A taxonomic review of the genera *Lachnostachys*, *Newcastelia* and *Physopsis* (Chloanthaceae) in Western Australia

B.L. Rye

Western Australian Herbarium, Department of Conservation and Land Management,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

Abstract

Rye, B.L. A taxonomic review of the genera *Lachnostachys*, *Newcastelia* and *Physopsis* (Chloanthaceae) in Western Australia. Nuytsia 11(1): 79-107 (1996). Three species are transferred from *Newcastelia* to *Physopsis*, bringing the total number of species in the latter genus to five. Keys are provided for the genera of tribe Physopsideae and the species belonging to *Lachnostachys*, *Newcastelia* and *Physopsis*. Information on the Western Australian members of each of these three genera, including distribution, habitat, flowering time and conservation status, is also given, and the new species *Newcastelia roseoazurea* Rye is described.

Introduction

A recent survey of Western Australian plants of conservation priority in the family Chloanthaceae revealed problems with the delimitation of the genus *Physopsis* and also the infraspecific entities included in *Lachnostachys* and *Newcastelia*. A few species traditionally included in *Newcastelia* were found to match *Physopsis* in all characters except their usually 5-merous flowers, yet differed in several characters from other members (including the type) of *Newcastelia*. Only two species, both with consistently 4-merous flowers, had been included in *Physopsis* and both appeared to be more closely related to at least one of the 5-merous '*Newcastelia*' species than to one another. This paper addresses these anomalies by transferring three species from *Newcastelia* to *Physopsis*.

Physopsis, *Lachnostachys* and *Newcastelia* are closely related genera belonging to tribe Physopsideae, the first two endemic to south-western Australia and the last extending from Western Australia east to Queensland. The history of all members of the tribe is presented in detail in Munir (1978). Munir's taxonomic revision also provides detailed descriptions and illustrations of all the species except for one new *Newcastelia* species, which is described and illustrated in this paper. The information given here for the previously described taxa is restricted mainly to new data relating to the altered generic limits and to areas not covered in the revision, such as habitat, flowering time and conservation status. New distribution maps are also provided, incorporating the data from recent collections and disregarding some localities from old collections that appear to be vague or otherwise misleading.

Materials and methods

Apart from a few specimens borrowed from DNA and type specimens seen at MEL, all material examined in this study is housed at PERTH. A few recently collected specimens are cited to supplement the specimens cited previously by Munir (1978); all of them are represented at PERTH and many of them have duplicates at other herbaria.

For simplicity, the term 'spike' is used throughout for the spike-like inflorescences found in the three genera, but is not strictly correct as the cymes and flowers are subsessile or shortly stalked rather than sessile. The botanical provinces cited for Western Australia follow Beard (1980). Each symbol used on the geographical distributions indicates the presence of the species in an area measuring 0.25 degree latitude by 0.25 degree longitude. Conservation codes are those adopted by the Western Australian Department of Conservation and Land Management for its Gazetted Rare and Priority Flora List; they are defined at the end of this Nuytsia issue.

Taxonomic treatment

Table 1 compares the geographical distributions and morphological characteristics of the five genera currently recognized in tribe Physopsideae. It should be noted that generic and infrageneric boundaries in the *Dicrastylis-Mallophora* group need further investigation, but that is beyond the scope of this paper.

Key to genera of tribe Physopsideae

1. Style with dendritic hairs on basal part, the hairs 0.3-0.7 mm long; upper part of style divided into 2 branches or distinctly 2-lobed (in *Mallophora rugosifolia* Munir, the lobes are sometimes only *c.* 0.2 mm long). Calyx tube much to slightly shorter than, or rarely equalling, the calyx lobes
   2. Flowers all or mostly 5-merous or (in *Dicrastylis archeri* Munir and *D. capitellata* Munir) with the calyx mostly 5-lobed but corolla lobes and stamens mostly 4. Style hairy on more than half of the undivided portion and sometimes on the branches as well; branches usually about as long as undivided portion but sometimes almost reaching base of style or as little as 1/4 length of style ..... **Dicrastylis**
   2. Flowers all or mostly 4-merous. Style hairy only on the basal half of the undivided portion; branches or lobes short, less than 1/3 the length of the style ..... **Mallophora**
1. Style glabrous throughout or with simple or 2-branched hairs on basal half, the hairs up to 0.3 mm long; apex notched or 2-lobed. Calyx tube greatly to slightly exceeding, or rarely equalling, the calyx lobes
   3. Upper leaf surface slightly to distinctly rugose, becoming glabrous. Corolla yellow or white; lobes 4 or 5, broadly obtuse, either with prominent reticulate veins or thickened and with no veins visible ..... **Physopsis**

3. Upper leaf surface shallowly to deeply bullate, densely covered in dendritic hairs or becoming glabrous on the summits of the bullae but with hairs retained between the bullae. Corolla purple, blue or white; lobes either (4)5-8 or very reduced, if fully developed then either narrrow throughout or with a narrow apical protrusion, thin-textured, with the midvein obvious and usually also a couple of lateral veins clearly visible on each side
   4. Corolla with (4)5-8 lobes alternating with the stamens; lobes either narrow throughout or narrowed into an apical protrusion. Ovary 4-celled or with cells becoming fewer by abortion at maturity, with 1 ovule per cell ..... **Newcastelia**
   4. Corolla lacking lobes or with very reduced short broad lobes, with (4)5-10(12) stamens arising at summit of floral tube and appearing to form a continuation of it. Ovary 2-celled at maturity, with 2 ovules per cell ..... **Lachnostachys**

Lachnostachys Hook.

Hooker (1841: tt. 414, 415). *Type: Lachnostachys ferruginea* Hook.

Small or medium-sized *shrubs*, erect or spreading. *Young stems* terete or (if leaves decurrent) appearing 4-ridged and 4-angled, with a very dense indumentum of non-glandular dendritic hairs. *Leaves* opposite-decussate, sessile, sometimes decurrent, entire; lower surface with a dense persistent indumentum of non-glandular dendritic hairs; upper surface shallowly to deeply bullate, covered with non-glandular dendritic hairs, which often hide the bullae, the hairs sometimes shed from the bullae summits but persistent between the bullae. *Inflorescence* of reduced, almost sessile cymes arranged in solitary or multiple spikes terminating leafy branchlets; spikes dense in bud, remaining dense (except in *Lachnostachys eriobotrya*, which usually has short internodes between adjacent pairs of cymes at maturity); cymes usually 3-flowered, in opposite-decussate pairs. *Flowers* (4)5-10(12)-merous, with equal numbers of calyx lobes, corolla lobes (if present) and stamens. *Calyx* densely dendritic-hairy outside, glabrous inside; lobes shorter than tube. *Corolla* mauve to deep purple, glabrous outside; lobes absent or very reduced, when present equal, much shorter than corolla tube and stamens, depressed-ovate or shallowly triangular, acute to almost truncate, glabrous, thin-textured, with the midvein prominent and usually a few lateral veins clearly visible. *Stamens* inserted at the summit of floral tube, alternating with the corolla lobes (when present) and appearing to form a continuation of the tube, long-exserted, glabrous; filament slender with an expanded base. *Ovary* becoming 2-celled at maturity, with 2 ovules in each cell. *Style* greatly exserted, glabrous or with non-glandular simple or deeply 2-branched hairs on basal half, sometimes also with dendritic hairs at the extreme base; apex notched. *Fruit* dry, indehiscent, 1- or rarely 2-seeded, enclosed in the persistent calyx.

A genus of six species endemic in south-western Australia, occurring primarily on sandy soils, often associated with laterite, in the South-west Botanical Province and South-western Interzone and extending slightly into the Eremaean Botanical Province. (Figure 1)

Lachnostachys is distinguished from its closest relative, *Newcastelia*, by its very reduced to absent corolla lobes and its 2-celled mature ovary; indeed these two characters are unique in tribe Physopsidae. Several additional characters distinguish *Lachnostachys* from other genera in the tribe, as indicated in the key and Table 1.

Table 1. Comparison of the geographical distribution and morphological characteristics of the five genera of tribe Physopsideae.

	Mallophora	*Dicrastylis*	*Physopsis*	*Newcastelia*	*Lachnostachys*
Distribution					
main area	south-west	south-west & arid zone	south-west	arid zone	south-west
Leaves					
upper surface	bullate	rugose to bullate	smooth to rugose	bullate	bullate
glandular dendritic hairs	absent	usually absent	usually present	absent	absent
Flowers					
no. of parts	4(5)	4,5(6)	4,5	(4)5-8	(4)5-10(12)
Calyx					
tube length	< lobes	≤ lobes	> lobes	≥ lobes	> lobes
Corolla					
colour	white	white or coloured	yellow or white	purple, blue or white	purple
lobes	obvious	obvious	obvious	obvious	absent or inconspicuous
lobes apex	obtuse	obtuse or subacute	broadly obtuse	attenuate to caudate	acute to truncate
lobes midvein*	not prominent	rarely prominent	not prominent	prominent	prominent
Style					
exsertion	exserted	exserted	included	included or exserted	exserted
indumentum	dendritic	dendritic	absent or simple	absent	absent, simple or 2-branched
apex	distinctly lobed or branched	branched	distinctly lobed	notched or slightly lobed	notched
Mature ovary					
ovules/cell	1	1	1	1	2

* The midvein is termed 'prominent' when it is more obvious or extending much further than the lateral veins and 'not prominent' when there is a prominent reticulate pattern of both types of veins or when the veins are not visible.

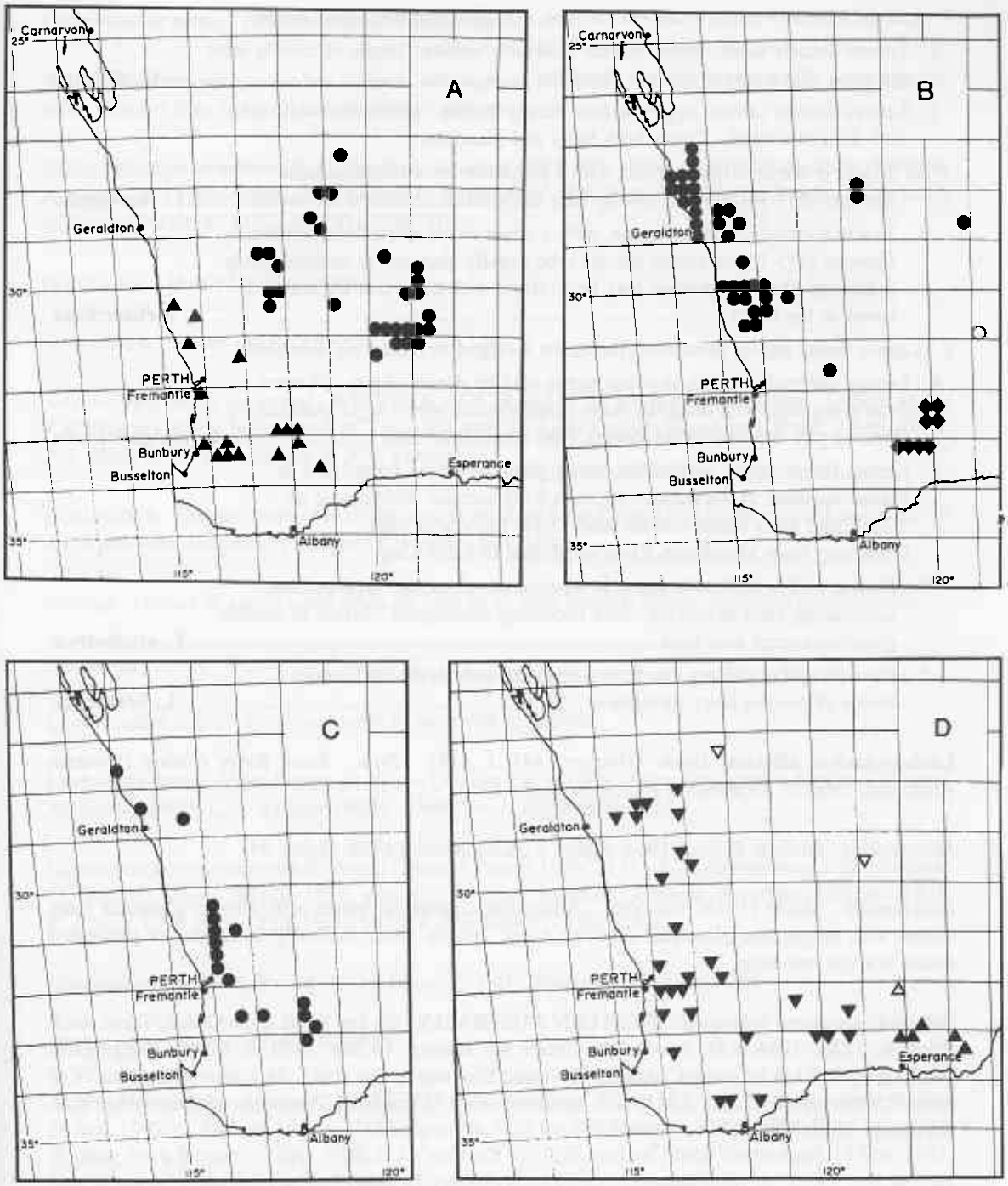

Figure 1. Geographical distribution of *Lachnostachys* species. A - *L. albicans* ▲ and *L. coolgardiensis* ● ; B - *L. bracteosa* ◆ and *L. eriobotrya* ● ; C - *L. ferruginea*; D - *L. verbascifolia* var. *paniculata* ▲ and *L. verbascifolia* var. *verbascifolia* ▼. Open symbols are used to indicate doubtful records, all of which date from before 1910.

Key to *Lachnostachys* species

1. Leaves narrowly ovate to almost circular, not decurrent (the stems terete)
   2. Leaves usually acute; upper surface shallowly bullate. Inside of corolla tube glabrous. Ovary hairy but not glandular ..... **L. albicans**
   2. Leaves usually obtuse; upper surface deeply bullate. Inside of corolla tube with dendritic hairs. Ovary both hairy and glandular
      3. Bracts ovate or broadly ovate, with a purple or brown indumentum. Flowers (6)7-10-merous; corolla tube hairy inside almost to the summit ..... **L. ferruginea**
      3. Bracts narrowly ovate or ovate, with a white or off-white indumentum. Flowers (4)5-7(8)-merous; corolla tube usually glabrous at summit inside (although glabrous portion may be overlaid with hairs that are inserted lower in the tube) ..... **L. verbascifolia**
1. Leaves linear and/or decurrent (the stems 4-ridged or appearing 4-angled)
   4. Leaves narrowly oblong to ovate; upper surface densely hairy. Flowers 5- or 6-merous, with dendritic hairs inside corolla tube. Style glabrous. Occurring in the Sandstone-Paynes Find-Coolgardie area ..... **L. coolgardiensis**
   4. Leaves linear; upper surface becoming glabrous on the tuberculate or rugose summits of the bullae. Flowers 7-12-merous, with simple or 2-branched hairs inside corolla tube. Style hairy near base. Occurring from Murchison River south-east to Lake King
      5. Flower spikes several to many in an opposite-decussate arrangement terminating each branchlet, often becoming interrupted. Inside of corolla glabrous except near base ..... **L. eriobotrya**
      5. Flowers spikes solitary (each on a separate leafy branchlet), dense. Inside of corolla hairy throughout ..... **L. bracteosa**

Lachnostachys albicans Hook. (Hooker 1841: t. 414). *Type:* Swan River Colony [Western Australia], 1839, *J. Drummond s.n.* (*holo:* K *n.v.*).

Illustrations. Diels & Pritzel (1904: Figure 57A,B); Munir (1978: Figure 48).

Description. Munir (1978: 646-650). Additional characters: leaves with simple glandular hairs mixed with longer non-glandular dendritic hairs; corolla lobes shallowly triangular or depressed ovate, 0.3-0.6 mm long.

Selected specimens examined. WESTERN AUSTRALIA: 28 km W of Lake Grace, Tarin Rock Reserve, 2 Oct. 1984, *J.M. Brown* 306; Frazer Rd, Banjup, 18 Sep. 1979, *R. Carey*; Badgingarra National Park, 8 km W along Cadda Rd off Brand Highway, 8 Oct. 1985, *M. Carter* 407; 2 km W of Muja, Collie region, 9 Oct. 1981, *G.J. Keighery* 4083; 5 km E of Tincurrin, 26 Oct. 1982, *K.H. Rechinger* 59106.

Distribution. Extends from Badgingarra south to Collie and south-east to Tarin Rock, in the South-west Botanical Province of Western Australia.

Habitat. Occurs in sandy soils, commonly over laterite, in *Eucalyptus marginata* forest on the eastern side of the Darling Range and associated hills, or in shrublands in other areas.

Flowering period. Mainly August-October, also recorded March and May-June.

Conservation status. Not considered to be at risk.

Notes. This species always has distinct, although very reduced, corolla lobes, which are generally more obvious than in other *Lachnostachys* species.

Lachnostachys bracteosa C.A. Gardner (Gardner 1964: 47). *Type:* West of Lake King, Western Australia, 25 October 1961, *C.A. Gardner* 13636 (*lecto:* PERTH 01607340, *fide* Munir (1978: 669); *isolecto:* CANB, K, MEL, PERTH 01607308).

Illustration. Munir (1978: Figure 52).

Description. Munir (1978: 669-672).

Selected specimens examined. WESTERN AUSTRALIA: 10 km N of Lake Cronin, 13 Sep. 1981, *K.R. Newbey* 8795; Intersection of Tarco Rd with the Lake King to Newdegate Road, 7 Sep. 1986, *P.S. Short* 2755, *M. Amerena & F.A. Fuhrer*.

Distribution. Extends from near Hyden east to north of Lake Cronin and south-east to Lake King, in the South-west Botanical Province of Western Australia.

Habitat. Occurs in sandy soils, often on laterite or with lateritic gravel, recorded in shrublands.

Flowering period. September-December.

Conservation status. Not considered to be at risk at present.

Lachnostachys coolgardiensis S. Moore (Moore 1903: 100). *Type:* Coolgardie district, [Western Australia], 1900, *L.C. Webster* (NSW 106693 *n.v.*, illustration seen).

Lachnostachys brevispicata E. Pritzel (Diels & Pritzel 1904: 511). - *L. coolgardiensis* f. *brevispicata* (E. Pritzel) Munir (Munir 1978: 654-655). *Type:* Menzies, Western Australia, October 1901, *E. Pritzel* 1018 (*lecto:* PERTH 01607359, *fide* Munir (1978: 654)).

Illustrations. Diels & Pritzel (1904: Figure 57F-H); Munir (1978: Figure 49).

Description. Munir (1978: 650-655).

Selected specimens examined. WESTERN AUSTRALIA: 500 m [0.5 km] N of Gnarlbine Rocks, 28 Sep. 1992, *G. Barrett*; 104 km N of Kalgoorlie, *c.* 26 km S of Menzies, 3 Sep. 1985, *B.J. Conn* 1924; Walling Rock Station, 12 Sep. 1988, *R.J. Cranfield* 7371; 28 km E of Jaurdi Homestead, 17 Sep. 1981, *K.R. Newbey* 8820; 5.5 km S of Paynes Find, 10 July 1980, *C.I. Stacey* 643.

Distribution. Occurs in southern Western Australia, extending from Gidgee Station (north of Sandstone, in the Eremaean Botanical Province) south-west to Cleary (just inside the South-west Botanical Province), south to Boorabbin National Park and south-east to Boulder (in the South-western Interzone).

Habitat. Occurs in sandy soils of red, yellow or other colours, on sandplains, dunes or rarely on lateritic rises, in spinifex grasslands or in shrublands, sometimes in open woodlands.

Flowering period. June-October.

Conservation status. Not considered to be at risk.

Notes. Previously two forms of *Lachnostachys coolgardiensis* were recognised, f. *brevispicata* having broader leaves and larger spikes than f. *coolgardiensis* (Munir 1979: 645). As in many other species, there is a tendency for leaf size and inflorescence size to be correlated, but both characters show continuous variation with no clearcut division into forms. Such characters might also be expected to vary greatly within populations and individuals partly as a result of rainfall fluctuations from year to year, which can be extreme in arid environments.

Lachnostachys eriobotrya (F. Muell.) Druce (Druce 1917: 630). - *Walcottia eriobotrya* F. Muell. (Mueller 1859: 241-242). - *Lachnostachys walcottii* F. Muell. (Mueller 1861: 140). *Type:* Murchison River, Western Australia, *P. Walcott* (*lecto:* MEL 41166, *fide* Munir (1978: 673)).

Lachnostachys rodwayana W. Fitzg. (Fitzgerald 1904: 29). *Type:* Arrino, Western Australia, September 1903, *W.V. Fitzgerald* (PERTH 01607367).

Pycnolachne ledifolia Turcz. (Turczaninow 1863: 214-215). *Type:* Swan River [Western Australia], *J. Drummond* coll. 7, n. 220 (*holo:* KW *n.v.*, photograph PERTH 04134559).

Illustrations. Diels & Pritzel (1904: Figure 57C-E); Munir (1978: Figure 53).

Description. Munir (1978: 672-679). Additional characters: leaves often decurrent; corolla lobes absent or depressed ovate and up to 0.6 mm long; stamens 7-12, most commonly 8-10.

Selected specimens examined. WESTERN AUSTRALIA: 10 km S of Eneabba along Brand Highway, 24 Jan. 1979, *B. Barnsley* 893; Marr Rd, Watheroo National Park, 11 Oct. 1985, *M. Carter* 456; 13.2 km W of Coomberdale, on Coomberdale West Rd, 17 Oct. 1993, *B. Conn* 3857 *& M.E. Tozer*; Port Gregory road, 14.6 km NW of Northampton, 27 Sep. 1985, *N. Hoyle* 473; Eurady Station, 26 Sep. 1988, *P. Roberts* 907.

Distribution. Occurs mainly in the South-west Botanical Province of Western Australia, extending from north of Eurady Station (near Murchison River) south-east to near Moora, with an isolated record from Kellerberrin. There are also a few records from inland areas, including Mount Magnet and Sturt Meadows Station, in the Eremaean Botanical Province.

Habitat. Occurs in sandy soils, often over laterite, in low to tall shrublands or woodlands, sometimes dominated by *Banksia* or *Eucalyptus* species.

Flowering period. August-November.

Conservation status. Not considered to be at risk.

Notes. Flower size is extremely variable, with large-flowered specimens (having up to 12 stamens) more common north of Geraldton and small-flowered specimens (sometimes with as few as 7 stamens) more common south of Geraldton. Also, nearly all the specimens from north of Geraldton have decurrent leaves but this character is much less frequent south of Geraldton. Some specimens have distinct small corolla lobes up to 0.6 mm long.

Lachnostachys ferruginea Hook. (Hooker 1841: t. 415). *Type:* Swan River Colony [Western Australia], *J. Drummond* 14 (*holo*: K *n.v.*, illustration seen).

Lachnostachys ferruginea f. *acutifolia* Munir (Munir 1978: 659-660). *Type:* Kulin, Western Australia, September 1946, *A.M. Ashby* 16 (*holo:* AD *n.v.*; *iso:* PERTH 01292986).

Lachnostachys ferruginea f. *obtusifolia* Munir (Munir 1978: 663). *Type:* 100 miles [161 km] north of Perth, between New Norcia and Moora, Western Australia, 15 September 1958, *H. & E. Walter* 719 (*holo:* B *n.v.*)

Lachnostachys ferruginea f. *reticulata* Munir (Munir 1978: 659). *Type:* Tarin Rock, Western Australia, 26 October 1946, *A.M. Ashby* 1279 (*holo:* AD *n.v.*).

Illustration. Munir (1978: Figure 50).

Description. Munir (1978: 655-663).

Selected specimens examined. WESTERN AUSTRALIA: Tarin Rock Reserve, 1 Sep. 1990, *D.E. Albrecht* 4127 *& B.A. Fuhrer*; Near Avon Valley National Park, 28 Oct. 1985, *C. Barrow*; 3.5 km at 227 degrees from New Norcia, 31 Oct. 1990, *E.A. Griffin* 5927; *c.* 17 km by road N of Neendaling, 17 Aug. 1979, *L. Haegi* 1819; E edge of the Wongan Hills, *c.* 15 km N of township of Wongan Hills, 31 Aug. 1980, *K.F. Kenneally* 7465.

Distribution. Extends from Kalbarri National Park south-east to Lake Grace, in the South-west Botanical Province of Western Australia.

Habitat. Occurs in sandy or clayey soils, commonly over laterite or with lateritic gravel, in shrublands, often dominated by *Eucalyptus*, *Allocasuarina* or *Dryandra* species.

Flowering period. August-November.

Conservation status. Two of the forms of *Lachnostachys ferruginea*, namely f. *obtusifolia* and f. *reticulata,* were included on the Gazetted Rare and Priority Flora List, but have now been removed because they are no longer considered to be sufficiently distinct to warrant recognition. The species as a whole is not considered to be at risk.

Notes. In addition to the forms listed above as synonyms of *Lachnostachys ferruginea*, the varietal name var. *paniculata*, which was originally described under the closely related species *L. verbascifolia*, was transferred to this species by Munir (1978). More recently, Munir has redetermined several specimens of this taxon (e.g. *W. Archer* 2508903) as *L. verbascifolia*, a correction endorsed here. Var. *paniculata* matches *L. ferruginea* in its short calyx indumentum but in all other respects matches *L. verbascifolia*, and it occurs well beyond the known range of *L. ferruginea.* However, a taxon described originally under this varietal name, as var. *paniculata* f. *obtusifolia*, does belong in

L. ferruginea; it is from an area where there have been many collections of *L. ferruginea* but none of *L. verbascifolia*.

Of the forms previously recognized in *Lachnostachys ferruginea*, f. *acutifolia* and f. *reticulata* are separated from f. *ferruginea* by leaf characters, while f. *obtusifolia* is separated by its inflorescence consisting of more spikes. Two of the taxa, f. *obtusifolia* and f. *reticulata*, were named originally from single specimens. Since then, other specimens of both taxa have been collected from the type localities or nearby, as well as intermediate specimens from these or other sites. As *Lachnostachys ferruginea* shows continuous variation in each of the characters used to distinguish the forms, with considerable variation apparently occurring within populations, there appears to be no justification for maintaining these forms as distinct entities.

Lachnostachys verbascifolia is very closely related to *L. ferruginea* and, owing to the great variability of these taxa, particularly the former, key characters that are reliable throughout the range of both species are hard to find. Apart from the differences given in the key, *L. verbascifolia* can generally be distinguished from *L. ferruginea* by its longer leaves with a greater length/width ratio. Although both species have inflorescences varying from one to many spikes terminating each branchlet, *L. verbascifolia* almost invariably has more than one spike per branchlet whereas solitary spikes are fairly common in *L. ferruginea*. Of the two varieties of *L. verbascifolia*, only var. *verbascifolia* overlaps in geographical range with *L. ferruginea*, and this variety is readily distinguished by its longer calyx indumentum with fine antrorse branches on the dendritic hairs.

Lachnostachys verbascifolia F. Muell. (Mueller 1868: 158-159). *Type:* [Western Australia], *J. Drummond* coll. 5, n. 237 (*lecto:* MEL 41202, *fide* Munir (1978: 663)).

Description. Munir (1978: 663-669). Additional characters: flowers (4)5-7(8)-merous; calyx indumentum white or rarely very pale ferruginous.

Distribution. Occurs mainly in the South-west Botanical Province of Western Australia, extending from Pinjar south to Collie and Cranbrook and from there east to near Mt Coombaninya (south of Balladonia) and Mt Ragged. Also extends inland to Noongal Station (near Yalgoo) in the Eremaean Botanical Province, with a few other doubtful inland records.

Habitat. Occurs in sandy soils, rarely associated with laterite, in shrublands or woodlands, sometimes dominated by *Eucalyptus* species.

Flowering period. June-November.

Notes. Specimens from the north (in the Pinjar-Yalgoo-Wongan Hills area) always have a long indumentum on the stems and leaves, whereas those from the south-east (from near Grass Patch eastwards) have a relatively short indumentum, and there is a mixture of short- and long-haired specimens in intermediate areas. The south-eastern variant differs from other variants of the species in its shorter calyx indumentum with more spreading branches on the dendritic hairs; it has been recognized both at the species level, as *Lachnostachys dempsteri*, and at the varietal level, as *L. verbascifolia* var. *paniculata*. Varietal rank is currently accepted.

Most flowers are 5-7-merous, but occasional 8-merous flowers have been observed on a predominantly 7-merous specimen (*A.S. George* 6851) of var. *verbascifolia* and 4-merous flowers are as common as

5-merous flowers on at least one specimen (*W.R. Archer* 2209910) of var. *paniculata*. No 4-merous flowers have been reported in any other members of the genus *Lachnostachys*.

Lachnostachys verbascifolia var. **paniculata** Ewart (Ewart 1907: 58). - *Lachnostachys dempsteri* E. Pritzel (Diels & Pritzel 1904: 512). - *Lachnostachys ferruginea* var. *paniculata* (Ewart) Munir (Munir 1978: 660-663). *Type:* 85 miles [137 km] north-east from Esperance Bay, between Esperance Bay and Fraser Range, [Western Australia], 1884, *A. Dempster* (*lecto*: MEL 41206, *fide* Munir (1978: 660) for var. *paniculata*, here designated for *L. dempsteri*).

Selected specimens examined. WESTERN AUSTRALIA: 23 km NNE of Mt Buraminya, 14 July 1990, *W. Archer* 1407906; S of Crystal Lake, 25 Aug. 1990, *W. Archer* 2508903; 12 km W of Mt Coobaninya, 22 Sep. 1990, *W.R. Archer* 2209910; 27.5 km N of Mt Ridley, 20 Oct. 1990, *W.R. Archer* 2010902.

Distribution. Extends from Grass Patch (north of Esperance) east to near Mt Coombaninya (south of Balladonia) and Mt Ragged (in Cape Arid National Park).

Conservation status. Not considered to be at risk at present. Up to 1994 *Lachnostachys verbascifolia* var. *paniculata* was listed (under the name *L. ferruginea* var. *paniculata*) on the Gazetted Rare and Priority Flora List, but its apparent rarity resulted from having most of the specimens housed under *L. verbascifolia* with the variety not specified. Now that these specimens and those previously misplaced under *L. ferruginea* have been redetermined as *L. verbascifolia* var. *paniculata*, the variety is known from about nine localities, including one in Cape Arid National Park. It may be favoured by fires.

Notes. According to Munir (1978: 662), this taxon usually has 6-9 stamens per flower and rarely has 5 stamens or more than 9 stamens. In this study, stamen number was found to vary from 4 to 7, with the most common number being 5. Perhaps the larger stamen numbers recorded by Munir were from specimens of *Lachnostachys ferruginea* f. *obtusifolia* (see notes under *L. ferruginea*), which do have higher stamen numbers typical of those in *L. ferruginea*, rather than from true *L. verbascifolia* var. *paniculata*.

Ewart (1907) gave *Lachnostachys dempsteri* as a synonym of his new variety *L. verbascifolia* var. *paniculata* and included a type of *L. dempsteri* in his cited collections, evidently intending the two names to be equivalent. It therefore seems appropriate to choose the same lectotype here for *L. dempsteri* as that already nominated by Munir (1978: 660) for var. *paniculata*. The other two specimens cited by Munir are also less suitable choices for the lectoype because one (MEL 41207) lacks label details and the other (MEL 41139) has much less plant material on the sheet and an unreadable date on the label.

Lachnostachys verbascifolia F. Muell. var. **verbascifolia**

Lachnostachys cliftonii F. Muell. (Mueller 1875: 3-4). *Type:* Sources of Arrowsmith River, [Western Australia], *W. Clifton* (MEL 41140, 41186).

Lachnostachys cordifolia S. Moore (Moore 1921: 247). *Type:* Sand Springs, about 15 miles [24 km] south-east of York, Western Australia, *G. Turvey*, Herb. O.H. Sargent 808 (BM *n.v.*).

Illustration. Munir (1978: Figure 51).

Selected specimens examined. WESTERN AUSTRALIA: 42 km NE of Coujinup Hill, 27 km N of Rollands Rd on Carmody Rd, 25 June 1983, *M.A. Burgman* 1505 *& S. McNee*; Noongal Station, 9 Aug. 1993, *S. Dawson* 929; 75 km NE of Ravensthorpe, 4 km W of Dunn Swamp, 21 Sep. 1979, *J. Taylor* 767, *M.D. Crisp & R. Jackson*; E Perenjori, 25 July 1995, *J. Trott.*

Distribution. Extends from Pinjar and Noongal Station (near Yalgoo) south to Collie and Cranbrook and south-east to near the upper Young River.

Conservation status. Widespread and not considered to be at risk.

Notes. Three *O.H. Sargent* specimens from Sand Springs (south-east of York) were examined, one labelled 909a (PERTH 03718247) and the other two unnumbered (PERTH 03717739, 03717992). Although these were collected from the type locality of *Lachnostachys cordifolia*, they appear not to belong to the type collection but to have been collected shortly after the taxon was named, probably in 1924.

Newcastelia F. Muell.

Mueller (1857: 22). *Type: Newcastelia cladotricha* F. Muell.

Small or medium-sized *shrubs*, erect or spreading, with an indumentum of non-glandular dendritic hairs on the stems, leaves and calyces. *Young stems* terete, densely hairy. *Leaves* opposite-decussate or rarely (occasionally in *N. interrupta*) in whorls of 3, sessile or shortly petiolate, entire; lower surface with a dense persistent indumentum of dendritic hairs; upper surface bullate, covered with dendritic hairs, often also with sessile glands or simple glandular hairs but these generally hidden by the longer dendritic hairs. *Inflorescence* of reduced, almost sessile cymes arranged in solitary or multiple spikes or dense heads terminating leafy branchlets; spikes dense in bud, sometimes developing short or long internodes between the adjacent pairs of cymes at maturity; cymes 3-flowered or (in *N. cladotricha*) reduced to a solitary flower, in opposite-decussate pairs. *Flowers* (4)5-8-merous, with equal numbers of calyx lobes, corolla lobes and stamens. *Calyx* densely dendritic-hairy outside, glabrous inside; lobes shorter than or rarely as long as calyx tube. *Corolla* usually pale to deep purple or blue, rarely white, glabrous outside; tube longer than or about as long as the lobes, with a dense long antrorse indumentum inside but often partially glabrous; lobes equal, spreading, very narrowly to broadly ovate, glabrous, either narrow throughout or attenuate to a slender terminal protrusion, thin-textured, with the midvein prominent and commonly a few lateral veins clearly visible, the main lateral veins becoming more or less parallel to the midvein towards the apex; terminal protrusion of each lobe recurved or spreading, the apex obtuse and with a recurved margin. *Stamens* alternating with the corolla lobes, included to greatly exserted, glabrous; filament inserted in upper part of corolla tube or at summit of tube, expanded at the base or slender throughout. *Ovary* 4-celled, with 1 ovule in each cell. *Style* included to greatly exserted, glabrous; apex notched or slightly 2-lobed. *Fruit* dry, indehiscent, 1(2)-seeded, enclosed in the persistent calyx.

A genus of nine species, occurring primarily in arid regions, extending from Eighty Mile Beach in Western Australia east across central Australia (Northern Territory and South Australia) to south-eastern Queensland. In Western Australia, it occurs mainly in the Eremaean Botanical Province, but also occurs in the southern part of the Northern Botanical Province and in the South-western Interzone (Figures 2-4). Two species, *Newcastelia interrupta* Munir and *N. velutina* Munir, are endemic to Queensland; the remaining species all occur in Western Australia, where three of them are endemic.

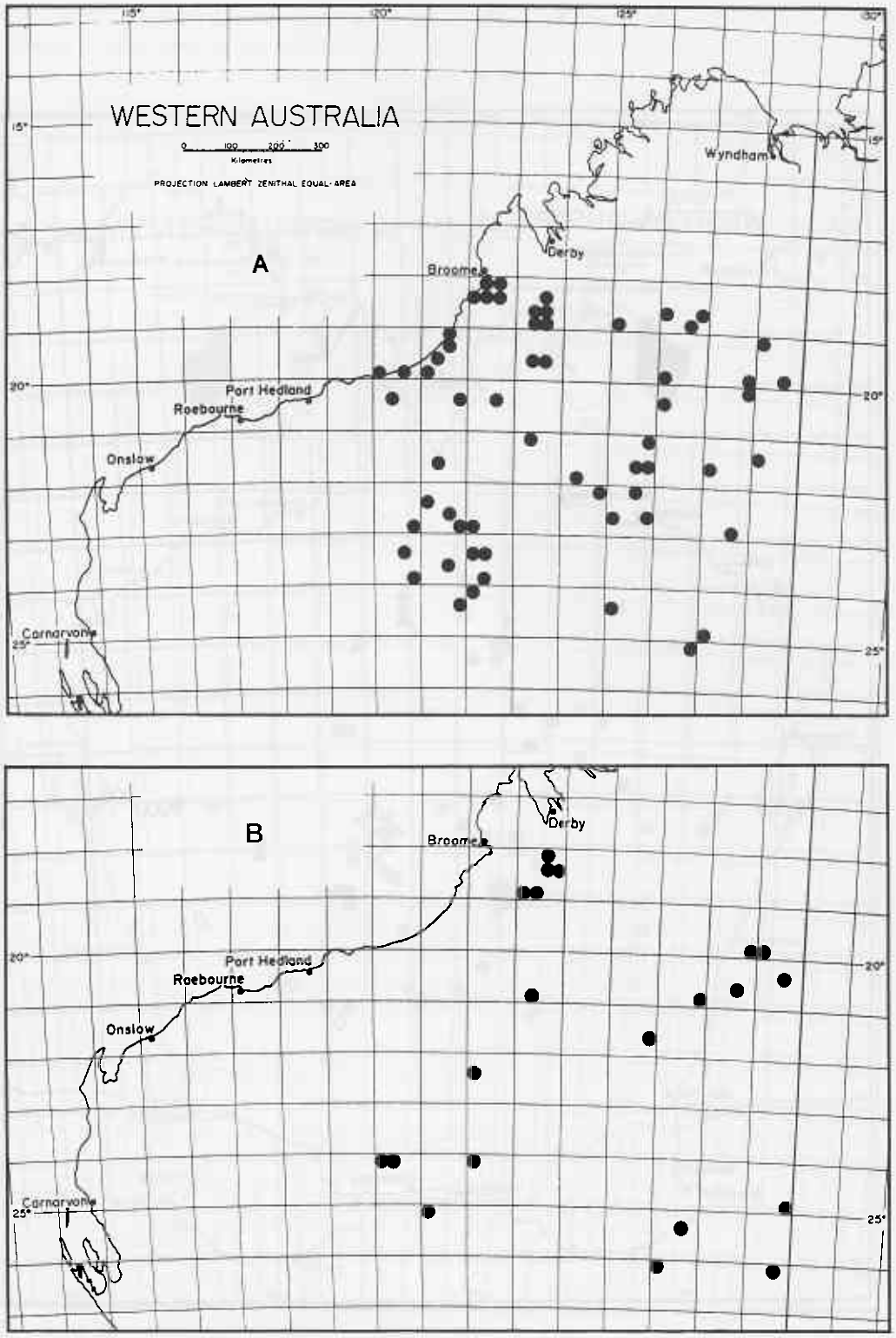

Figure 2. Distribution in Western Australia. A - *Newcastelia cladophora*, B - *Newcastelia spodiotricha*.

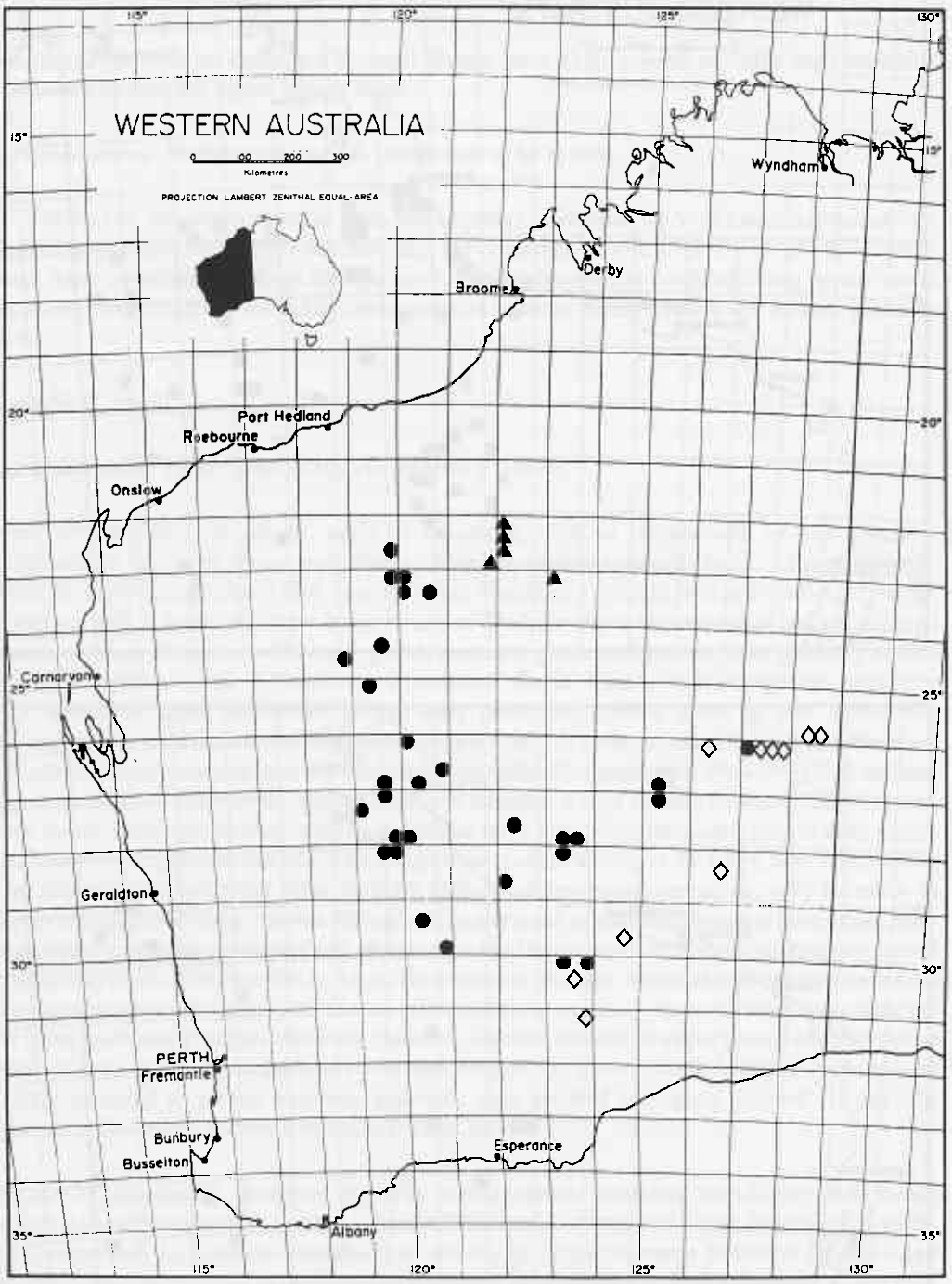

Figure 3. Distribution in Western Australia of *Newcastelia bracteosa* ◇ and full distribution of *Newcastelia hexarrhena* ● and *Newcastelia roseoazurea* ▲ .

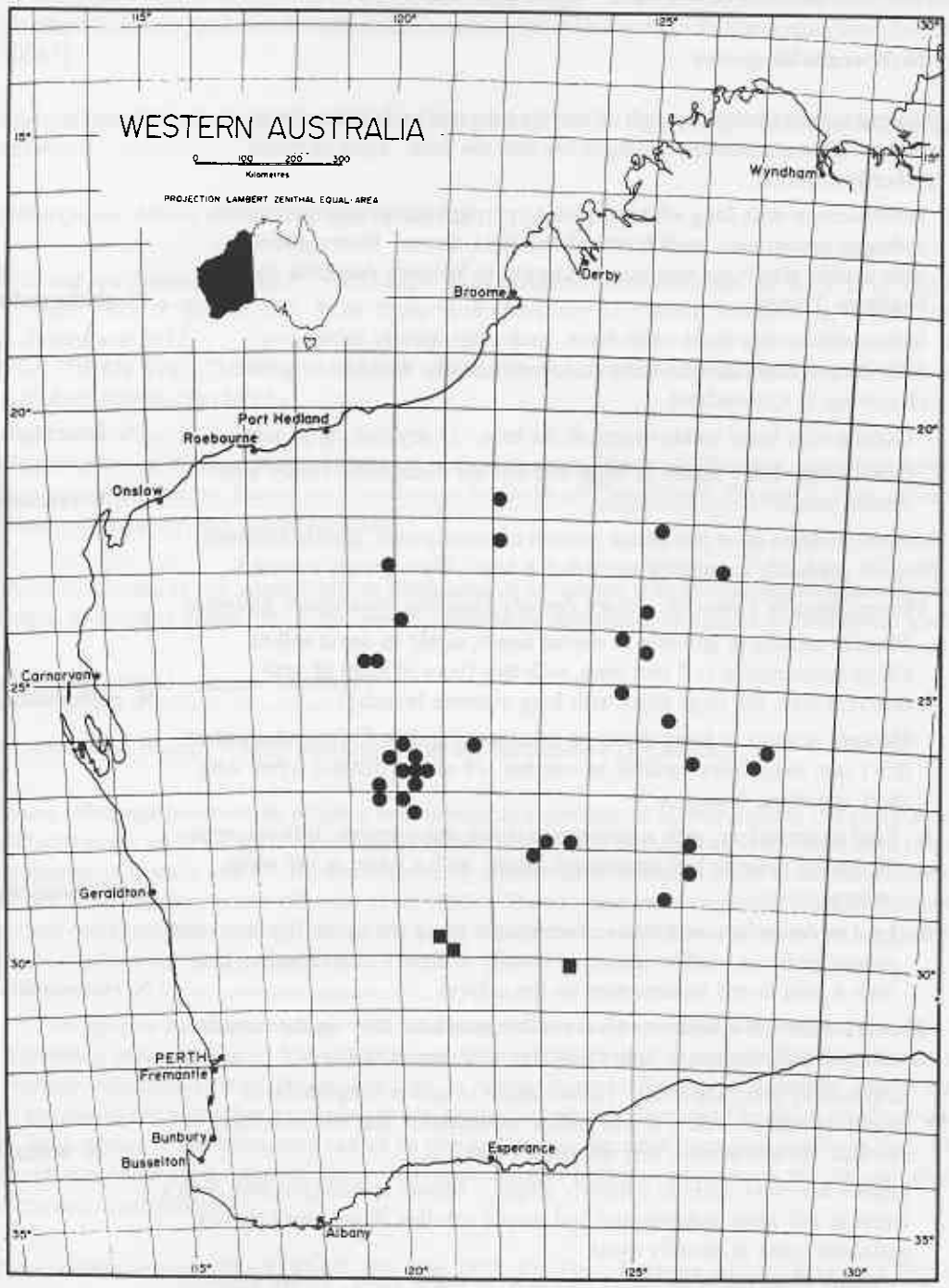

Figure 4. Distribution in Western Australia of *Newcastelia cephalantha* ● and full distribution of *Newcastelia insignis* ■ .

This genus is closely related both to *Lachnostachys* and *Physopsis*, but can be distinguished from the former by the number of ovary cells, from the latter by leaf characters and from both genera by corolla characters. *Newcastelia* species differ from the other genera in that their corolla lobes are either narrower throughout or have a narrow apical protrusion.

Key to *Newcastelia* species

1. Stamens inserted below summit of corolla tube and included or barely exserted; filament scarcely enlarged towards the base. Style included to shortly exserted
   2. Inflorescence with long white or pink to purple hairs giving the flowers a shaggy appearance, each bract subtending 1 flower. Ovary glabrous, with sessile glands on summit. Occurring in Western Australia and Northern Territory ..... **N. cladotricha**
   2. Inflorescence with short white hairs, each bract usually subtending 3 flowers. Ovary hairy on summit, sometimes also with sessile glands. Occurring in Queensland.
      3. Corolla tube hairy inside except at the base. Ovary lacking glands ..... **N. interrupta**
      3. Corolla tube hairy inside in basal half but not distal half. Ovary with sessile glands ..... **N. velutina**
1. Stamens inserted at or just below summit of corolla tube, greatly exserted; filament gradually expanding towards the base. Style greatly exserted.
   4. Flowers usually 5-merous. Ovary densely glandular throughout, glabrous.
      5. Flowers usually in globular to obloid heads, rarely in dense spikes. Calyx indumentum *c.* 2 mm long, with two types of hairs of very different size, the large hairs with long antrorse branches ..... **N. cephalantha**
      5. Flowers in short to long, dense or interrupted spikes. Calyx indumentum 0.5-1 mm long; hairs variable in size but not of two distinct types, with short spreading branches
         6. Leaf undersurface with a continuous dense indumentum. Inflorescence of usually more or less continuous spikes, with a white or off-white indumentum ..... **N. spodiotricha**
         6. Leaf undersurface with hairs concentrated along the veins, the interveinal spaces glabrous. Inflorescence of usually distinctly interrupted spikes, with a pink to red indumentum on the calyces ..... **N. roseoazurea**
   4. Flowers usually 6-8-merous. Ovary either glandular only on the summit or densely hairy at first in upper half (but glabrescent in fruit)
      7. Leaves very narrowly ovate. Flower heads or spikes subglobular to shortly cylindric, with a bright yellow indumentum and white or lilac corollas. Bracts sessile, very narrowly ovate ..... **N. insignis**
      7. Leaves narrowly ovate to narrowly elliptic. Flower spikes cylindric, with a white or off-white indumentum and purple corollas. Bracts very shortly petiolate, ovate or broadly ovate
         8. Corolla lobes rather suddenly narrowed to apical point. Ovary glabrous, with sessile glands on summit ..... **N. bracteosa**
         8. Corolla lobes very gradually attenuate to apical point. Ovary densely hairy at first in upper half but glabrescent in fruit, also with sessile glands ..... **N. hexarrhena**

Newcastelia bracteosa F. Muell. (Mueller 1873: 49-50). *Type:* MacDonnell Ranges, [Northern Territory], 1872, *E. Giles* (*holo:* MEL 40990).

Newcastelia elliptica Munir (Munir 1978: 609-612). *Type:* 50 miles [80 km] west of Ayers Rock, Northern Territory, 18 January 1969, *J.R. Maconochie* 654 (*holo*: AD *n.v.*, illustration seen; *iso:* MEL 40985).

Illustrations. Diels & Pritzel (1904: Figure 56D); Munir (1978: Figures 36, 39); Munir (1986: Figure 550A).

Description. Munir (1978: 596-600, 609-612).

Selected specimens examined. WESTERN AUSTRALIA: Ponton Creek, 20.5 km E of Zanthus, 17 Sep. 1979, *J. Taylor* 557, *M.D. Crisp & R. Jackson*; 21.7 km E of Zanthus, 3 Nov. 1993, *L. Sweedman* 2912.
NORTHERN TERRITORY: *c.* 10 km E of Tarn of Auber, Mereenie oilfield area, 16 Oct. 1984, *P.K. Latz* 10009 (also DNA).

Distribution. In Western Australia, occurs in the Eremaean Botanical Province, extending from the Warburton-Blackstone Range area south-west to Goddard Creek (near Zanthus). Also occurs in Northern Territory and South Australia.

Habitat. Occurs in red sandy soils, on sandplains or associated with (on or between) dunes or sand ridges, in spinifex grasslands, sometimes dominated by shrublands of *Acacia* or *Eucalyptus* species.

Flowering period. August-November.

Conservation status. Widely distributed and not considered to be at risk.

Notes. Although *Newcastelia elliptica* was reduced to a synonym of *N. bracteosa* in 1985 by P.K. Latz (determinavits on DNA specimens) and by Munir (1986), this change was overlooked until recently in Western Australia and *N. elliptica* is given by mistake as an accepted name in the most recent list of Northern Territory plants (Dunlop *et al.* 1995). The two taxa were originally separated primarily on leaf thickness, but Munir (1986: 1188) noted that the difference between the two taxa appeared to be due to "age and seasonal growth".

This species overlaps in range with its closest relative, *Newcastelia hexarrhena*, between the Warburton area and Queen Victoria Springs. One specimen (*A.S. George* 8445) from the area of overlap, collected east of Neale Junction in Great Victoria Desert, is currently identified as *N. bracteosa* because it has a glabrous ovary, but has broad inflorescences like those usually found in *N. hexarrhena*. Some characters cannot be checked on this specimen because it is only in bud. More material is needed from this locality to determine whether both species occur at the site and whether there are intermediates.

Newcastelia cephalantha F. Muell. (Mueller 1875: 4). *Type:* Between Alberta River and Mt Olga, [South Australia], *E. Giles* (*holo:* MEL 41005).

Newcastelia cephalantha var. *oblonga* Munir (Munir 1978: 634-635). *Type:* Hann Range, 70 miles [119 km] north of Alice Springs, Northern Territory, 1 June 1962, *D.J. Nelson* 372 (*holo:* AD *n.v.; iso*: PERTH 01607375).

Newcastelia cephalantha var. *queenslandica* Domin (Domin 1928: 1107). *Type:* Windorah, Queensland, 1910, *W. Rose (holo:* PR 530702 *n.v.*).

Newcastelia cephalantha var. *tephropepla* Munir (Munir 1978: 635-636). *Type:* About 46 km west of Musgrave Park Homestead, along track to Mt Davies, western portion of Musgrave Ranges, South Australia, 6 September 1963, *Hj. Eichler* 17310 (*holo:* AD *n.v.*).

Illustrations. Diels & Pritzel (1904: Figure 56H,J); Munir (1978: Figure 45); Munir (1981: Figure 399); Munir (1986: Figure 550B).

Description. Munir (1978: 629-636).

Selected specimens examined. WESTERN AUSTRALIA: Rudall River region, June 1987, *R.P. Hart* 648; 48 km N of Wiluna on road to Neds Creek, 12 Sep. 1987, *J.W. Green* 5355; Paroo Station, 26 July 1983, *A.A. Mitchell* 1140; 18 km E of Woolnough Range, 30 June 1984, *G.J. Morse* 224; 13 km N of Kumarina Roadhouse, 10 Aug. 1980, *C.I. Stacey* 670.

Distribution. In Western Australia, distributed in the Eremaean Botanical Province, extending from Telfer Mining Centre south to Albion Downs Station (south of Wiluna) and from Kumarina Station east to the border with Northern Territory. Also occurs in Northern Territory, South Australia and Queensland.

Habitat. Occurs in red sandy soils with spinifex grasslands, sometimes dominated by shrubs, commonly *Acacia* species, or by *Eucalyptus* species with a mallee habit.

Flowering period. June-October.

Conservation status. Widely distributed and not considered to be at risk.

Notes. The varieties of *Newcastelia cephalantha* are no longer recognized in Western Australia. The indumentum colours and leaf measurements used to distinguish var. *tephropepla* from the other two varieties are conflicting on some of the PERTH specimens annotated by Munir; for example *A.S. George* 9070 is a large-leaved specimen included under var. *cephalantha* but has white hairs rather than ferruginous ones. Var. *oblonga* was distinguished from var. *cephalantha* by its larger leaves and flower heads but there is considerable overlap in these characters on the annotated specimens of the two varieties, a situation similar to that discussed above for the forms of *Lachnostachys coolgardiensis.*

Newcastelia cladotricha F. Muell. (Mueller 1857: 22). *Type:* Sturt's [Sturt] Creek, towards Mt Mueller, [Western Australia], March 1856, *F. Mueller* (*holo:* MEL 41017).

Illustration. Munir (1978: Figure 41).

Description. Munir (1978: 615-619).

Selected specimens examined. WESTERN AUSTRALIA: Near Canning's Cairn, Canning Stock Route, 27 July 1995, *B. & B. Backhouse* 131; N of Well 15, Canning Stock Route, 22 July 1989, *S. Barker* 36; Gibson Desert, *c.* 130 km W of Giles, 19 June 1987, *H.M. Lee* 235; 5 km E of Thangoo Homestead, 8 July 1992, *A.A. Mitchell* 2597; Great Northern Highway, 11.3 km E of Pinnacle Creek, 31 Aug. 1991, *Peter G. Wilson* 870 *& R. Rowe.*

Distribution. In Western Australia, extends from near Roebuck Bay and Eighty Mile Beach in the south-east of the Northern Botanical Province through the north-eastern part of the Eremaean Botanical Province, south to Rawlinson Range. Also occurs in Northern Territory.

Habitat. Occurs in red sandy soils on sandplains or associated with dunes (usually on the lower slopes or in the hollows between the dunes), usually in spinifex grasslands, often with a shrub layer dominated by *Acacia* species.

Flowering period. Flowers recorded April-October, with a peak in July-August.

Conservation status. Widely distributed and not considered to be at risk.

Notes. This species is the only member of its genus having each cyme reduced to a solitary flower.

Newcastelia hexarrhena F. Muell. (Mueller 1876: 16). *Type:* Between Victoria Spring and Ularing, [Western Australia], *J. Young* (*holo:* MEL 41024).

Illustrations. Munir (1978: Figure 37); Munir (1981: Figure 400).

Description. Munir (1978: 600-603).

Selected specimens examined. WESTERN AUSTRALIA: 10 km E of Duketon on Bandya Station, 7 June 1988, *R.J. Cranfield* 6891; Gravel Pit Junction, 20 km N by track from Ponton Camp, Queen Victoria Spring Nature Reserve, 22 Oct. 1995, *D.J. Edinger* 1131; SW of Adelong Station, 24 Oct. 1989, *G.J. Keighery* 11396; 16 km SW of Tangadee Homestead, 22 Aug. 1984, *T. Houston* 589-1; 15 km SE of Officer Basin, 9 Dec. 1987, *D.J. Pearson* 352.

Distribution. Endemic to the Eremaean Botanical Province of Western Australia, extending from Roy Hill south to Walling Rock Station (west of Menzies) and from near Sandstone east to Mt Eveline (east of Warburton).

Habitat. Through most of its range, the species occurs in red sandy soils with spinifex grasslands, but in the southernmost part it often occurs in yellow sandy soils, occasionally dominated by *Eucalyptus* species with a mallee habit.

Flowering period. August-November.

Conservation status. Not considered to be at risk.

Newcastelia insignis E. Pritzel (Diels & Pritzel 1904: 506). *Type:* Menzies, Western Australia, October 1901, *E. Pritzel* 849 (*lecto:* AD 79221080, *fide* Munir (1978: 626), illustration seen; *isolecto*: PERTH 01607820).

Illustrations. Diels & Pritzel (1904: Figure 56E-G); Munir (1978: Figure 44).

Description. Munir (1978: 626-629). Additional characters: corolla probably varying from pale purple to white, the lobes narrowly obtuse or acute.

Selected specimens examined. WESTERN AUSTRALIA: Doney Lagoon, Adelong Station, 22 Sep. 1988, *R.J. Cranfield* 7590; 2.5 km NE of Comet Vale, 16 Oct. 1987, *G.J. Keighery* 9680; 6.5 km SE of Argus Corner, 26 Nov. 1986, *D.J. Pearson* 109A.

Distribution. Endemic to Western Australia, recorded from the Comet Vale area and from the northern boundary of Queen Victoria Spring Nature Reserve, the two areas about 250 km apart.

Habitat. Occurs in red, or occasionally yellow, sandy soils. Recorded in spinifex grasslands and/or in shrublands, sometimes dominated by *Acacia* or *Eucalyptus* species.

Flowering period. September-November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 3. Recorded from about four localities.

Notes. Although the corolla colour is given as "yellow or whitish-yellow" in Munir (1978: 628), there are only two specimens at PERTH with a label indicating corolla colour, and this is recorded as "lilac or white" (*C.A. Gardner* 11104) and "white" (*G.J. Keighery* 9680). The bright yellow hairs on the calyx give the flowers and fruits on the dried specimens a strong yellow appearance overall, but the dried corolla colour is pale to medium brown and there does appear to be a slight purplish tinge on some specimens.

Newcastelia roseoazurea Rye, *sp. nov.*

Newcasteliae spodiotrochae affinis sed indumento folii paginae inferioris minus denso, indumento alabastrorum fusco rosea vel rubro.

Typus: South of Rudall River camp, Western Australia, 12 August 1971, *P.G. Wilson* 10475 (*holo:* PERTH 03771148; *iso:* CANB, MEL, NSW).

Shrubs 0.3-1 m high, often rounded, with an indumentum of patent dendritic hairs on the stems, leaves and parts of the flowers, the many-branched hairs often broader than long. *Stem indumentum* 0.5-0.8 mm long, white or ferruginous on the vegetative stems and pinkish on the inflorescence axes. *Leaves* opposite-decussate, sessile or very shortly petiolate, ovate to very broadly ovate or oblong-elliptic, 8-38 x 4-19 mm, acute or obtuse, with recurved margins, green below the indumentum but often tinted by the white or ferruginous colour of the indumentum, the upper leaf surface usually grey-green throughout or grey-green towards the base and ferruginous towards the apex; lower surface reticulate-veined, with hairs concentrated along the veins and with scattered sessile glands, the veins almost white or yellow to pale ferruginous; upper surface deeply bullate, with several hairs towards the summit of each bulla; hairs 0.2-0.5 mm long on upper surface, slightly longer on lower surface. *Inflorescence* up to 200 mm long, usually comprising a terminal spike and two or more axillary spikes in an opposite-decussate arrangement, rarely (in depauperate specimens) reduced to a single terminal spike typically 25-35 mm long; peduncles up to 50 mm long but usually 5-20 mm; spikes up to

110 mm long, 10-15 mm wide, usually distinctly interrupted at anthesis, with the internodes 5-17 mm long, but with shorter, less obvious internodes in depauperate specimens; cymes 3-flowered. *Bracts* sessile, ovate or broadly ovate, dendritic-hairy outside, glabrous inside, caducous. *Flowers* 5-merous. *Calyx* green below the indumentum but the very dense indumentum resulting in a deep pink to red colour in bud, altering at anthesis to a pale yellow colour at the base and pink in the remainder, the largest hairs 0.5-0.8 mm long and 0.5-1.0 mm wide; tube 1.5-2.7 mm long; lobes ovate or broadly ovate, 1.1-1.5 mm long, acute. *Corolla* blue; tube 2.3-3.5 mm long, with dendritic hairs inserted towards but not reaching the base of tube, the hairs antrorse and 1-2 mm long; lobes ovate or broadly ovate, 2.3-3 mm long, attenuate-caudate at the apex, the apical protrusion 0.5-1.3 mm long and with a recurved obtuse apex. *Stamens* greatly exserted, blue; filament inserted at summit of tube at the junction of two corolla lobes, 2.1-2.6 mm long, 0.2-0.4 mm wide at the extreme base, narrowed to 0.1-0.2 mm halfway between the base and apex; anther 0.6-0.9 mm long at the onset of dehiscence. *Ovary* glabrous, with sessile glands throughout. *Style* greatly exserted, 3.3-4 mm long; apex notched or slightly 2-lobed. *Fruit* not seen at maturity. (Figure 5)

Other specimens examined. WESTERN AUSTRALIA: Rudall River National Park, 4 Aug. 1995, *B. & B. Backhouse* 46, 47; W of Well 23, Canning Stock Route, 2 Aug. 1967, *J.S. Beard* 4932; 1.2 km along the Tallawana track from its intersection with the Canning Stock Route, 15 July 1988, *A.E. DeJong*; N Rudall River National Park, 8 Aug. 1989, *A.E. DeJong*; Rudall River region, Sep. 1986, *R.P. Hart* 132; Kintyre: Rudall River region, Aug. 1988, *R.P. Hart* 841; Rudall River region, 4 Aug. 1995, *R.P. Hart* 977; Yandogooge catchment just N of Rudall River National Park, 4 Aug. 1995, *R.P. Hart* 1013-1015; Rudall River region, Sep. 1987, June 1988 & Aug. 1988, *W.G. Martinick & Associates*.

Distribution. Endemic to the Eremaean Botanical Province of Western Australia, apparently restricted to the Rudall River area, extending from near Moses Chair south to near Wells Range and south-east to Canning Stock Route.

Habitat. Recorded in red sandy soils on silty flats, in spinifex grasslands with a shrub layer.

Flowering period. July-September.

Conservation status. Not considered to be at risk at present. With a known range of just over 150 km, this species is much more restricted than the other Western Australian *Newcastelia* species except for *N. insignis*, which is known from fewer locations but over a greater distance. *N. roseoazurea* has been collected from at least eight sites, including some in a national park, and is reported to be common in the area.

Etymology. From the Latin *roseus* - pink-coloured and *azureus* - blue, referring to the striking combination of these two colours on the flowers, the calyx with bright pink hairs and the corolla blue. Flower colour is variously described as red, yellow, blue or purplish on herbarium specimens, depending partly on the stage of flowering and whether the overall flower colour or only part of the flower is being described.

Notes. Closely related to *Newcastelia spodiotricha*, which differs in its more densely hairy leaf undersurface and white or off-white indumentum on the flower buds. In *N. spodiotricha* the inflorescence is usually more or less continuous, whereas in *N. roseoazurea* the inflorescence is usually distinctly interrupted, and *N. spodiotricha* usually has longer flowers with narrower corolla lobes than *N. roseoazurea*.

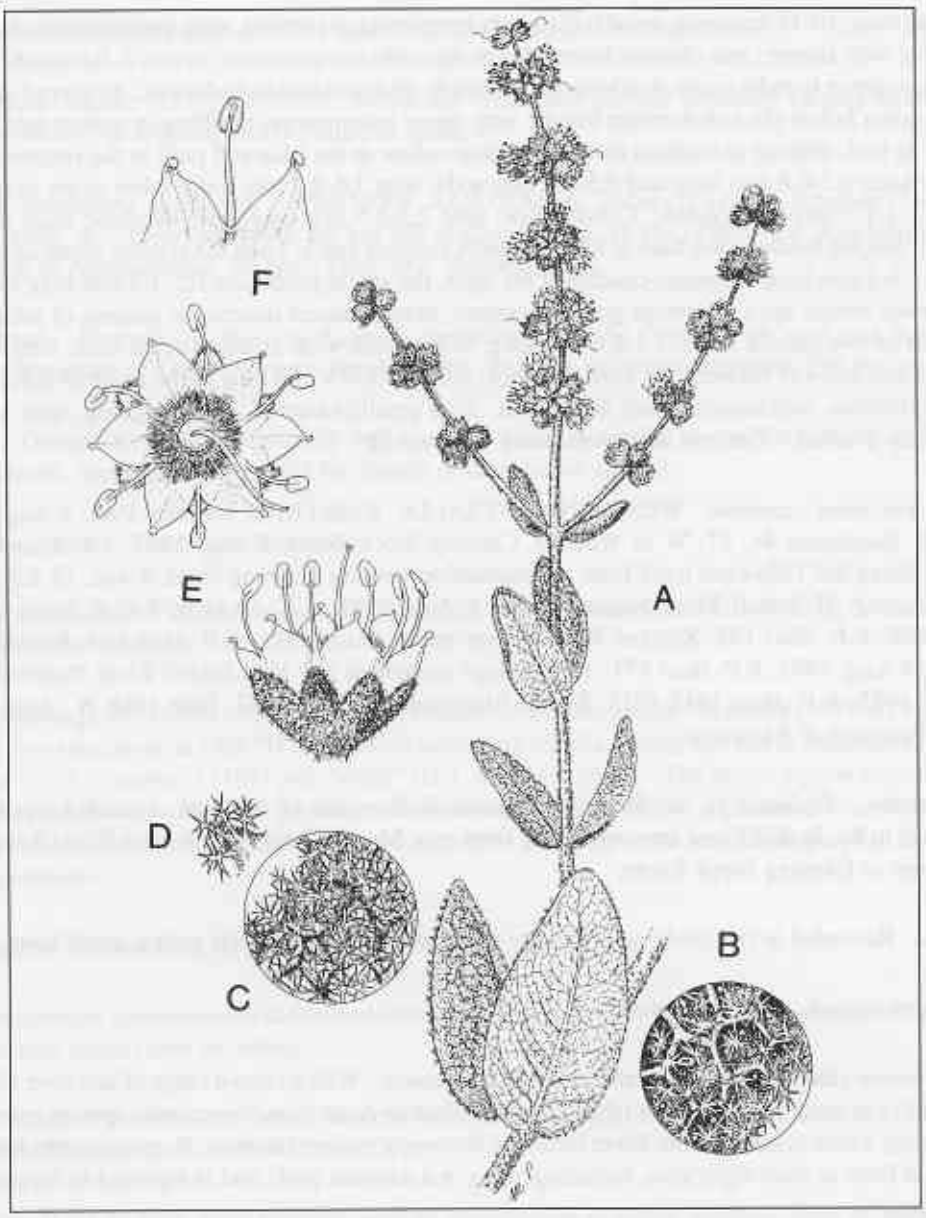

Figure 5. *Newcastelia roseoazurea.* A - flowering stem (x1), B - portion of undersurface of leaf (x9), C - portion of upper surface of leaf (x9), D - enlargement of bullae (side view) from upper surface of leaf (x9), E - top and side views of flower (x4), F - stamen and adjacent corolla lobes (x6). Drawn from *R.P. Hart* 977.

Newcastelia spodiotricha F. Muell. (Mueller 1862: 21-22). *Type:* Between Victoria River and Gulf of Carpentaria, [Northern Territory], *J. McDouall Stuart (holo:* MEL 41041).

Illustrations. Munir (1978: Figure 38); Munir (1981: Figure 401); Munir (1986: Figure 550C).

Description. Munir (1978: 603-609).

Selected specimens examined. WESTERN AUSTRALIA: Track to Red Bluff, S of Moffettah Well, 9 Dec. 1991, *H.N. Foote* 300; Gardner Range, 190 km SE of Halls Creek, 6 July 1995, *K. Coate* 378B;

Rudall River Region, 29 Mar. 1990, *R.P. Hart* 894; *c.* 58 km SSW of No 1 McHugh Bore on Dampier Downs Station, 26 Sep. 1980, *S.D. Hopper* 1729; 5.4 km W of Geegully Creek Crossing towards Frome Rocks, Edgar Ranges, 6 Oct. 1983, *T. Willing* 109.

Distribution. In Western Australia, extends from near Frome Rocks (north of Edgar Ranges in the southern part of the Northern Botanical Province) through the north-eastern part of the Eremaean Botanical Province south to near Muggan Rockholes (south-west of Warburton Range). Also occurs in Northern Territory, South Australia and Queensland.

Habitat. Occurs in red sandy soils, often on dune summits, sometimes on rocky hills. Recorded in spinifex grasslands with a shrub layer.

Flowering period. March-November, especially June-October.

Conservation status. Widely distributed and not considered to be at risk.

Physopsis Turcz.

Turczaninow (1849: 34-35). *Type: Physopsis spicata* Turcz.

Small to tall *shrubs*, with *P. chrysophylla* possibly sometimes a small *tree*, erect or spreading; indumentum of dendritic hairs, with shorter simple hairs often also present. *Young stems* terete, densely hairy. *Leaves* opposite-decussate or in whorls of 3, sessile or very shortly petiolate, entire or slightly toothed; lower surface with a dense persistent indumentum of dendritic hairs; upper surface fairly smooth to distinctly rugose, often ridged but not or scarcely bullate, with glandular dendritic hairs and glandular simple hairs or sessile glands (glands often visible only on very young leaves), sometimes also with non-glandular dendritic hairs, becoming glabrous but sometimes remaining sticky. *Inflorescence* of reduced, almost sessile cymes arranged in solitary or multiple spikes terminating leafy branchlets; spikes dense in bud, sometimes developing short internodes between the pairs or whorls of cymes at maturity; cymes 3-flowered or reduced to a solitary flower, in opposite-decussate pairs or whorled. *Flowers* 4- or 5-merous, with equal numbers of calyx lobes, corolla lobes and stamens. *Calyx* densely dendritic-hairy outside, glabrous inside; lobes slightly to much shorter than tube. *Corolla* yellow or white, glabrous outside, partially to largely glabrous inside but always with a region of simple or rarely 2-branched hairs; tube longer than lobes; lobes equal, spreading, broadly ovate to almost spathulate, broadly obtuse, sometimes hairy and distinctly thickened at the base, the upper portion either thickened or with prominent reticulate veins. *Stamens* inserted within the upper part of floral tube, alternating with the corolla lobes, sessile, subsessile or with a short filament, glabrous; filament slender; anther included or borne at the corolla throat. *Ovary* 4-celled, with 1 ovule in each cell. *Style* included or borne at the corolla throat, glabrous throughout or with simple hairs towards the base, sometimes glandular towards base; apex with 2 distinct spreading lobes. *Fruit* dry, indehiscent, 1(2)-seeded, enclosed in the persistent calyx.

A genus of five species, endemic to the south-west of Western Australia. *Physopsis* occurs primarily in the South-west Botanical Province and South-western Interzone but extends slightly into adjacent areas of the Eremaean Botanical Province (Figure 6).

Physopsis can be distinguished from *Newcastelia* mainly by the leaf and corolla characters used in the generic key, and from *Lachnostachys* by these and several additional characters. All species of *Physopsis* have been observed to have glandular dendritic hairs (as well as simple glandular hairs)

on very young leaves, usually on the upper surface or margin of the lamina, although these may not be present on all specimens. Such hairs are rare in the remainder of the family but do occur in *Dicrastylis incana* Munir (tribe Physopsideae) and *Pityrodia scabra* A.S. George (tribe Chloantheae). Sessile glands and simple glandular hairs are commonly found on very young leaves in other genera but are generally not obvious because of the much larger non-glandular dendritic hairs.

Other characters present in *Physopsis* but uncommon in the remainder of tribe Physopsideae, are the relatively smooth and glabrous upper surface of mature leaves, the very short stamens, the filaments being more reduced in *Physopsis chrysophylla* and *P. spicata* than in any other members of the tribe, and the short style with a distinctly lobed apex.

Key to *Physopsis* species

1. Leaves with a very short petiole 0.5-3 mm long (petiole may only be clearly visible when the leaf is removed from the stem); upper surface of lamina usually fairly flat, the margins often narrowly recurved. Flowers 1 per bract. Stamens sessile or subsessile. Style base with sessile glands or glandular hairs
   2. Leaves with a white indumentum on undersurface. Inflorescence with a white indumentum and yellow corollas. Calyx lobes much shorter than tube. Corolla tube 4-7 mm long; lobes 4, with small simple glandular hairs inside towards the base ..... **P. spicata**
   2. Leaves with a yellow indumentum on undersurface. Inflorescence with both the indumentum and corollas yellow. Calyx lobes slightly shorter than tube. Corolla tube *c.* 2 mm long; lobes (4)5, with long simple non-glandular hairs inside towards base ..... **P. chrysophylla**
1. Leaves sessile, with strongly recurved to revolute margins. Flowers mostly 3 per bract. Stamens with a short filament 0.3-0.5 mm long. Style glabrous, not glandular
   3. Leaves mostly opposite, narrowly ovate to ovate or elliptic. Corolla tube hairy inside towards the base; lobes 4 ..... **P. lachnostachya**
   3. Leaves mostly in whorls of 3, more or less linear. Corolla tube hairy inside throughout; lobes (4)5
      4. Stems, leaves and flowers with a bright yellow indumentum. Calyx indumentum 0.4-0.5 mm long ..... **P. chrysotricha**
      4. Stems, leaves and flowers with a white or off-white indumentum. Calyx indumentum 0.7-1.2 mm long ..... **P. viscida**

Physopsis chrysophylla (C.A. Gardner) Rye, *comb. nov.*

Newcastelia chrysophylla C.A. Gardner (Gardner 1964: 62). *Type:* About 45 km N of Murchison River, Western Australia, 3 January 1959, *C.A. Gardner* 12054 (*lecto:* PERTH 01607804, here designated; *isolecto:* CANB, MEL, PERTH 01607812).

Illustration. Munir (1978: Figure 40).

Description. Munir (1978: 612-615). Additional characters: calyx indumentum 0.5-1 mm long; corolla apparently yellow, the lobes very prominently reticulate-veined.

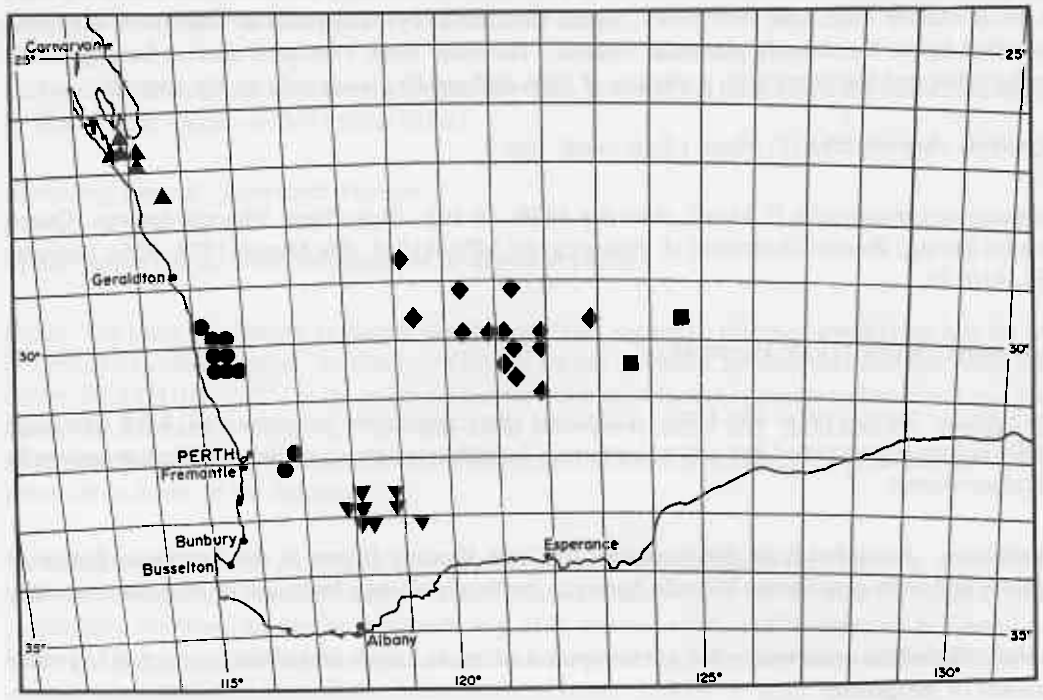

Figure 6. Geographical distribution of *Physopsis* species. *P. chrysophylla* ▲, *P. chrysotricha* ■, *P. lachnostachya* ▼, *P. spicata* ● and *P. viscida* ◆.

Selected specimens examined. WESTERN AUSTRALIA: 6 km W of Denham turnoff towards Tamala Station, 10 Nov. 1982, *R.J. Cranfield* 2534; Cooloomia Nature Reserve, 13 km W of Cooloomia homestead, 19 Sep. 1979, *S.D. Hopper* 1394.

Distribution. Restricted to the far north of the South-west Botanical Province of Western Australia, extending from stations in the Freycinet Estuary-Hamelin Pool area south to Eurardy Station.

Habitat. Occurs in red or yellow sandy soils, one record from sand over limestone, in dense shrublands dominated by species of *Acacia, Banksia* or other genera.

Flowering period. October-January.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 3. The species has been recorded from at least seven localities, including one in a nature reserve.

Notes. There are several herbarium sheets with the type collection number 12054, but none annotated by Gardner as the type. The sheet cited as the holotype by Munir (1978: 612) is here designated the lectotype.

Gardner (1964) stated that this species was related to *Newcastelia* (now *Physopsis*) *chrysotricha*, but did not elaborate on his reasons for this belief, noting only how the two taxa differed. This study confirms the relationship between the two species, although *P. chrysophylla* appears to show greater similarity to *P. spicata* than to *P. chrysotricha*. Apart from the characters used in the key, the

similarities between *P. chrysophylla* and *P. spicata* include their long corolla lobes, which are hairy on the thickened base, and their ovary, which is either hairy throughout or with hairs extending somewhat below the densely glandular summit. The other three *Physopsis* species have glabrous corolla lobes and the ovary with a mixture of hairs and sessile glands only on the summit.

Physopsis chrysotricha (F. Muell.) Rye, *comb. nov.*

Newcastelia chrysotricha F. Muell. (Mueller 1876: 15-16). *Type:* Near Victoria Springs [Queen Victoria Spring, Western Australia], *J. Young* (*lecto:* MEL 41013, *fide* Munir (1978: 636); *isolecto:* MEL 41012).

Illustration. Munir (1978: Figure 46).

Description. Munir (1978: 636-639). Additional characters: calyx indumentum 0.4-0.5 mm long; corolla colour not recorded but almost certain to be either yellow or white, the lobes prominently reticulate-veined.

Distribution. Recorded from the south-east of Great Victoria Desert in the Eremaean Botanical Province and from near Queen Victoria Spring in the South-western Interzone of Western Australia.

Habitat. No habitat details recorded, but the species occurs in a more arid environment than any other members of the genus.

Flowering period. September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority 1. *Physopsis chrysotricha* has not been collected since 1891, suggesting that it is very rare or extinct. However, the absence of recent collections may be due partly to the remoteness of the area where the taxon has been recorded; a field survey specifically for this species is clearly needed.

Notes. Very closely related to *Physopsis viscida*, which possibly should be regarded as a subspecies of *P. chrysotricha*, but readily distinguished by its bright yellow indumentum. *P. chrysotricha* also appears to have more leafy and more interrupted spikes with a shorter indumentum. However, it is known from only two collections, neither of which is in fruit. More material is needed of this very poorly known taxon to determine whether these character differences are reliable.

Physopsis lachnostachya C.A. Gardner (Gardner 1939: t. 3384). *Type:* Gravelly hills, Kukerin, Western Australia, 9 November 1935, *C.A. Gardner s.n.* (*holo:* PERTH 01607863; probable *iso:* PERTH 01607855).

Illustrations. Gardner (1939: Tablet 3384); Munir (1978: Figure 35).

Description. Munir (1978: 585-688). Additional characters: calyx indumentum 1.2-1.8 mm long; corolla lobes prominently reticulate-veined.

Selected specimens examined. WESTERN AUSTRALIA: Tarin Rock Reserve, 28 km W of Lake Grace, 2 Oct. 1984, *J.M. Brown* 305; 22 km S of Hyden on road to Newdegate, 18 Sep. 1984, *D.B. Foreman* 775; 23 km S of Hyden, 23 Nov. 1985, *D.B. Foreman* 1177; Kananda Farm, Kulin East, 24 Oct. 1994, Kulin Kondinin Herbarium 14.

Distribution. Endemic to the South-west Botanical Province of Western Australia, extending from Kulin south to near Kukerin and east to near Lake King.

Habitat. Commonly occurs in lateritic or gravelly soils, in low to tall shrublands sometimes dominated by *Eucalyptus* species with a mallee habit.

Flowering period. September-January.

Conservation status. Not considered to be at risk at present.

Notes. The sheet cited above as the holotype bears a label, signed by Gardner, identifying it as the type of *Physopsis lachnostachya*. As Munir (1978) did not see this sheet, he cited the other specimen listed above (PERTH 01607855) as the holotype, but the latter sheet lacks Gardner's endorsement and gives a slightly different locality, *viz.* "gravelly rises between Kukerin and Tarin Rock". Despite this difference, the second specimen is probably an isotype, as the description of the plant and the date are identical to those on the holotype.

Considering its small geographical range, *Physopsis lachnostachya* is very variable, especially in leaf size and shape. The leaf lamina varies from very narrowly ovate to ovate or elliptic, and is particularly small and narrow in specimens (e.g. *D.B. Foreman* 775, 1177) occurring in a small area between Hyden and Newdegate. In all areas, the leaves have bright yellow hairs on the undersurface as in *P. chrysophylla*, although the undersurface is largely hidden on some specimens.

Physopsis spicata Turcz. (Turczaninov 1849: 35). *Type:* New Holland [Western Australia], 1846-1847, *J. Drummond* coll. 4, n. 234 (*holo:* KW *n.v.*, photograph PERTH 04134567).

Illustrations. Diels & Pritzel (1904: Figure 55A-C); Gardner (1939: Tablet 3383); Munir (1978: Figure 34).

Description. Munir (1978: 581-585). Additional characters: calyx indumentum 1.5-3 mm long; corolla lobes thick-textured, the veins not visible, with small glandular hairs inside on the thickened base.

Selected specimens examined. WESTERN AUSTRALIA: 5.6 km W of Brand Mudge Rd, Alexander Morrison National Park, 5 Nov. 1992, *R.J. Cranfield & P. Spencer* 8404; Talbot West Rd, 3.7 km by road NW of Luelf Rd, *c.* 15 km SW of York, 30 Oct. 1993, *B.J. Conn* 3943, *M.E. Tozer & F. Ovens*; Watheroo West Rd, NE of Badgingarra, 7 Nov. 1988, *E.A. Griffin* 5478; Eneabba, 16 Dec. 1987, *H. Demarz* 12017; Beekeeper Rd, 19 Apr. 1994, *J.L. Robson* 621.

Distribution. Endemic to the South-west Botanical Province of Western Australia, occurring mainly from Arrowsmith Hill south-east to Watheroo National Park and near Bald Hill (south-east of Badgingarra), also occurring near York.

Habitat. Occurs in sandy soils, sometimes with laterite, recorded in low shrublands.

Flowering period. August-February.

Conservation status. Not considered to be at risk at present.

Notes. This species differs from other members of the genus in its very long calyx and corolla tube, its corolla lobes lacking obvious veins but having glandular hairs at the base, and also in the occurrence of hairs and sessile glands on the base of the style. Its nearest relative appears to be *Physopsis chrysophylla*.

Physopsis viscida (E. Pritzel) Rye, *comb. nov.*

Newcastelia viscida E. Pritzel (Diels & Pritzel 1904: 505). *Type:* Coolgardie goldfields, Western Australia, October 1901, *E. Pritzel* 858 (*lecto:* AD, *fide* Munir (1978: 640), *n.v.*, illustration seen; *isolecto*: PERTH 01607847).

Illustrations. Diels & Pritzel (1904: Figure 56A-C); Munir (1978: Figure 47); Munir (1981: Figure 402).

Description. Munir (1978: 639-643). Additional characters: calyx indumentum 0.7-1.2 mm long; corolla white, the lobes prominently reticulate-veined.

Selected specimens examined. WESTERN AUSTRALIA: *c.* 25 km W of Mulline on Menzies to Diemals road, 17 Sep. 1989, *B.J. Conn* 3161 *& J.A. Scott*; 7 km N of Emu Well, Adelong Station, 22 Sep. 1988, *R.J. Cranfield* 7578; *c.* 6 km NE of Bungalbin Hill, 28 Sep. 1995, *B.J. Lepschi* 2074; Melita Station, 4 Nov. 1988, *H. Pringle* 2210; N of Leonora, Sep. 1994, *T. Read* 7.

Distribution. Recorded mainly from the South-west Interzone, but extending slightly north into the Eremaean Botanical Province of Western Australia. Extends from north of Lake Barlee east to near Elora Soak and south-east to Hampton Hills Station (south of Kalgoorlie).

Habitat. Occurs mainly in red sand or sandy clay, also sometimes in yellow soils, recorded on rocky hillsides, sand dunes and on plains, often with laterite or lateritic gravel, rarely associated with other types of rocks. The vegetation is usually recorded as shrublands or woodlands dominated by *Eucalyptus* or a variety of other genera.

Flowering period. Mainly September-November.

Conservation status. Not considered to be at risk.

Notes. In the protologue, Diels & Pritzel (1904: 505), noted that this species has a similar floral structure to *Newcastelia* (now *Physopsis*) *chrysotricha*, *Newcastelia cladotricha* and *Physopsis spicata*. The first of these is undoubtedly its closest relative (see notes under *P. chrysotricha*), and all three species are similar to *P. viscida* in having short stamens and style. Most *Newcastelia* species and all *Lachnostachys* species have prominently exserted stamens and style.

Discussion

The transfer of three primarily 5-merous species from *Newcastelia* to *Physopsis*, has resulted in a clearer separation of the two genera. Previously, the sole character used to distinguish *Physopsis* and *Newcastelia*, was the number of floral parts. This was, in any case, a somewhat incomplete difference, separating species with consistently 4-merous flowers from those producing mainly 5- but

also some 4-merous flowers. A second difference suggested by the table and accompanying illustration in Munir (1978: 415) is that the style apex tends to be more deeply divided in *Physopsis*. This has become a more reliable difference by the current change to the generic limits, as the three species transferred from *Newcastelia* into *Physopsis* have the style apex distinctly lobed, unlike the usually notched apex of the species remaining in *Newcastelia*.

Most of the species of *Lachnostachys* and *Newcastelia*, especially those with wide geographical ranges, show a great deal of morphological variation. The characters that have been used to distinguish most of the varieties and forms in these species appear to have been chosen partly for historical reasons, either because the variant had already been named at some level or because the herbarium collections at the time of publication of the names had fewer specimens of intermediate morphology. Certainly these characters have no clear geographical significance and, at least in some cases, vary within populations and probably on individual plants. Most of the named infraspecific taxa in *Lachnostachys* and *Newcastelia* are, therefore, no longer recognized.

Acknowledgements

I would like to thank A.A. Munir for his detailed comments on an early draft of this manuscript, which have led to considerable improvements. I am also grateful to Barry Conn and Brendan Lepschi for reviewing the paper and Paul Wilson for advice on nomenclature and the Latin diagnosis. The illustration was drawn by Margaret Pieroni.

References

Beard, J.S. (1980). A new phytogeographic map of Western Australia. W. Austral. Herb. Res. Notes 3: 37-58.

Diels, L. & Pritzel, E. (1904). Fragmenta Phytographiae Australiae occidentalis. Bot. Jahrb. Syst. 35: 55-528.

Domin, K. (1928). Beitrage zur Flora und Pflanzengeographie Australiens. Biblioth. Bot. 21 [= 89(6)]: 1033-1128.

Druce, G.C. (1917). Nomenclatural notes: chiefly African and Australian. Bot. Exch. Club Soc. Brit. Isles Suppl. 2. pp. 601-653.

Dunlop, C.R., Leach, G.J., Latz, P.K., Barritt, M.J., Cowie, I.D. & Albrecht, D.E. (1995). "Checklist of the Vascular Plants of the Northern Territory, Australia." (Conservation Commission of the Northern Territory.)

Ewart, A.J. (1907). Contribution to the flora of Australia. No. VIII. Victorian Naturalist 24: 56-60.

Fitzgerald, W.V. (1904). Additions to the west Australian flora. J. W. Austral. Nat. Hist. Soc. 1: 3-36.

Gardner, C.A. (1939). *In:* Hooker's Icon. Pl. 34(4): tt. 3376-3400.

Gardner, C.A. (1964). Contributiones florae Australiae occidentalis. XIII. J. & Proc. Roy. Soc. Western Australia 47: 54-64.

Hooker, W.J. (1841). Hooker's Icon. Pl. 5(9): tt. 401-450.

Moore, S. le M. (1903). New plants from Australia. II. J. Bot. 41: 98-101.

Moore, S. le M. (1921). New west Australian plants. J. Bot. 59: 245-249.

Mueller, F. (1857). Nova genera et species aliquot rariores in plagis Australiae intratropicus nuperrime detecta. Hooker's J. Bot. Kew Gard. Misc. 9: 14-24.

Mueller, F. (1859-1876). "Fragmentae Phytographiae Australiae." Vol. 1-10. (Govt Printer: Melbourne.)

Munir, A.A. (1978). Taxonomic revision of Chloanthaceae trib. Physopsideae. Brunonia 1: 407-692.

Munir, A.A. (1981). 91. Chloanthaceae. *In*: Jessop, J.P. (ed.) "Flora of Central Australia." pp. 297-308. (Reed Books: Sydney.)

Munir, A.A. (1986). Family Chloanthacaeae. *In:* Jessop, J.P. & Toelken, H.R. (eds) "Flora of South Australia." Part 3. pp. 1180-1190. (Govt Printer: Adelaide.)

Turczaninow, N. (1849). Decas sexta generum plantarum hucusque non descriptorum adjectis descriptionibus specierum nonnullarum. Bull. Soc. Imp. Naturalistes Moscou 22(2): 3-38.

Turczaninow, N. (1863). Verbenaceae et Myoporaceae nonnullae hucusque indescriptae. Bull. Soc. Imp. Naturalistes Moscou 36(3): 193-227.