A revision of *Byblis* (Byblidaceae) in south-western Australia

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Abstract

Conran, J.G., Lowrie, A. and Moyle-Croft, J. A revision of *Byblis* (Byblidaceae) in south-western Australia. *Nuytsia* 15(1): 11–19 (2002). The south-western Australian populations of *Byblis* (Byblidaceae) are revised. A new species, *B. lamellata* Conran & Lowrie, is recognised on habit, ecology and seed morphology and named for the populations between Arrowsmith River and Cataby. *Byblis gigantea* Lindl. and its synonym *B. lindleyana* Planch. are lectotypified. A generic description and a table of distinguishing features for all species is given. A key and distribution map are provided for the two species from the south-west of Western Australia.

Introduction

The genus *Byblis* (Byblidaceae) currently consists of five species; four annual species from northern Australia (Lowrie & Conran 1998) with *B. liniflora* extending to southern New Guinea, and a single perennial species *B. gigantea* from two disjunct regions in south-western Australia. Investigation of the populations of *B. gigantea* in the field, as well as studies of seed morphology of these populations and within the genus as a whole, suggested that the populations from the two disjunct regions differed in a number of habit, ecological and seed morphological characteristics, despite their overall similarity in gross and floral morphology. In particular, the seeds of *B. gigantea* from the two regions differed from each other more than did seeds of the other species within the genus. As seed morphology is a useful character at the species level in *Byblis*, we concluded that *B. gigantea*, as currently recognised, represents two species.

The aims of this study were to determine the degree of morphological and ecological differences between populations of *B. gigantea* from the two regions, and to resolve the nomenclature and typification of these taxa.

Materials and methods

Field studies of the south-western *Byblis* populations were variously undertaken by Allen Lowrie and John Conran between 1988 and 1999. In addition, herbarium specimens lodged at PERTH and AD were examined, as was type material and associated collections held at K and BM. Wild-collected seed of populations of *B. gigantea* from the Perth region (*A. Lowrie* 566, 1675 (PERTH)) and the region between Arrowsmith River and Cataby (*A. Lowrie* 798, 1672 (PERTH)) were examined under SEM and

stereo dissecting microscope. To allow for comparisons with the other species in the genus, seed samples from *B. aquatica* (*A. Lowrie* 2264, 2276 from the Northern Territory (PERTH)), *B. filifolia* (*A. Lowrie* 722, 1177, 1199, 1233, 1249, 1326, 1329, 1395, 1425, 1498, 1715, 1721, 1754, 1762, 1781, 2041 from the Kimberley region (PERTH)), *B. liniflora* (*J.G. Conran s.n.* Atherton Tableland, *W.A. Travers s.n.* Cardwell State Forest in Queensland (ADU)) and *B. rorida* (*A. Lowrie* 1394, 1405, *R.L. Barrett* 595 from the Kimberley region (PERTH)) were also examined.

Morphological descriptions were based on fresh, dried and spirit material.

Taxonomic treatment

Byblis Salisb., *Parad. Lond.* 2: t. 95 (1808). *Type: Byblis liniflora* Salisb.

Carnivorous *shrubs* regenerating each year from a subterranean rhizome, or *ephemeral herbs* with fibrous roots. *Stems* simple to branched, short-lived and elongating at flowering, erect, scrambling or floating. *Leaves* cauline, alternate, exstipulate, subulate-linear, with sticky glandular hairs and an apical swelling. *Flowers* solitary in upper leaf axils, hermaphrodite, regular, rotate. *Sepals* 5, fused basally, imbricate, persistent. *Petals* 5, fused basally but appearing free, 5-lobed. *Stamens* 5, opposite the sepals, inserted at the base of the tube; filaments free, twisted to face abaxially; anthers basifixed, 2-thecate, 4-sporangiate, introrse, opening by pore-like short apical slits. *Ovary* superior, 2-locular; ovules numerous, axile. *Style* curved-filiform, stigma minutely capitate or bilobed. *Fruit* a smooth, loculicidal capsule. *Seeds* small, angular, black, prominently sculptured with smooth or denticulate ridges; endosperm starchy; embryo small, linear.

Size and distribution. A genus of six species from northern and south-western Australia, a single species extending to New Guinea. Figure 1 is a generalised distribution map of the south-western Australian taxa.

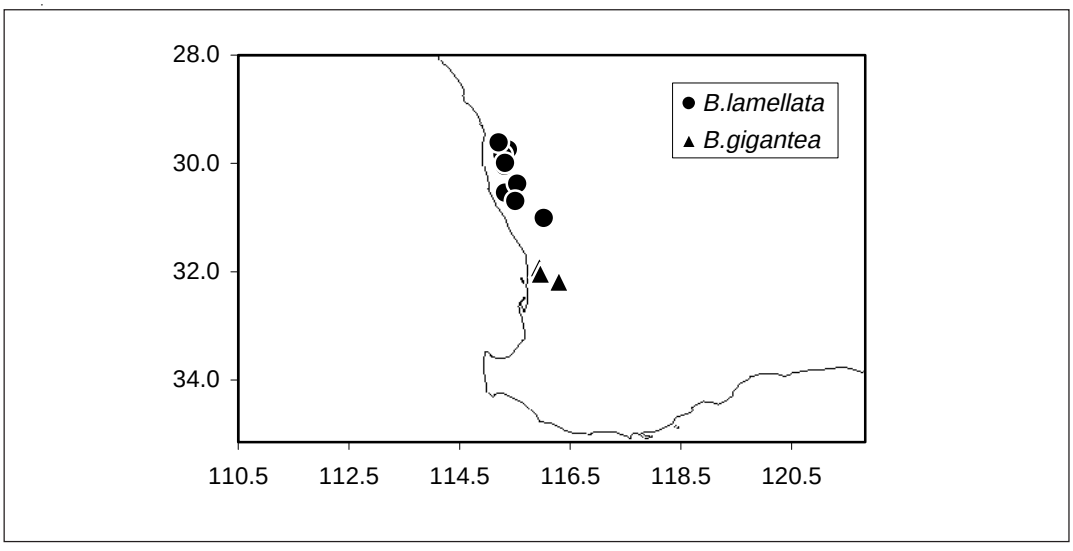

Figure 1. Generalised distribution map of *Byblis* in south-west Western Australia.

Table 1. Morphological and ecological comparisons of *Byblis* species. Numbers in brackets are means.

	B. gigantea	***B. lamellata***	***B. liniflora***	***B. filifolia***	***B. aquatica***	***B. rorida***
Plants						
habit	perennial sub-shrub	perennial sub-shrub	annual herb	annual herb	annual herb	annual herb
fire regrowth response	resprouting mainly from rhizome	resprouting from aerial shoots and rhizome	seed	seed	seed	seed
Seeds						
length	0.6–1.5 mm (1. mm)	1.0–1.8 mm (1.3 mm)	0.5–0.9 mm (0.7 mm)	0.4–1.1 mm (0.7 mm)	0.9–1.3 mm (1.0 mm)	0.5–0.8 mm (0.6 mm)
width	0.6–1.0 mm (0.8 mm)	0.8–1.5 mm (1.1 mm)	0.4–0.6 mm (0.5 mm)	0.3–0.8 mm (0.5 mm)	0.4–0.7 mm (0.6 mm)	0.4–0.6 mm (0.5 mm)
longitudinal ridges	with massive processes	with massive processes	minutely denticulate-crenulate	denticulate	smooth, prominent	minutely denticulate
transverse ridges	shallow	shallow	shallow	deep	absent	shallow
sculpturing	processes muricate	processes lamellate	tuberculate-verrucate	smooth	smooth	irregularly roughened
ribbing of processes	prominent, irregular	prominent, regular	n/a	n/a	n/a	n/a
pore length	68–125 µm (89 µm)	59–112 µm (76 µm)	73–165 µm (119 µm)	57–178 µm (120 µm)	114–150 µm (130 µm)	54–74 µm (66 µm)
pore width	24–53 µm (36 µm)	25–34 µm (28 µm)	68–104 µm (88 µm)	42–132 µm (82 µm)	10–78 µm (66 µm)	52–65 µm (60 µm)
periclinal pore wall	smooth	smooth	foveolate	foveolate	smooth	smooth

Notes. The differences in seed sculpturing, habit and apparent fire regrowth response between the different *Byblis* species and the two *B. gigantea* morphs are detailed in Table 1 and representative seeds of each taxon are illustrated in Figure 2. Based on a comparison of the degree of difference between the seeds of the northern (Figure 2A) and southern (Figure 2B) *B. gigantea* morphs alone, it is clear that they more different from each other than most of the accepted species which form the *B. liniflora* complex (Figure 2C–F). This, combined with their geographic separation, different regrowth responses after fire and different habitat requirements supports the separation of the northern and southern morphs into separate species.

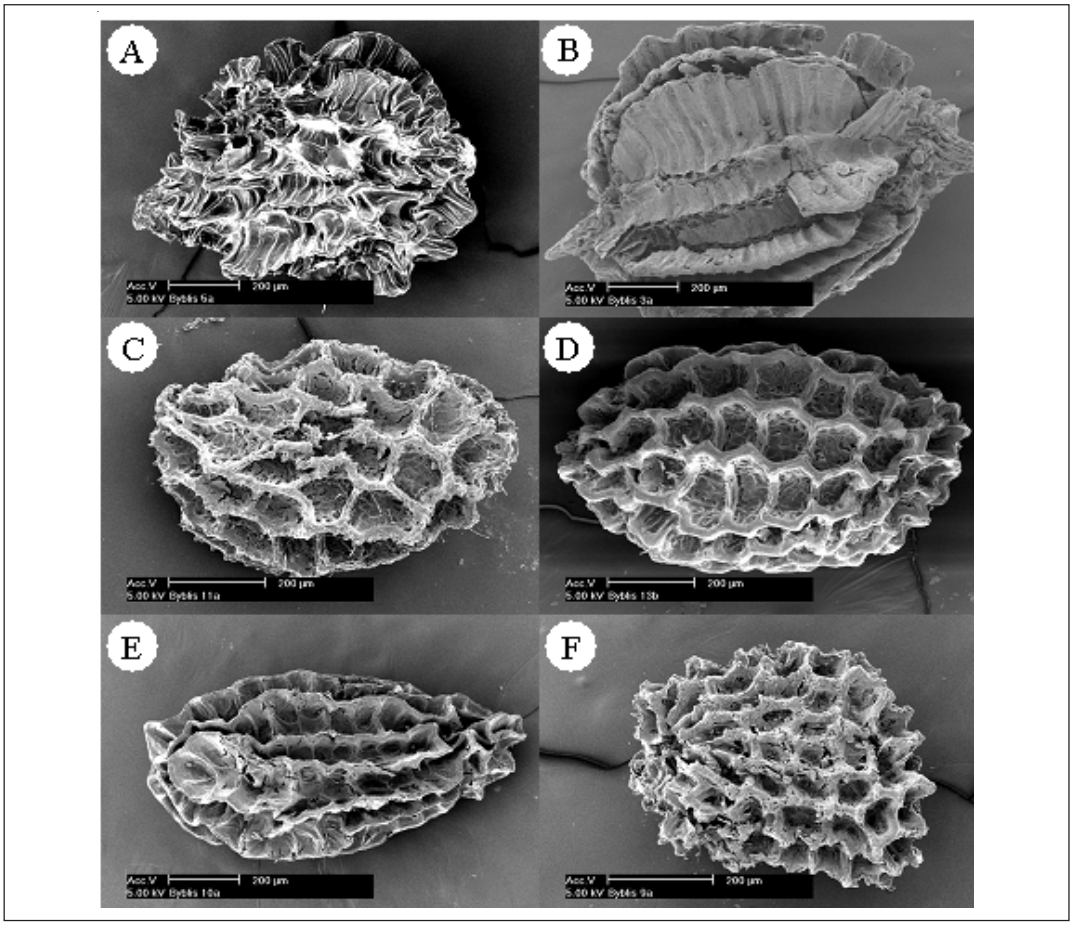

Figure 2. SEM micrographs of seeds of *Byblis* species. A – *B. gigantea, A. Lowrie* 1681 (PERTH); B – *B. lamellata, A. Lowrie* 798B (PERTH); C – *B. liniflora, A. Lowrie* 1416 (PERTH); D – *B. filifolia, A. Lowrie* 1425 (PERTH); E – *B. aquatica, A. Lowrie* 2276 (PERTH); F – *B. rorida, R. L. Barrett* 595 (PERTH).

Key to the species of *Byblis* in south-western Australia

1. Seeds with strongly corrugated and ribbed sculptured plates; plants mainly resprouting from rhizomes after fire ..... **B. gigantea**
1: Seeds with erect non-corrugated, weakly ribbed lamellar plates; plants resprouting from aerial stems as well as rhizomes after fire ..... **B. lamellata**

Byblis gigantea Lindl., Sketch Veg. Swan Riv. Col. 21 (1839). *Type:* Swan River, N [New] Holland [Western Australia], no date, *Drummond s.n.* ex Herb. Lindl. in Herb. Hook. (*lecto:* K, here designated, left hand element; *isolecto*: K, right hand element); Swan River, 1939, *Drummond s.n.* ex Herb. Lindl. in Herb. Benth. (*isolecto:* K).

Byblis lindleyana Planch., *Ann. Sci. Nat. Bot. sér. 3.* 9: 307 (1848). *Type:* Swan River, N [New] Holland [Western Australia], no date, *Drummond s.n.* labelled "*Byblis grandiflora*" ex Herb Lindl. in Herb. Hook. (*lecto:* K, here designated); Swan River, NH [New Holland], 1839, *Drummond s.n.* ex Herb. Lindl. in Herb. Benth. (*isolecto:* K).

Small branched *perennial sub-shrub* to *c.* 45 cm from a branched underground woody more or less rhizomatous base, aerial shoots rarely branched, more or less herbaceous, and generally short-lived. *Leaves* linear, to 20 cm long, lamina reniform in cross-section, marginally and abaxially glandular-hairy. *Pedicels* to 15 cm long, glandular-hairy. *Sepals* lanceolate, 8–15 mm long, 2.5–3.5 mm wide basally, abaxially glandular-hairy. *Petals* 15–20 mm long, glabrous, lobes obovate, to 15 mm wide, apically serrate, pink to cerise-mauve, rarely white. *Stamens* 5, filaments 2.5–3.5 mm long; anthers 5–6 mm long, yellow with a brown apex. *Ovary* spheroid, 1.5–2 mm long, ± glabrous. *Style* 7–9 mm long, basally glandular. *Capsule* ovoid, 5–7 mm long, 3.5–4 mm wide. *Seeds c.* 1 mm long, with prominent longitudinal corrugate-sculptured and ribbed muricate processes. **Rainbow Plant** (Figure 2A)

Selected specimens examined. WESTERN AUSTRALIA: Guildford, Dec. 1901, *C. Andrews s.n.* (PERTH); Perth [precise locality withheld], 24 Aug. 1957, *C.L. Wilson* 864 (PERTH); sandy flats, lower Canning River, 4 Dec. 1901, *A. Morrison s.n.* (PERTH)**;** Southern River [precise locality withheld] 11 Nov. 1991, *A. Lowrie* 518 (PERTH); Southern River, [precise locality withheld], 31 Dec. 1991, *A. Lowrie* 566; Brookton Highway, E of Albany Highway, 28 Dec. 1996, *A. Lowrie* 1675 (PERTH); Newburn, Perth, 28 Dec. 1996, *A. Lowrie* 1681A (PERTH); Newburn, Perth, 11 Dec. 2001, *A. Lowrie* 2736 (PERTH).

Distribution. Undoubtedly more widespread in the past. As a result of land clearing this species is now confined to four relatively small populations all more or less within the greater Perth region, mostly along the Canning River drainage system. Surveys are needed to determine whether there are other populations of this species in the region, or in other areas where it was known historically (e.g. Guildford). Similarly, the report by Erickson (1968) of *Byblis gigantea sens. lat.* extending from the Murchison River north of Geraldton south to the Murray River south of Perth and with population centres at the Hill, Moore and Canning Rivers requires investigation in view of the apparent absence of collections for either species across much of that area. Moore River in particular warrants investigation in view of its position between the current verified ranges of the two species. (Figure 1)

Habitat. Byblis gigantea grows in seasonally wet sandy-peat swamps in low *Leptospermum*/Restionaceae-dominated shrubland.

Flowering period. September to January.

Conservation status. Conservation Codes for Western Australian Flora: Priority Two. Although originally much more widespread and common, the species is now apparently absent over much of its former range. It is critically endangered from human activity, mostly due to urban expansion of the greater Perth area. At present, the species is known from a few small, isolated populations, only one of which is in a reserve. Further surveys are required urgently to determine the true extent of the remaining distribution of this species.

Etymology. The epithet is from the Latin *giganteus* – giant, with reference to the much larger size of this species relative to the previously recognised *Byblis liniflora*.

Lectotypification. There are two Drummond *Byblis* sheets at K labelled Herb Hook., only one of which corresponds to Planchon's description for *B. gigantea*. That specimen has two elements on the sheet, and the left hand piece has been selected as the lectotype, with the right hand element regarded as an isolectotype. The other Herb. Hook. sheet fits closely to Planchon's *B. lindleyana*, and has thus been designated as the lectotype for that epithet.

In addition there are two Drummond sheets at K labelled Herb. Benth., one for each of these taxa, which are listed above as isolectotypes.

Affinities. Readily distinguished from *B. lamellata* by the muricately sculptured and irregularly ribbed seed ridges, the apparent lack of aerially resprouting shoots after fire, and its occurrence in seasonally swampy habitats.

Notes. The generally used common name Rainbow Plant is recommended for this species. De Buhr (1975) postulated mimicry by *Byblis gigantea sens. lat*. of *Thysanotus multiflorus* (Lilianae: Laxmanniaceae) with which it co-occurs and co-flowers. Although both are buzz-pollinated, the identity of their pollinators and the pollination reward offered by each species is unknown (Erickson 1968). *B. gigantea* is found in seasonally waterlogged *Leptospermum*/Restionaceae low scrub (Speck & Baird 1984) and Erickson (1968) suggested that the aerial shoots were annual, dying back to the rootstock over summer. Baird (1984) found that following fire, *B. gigantea* survives by regenerating from the deep, woody perennial rootstock. In contrast, *B. lamellata* usually grows on deep silica sands in fire-prone dry heathlands, and is a taller branched shrub which resprouts from the above-ground stems after fire as well as from the rhizomes. However, as field observations suggest that *B. gigantea* plants from areas which have not had fire for extended periods can sprout aerially, further studies are needed to confirm the apparent post-fire differences between the taxa.

Planchon (1848) recognised two taxa within the *B. gigantea* complex, based largely on their stem elongation and sepal nervation as follows:

> "*Byblis gigantea* Lindl. [Plant] tall, leafy, closely pedunculate (leaf bases closely spaced), and (especially under the flowers) erect; sepals 3-nerved; capsule somewhat subglobose, obtuse, with many faint nerves apically. Locality: Swan River Colony; herb. Lindl.; *Drummond s.n.* in herb. Hook.
>
> *Byblis lindleyana* Planch. [Plant] tall, loosely leafy and almost all pedicels erect-patent, especially under the flowers where they are very wide-spreading; sepals 5-nerved; capsule ovate, acuminate, conspicuously multi-nerved apically. Locality: same as the previous [i.e. Swan River Colony]; herb. Lindl.; *Drummond s.n.* in herb. Hook. More robust than the preceding species [and] with fewer leaves. Plants sprinkled with short glandular hairs. Trunk rhizomatous, horizontal, not emerging out of the ground, short, thick, with spongy bark, decorticating with age, somewhat woolly (sub-flocculose), pale orange. Stems continuous with the rhizome, erect, about 2 feet long, simple, leafy at the base, alternate, more or less spreading to erect, distinguished by being more sparsely leafy with widely spaced axils, revealing the leaf bases and their single-flowered peduncles. Leaves slightly thickened at the base, filiform, compressed-terete, apex slightly clavate and unarmed [= eglandular], lower leaves 9–12 inches long, intermediate [= stem leaves?] 5–7 inches long, those under the peduncles shorter, ebracteate. Sepals basally lanceolate, long-attenuate apically, slightly clavate, unequal, longer in fruit 6–7 lines [12–15 mm] long. Petals about twice the length of the sepals, unequal, margins denticulate, rose-coloured when dry. Capsule a little larger than a peppercorn, glossy, smooth. Style longer than the stamens, bristle-like, curved apically, very shortly bifid or divided, both sides papillose-stigmatic on the inside, not thickened."

Although it might at first seem that from these descriptions, and from the herbarium specimens that *B. gigantea* more closely resembles many specimens of the northern taxon, *B. lamellata* (Figure 3),

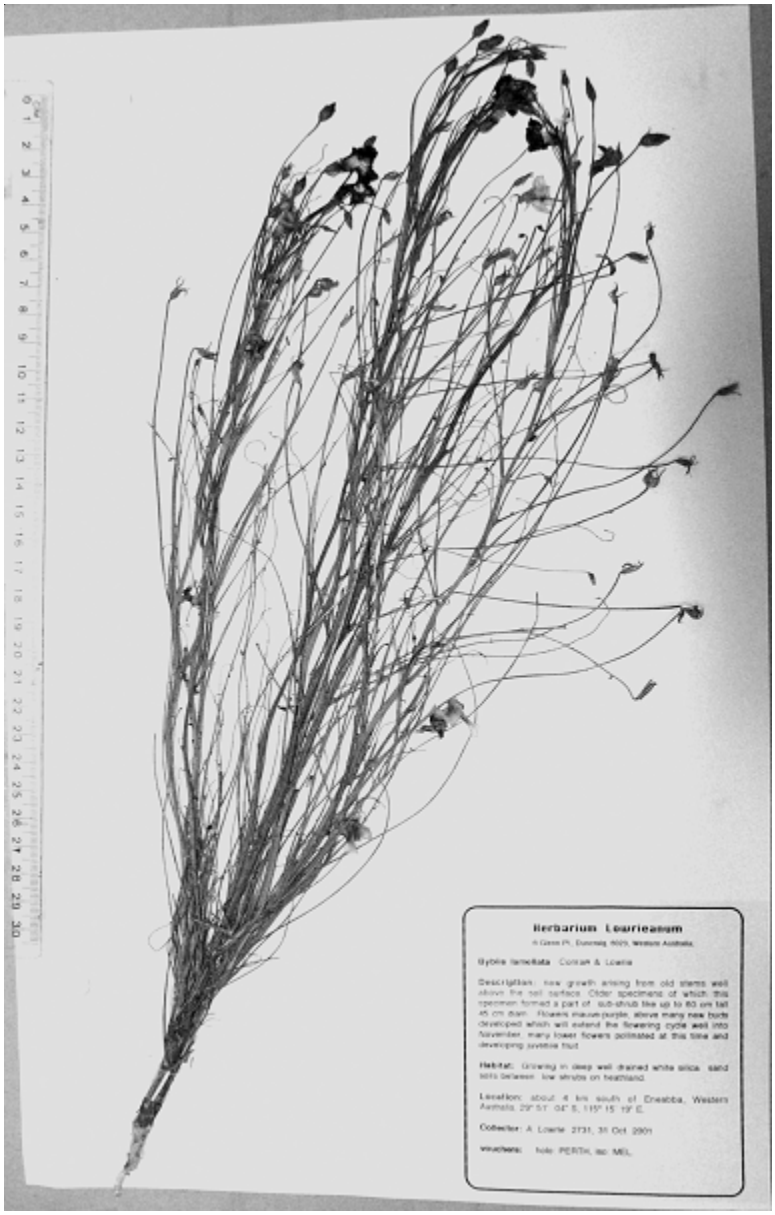

Figure 3. Holotype of *Byblis lamellata* Conran & Lowrie.

whereas *B. lindleyana* is like many of the plants encountered for the southern taxon, there are several reasons supporting the reduction of both names to synonymy and the recognition instead of a new name for the northern taxon. Although the specimens available to Planchon were very different in their stem elongation, field observation of both the northern and southern taxa confirms that they will undergo shoot elongation under crowding from other plants. As the southern species grows in generally more dense swamp vegetation, it is more common to find elongated plants of this taxon. The number of sepal nerves also varies in both *B. gigantea* and *B. lamellata* from 3 to 5.

More importantly, the collections cited by Planchon were Drummond collections from Lindley's herbarium and part of Herbarium Hookerianum. At the time that Planchon was working on this material, the only collections to which he had access were from the Drummond collections sent to Lindley in Nov. 1838 and Nov. 1839. All of these represented material collected from the Swan, Avon, Helena and Toodyay Valleys as well as the Guangan [Wongan Hills]. Drummond did not travel to the area where the northern taxon grows until 1852, when material from his sixth collection was sent to Hooker from the Murchison River and Champion Bay to Dandaragan Region (Erickson 1969). As all the Lindley collections were from plants in the southern taxon's range, and we now know that the habit can alter based on competition for light and space, it seems most likely that *B. gigantea* and *B. lindleyana* represent uncrowded and crowded plants respectively. Furthermore, examination of seeds on the type material for *B. lindleyana* confirm that they are part of the southern corrugately-ribbed taxon. Accordingly, the southern taxon represents *B. gigantea* and includes *B. lindleyana* as a synonym, whereas the northern taxon represents a new species.

Byblis lamellata Conran & Lowrie, *sp. nov.*

B. giganteae Lindl. affinis sed semina lamellata, non corrugata, inferme striata, et caule aerialis repullulans.

Typus: about 4 km south of Eneabba, Western Australia, 29°51'S, 115°16'E, 31 October 2001, *A. Lowrie* 2731 (*holo:* PERTH 05853834; *iso:* K, MEL).

Small branched woody *perennial sub-shrub* to *c.* 60 cm from a subterranean rhizome. *Leaves* linear to 20 cm long, lamina reniform in cross-section, marginally and abaxially glandular hairy. *Pedicels* to 15 cm long, glandular-hairy. *Sepals* lanceolate, 8–15 mm long, 2.5–3.5 mm wide basally, abaxially glandular-hairy. *Petals*15–20 mm long, glabrous, lobes obovate, to 15 mm wide, apically serrate, pink to cerise-mauve, rarely white. *Stamens* 5, filaments 2.5–3.5 mm long; anthers 5–6 mm long, yellow with brown apices. *Ovary* subglobose, 1.5–2 mm long, ± glabrous. *Style* 7–9 mm long, basally glandular. *Capsule* ovoid, 5-7 mm long, 3.5–4 mm wide. *Seeds* 1–1.8 mm long, with weakly longitudinally ribbed, lamellate plate-like ridges but lacking obvious transverse ridges or complex corrugate sculpturing. **Northern Sandplains Rainbow Plant** (Figures 2B, 3)

Selected specimens examined. WESTERN AUSTRALIA: 30 km N of Eneabba, 17 Sep. 1979, *P. Armstrong* 95 (PERTH); Western Titanium leases, 8 km S of Eneabba, 10 Sep. 1976, *E.A. Griffin* 524 (PERTH); 7.7 miles [12.3 km] NE of Eneabba on Three Springs road, 8 Oct. 1967, *W.A. Loneragan* 67018 (PERTH); 5 km S of Eneabba, 1 Oct. 1993**,** *A. Lowrie* 798B (PERTH); 5 km S of Eneabba, 16 Dec. 1996**,** *A. Lowrie* 1671 (PERTH); Arrowsmith River, E of Brand Highway, 16 Dec. 1996**,** *A. Lowrie* 1674 (PERTH); Mogumber, 2 Dec. 1965, *F. Lullfitz* 4465 (PERTH); 12 km W of Gingin–Dongara road, on road to Nambung National Park, 29 Nov. 1974, *A.E. Orchard* 4255 (PERTH); 16 miles [25.6 km] E of Green Head, Jan. 1968, *K.R. Newbey* 3144 (PERTH).

Distribution. *Byblis lamellata* is distributed on the northern sand plains from Arrowsmith River south to Cataby in south-west Western Australia (Geraldton Sandplains and Swan Coastal Plain Bioregions), although Erickson (1968) erroneously listed the Murchison River as the northern limit. (Figure 1)

Habitat. Byblis lamellata grows in open heathland on well drained white silica sands.

Flowering period. September to January.

Conservation status. *Byblis lamellata* is locally common in a number of areas within its range, several of which are in reserves. It is currently not threatened.

Etymology. The epithet *lamellata* is taken from the Latin *lamellus* – a plate, with reference to the plate-like processes on the seeds.

Affinities. The species is closely related to *B. gigantea*, but differs from it in seed morphology, lacking muricate sculpturing on the seed processes; resprouting response, by resprouting from aerial stem remnants as well as from the rhizome; habitat, growing in much drier environments; flowering time, tending to flower much earlier; and geography, being geographically disjunct from *B. gigantea* which grows some 100 km to the south.

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