-3 mm long. *Seeds* black, tuberculate to pusticulate, shining, broadly comma-shaped, 1.2-1.7 mm long; aril large.

Distribution. Largely subcoastal, occurring in scattered populations from Eneabba southwards to Northcliffe and east as far as Esperance, Western Australia. (Figure 1)

Conservation status. Previously listed as Priority 2 under CALM Conservation Codes for Western Australian Flora. Following this review, this taxon has been removed from the Priority Flora listing as it is more widespread than previously thought, with a number of populations occurring on protected lands. For definitions of conservation codes used by the Department of Conservation and Land Management, see the end of this issue.

Typification. Harvey (1855) did not cite any type material in the protologue of his new species. However, at TCD (the herbarium at which Harvey was curator (Ducker 1988, Stafleu & Cowan 1979)), there is a Drummond specimen comprising an entire, fertile plant, possibly labelled in Harvey's hand (S.C. Ducker pers. comm.) which accords well with the original description of *M. apetala*. This specimen is treated here as the holotype of this name.

At herb. K, MEL and PERTH there are other Drummond collections (both numbered and unnumbered) of *M. apetala*, but none appear to be annotated by Harvey. It is not possible to ascertain with any certainty whether any of these specimens represent duplicates of the holotype and therefore they are not accorded type status. The collections in question are: (1) Swan River, *J. Drummond* 677 (K, four sheets (one ex herb. Benthamianum, three ex herb. Hookerianum); (2) W.A., *J. Drummond* 677 (MEL 723999); (3) Swan River, *J. Drummond* 10 (K (ex herb. Hookerianum)); (4) W. Austr., *J. Drummond s.n.* (MEL 1058091, 1058092, 1058093 (ex herb. O.W. Sonder)); (5) West. Austr., *J. Drummond s.n.* (PERTH 01298259 (ex MEL)).

Notes. The combination of (usually) apetalous flowers, tuberculate to pusticulate seeds, sub-shrubby habit with erect, little-branched stems and overall glabrous nature serve to distinguish this species from all other taxa in Western Australia. The eastern Australian species *M. complanata* and *M. ephedroides* (in part) are also apetalous, but are distinct in their flattened to winged stems and inflorescence structure.

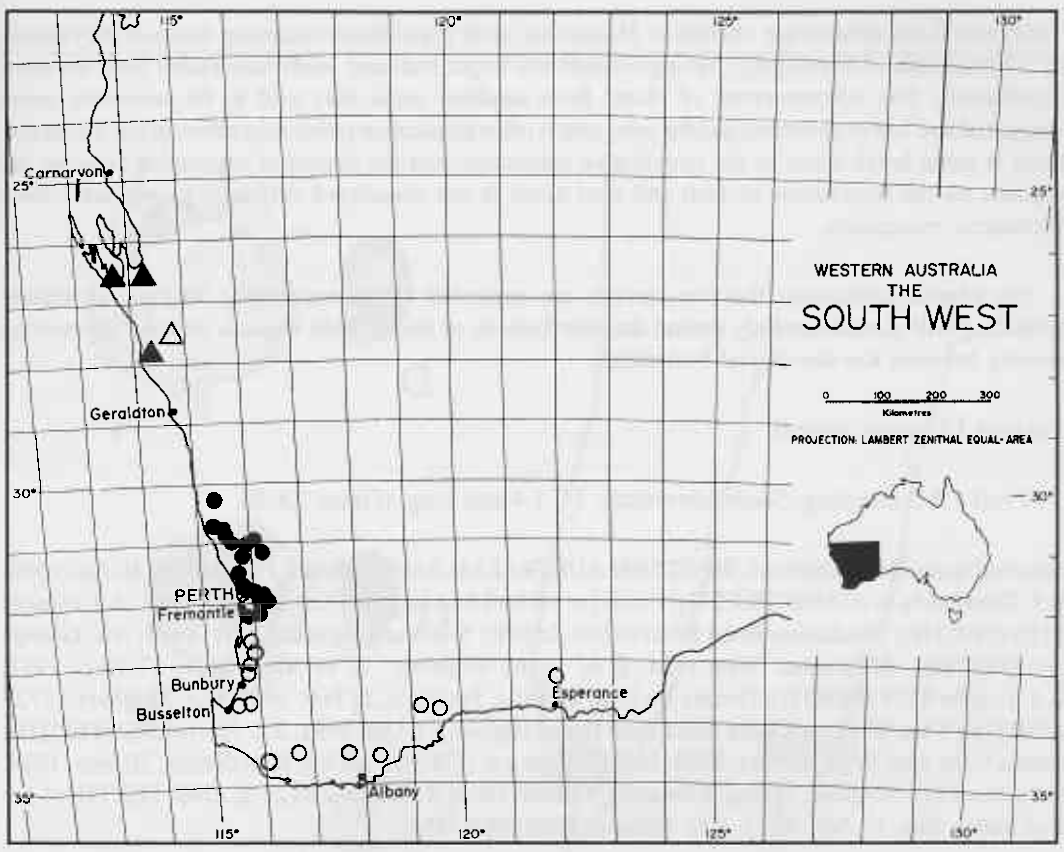

Figure 1. Distribution of *Macarthuria apetala* Variant 1 (typical variant) (●), *M. apetala* Variant 2 (southern variant) (○), *M. georgeana* (△) and *M. intricata* (▲).

Despite its name, this species sometimes produces petals. Petals were seen in some of the collections examined (e.g. *George* 3153, 15030, *Griffin* 8529, *Newbey* 11787, *Spjut* 7396), spread throughout the range of the species, and there is no correlation with other morphological characters and the presence of petals.

The name *Macarthuria apetala* Harv. has long been misapplied to *M. vertex*, a species with petal-bearing flowers from northern Australia (e.g. Chippendale 1971, Lazarides, *et al.* 1988, Specht & Mountford 1958).

M. apetala regenerates strongly from the rootstock following fire or mechanical disturbance, with recruitment of seedlings apparently also occurring after fire (G.J. Keighery, C.D. Turley pers. comm.).

A flowering collection (*D.M. Rose* 411) from Dryandra National Park, north-west of Narrogin, may belong here. It most closely resembles this species but differs in the presence of numerous, moderately well-developed papillae on the vegetative parts and also on the outer whorl of sepals (approaching those found in some individuals of *M. vertex*). Such processes are occasionally seen in other collections of *M. apetala* (such as *Keighery* 2652), but are generally less well developed and are restricted to the vegetative parts. *Rose* 411 may simply represent a variant of *M. apetala*, but the locality is outside the known range of this species.

Variation. Two variants are evident in *M. apetala*, with populations occurring south of Keysbrook (*c.* 17 km south of Mundijong) having consistently larger fruit and seeds than plants from northern populations. The inflorescences of plants from southern areas also tend to be somewhat more congested and fewer-flowered, and the seed coat is often pusticulate rather than tuberculate. However, there is some break-down in the quantitative characters, and the degree of separation between the variants on the dimensions of fruit and seed alone is not considered sufficient to warrant formal taxonomic recognition.

On present collections the two variants are separated by approximately 30 km, but further collecting will almost certainly extend the distributions of one or both variants into the intervening country between Keysbrook and Forrestdale.

Variant 1 (typical variant).

Fruit 1.5-2 mm long. *Seeds* tuberculate, 1.2-1.4 mm long. (Figure 2A-E)

Selected specimens examined. WESTERN AUSTRALIA: Anketell Road, Forrestdale, 16 Jan. 1980, *R.J. Cranfield s.n.* (CANB, PERTH); 1 mile [*c.* 1.6 km] S of Regans Ford, 20 Nov. 1961, *A.S. George* 3153 (PERTH); Strathmore Road Reserve (no. 26248), S of Badgingarra, 5 Nov. 1975, *A.S. George s.n.* (PERTH); Mogumber West road, E of Brand Highway, W of Mogumber, 17 Dec. 1992, *E.A. Griffin* 8529 (PERTH); Dennis De Jong Reserve, Jandakot, 21 Feb. 1992, *G.J. Keighery* 12722 (PERTH); 8 km W along Cadda Road from Brand Highway, 8 Oct. 1991, *S.J. Patrick* 882 (PERTH); Maida Vale, near Perth, 24 Oct. 1962, *M.E. Phillips s.n.* (CBG); *c.* 23 km W of Gingin, 30 Nov. 1974, *R. Pullen* 9745 (CANB); Miling-Roundhill, 18 Mar. 1964, *R.D. Royce* 8125 (CANB, PERTH); 4 km S of Jurien Bay, 12 Sep. 1973, *P.G. Wilson* 11559 (PERTH).

Distribution. Occurs in scattered populations from Eneabba south to Forrestdale (on the southern edge of Perth). Generally subcoastal in distribution, but extending to the coast in some sites, and inland as far as Mogumber and Miling.

Habitat. Recorded from heath and low *Eucalyptus* woodland with a heath understorey on grey or white sands, often in burnt sites or other disturbed areas.

Phenology. Flowering September to April, fruiting November to March.

Variant 2 (southern variant).

Fruit 2-3 mm long. *Seeds* pusticulate to tuberculate, 1.4-1.7 mm long. (Figure 2F-G)

Selected specimens examined. WESTERN AUSTRALIA: N end of Lake Muir, 2 Nov. 1977, *A.S. George* 15030 (PERTH); Capel Nature Reserve, 8 Nov. 1992, *B.J. Keighery & N. Gibson* 769 (CANB, K, PERTH); *c.* 5 km SW of Mondurup, unnamed hill, SW edge Stirling Ranges, 22 Nov. 1979, *G.J. Keighery* 2652 (KPBG); Capel Nature Reserve, 19 Dec. 1991, *G.J. Keighery s.n.* (CANB, PERTH); Adjacent Yarloop rubbish tip, *c.* 1.5 km ESE of Yarloop Railway Station, 17 July 1995, *B.J. Lepschi & T.R. Lally* 1919 (PERTH); 7 km NNE of Woolbernup Hill, Fitzgerald River National Park, 21 Nov. 1985, *K.R. Newbey* 11067 (PERTH); 24 km N of Cape Riche, 21 Oct. 1987, *K.R. Newbey* 11787 (PERTH); Bluman's Farm, Gibson, 20 May 1995, *C.D. Turley* 1/595b (CANB, MEL, NSW, PERTH); Summertime Track, *c.* 13 km SSW of Northcliffe, 19 Feb. 1989, *G. Wardell-Johnson* 38

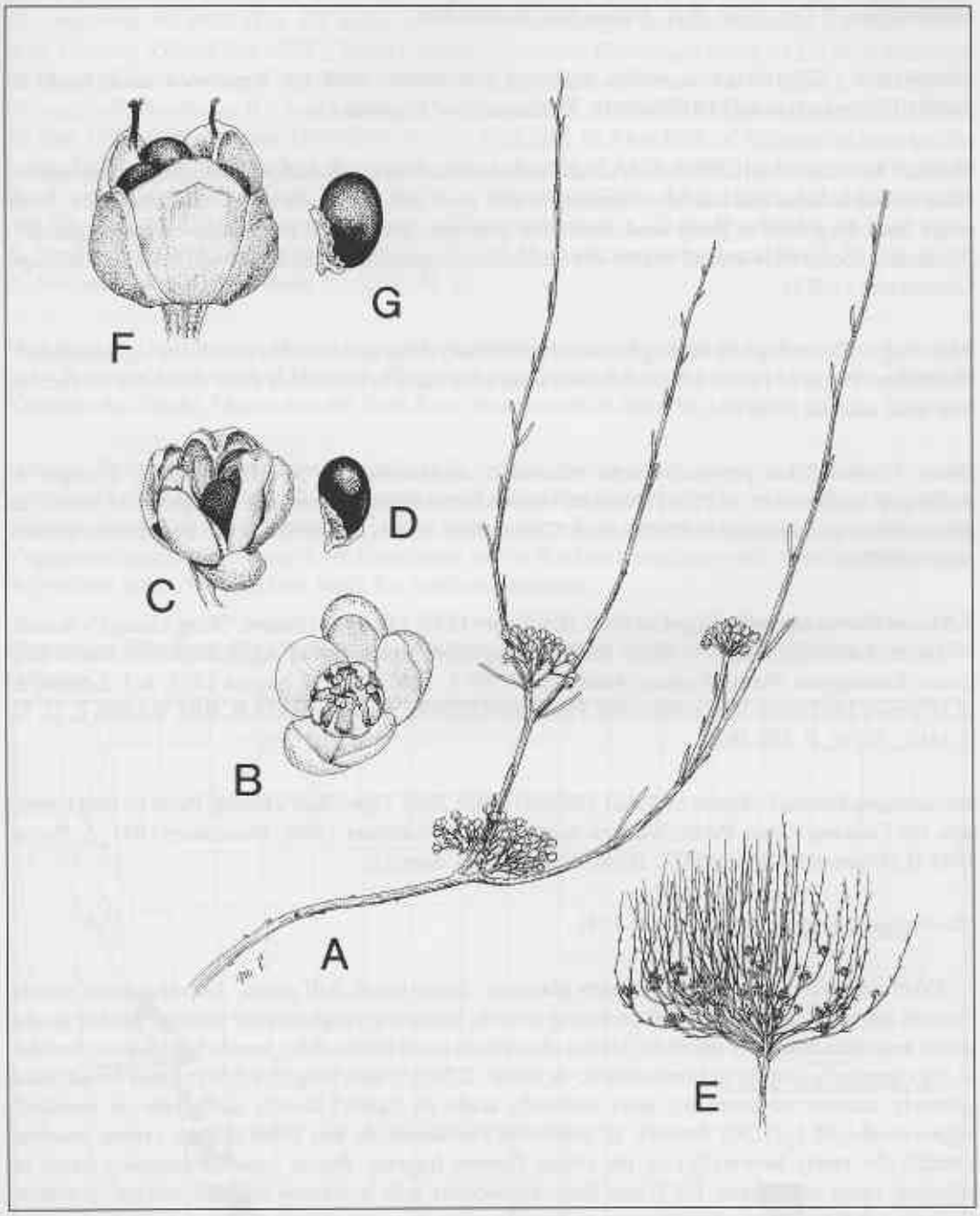

Figure 2A-E. *Macarthuria apetala* Variant 1 (typical variant) A - flowering branchlet (x1), B - flower (x7.5), C - fruit (x9), D - seed (x9), E - habit (x0.25); F, G . *M. apetala* Variant 2 (southern variant) F - fruit (x9), G - seed (x9). Drawn from *A.S. George* 3153 (A-E) and *G.J. Keighery s.n.* (PERTH 03415139) (F, G).

(PERTH); Fitzgerald River Reserve, along rabbit proof fence, *c.* 20 miles [*c.* 32 km] SE of Jerramungup, 7 Oct. 1970, *P.G. Wilson* 10179 (PERTH).

Distribution. Distributed in widely scattered populations from the Keysbrook area, south to Northcliffe and eastwards to Gibson (*c.* 25 km north of Esperance).

Habitat. Recorded from tall dense-shrubland and open *Banksia* and *Eucalyptus* woodland communities, occasionally in areas that had been burnt (up to four years previously), or subject to disturbance. Soils range from deep sand to peaty sand, sand over quartzite, loamy sand over sandy-clay and "gravel". Frequently occurs in or around winter-wet seasonal swamps, as noted by Blackwell & Cala Landscape Consultants (1983).

Phenology. Flowering and fruiting recorded in February, May and July, but mostly during September-December. Plants of *Turley* 1/595a & b were from a site burnt in November 1993 which did not receive rain until autumn of 1995.

Notes. Variant 2 has previously been referred to as *Macarthuria* sp. Harvey (M.E. Trudgen & A. Tingay *s.n.*) *in herb.* at PERTH and on various lists of priority taxa (e.g. Hopper *et al.* 1992), as *Macarthuria* sp. unnamed in Blackwell & Cala (1983), and as *Macarthuria* aff. *australis* in Gibson *et al.* (1994).

2. Macarthuria australis Hügel ex Endl. (Endlicher 1837: 11): *Type citation*: "King George's Sound, [Western Australia], *Hügel*". *Type:* Bushland opposite Department of Agriculture site, Baron Hay Court, Kensington, Perth, Western Australia, 31°59' S, 115°53' E, 31 August 1995, *B.J. Lepschi & M.H. Brims* 1943 (*neo,* here nominated: PERTH 04232631; *isoneo:* A, AD, B, BRI, CANB, E, G, K, L, MEL, NSW, P, US, W).

Macarthuria foliosa L. Preiss ex Steud. (Steudel 1845: 230). *Type:* Bull's Creek, Perth [= Bull Creek, near the Canning River, Perth, Western Australia, *fide* Marchant 1990], November 1841, *L. Preiss* 1672 (LD (photo PERTH), MEL 1058090 (ex herb. J. Steetz)).

Illustration. Marchant *et al.* (1987: 104).

Erect *subshrub* to 60 cm tall, all parts glabrous. *Stems* terete, dull green. *Leaves* present mainly towards the base of the stems and on young growth, becoming progressively reduced further up the stems, sessile to obscurely petiolate; lamina obovate (in basal leaves only), narrowly to linear-obovate, or very narrowly elliptic to linear-elliptic or linear, 2-28(55) mm long, 0.3-3.5(16) mm broad; base narrowly cuneate to attenuate; apex narrowly acute or (rarely) shortly acuminate or rounded. *Inflorescence* of 1-15(30) flowers, in somewhat condensed or less often diffuse cymes, inserted laterally (or rarely terminally) on the stems; flowers fragrant. *Bracts* ovate to narrowly ovate or subulate, often acuminate, 1-2.5 mm long, herbaceous with a narrow scarious margin, greenish. *Pedicels* 1.8-6 mm long. *Sepals* ovate to broadly ovate or rarely elliptic, 3-5 mm long, herbaceous (inner 2 less strongly so), with a narrow scarious margin. *Petals* elliptic to (rarely) very narrowly elliptic or ovate to broadly ovate, 3.5-4 mm long, base attenuate or rarely truncate, distinctly clawed. *Staminal ring* about one-third to half as long as ovary; free filaments 1.8-2 mm long; anthers 0.5-0.7 mm long. *Ovary* 1.6-2 mm long, with 2 or 3 ovules per locule; style branches 1.7-2.5 mm long. *Fruit* ovoid to more or less globular, 3.8-4.1 mm long. *Seeds* dark brown to almost black, faintly reticulate-areolate so as to appear almost smooth, shining, very broadly comma-shaped, 1.4-1.5 mm long; aril large.

Selected specimens examined. WESTERN AUSTRALIA: 2 km NW of Darlington, 4 Aug. 1979, *P. Armstrong* 50 (PERTH); 4.5 miles [*c.* 7 km] from Gingin towards Bindoon, 28 Sep. 1968, *E.M. Canning* 3565 (CBG, NSW); Water Catchment Reserve, Greenough River, 55 km W of Mullewa, 20 Oct. 1983, *S.J. Forbes* 1712 (BRI, CANB, MEL); Murchison House Stn, 10 miles [*c.* 16 km] NE of mouth of Murchison R., Aug. 1967, *C.H. Gittins* 1622 (NSW, PERTH); 11.5 km E of Jurien, 26 Sep. 1976, *R.W. Johnson* 3249 (BRI, K, MO, PERTH); 15.5 km ENE of Kalbarri on road to The Loop, Kalbarri National Park, 1 Aug. 1995, *T.R. Lally* 611 (CANB, PERTH); Junction of Midland Road and Helena Valley Road, 15 km WNW of Mundaring Weir, 3 Sep. 1995, *B.J. Lepschi* 1955 (CANB, K, L, PERTH, US); ± 47 mile peg on Dale Highway [= *c.* 17 km W of Dale], 30 Aug. 1963, *K. Newbey* 867 (PERTH); 20 km S of Regans Ford at Moore River (along Brand Hwy), 26 Sep. 1989, *B. Nordenstam & A. Anderberg* 11 (PERTH, S).

Distribution. Occurs from Murchison House Station (immediately north of Kalbarri), south to Red Lake Reserve (north-west of Harvey), Western Australia; from near the coast in the west, inland to Yandanooka, Eradu, Moora and the Dale River (south-west of Beverley). (Figure 3)

Habitat. Recorded from a variety of sandy soils (white to brown sands, including beach dunes, in the south, and yellow to red or black sands in the north), either deep sand, or sand over laterite or limestone. Once recorded from loam (*Newbey* 867) at its south-eastern limit, and once on laterite (*Armstrong* 50). Vegetation communities range from *Eucalyptus* and/or *Banksia* woodlands with a heathy understorey in southern areas, to sandplain heath for northern localities.

Phenology. Flowering May to February (but mainly August to September), and fruiting October to February.

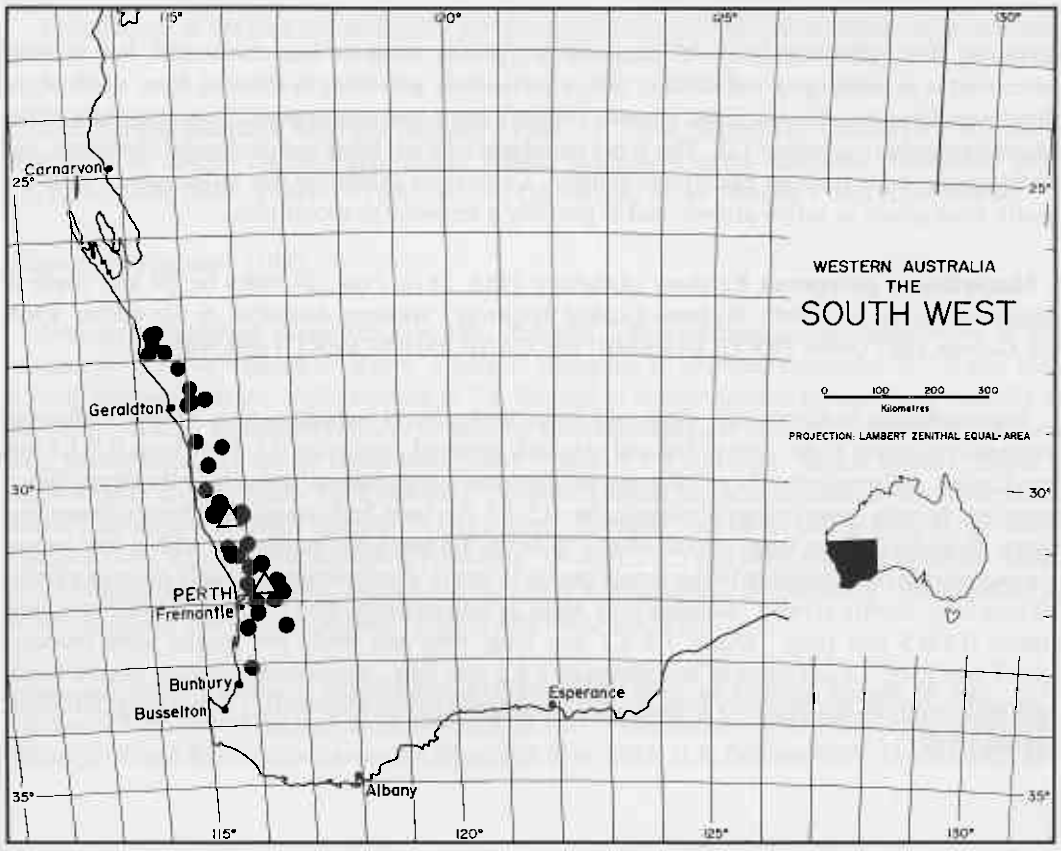

Figure 3. Distribution of *Macarthuria australis* (●) and *M. keigheryi* (△).

Conservation status. Not considered to be at risk. Widespread and common over a considerable range, with populations in a number of conservation reserves.

Typification. No type material of *Macarthuria australis* has been located at herb. W, where Hügel's herbarium is held (Stafleu & Cowan 1979), and it is believed to have been destroyed during the Second World War (E. Vitek *pers. comm.*). Searches for type material at other herbaria (e.g. B, BR, CGE, HBG, K, LE, M, MEL, P and WRSL) where duplicates may exist have also been unsuccessful. A neotype is therefore nominated for *M. australis*. It agrees well with the protologue, except that stamens are consistently eight rather than ten, the staminal ring is white to cream (both in dried and live material) as opposed to pink, and the ovary is strictly 3-locular rather than 3- or 4-locular; this is also consistent for all other material of this species examined by the present author. Endlicher appears to have misinterpreted these characters, or perhaps based his observations on teratological material, as was suggested by Steetz (1848) and Harvey (1855).

Notes. *M. australis* is easily distinguished from all other taxa in Western Australia in having two or three ovules per locule. However in *M. vertex* an additional one or two ovules are sometimes produced, but at least one locule in any given flower has a single ovule, a situation not found in *M. australis*. *M. australis* superficially resembles *M. georgeana* and *M. keigheryi*, but can be distinguished from these taxa (apart from ovule number) by a number of vegetative and floral characters (see under relevant species).

Note that in the key to *Macarthuria* in Marchant *et al.* (1987) the characters on ovule numbers have been inadvertently transposed; *M. australis* has two or three ovules per locule (as per description and illustration), while *M. apetala* has only one.

Variation. The inflorescence in *M. australis* is typically more or less condensed, but in some collections it is more open and diffuse; this is particularly prevalent in material from north of the Murchison River (e.g. *Craven* 7064, *Hnatiuk* 760506), but is also seen in plants from elsewhere within the species range (e.g. *Alford* 11). This is not correlated with any other morphological characters, and would appear to be (at least partly) ontogenetic. Collections exhibiting this inflorescence form are mostly from plants in active growth, and is possibly a response to recent rain.

3. Macarthuria georgeana Keighery (Keighery 1983: 387). *Type*: 24 miles [*c.* 39 km] north of Murchison River on North Western Coastal Highway, Western Australia, 6 November 1966, *A.S. George* 7887 (*holo*: PERTH 01560301; *iso:* CANB 351839, PERTH 03634876)

Erect *subshrub* to 40 cm high, glabrous. *Stems* terete, finely verrucose, rusty-brown or glaucous (when dried), apices acute. *Leaves* reduced to scales, scattered, triangular, 0.7-2 mm long, 0.5-1.5 mm broad, acute. *Inflorescence* of 1 or 2 flowers, in contracted cymes inserted laterally on the stems. *Bracts* numerous, broadly ovate to (rarely) subcircular, 0.5-1.3 mm long, herbaceous, dark brown (inner ones paler). *Pedicels* 2-3 mm long. *Sepals* elliptic to ovate, 3-4 mm long; herbaceous with a very narrow scarious margin (both outer and inner sepals similar in form). *Petals* ovate to broadly ovate or elliptic, 2-3 mm long, shortly clawed. *Staminal ring* about as long as ovary; free filaments 0.5-1.2 mm long; anthers 0.4-0.5 mm long. *Ovary* 1.8-2.2 mm long, with one ovule per locule; style branches 0.5-0.7 mm long. *Fruit* more or less globular, 3-3.5 mm long. *Seeds* dark brown to almost black, apparently smooth, shining, very broadly comma-shaped (almost ellipsoid), 1.7 mm long; aril large. (Figure 4A-D)

Other specimens examined. WESTERN AUSTRALIA: Sandplain 30 miles [*c.* 48 km] N of Ajana, 28 Aug. 1931, *W.E. Blackall* 595 (PERTH); Sandhills north of Murchison River, 30 Aug. 1930, *C.A. Gardner* 2580 (PERTH); 22 miles [*c.* 35 km] N of Galena, Aug. 1967, *C.H. Gittins* 1587 (BRI, NSW, PERTH); 96 km N of Northampton, 6 Aug. 1976, *R.J. Hnatiuk* 760456 (PERTH).

Distribution. Currently only known from the north-eastern portion of Eurardy Station, *c.* 95 km north of Northampton, adjacent to the North West Coastal Highway, Western Australia. (Figure 1)

Habitat. Occurs in scrub heath and mallee scrub communities on deep yellow sand, the 'Eurardy System' of Beard (1976a).

Phenology. Flowering August to September, with all known collections having been made during this period. *Gittins* 1587 has a few mature fruits also, but is predominantly flowering; it is likely that the main fruiting period occurs later in the season, probably October to February.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 1. *M. georgeana* is not known to occur in any reserves, and there are no recent measures of abundance. It has also not been collected for nearly 20 years, although this may not be an indication of actual rarity. Surveys are required to ascertain whether it occurs in nearby areas of similar habitat, especially Kalbarri National Park.

Notes. M. georgeana is distinct in its finely verrucose, often rusty stems, and few-flowered inflorescences with large petal-bearing flowers.

Descriptions of the fruit and seed of *M. georgeana* are based on the few available fruits on *Gittins* 1587.

4. Macarthuria intricata Keighery (Keighery 1982: 5). *Type*: Hamelin to Tamala [= *c.* 6.5 km W of junction of road to Denham and road to Tamala Station], Western Australia, 10 October 1973, *J.S. Beard* 6789 (*holo:* PERTH 01560328; *iso:* CANB *n.v.*, NSW 369259, PERTH 03634884)

Illustration. Keighery (1982: 5).

Intricately branched *shrub* 0.5-1 m tall, glabrous. *Stems* terete, green, often more or less spinescent. *Leaves* reduced to scales, scattered, triangular to rounded triangular, 0.7-1 mm long, 0.5-0.8 mm broad, acute. *Inflorescence* of 2-6 flowers, in cymes inserted terminally or laterally on the stems. *Bracts* rounded-triangular to broadly rounded-triangular or angular-ovate, 0.5-0.7 mm long, herbaceous, dark brown (inner ones paler). *Pedicels* 1-2 mm long. *Sepals* broadly elliptic to subcircular or broadly ovate, 1.8-2 mm long; the outer 3 sepals herbaceous (inner 2 less strongly so), with a very narrow scarious margin. *Petals* absent. *Staminal ring* about half as long as the ovary; filaments 0.5-1 mm long; anthers 0.4-0.5 mm long. *Ovary* 1.2-1.5 mm long, with one ovule per locule; style branches 0.6-0.7 mm long. *Fruit* ovoid to more or less globular, 2.5-3 mm long. *Seed* dark brown to almost black, tuberculate, shining, 1.5-1.6 mm long, aril large.

Other specimens examined. WESTERN AUSTRALIA: West of Coburn Station, 8 Apr. 1975, *J.S. Beard* 7394 (PERTH); Red Bluff, Kalbarri, 11 Nov. 1980, *Bellairs* 2345 (PERTH); On boundary of Golf Club and Kalflora, outskirts of Kalbarri, 18 Mar. 1995, *D.R. Bellairs* 1097 (CANB, PERTH);

1.5 miles [*c.* 2 km] from turnoff from Denham road on Tamala Station road, 16 Mar. 1968, *S.G.M. Carr* 380 (PERTH); Nanga Station, 15 Nov. 1982, *R.J. Cranfield* 2589 (PERTH); 5.7 miles [*c.* 9 km] [along] Tamala road [to Tamala Station from Denham road], 9 Dec. 1974, *H. Demarz* 5526 (PERTH); Shark Bay: entrance to Tamala and Hamelin Stations, 21 July 1988, *P. Morat* 8274 (P, PERTH); Tamala road, on Nanga Station, Shark Bay, 26 Aug. 1973, *E.C. Nelson* ANU 17322 (CANB, PERTH); Murchison River, *s. dat.*, *Oldfield s.n.* (BRI AQ 277518, MEL); *c.* 25 km NW of Tamala Station Homestead, 18 Sep. 1989, *M.E. Trudgen* 7162 (CANB, PERTH); Tamala, 12 Aug. 1976, *E. Wittwer* 1806 (PERTH).

Distribution. Occurs on Nanga and possibly Coburn Stations, in the southern Shark Bay region, Western Australia. Also occurs in the Kalbarri-Red Bluff area, *c.* 120 km south of the species' main range. (Figure 1)

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 3. While some populations are within the Shark Bay World Heritage Area, this has no conservation status, and at least one population at Kalbarri has been destroyed as a result of clearing activities (D.R. & B. Bellairs, pers. comm.). Further surveys are urgently required to assess the possible occurrence of *M. intricata* in any reserves, in particular Kalbarri National Park.

Habitat. In the Shark Bay area *M. intricata* occurs in low open shrubland, the 'Tamala System' of Beard (1976b), on red sand over limestone. Once recorded from red sandy clay (*Cranfield* 2589). At Kalbarri and Red Bluff, *M. intricata* has been collected from scrub vegetation on black sand over limestone (*Bellairs* 2345) and shrubland on grey sand over sandstone (*Bellairs* 1097).

Phenology. Flowering recorded July-April, fruiting November-March.

Notes. This species is easily distinguished by its intricate branching with the leaves reduced to appressed, triangular scales (this leaf character also occurs in *M. georgeana*, but the latter differs in a number of other characters). It is also the only member of the genus which could be considered a true shrub.

The label on *Trudgen* 7162 states "[flowers] visited by a small butterfly".

5. Macarthuria keigheryi Lepschi, *sp. nov.*

Sp. nov. *M. apetalae* Harv. affinis a qua planta pubescenti, floribus majoribus, petala plerumque ferentibus, testa laevi differt.

Type: *c.* 30 km W of Dandaragan [precise locality withheld for conservation reasons], Western Australia, 15 December 1989, *B.J. Keighery* 743B (*holo:* PERTH 04176782; *iso:* CANB, K, PERTH 01298283, US).

Erect *subshrub* to 40 cm tall. *Stems* terete, green, ageing yellowish-green in life; all vegetative parts and outer whorl of sepals hairy with more or less coarse, short, spreading, simple hairs (i.e. hirsute). *Leaves* sessile to obscurely petiolate, present mainly towards the base of the stems and on young growth, becoming progressively reduced further up the stems; lamina obovate to very narrowly obovate or narrowly to very narrowly elliptic, 2.7-11.5 mm long, 0.7-3.5 mm broad; base

cuneate to narrowly cuneate; apex shortly acuminate to narrowly acute. *Inflorescence* of 1-25(30) flowers in somewhat condensed cymes, becoming more diffuse in fruit, inserted terminally (or laterally), on the stems. *Bracts* rounded-triangular to triangular or subulate, 1.2-4 mm long, herbaceous with a narrow scarious margin, the herbaceous portion hirsute, greenish. *Pedicels* 2.5-6 mm long. *Sepals* ovate to narrowly ovate, 2-3.5 mm long, herbaceous (inner 2 scarious, glabrous) with a scarious margin, the herbaceous portion hirsute, green, ageing golden-yellow in life. *Petals* usually present (though sometimes absent), very narrowly obovate to narrowly elliptic, 2-2.5 mm long, occasionally obscurely clawed. *Staminal ring* about one-third to half as long as the ovary; free filaments 0.9-1.5 mm long; anthers 0.4-0.5 mm long. *Ovary* 1.8-2 mm long, with one ovule per locule; style branches 0.7-0.8 mm long, stigma at apex. *Fruit* ovoid to more or less globular, 2.5-3 mm long. *Seeds* dark brown to almost black, faintly reticulate-areolate so as to appear almost smooth, shining, broadly comma-shaped, 1.3-1.4 mm long; aril large. (Figure 4E-H)

Other specimens examined. WESTERN AUSTRALIA: Kewdale, 7 Sep. 1976, *R.J. Coveny* 8180 (NSW, PERTH); Type locality, 6 Nov. 1988, *B.J. Keighery* 517B, (MEL, PERTH); Type locality, 21 Oct. 1990, *B.J. Keighery* 1990/13 (PERTH); Type locality, 11 Sep. 1991, *S.J. Patrick* 795 (PERTH); Dundas road, Forrestfield, 28 Feb. 1996, *B.J. Keighery* 2109A, B, C (PERTH).

Distribution. Known only from the type locality, *c.* 30 km west of Dandaragan, and from the Kewdale-Forrestfield area, in the eastern part of Perth, Western Australia. (Figure 3)

Habitat. Recorded from open *Banksia* woodland (generally *B. attenuata* and *B. menziesii* dominant) with a heathy understorey and often with some scattered eucalypts, on white or grey sand. Plants at the Forrestfield site were frequently associated with areas where *Kingia australis* occurred.

Phenology. Flowers recorded September-December and February-March, fruits recorded December and February-March.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 1. This species is known from only two populations (Dandaragan and Forrestfield), neither of which is on protected land; the third population at Kewdale has not been relocated since its initial discovery in 1981.

Etymology. This species is named after Greg Keighery, in recognition of his contributions to Australian botany. He was also the first to recognize this taxon as distinct.

Notes. This taxon has been previously known as *Macarthuria* sp. Mullering (B.J. Keighery 517), *Macarthuria* sp. aff. *georgeana* (B.J. Keighery 517), or *Macarthuria* sp. aff. *georgeana* (B.J. Banyard 517) ('Banyard' is in error and should read 'Keighery') in herb. PERTH and in lists of priority flora (e.g. Hopper *et al.* 1992).

M. keigheryi is the only member of the genus in which the vegetative parts and outer sepals are always hairy. *M. vertex* is sometimes hairy, but *M. keigheryi* is easily distinguished from hairy forms of *M. vertex* by its inflorescence structure, more robust stems, virtually smooth seeds, geography and ecological preference. *M. keigheryi* is probably allied to *M. apetala*, from which it differs in the presence of indumentum, predominantly terminal inflorescences, larger flowers (generally with petals) and smooth seeds.

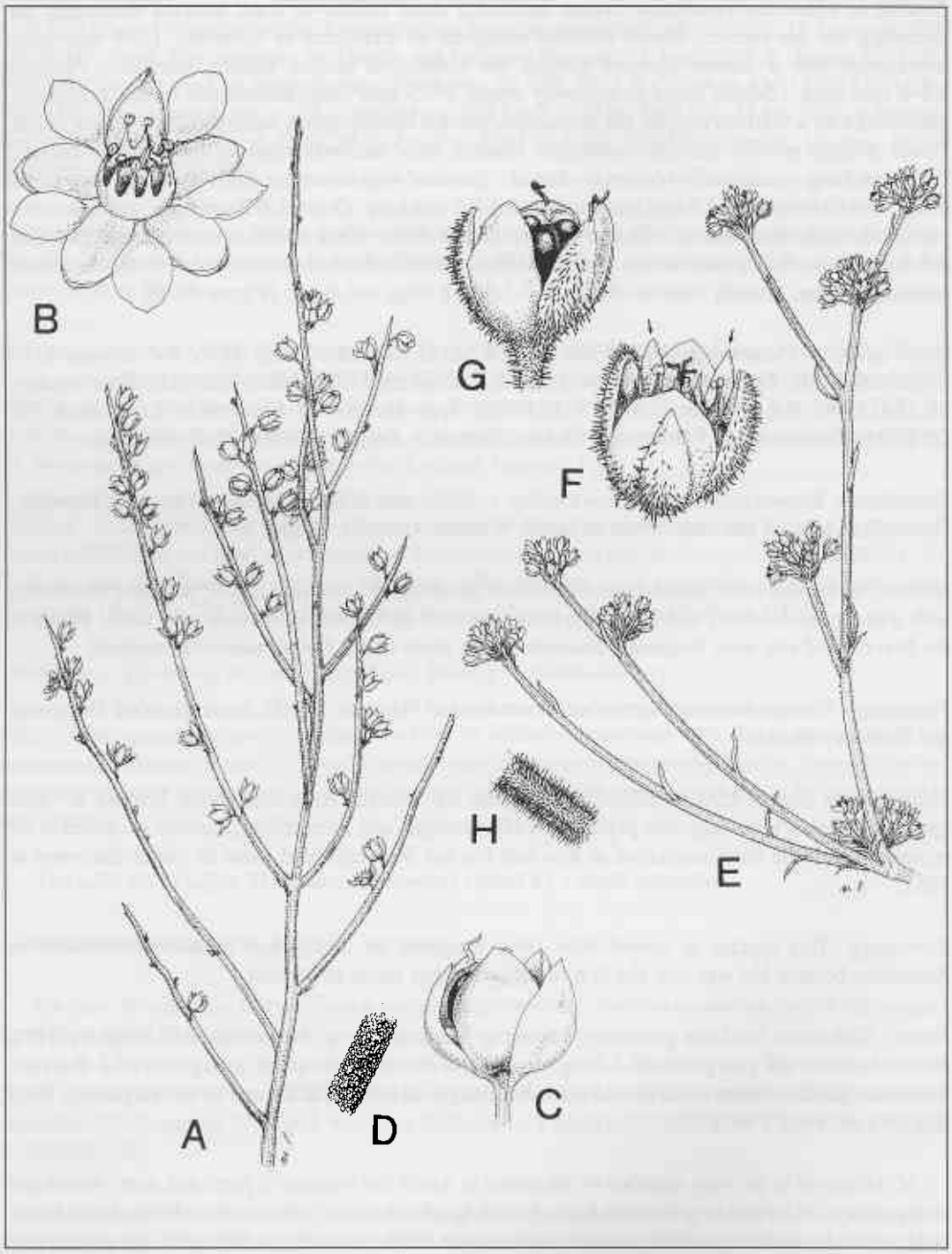

Figure 4A-D. *Macarthuria georgeana* A - flowering branchlet (x1), B - flower (x4.5), C - fruit (x6), D - detail of branchlet surface (x3.5); E-H. *M. keigheryi* E - flowering branchlet (x1), F - flower (3 petals removed; 2 remaining petals arrowed) (x6), G - fruit (x6), H - detail of branchlet surface (x3.5). Drawn from *C.A. Gardner* 2580 (A, B, D), *C.H. Gittins* 1587 (C) and *B.J. Keighery* 743B (E-H).

Plants from the type locality were described as being common to abundant along a fire break during 1988-1990, but uncommon in adjacent woodland. At the same site in 1991, only one plant was found (*Patrick* 795), suggesting that, along with some other *Macarthuria* species, *M. keigheryi* is a disturbance opportunist. This species may also respond favourably to fire, as the Forrestfield site was burnt during 1994/1995.

6. Macarthuria vertex Lepschi, *sp. nov.*

Macarthuria apetala auct. non Harv. (Harvey 1855: 55).

Sp. nov. *M. ephedroide* C.T. White affinis a qua planta plerumque pubescenti, caulibus teretibus et floribus semper petala ferentibus differt.

Type: *c.* 4 miles north-east of Mudginbarry Homestead, Northern Territory, 7 July 1972, *M. Lazarides* 7565 (*holo:* CANB 250669 (photo PERTH); *iso:* BRI AQ 177395; B, DNA, K, L, NSW, US all *n.v.*).

Illustration. Wheeler *et al.* (1992: 140) (as '*Macarthuria* sp. A').

Erect to spreading, or rarely prostrate *subshrub* or *shrub* 0.7(2) m tall, glabrous, or the vegetative parts and outer whorl of sepals hairy with coarse, short, spreading, simple hairs (i.e. scabrous to less often hirsute), and/or blunt, short papillae. *Stems* terete, slender, green to yellowish, often glaucous or greyish when dried. *Leaves* present mainly towards the base of the stems and on young growth, becoming progressively reduced further up the stems, sessile to obscurely petiolate; lamina narrowly to linear-obovate, very narrowly to linear-ovate or subulate, or very narrowly elliptic to linear, 2-81 mm long, 0.3-7 mm broad; base very narrowly cuneate to attenuate; apex acute to narrowly acute or rarely very shortly acuminate. *Inflorescence* of 1-6 flowers in contracted cymes at the apex of the ultimate inflorescence branchlets (rarely some borne laterally as well). *Bracts* narrowly to very narrowly triangular, or rarely very narrowly ovate or subulate, 0.5-2 mm long, herbaceous, brown. *Pedicels* 0.5- 6.5 mm long. *Sepals* ovate to (rarely) broadly or narrowly ovate, ovate-elliptic or elliptic, 1.5-4.2 mm long, herbaceous (inner 2 weakly herbaceous to scarious, rarely with some small papillae in hairy plants), occasionally with a narrow scarious margin. *Petals* elliptic to very narrowly elliptic, 1.5-3 mm long, base attenuate, generally obscurely clawed. *Staminal ring* about half as long as the ovary; free filaments 0.5-1.1 mm long; anthers 0.3-0.7 mm long. *Ovary* usually with 1 ovule per locule (3 in total; occasionally an additional 1 or 2 ovules may be present (4 or 5 in total), but these generally do not develop further), 1-2.7 mm long, style branches 0.4-0.6 mm long, stigma at apex. *Fruit* ovoid to ellipsoid or more or less globular, 2-3.5 mm long. *Seeds* black, tuberculate, shining, broadly comma-shaped, 1.3-1.7 mm long; aril large. Mostly only 1-3 seeds per fruit are produced but rarely 4 or even 5 may be present.

Selected specimens examined: WESTERN AUSTRALIA: Manning Gorge, 275 km SW of Wyndham, 9 June 1976, *A.C. Beauglehole* 52580 (PERTH); Near Solea Falls, Drysdale River National Park, 12 Aug. 1975, *A.S. George* 13767 (PERTH); 4 km N of Kalumburu, 24 June 1978, *A.S. George* 15197 (BRI, CANB, MEL, PERTH); Adjacent to King George River above Falls, 7 June 1992, *K.F. Kenneally* 11269 (DNA, PERTH); S side of Walcott Inlet & about 1 km W of the mouth of the Isdell River, 25 Mar. 1995, *A.A. Mitchell* 3540 (CANB, PERTH).
NORTHERN TERRITORY: Mt Brockman, 13 km S of Jabiru East, 8 June 1980, *L.A. Craven* 6497 (CANB); Top of Jim Jim Falls, 30 Jan. 1981, *C.R. Dunlop* 5683 (DNA, MEL, NSW); *c.* 26 miles [*c.* 42 km] E of Oenpelli Mission, 17 Feb. 1973, *M. Lazarides* 7755 (BRI, CANB, DNA); Koongarra, 30 May 1978, *B.L. Rice* 2663 (CANB); Tributary of 17 mile Creek NE of Katherine, 21 Mar. 1965, *I.B. Wilson* 397 (CANB, DNA, K, L, NSW, US).

Distribution. Disjunct in northern Australia. In Western Australia recorded from the Kimberley Region at Drysdale River National Park, Kalumburu, King George River, Walcott Inlet and Manning Gorge, north-east of Fitzroy Crossing. In the Northern Territory it occurs from north-north-west of Oenpelli, south to Katherine Gorge National Park and east as far as the Mann and Cadell Rivers. (Figure 5)

Habitat. Recorded from sand over sandstone or deep sand, frequently associated with sandstone outcrops, escarpments and other rocky sites. Often growing in rock crevices or amongst boulders, less frequently in alluvial sands along watercourses and floodouts. Vegetation communities include low open *Eucalyptus* woodland or (rarely) forest, open shrubland, and sparse shrubs, herbs and grasses on rocky sites. Also recorded as a component of post-fire regeneration (*Forster* 6116).

Phenology. Flowering and fruiting recorded all months of the year.

Conservation status. Apparently common at least in the Northern Territory; the few records from Western Australia probably reflect poor collecting rather than rarity. Occurs in a number or conservation reserves, including national parks, within its range.

Etymology. Named from the Latin *vertex* (height, elevation, peak), in reference to the species' inflorescence structure, where the cymes are inserted at the apices of the uppermost branchlets of the inflorescence. The epithet is used here deliberately as a noun in apposition.

Notes. This is *Macarthuria* sp. A of Wheeler *et al.* (1992). Also referred to as *Macarthuria* sp. A Kimberley Flora (*A.S. George* 13767) *in herb.* at PERTH.

M. vertex can be distinguished from all other taxa in Western Australia by its inflorescence structure, in which the few-flowered cymes are borne predominantly at the apices of the ultimate inflorescence branchlets. It is the only *Macarthuria* species in Western Australia which occurs outside the South-west Botanical Province. *M. vertex* is probably most closely related to *M. ephedroides*, a species from central Queensland, with which it shares similar inflorescence structure and floral and seed characters, but can be distinguished by the frequent presence of indumentum, terete rather than

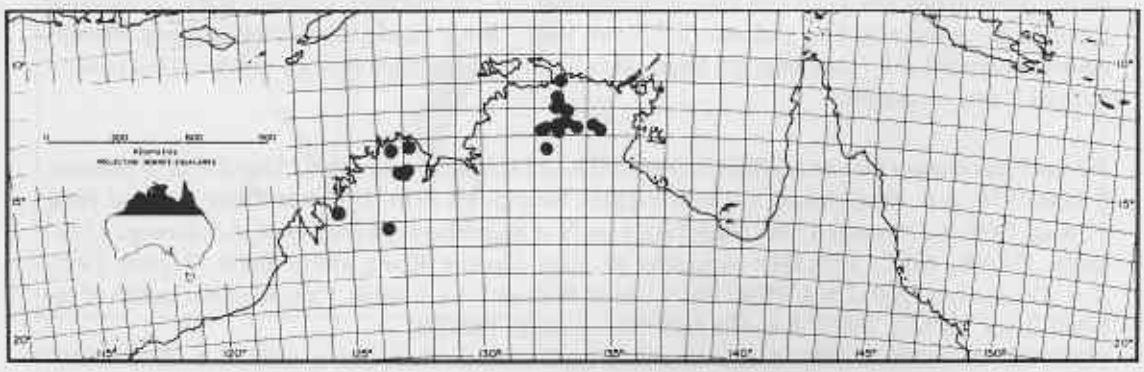

Figure 5. Distribution of *Macarthuria vertex*.

flattened stems and generally more floriferous cymes with consistently petal-bearing flowers. In the protologue of his new species, White (1946) describes *M. ephedroides* as having apetalous flowers, and this has been followed in other publications (e.g. Stanley & Ross 1983). However, from examination of further herbarium collections (e.g. *Speck* 1926) it is apparent that flowers with petals are occasionally produced; a photograph of a plant of *M. ephedroides* with petal-bearing flowers is also in Pearson & Pearson (undated).

M. neocambrica, an eastern Australian species, is also similar to *M. vertex*. It differs in being a generally smaller, consistently glabrous perennial herb (or subshrub), with large, well-developed basal leaves usually present at anthesis (though sometimes withered, especially in sub-shrubby plants) and usually persisting into the fruiting stage, often with some large cauline leaves also. Also, the inflorescence is frequently dichotomously branched, with the flowers solitary at nodes within the inflorescence as well as in few-flowered cymes at the apex of the ultimate inflorescence branchlets. An inflorescence structure approaching that of *M. neocambrica* is sometimes found in flowering/fruiting seedlings of *M. vertex* (e.g. some plants of *Craven* 2297 and *Lazarides* 7797); however, other plants from the same collections have inflorescences typical of *M. vertex*. No such variation has been observed in mature plants of *M. vertex*.

Further study is required to assess the status and affinities of a probable undescribed taxon of *Macarthuria* from northern Queensland (e.g. *Clarkson* 5447, *Clarkson & Neldner* 8648, *Forster et al.* 10583; all BRI) which appears to be allied to the *M. ephedroides* - *M. neocambrica* - *M. vertex* group.

Variation. *M. vertex* is variable with regard to the presence or absence of indumentum, with hairy and glabrous individuals occurring throughout the species range; however, there seem to be no other morphological characters which correlate with the presence or absence of indumentum, nor any apparent geographic separation or ecological differences, and these variants have not been afforded any taxonomic status. There is also gradation from glabrous plants (such as the type) through to plants with some short papillae on the vegetative parts (e.g. *Forster* 6116, *Fox* 2552) to hairy plants (e.g. *Must* 1058, *Rice* 2663). Both variants may be present in the same area (e.g. Nabarlek), but it is not known whether they occur in mixed populations. Papillate collections of *M. apetala*, a normally glabrous taxon, have also been recorded.

Plants of *Russell-Smith* 814 are recorded as being up to 2 m tall; this is quite exceptional, as the height stated on most other collections rarely exceeds 1 m.

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