

A taxonomic revision of *Pterocaulon* section *Monenteles* (Labill.) Kuntze (Asteraceae: *Inuleae–Plucheinae*)

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Summary

Bean, A.R. (2011). A taxonomic revision of *Pterocaulon* section *Monenteles* (Labill.) Kuntze (Asteraceae: *Inuleae–Plucheinae*). *Austrobaileya* 8(3): 280–334. *Pterocaulon* section *Monenteles*, comprising all species of the genus from Asia, Malesia, Australia and Melanesia, is revised. 14 species are recognised, including the six new species, *P. brachyanthum* A.R.Bean, *P. ciliosum* A.R.Bean, *P. discolor* A.R.Bean, *P. paradoxum* A.R.Bean, *P. tricholobum* A.R.Bean and *P. xenicum* A.R.Bean, and one new combination, *P. intermedium* (DC.) A.R.Bean. Descriptions, illustrations, and distribution maps are provided for all taxa. *Monenteles sphacelatus* and *M. spicatus* are lectotypified. The ecology, chemistry and diagnostic morphological characters of members of the section are discussed, and an identification key to species is provided.

Key Words: Asteraceae, *Pterocaulon*, *Pterocaulon brachyanthum*, *Pterocaulon ciliosum*, *Pterocaulon discolor*, *Pterocaulon intermedium*, *Pterocaulon paradoxum*, *Pterocaulon tricholobum*, *Pterocaulon xenicum*, taxonomy, Australia flora, New Caledonia flora, Malesia flora, coumarins, identification key, taxonomy, new species

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Introduction

Pterocaulon Elliott comprises 26 species distributed in North America, South America, south-east Asia, Malesia, Melanesia and Australia. In a revision of the genus by Cabrera & Ragonese (1978), four taxonomic sections were recognised. Three of these sections consist wholly of American species while the fourth, *Pterocaulon* section *Monenteles* (Labill.) Kuntze, comprises all of the Old World taxa.

Monenteles Labill. was described at generic rank by Labillardière (1825), with two species, *M. sphacelatus* Labill. and *M. spicatus* Labill., both named from specimens collected in New Caledonia. De Candolle (1836) and Bentham (1867) maintained *Monenteles* at generic rank, but the latter commented, “From the American genus *Pterocaulon* it scarcely differs in the hermaphrodite flowers usually reduced to a single one”.

The reduction of *Monenteles* to synonymy with *Pterocaulon* was effected by Bentham (1873), and species combinations were made by Mueller (1882). *Monenteles* was reinstated as a section of *Pterocaulon* by Kuntze (1903).

Anderberg (1989) suggested that the genus *Monenteles* could be resurrected, but later (Anderberg 1991) he abandoned the idea.

The differences between *Pterocaulon* section *Pterocaulon* and *P.* section *Monenteles* are minimal. Nesom (2006) stated that species in *Pterocaulon* section *Pterocaulon* have 1–17 functionally staminate florets per capitulum, a 1 or 2-seriate pappus, and the hairs have a relatively long aseptate portion arising from a cluster of basal cells; while species in *P.* section *Monenteles* have a single staminate floret per capitulum, a uniseriate pappus, and the hairs are more-or-less uniformly septate throughout.

Pterocaulon has been consistently placed in the *Pluchea*-group of genera. The rank of this group was originally a Subtribe (Subtribe *Plucheinae* Benth. & Hook.f. of the Tribe *Inuleae* Cass.; Bentham 1873); then it was deemed a Tribe (Tribe *Plucheeae* A.Anderb.; Anderberg 1991, 1994). Evidence from molecular data now favours subtribal rank (Anderberg *et al.* 2005). Within the subtribe, Anderberg (1991) grouped *Pterocaulon* alongside *Neojeffreya* Cabrera and *Stenachaenium* Benth. in the “*Pterocaulon* clade”.

Pterocaulon species are readily identified by the winged stems formed by decurrent leaf bases, the sessile capitula grouped into spiciform, cylindrical or spherical secondary heads (capitulescences), and the pappus of capillary bristles. In *Pterocaulon* section *Monenteles*, the secondary heads are usually aggregated to form a globose or ellipsoidal capitulescence, and only two or three species have a spicate or cylindrical capitulescence. *Pterocaulon* is sometimes confused with the related genus *Sphaeranthus* L., as the latter also has globose capitulescences and winged stems. However, *Sphaeranthus* differs by the much-reduced capitula and the florets that lack a pappus.

Cabrera & Ragonese (1978) recognised six species in *Pterocaulon* section *Monenteles*, including one species newly described therein. Wilson (1992) reinstated *Pterocaulon globuliflorum* W.Fitzg., so that there were seven accepted species prior to this study, viz. *P. globuliflorum*, *P. niveum* Cabrera & A.M.Ragonese, *P. redolens* (Willd.) Fern.-Vill., *P. serrulatum* (Montrouz.) Guillaumin, *P. sphacelatum* (Labill.) F.Muell., *P. sphaeranthoides* (DC.) F.Muell. and *P. verbascifolium* (Benth.) F.Muell.

Fourteen species are recognised in this paper. The following species are described as new; *Pterocaulon brachyanthum* A.R.Bean, *P. ciliosum* A.R.Bean, *P. discolor* A.R.Bean, *P. paradoxum* A.R.Bean, *P. tricholobum* A.R.Bean and *P. xenicum* A.R.Bean. *Monenteles intermedius* DC. is reinstated and transferred to *Pterocaulon*. *Pterocaulon serrulatum* is maintained with two varieties.

Materials and methods

This revision is based on morphological examination of herbarium specimens from A, AMES, BRI, CANB, CNS, DNA, GH, K, L, MEL, NOU and PERTH, and images of type specimens from B, FI, G, K and P. Specimens from NSW and P were not available for loan when this paper was being prepared.

All measurements were made from dried material. Leaf measurements are of cauline leaves only, and do not include leaves from the basal rosette (if present). Leaf length is the

distance from the apex to where the midrib joins the stem. The width of the stem wings was measured on the main stem at 20–25 cm from the apex of the specimen.

Measurements of the dimensions of capitulescences (secondary heads) reported in this paper were made at or near anthesis, on capitulescences where the corolla lobes of the hermaphrodite floret were open, and where the inner involucre bracts and the florets were still attached to the receptacle. After anthesis, and especially in fruiting plants, the inner bracts and florets become detached from the receptacle and form expanded “fluffy” heads, often two or more times the diameter of the intact heads. Pappus length was measured on female florets.

Notes on conservation status have not been given. Most species are common and widespread; for the species that may perhaps be threatened (*Pterocaulon discolor*, *P. globuliflorum*, *P. xenicum*), I have no knowledge of their extent or population sizes.

The catalogue of Malesian plant collectors (van Steenis-Kruseman 2006-onwards) was used for checking the interpretation of label data of Malesian specimens.

Species treatments are arranged in alphabetical order. Common abbreviations used in the specimen citations are N.P. (National Park) and S.F. (State Forest).

Chemistry

Species in the genus *Pterocaulon* are rich in chemical compounds, particularly coumarins and flavonoids. These are thought to have a biocidal effect against bacteria and fungi, and to protect against herbivory (Daniel *et al.* 1999).

Johns *et al.* (1968) identified 6,7-dimethoxycoumarin as a major alkaloid constituent of a *Pterocaulon* from Inkerman, Queensland, which they identified as *P. sphacelatum*. I have located the specimen on which this is based. It is held at CANB (Inkerman, 8 June 1960, *W.T.Jones 1531*), and it bears a stamp saying “Voucher for identity of Bulk Sample No. 6489, Aust. Phytochemical Survey”. The specimen is *Pterocaulon intermedium*.

MacLeod & Rasmussen (1999) reported the identification of a new caryophyllene from *Pterocaulon serrulatum*, as well as three coumarins and a flavanone. Semple *et al.* (1998) found that a flavonoid (chrysosplenol C) they extracted from the leaves of *Pterocaulon sphacelatum* has an antiviral effect, by inhibiting the replication of rhinoviruses, the most frequent causative agent of the Common Cold. *Pterocaulon* species, especially *P. sphacelatum* and *P. serrulatum* have traditionally been used by Aboriginal peoples as a medicine, helpful in the treatment of respiratory infections, colds and fevers (Barr *et al.* 1993; Latz 1995).

In Asteraceae Subtribe *Plucheinae*, *Pterocaulon* is the only genus known to contain coumarins, and around 40 different coumarins have been found in the 15 investigated species (Stein *et al.* 2007). These authors stated that although the species of *Pterocaulon* exhibit other classes of compounds, coumarins are characteristic of the genus and they postulated that they could be considered chemotaxonomic markers for the genus.

Ecology and distribution

Taxa belonging to *Pterocaulon* section *Monenteles* are forbs and shrubs. They do not occur in rainforest or other densely shaded areas and are primarily found in sunny shrublands, woodlands and open forests. Most species are confined to areas where the climate is frost-free and the rainfall exceeds c. 600 mm per year. All species show a preference for coarse-grained soils, probably because of the associated good drainage, but can sometimes be found on finer grained clay-loams. None however, occurs on cracking clays.

Many species of *Pterocaulon* clearly tolerate salt-bearing wind, as a few species are found in littoral habitats, not only in Australia, but also in Indonesia and New Caledonia. In coastal areas, they can be found close to salt marsh or mangrove communities, and in the arid areas close to salt lakes. The label for *Henry 952* (NT), collected from the Simpson Desert, says that *Pterocaulon sphacelatum* is “common in saline soil on surrounding edges of salt lake”.

It is presumed that *Pterocaulons* do not have strict requirements with regard to soil acidity or soil chemistry. While they frequently occur on soils derived from sandstone, where the pH would be quite low, some species (e.g. *Pterocaulon globuliflorum*, *P. niveum*) occur on alkaline limestone substrates. In New Caledonia and near Rockhampton in Queensland, *Pterocaulon* spp. occur on serpentinite, and the soils that develop there are toxic to most plant species.

As with numerous other species in the Asteraceae, *Pterocaulon* species are pioneer plants. Accordingly, they favour places that have been disturbed by fire or machinery, and may occur in large numbers at such sites. For this reason, they are sometimes regarded as weeds, but they are readily displaced by alien species that have a similar ecological preference.

The life cycle is not known in detail for any species of *Pterocaulon* section *Monenteles*. All species appear to develop a rootstock of some kind, and in some species (e.g. *P. intermedium*) it is distinctly woody. Some species are clearly perennial, living for three or four years at least; while others are probably annual resprouters (above-ground parts dying each year, but resprouting for one or more years).

Pterocaulon section *Monenteles* is distributed in southern China, Burma, Thailand, Indochina, Malesia, much of Australia (north of about 30°S), New Caledonia and Vanuatu. The greatest diversity of species is in the Kimberley region of Western Australia and the ‘Top End’ of the Northern Territory. Only one species (*Pterocaulon brachyanthum*) does not occur in Australia.

Discussion of characters

1. Winged stems

Winged stems formed from the decurrent leaf bases are a constant feature of all species in the genus, and the generic name is derived from this attribute. The width of the stem wings is useful in distinguishing some species in *Pterocaulon* section *Monenteles*. For example, the stem wings of *Pterocaulon niveum* are invariably narrow (usually 0.5–

1.5 mm wide), while the stem wings of the vegetatively similar *P. verbascifolium* are broad (usually 2.5–6 mm wide). In *Pterocaulon serrulatum* and *P. sphaeranthoides* the stem wings are serrated; in other species they are nearly always entire (*P. sphacelatum* and *P. brachyanthum* sometimes have sparsely toothed stem wings).

2. Leaves

Some species, and perhaps all species, begin as a rosette of leaves at ground level. Knowledge about this stage of the plant's life cycle is poor, as these leaves are rarely represented on herbarium specimens. In some species, the cauline leaves are obovate or oblanceolate, i.e. broadest above the middle, while in others, they are elliptical, i.e. broadest at around the midpoint. The upper leaf surface of most species is bullate to a greater or lesser extent. The leaf margins are always dentate to denticulate, though sometimes appearing entire as the teeth can be obscured by dense indumentum or by recurved margins.

3. Leaf indumentum

Lanate hairs (uniseriate, multicellular) (**Fig. 1A**) are found in all species, but their density varies greatly, with some taxonomic correlation. In *Pterocaulon verbascifolium* and *P. niveum*, the lanate hairs are dense enough to obscure the lamina surface even under magnification; in *P. sphaeranthoides* and *P. serrulatum* var. *serrulatum*, the lanate hairs may be very sparse. The upper leaf surface often has a sparser indumentum than the lower, and this is particularly the case in *Pterocaulon discolor*. In *Pterocaulon intermedium*, the lanate hairs on the upper surface are as dense as or denser than those on the lower surface.

Two taxa have broad-based stalked glandular hairs on the leaves and stem wings (**Fig. 1B**). Globose sessile glands (often shining-yellow) are found on the lower leaf surface of all species, and their density can be diagnostic for some species (**Fig. 1A**).

4. Capitulescence (secondary head) shape and diameter

The capitulescences of *Pterocaulon globuliflorum* and *P. brachyanthum* are consistently narrower in diameter than other species in the section.

While head shape varies within species, it is still quite diagnostic. Three species (*Pterocaulon serrulatum*, *P. redolens* and *P. verbascifolium*) have heads usually described as cylindrical or spicate. In *Pterocaulon paradoxum*, capitulescences are usually markedly ellipsoidal, though sometimes approaching globose. Similarly, the heads of *Pterocaulon serrulatum* are sometimes almost globose.

For the remainder, heads are globose or ellipsoidal; in some species (e.g. *Pterocaulon intermedium*) the capitulescences are always close to globose while in others (e.g. *P. sphaeranthoides*, *P. sphacelatum*) they may vary from globose to broadly-ellipsoidal, sometimes on the same plant.

5. Branching patterns and peduncles

Capitulescences are in some species predominantly sessile, while in others consistently pedunculate. Peduncle length can be reliably determined only for overtopped capitulescences, i.e. those where a side branch has arisen below it, exceeding it and producing a further (younger) capitulescence. The peduncle length is the distance between the base of the overtopped capitulescence and the insertion of the lateral branchlet. *Pterocaulon intermedium* is notable for its consistently pedunculate heads. The lateral branchlets usually protrude at 30–60° and sometimes at right angles to the subtending branch. In a few species with sessile capitulescences, e.g. *Pterocaulon tricholobum*, they may continue in more-or-less the same direction (0–30°), here termed 'continuous' branchlets (e.g. **Fig. 19**). Where this happens, the sessile capitulescence appears to be borne laterally and its shape can be globose-truncate.

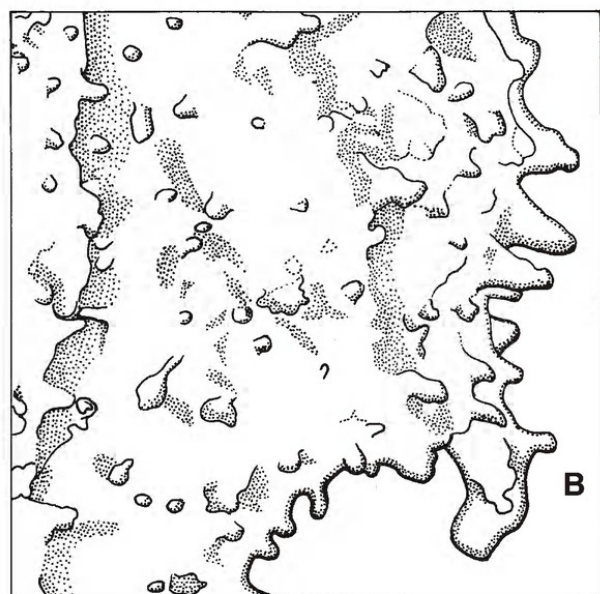
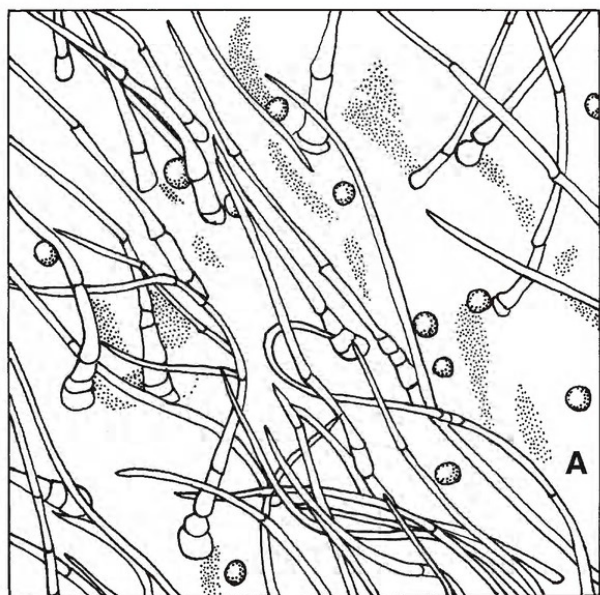


Fig. 1. Leaf hairs in *Pterocaulon*. A. *P. serrulatum* var. *velutinum*, showing lanate hairs and sessile glands $\times 40$. B. *P. serrulatum* var. *serrulatum*, showing broad-based glandular trichomes and sessile glands $\times 40$. A from Bean 22246 (BRI); B from Fox 25 & Bean (BRI). Del. W.Smith.

6. Inner involucre bracts

The inner involucre bracts offer some diagnostic characters. Firstly, the bract length (only the longest (innermost) bracts are documented in this paper) may be diagnostic for some species. Their colour may be white, straw-coloured or pink, or pink with violet speckles. The colour is not totally fixed for each species, but some species have predominantly

pink bracts, some have predominantly white, and in others the bracts are straw-coloured.

The upper margins of the inner bracts may be entire, slightly toothed, strongly toothed or lacerate, and this is strongly correlated to the species. For example, in *Pterocaulon redolens* the upper margins are entire, tapering to an attenuate apex; in *P. sphacelatum*, the upper margins are often lacerate, and there is no single bract apex.

7. Cilia

The margins of the inner bracts of every species have $\pm$ straight, hyaline, antrorse cilia, up to 75% of the bract length. The cilia of different species may vary in number, position and length.

This character may be usefully employed on intact or in-situ heads, i.e. where the capitula are still attached to the receptacle. The cilia protrude beyond the outer bracts and may be seen alongside the inner bracts and the pappus. The cilia of the bracts are distinguishable from the bristles of the pappus because the cilia are not barbellate. The prominence of cilia varies greatly between species. In some species e.g. *Pterocaulon tricholobum*, *P. ciliosum*, numerous cilia are clearly visible on the protruding part of inner bracts, and in *P. ciliosum* only, these cilia can exceed the bract apices; in other species e.g. *P. intermedium*, *P. sphacelatum*, *P. brachyanthum*, very few if any cilia can be seen on the protruding part of inner bracts (Fig. 2).

8. Number of female florets per capitulum

The number of female florets is difficult to determine by casual observation of the capitulum, and an accurate count is rather tedious, involving removal of an intact capitulum and spreading out the contents so that each element is clearly visible. However, it can be very useful in distinguishing between some species in the section. Three groups of species can be distinguished using this character; *Pterocaulon redolens*, *P. serrulatum*, *P. verbascifolium* and *P. xenicum* with 26–58 florets; *P. ciliosum*, *P. globuliflorum*, *P. paradoxum*, *P. sphacelatum*, *P. sphaeranthoides* and *P. tricholobum* with

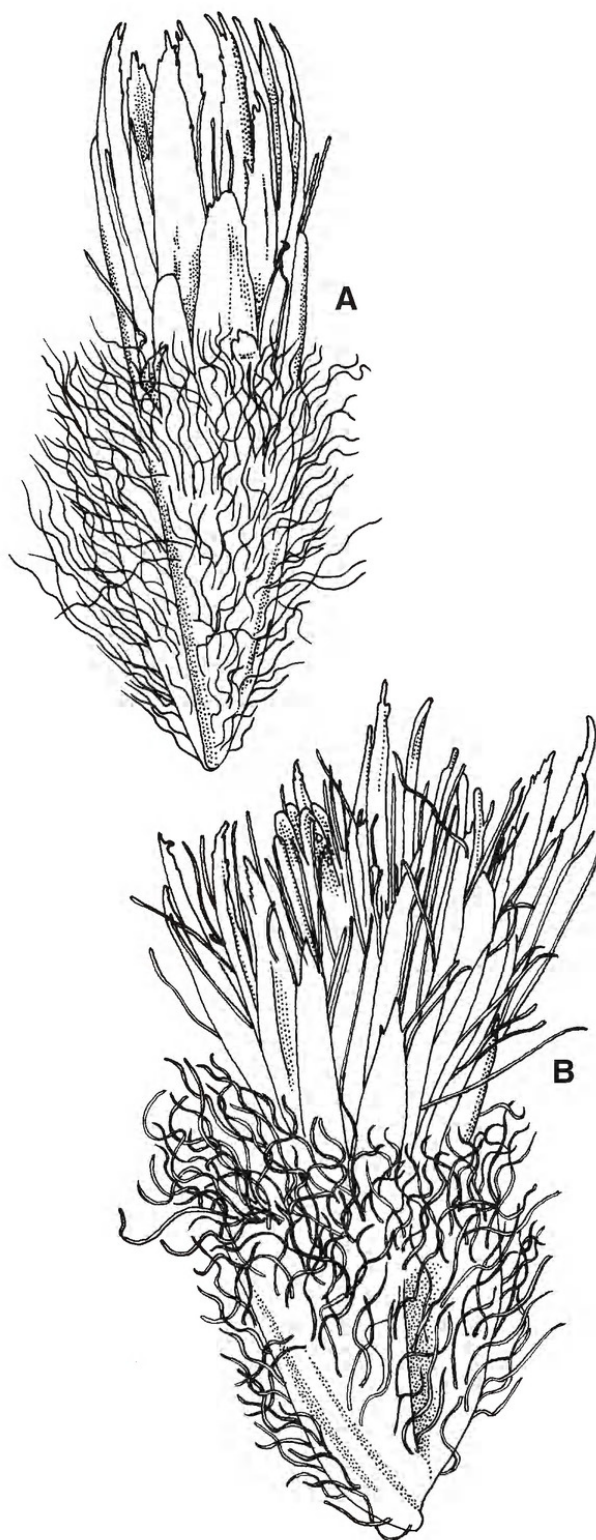


Fig. 2. Single capitula in *Pterocaulon*. A. *P. sphacelatum* $\times 16$. B. *P. ciliolum* $\times 12$. A from Piercey 51 (DNA); B from Bean 19221 (BRI). Del. W.Smith.

14–29 florets; *P. brachyanthum*, *P. discolor*, *P. intermedium* and *P. niveum* with 7–17 florets.

9. Florets

There is a single hermaphrodite floret in each capitulum of every species, except *Pterocaulon verbascifolium* and *P. sphaeranthoides*, which can sometimes have two.

On this floret, a cluster of globose sessile glands is consistently present on the outer surface of each corolla lobe, for all species except *Pterocaulon verbascifolium*, in which these glands are lacking. In some species (e.g. *Pterocaulon tricholobum*) the corolla lobes of the hermaphrodite floret consistently bear numerous conspicuous eglandular unicellular trichomes on their outer surface. In other species (e.g. *Pterocaulon intermedium*) the lobes are always glabrous. In some species (e.g. *Pterocaulon ciliolum*) the trichomes are absent on some collections, but present on others.

The length of the corolla lobes of the hermaphrodite floret is taxonomically informative. In one group of species, the corolla lobes are 0.7–1.2 mm long; in another group, they are 0.3–0.6 mm long. In only two species (*Pterocaulon intermedium* and *P. paradoxum*) are the lobes of intermediate length.

The female florets are very slender, with an inconspicuously lobed corolla and a 2-fid style (**Fig. 20L**). The female corolla length can be diagnostic for species determination.

10. Achenes and pappus

The length of achenes varies from 0.5–1.2 mm within the section, with each species showing a small range of lengths. Twin hairs are found on the achenes of all species, but the number of hairs varies between species, and is hence taxonomically useful.

In a few species, it is possible to find a ring of transparent globose glands at the junction of the achene and the pappus (**Fig. 11L**). These glands are not consistently present in any species, but can most frequently be seen in *Pterocaulon redolens*. The pappus length varies between species and is often diagnostic,

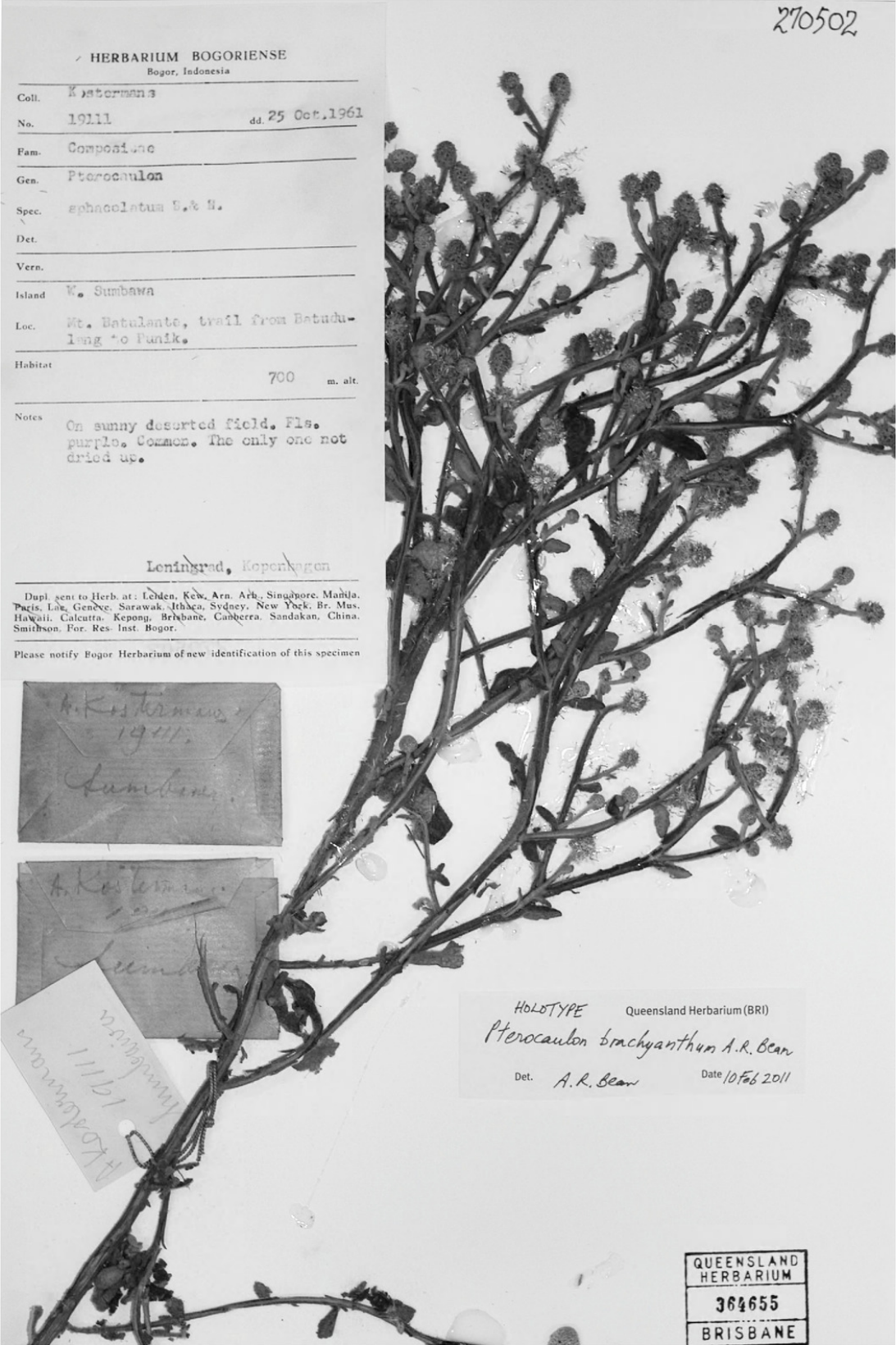


Fig. 3. Holotype of *Pterocaulon brachyanthum* (Kostermans 19111 [BRI]).

but no other pappus characteristics appear to be of taxonomic utility.

Taxonomy

Pterocaulon section **Monenteles** (Labill.) Kuntze, *Lex. Gen. Phan.* 468 (1903); *Monenteles* Labill., *Sert. Austro-Caledon.* 42, t. 43, 44 (1825). **Type species:** *Monenteles spicatus* Labill. (= *Pterocaulon redolens* (Willd.) Fern.-Vill., *fide* Cabrera & Ragonese [1978: 202]).

Annually resprouting or perennial forbs or shrubs, often aromatic. Basal rosette present in some species. Stems conspicuously winged due to decurrent leaf margins, wings extending for 1 and 2 nodes. Leaves alternate, sessile, decurrent; indumentum of uniseriate, multicellular hairs; hairs of the upper surface with short basal cells and relatively long upper cells; hairs of the lower surface with cell length relatively uniform throughout; broad-based glandular hairs sometimes present; lower surface with yellow, shining, globose sessile glands. Capitulescences terminal, monochasially cymose; globose, ellipsoidal, cylindrical or spiciform; partial clusters subtended by a bract. Capitula cylindrical, with involucre bracts in two series; the outer bracts persistent, lanate-hairy and sometimes glandular-hairy, all similar in size; the inner bracts caducous, margins with $\pm$ straight,

spreading to antrorse cilia, dorsal surface glabrous or with tiny translucent sessile glands, inner whorls slender, outer whorls shorter and broader. Receptacle epaleate, glabrous. Outer florets numerous, filiform, female; corolla three-lobed, style bifid. Disc floret hermaphrodite, solitary (rarely 2), tubular, functionally male; corolla broad, 5-lobed; anthers tailed; style bifid; style branches with acute sweeping-hairs reaching beyond the furcation. Achenes narrowly-ellipsoid to obovoid, with a conspicuous white ring-shaped carpodium; twin hairs antrorse, appressed. Pappus comprising a single row of barbellate capillary bristles, united at the base, persistent.

Cytology

The only published cytological record for *Pterocaulon* section *Monenteles* is $n = 10$ for *Pterocaulon sphacelatum* (Watanabe *et al.* 1999).

Etymology

Monenteles is derived from the Greek *monos* meaning 'single' and *enteles* meaning 'complete, entire or perfect'. This refers to the single hermaphrodite floret in each capitulum, surrounded by numerous female florets.

Fourteen species; distributed in Australia, Melanesia, Malesia and South-east Asia.

Key to the species of *Pterocaulon* section *Monenteles*

- 1 Capitulescences globose-ovoid, spherical to ellipsoidal, 0.7–2.1 times longer than wide 2
1. Capitulescences cylindrical or spicate, 2.2–5.8 times longer than wide 13
- 2 Some capitulescences on each plant laterally placed on continuous branchlets, side branches erect or diverging at less than 30 degrees (Fig.7). 3
2. All capitulescences terminal, side branchlets diverging at 30–90 degrees (Fig. 5) 6
- 3 Stem wings broad, 2.8–5.5 mm wide 12. *P. tricholobum*
3. Stem wings narrow, 0.3–2.5 mm wide 4
- 4 Upper side of leaves with dense to very dense lanate indumentum; inner involucre bracts pink to violet in dried specimens 6. *P. niveum*

4. Upper side of leaves with sparse lanate indumentum; inner involucrel bracts greenish-white to white in dried specimens. **5**
- 5 Capitulescences 8.5–10 mm wide; pappus 1.3–1.8 mm long **4. P. globuliflorum**
5. Capitulescences 11–13 mm wide; pappus 2.6–3.4 mm long **3. P. discolor**
- 6 Stem wings serrate or dentate. **7**
6. Stem wings entire or sparsely toothed **8**
- 7 Leaf upper surface conspicuously bullate; few or no cilia visible on protruding part of inner bracts (**Fig. 2A**); inner bracts pink, violet or white **11. P. sphaeranthoides**
7. Leaf upper surface not or slightly bullate; many cilia visible on protruding part of inner bracts (**Fig. 2B**); inner bracts white or greenish-white . . . **9. P. serrulatum**
- 8 Capitulescences 8.5–10 mm wide at anthesis; longest inner bracts 2.8–3.5 mm long; sessile glands on lower leaf surface very sparse **1. P. brachyanthum**
8. Capitulescences 10–15 mm wide at anthesis; longest inner bracts 3.4–5.6 mm long; sessile glands on lower leaf surface sparse to dense **9**
- 9 Female florets 8–17 per capitulum; achenes hairs 0–25; leaves elliptic to lanceolate, broadest near the middle **5. P. intermedium**
9. Female florets 16–44 per capitulum; achenes hairs 25–50 or more than 50; leaves oblanceolate to obovate, broadest towards apex **10**
- 10 Corolla lobes of hermaphrodite floret 0.5–0.8 mm long; numerous cilia visible on protruding part of inner bracts, but none exceeding apices . . **7. P. paradoxum**
10. Corolla lobes of hermaphrodite floret 0.35–0.6 mm long; cilia on protruding part of inner bracts either few or absent, or cilia abundant with some exceeding bract apices **11**
- 11 Stem wings 0.3–0.5 mm wide; longest inner bracts 4.8–5.6 mm long **14. P. xenicum**
11. Stem wings 0.7–3 mm wide; longest inner bracts 3.4–4.6 mm long **12**
- 12 Protruding part of inner bracts with abundant cilia (**Fig. 2A**), some exceeding bract apices (**Fig. 2B**); inner involucrel bracts straw to white coloured; leaves 2.1–3.5 times longer than wide **2. P. ciliosum**
12. Protruding part of inner bracts with few or no cilia; inner involucrel bracts, white or pink to violet; leaves 3.3–5.8 times longer than wide **10. P. sphacelatum**
- 13 Stem wings serrate; achenes 0.7–1 mm long; outer involucrel bracts with broad-based glandular hairs and lanate trichomes outside. **9. P. serrulatum**
13. Stem wings entire; achenes 0.5–0.7 mm or 1.1–1.3 mm long; outer involucrel bracts with lanate hairs only outside **14**
- 14 Capitulescence 17–30 mm wide at anthesis; hermaphrodite corolla 4–6.5 mm long; achenes 1.1–1.3 mm long **13. P. verbascifolium**
14. Capitulescence 8–14 mm wide at anthesis; hermaphrodite corolla 2.5–3 mm long; achenes 0.5–0.7 mm long **8. P. redolens**

1. *Pterocaulon brachyanthum* A.R.Bean **species nova** affinis *P. sphacelato* sed capitulescentiis minoribus, bracteis interioribus brevioribus, dentibus minoribus in margine superiore illarum et flosculis femineis paucioribus in quoque capitulo differens. **Typus:** Indonesia. WEST NUSA TENGGARA PROVINCE: Trail from Batudulang to Punik, Mt. Batulante, west Sumbawa, 25 October 1961, *A.J.G. Kostermans 19111* (holo: BRI; iso: CANB, L).

Shrub 40–70 cm high; stems densely to very densely lanate; stem wings entire or with scattered teeth, 0.9–3 mm wide. Leaves narrowly-elliptic to oblanceolate, 36–55 × 10–22 mm, 2.5–3.6 times longer than wide, apex acute; margins recurved, denticulate, with 2–14 pairs of blunt teeth, sometimes obscure. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface with hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs spreading, dense to very dense, extending 0.4–0.7 mm from the surface, basal cells not very short; sessile glands globose, yellow and shining, very sparse, 8–30 diameters apart. Capitulescence globose to ellipsoidal, 9–14 mm long and 8.5–10 mm wide at anthesis, 1–1.5 times longer than wide; side branchlets never continuous, at 20–60°; peduncles 2–17 mm long. Outer involucre bracts 1.5–1.8 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surfaces, inner surface glabrous or with hairs on the distal end of inner surface; glands absent; apex obtuse, erose or truncate. Inner bracts straw-coloured or white on dorsal surface; longest ones linear, 2.8–3.5 × 0.25–0.5 mm, apex acute, upper margins with numerous small teeth; cilia 3–9, up to 1.7 mm long, attached along the proximal half, few extending to the distal one third, none exceeding the bract apex. Filiform (female) florets 7–17, colour unknown, corolla 2–2.4 mm long, styles extending 0.3–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla colour unknown, 2.4–2.8 mm long; corolla lobes 0.3–0.5 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.5–0.8 mm

long, dark brown, with 0–25 or 25–50 twin hairs each *c.* 0.05 mm long; globose sessile glands at junction between achene and pappus sometimes present; pappus 2.1–2.5 mm long. **Figs. 3, 4A–D.**

Additional specimens examined: Indonesia. Likoeatang – Taramana, Alor Island, May 1938, *Jaag 853* (L); Saseël Island, Kangean Archipelago, Apr 1919, *Backer 288635* (L); Karimunjawa Island, north-central Java, Nov 1955, *Hoogerwerf 172* (L); Flores, Lesser Sunda Islands, Sep 1966, *Schmutz 355* (L); Soembawa, Nov 1879, *Colfs 129* (L); Kambanirroe, Soemba [Sumba] Island, *s.dat.* [Sep 1873], *Teysmann 8824* (A, L); Soemba [Sumba Island], Lesser Sunda Islands, Nov 1932, *Posthumus 3026* (L); Sumba, Lesser Sunda Islands, Jul 1974, *Verheijen 4147* (L); Banyupoh, Bali, Oct 1929, *Demandt & Van Dillewijn s.n.* (L); Timor, *s.dat.*, *Spanoghe s.n.* (L); Timor, *s.dat.*, *Zippelius s.n.* (L); Buton Island, south-east Celebes, Sep 1909, *Elbert 2598* (L); Timor, Aug 1973, *Kooy 957* (K, L). **Timor-Leste.** *s.loc.*, 1962–63, *Cinatti 210* (L); in Tasitolu area, just west of Dili, Oct 2006, *Cowie 11213* (DNA, L).

Distribution and habitat: *Pterocaulon brachyanthum* is endemic to Indonesia and Timor-Leste. Most collections are from the Lesser Sunda Islands, east of Java, and from Timor, but there are two records from islands north of Java, and one from the south-eastern end of Sulawesi (**Map 1**). It inhabits grassy areas near the coast. One specimen label states “from the upper margin of mangroves and salt flat, at the base of a steep shale hill”. The collections seen were made between altitudes of 0–200 metres, except the type, which was from 700 metres.

Phenology: Flowers and fruits are recorded from April to November.

Affinities: *Pterocaulon brachyanthum* is similar to *P. sphacelatum*, but differs by the 8.5–10 mm wide capitulescences (10–14 mm wide for *P. sphacelatum*); longest inner bracts 2.8–3.5 mm long (3.5–4.5 mm long for *P. sphacelatum*); upper margins of inner bracts with small teeth (lacerate or conspicuously toothed for *P. sphacelatum*); female florets 7–17 (17–29 for *P. sphacelatum*); and globose sessile glands very sparse on the lower leaf surface (dense for *P. sphacelatum*).

Notes: Cabrera & Ragonese (1978) cited specimens of the type (*Kostermans 19111*) from P and NY.

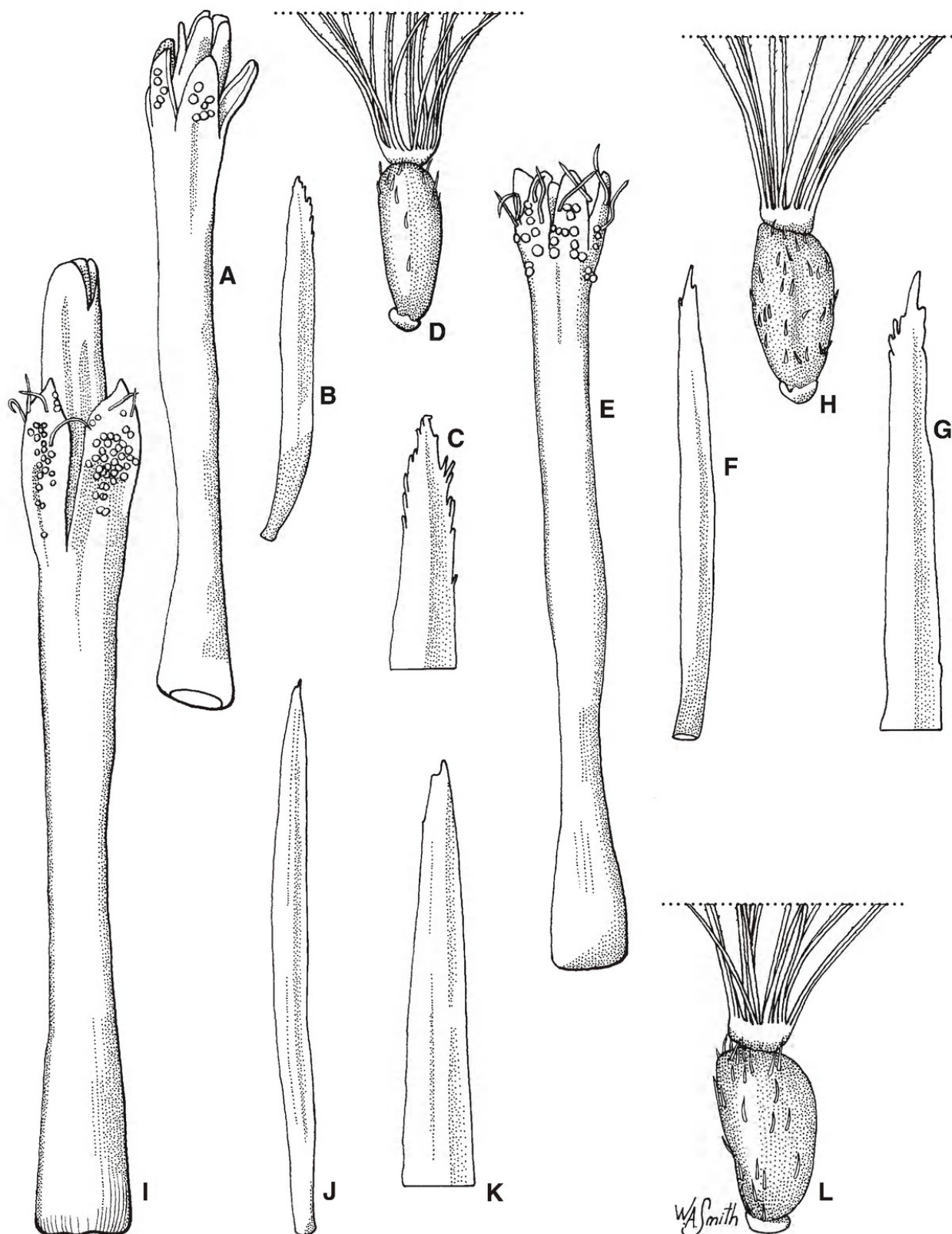


Fig. 4. *Pterocaulon brachyanthum*. A. hermaphrodite floret $\times 32$. B. inner involucre bract (cilia not shown) $\times 16$. C. upper portion of inner involucre bract $\times 32$. D. mature achene and basal portion of pappus $\times 32$. *P. ciliosum*. E. hermaphrodite floret $\times 32$. F. inner involucre bract (cilia not shown) $\times 16$. G. upper portion of inner involucre bract $\times 32$. H. mature achene and basal portion of pappus $\times 32$. *P. discolor*. I. hermaphrodite floret $\times 32$. J. inner involucre bract (cilia not shown) $\times 16$. K. upper portion of inner involucre bract $\times 32$. L. mature achene and basal portion of pappus $\times 32$. A–D from Cowie 11213 (DNA); E, H from Bean 12069 (BRI); F, G from Bean 27963 (BRI); I–L from Kerrigan 579 (DNA).

Distinctive features of this species are the capitulescences 8.5–10 mm wide; stem wings often toothed; glands very sparse on lower leaf surface; female florets few in each capitulum.

Etymology: From the Greek *brachys* meaning short and *anthos* meaning flower. This is in reference to both the hermaphrodite and female florets, which are shorter than in most other species of the section.

2. *Pterocaulon ciliosum* A.R.Bean species nova affinis *P. sphacelato* sed foliis latoribus, bracteis interioribus stramineis, ciliis abundantibus in capitulis in situ visibilibus, dentibus minoribus in margine superiore in bracteis interioribus et pedunculis brevioribus differens. **Typus:** Australia: Queensland. PORT CURTIS DISTRICT: 7.1 km by road NNW of Kalpowar Railway Station towards Many Peaks, 30 August 1975, *R.Coveny* 6847 & *P.Hind* (holo: BRI; iso: L, NSW).

Illustration: Stanley & Ross (1986: 532), as *P. sphacelatum*

Aromatic shrub 40–100 cm high; stems one to several from non-woody rootstock, sparsely to densely lanate and sometimes with a few globose sessile glands; stem wings entire, 1.2–3 mm wide. Leaves oblanceolate to obovate, 32–56 × 11–21 mm, 2.1–3.5 times longer than wide, apex acute; margins recurved, denticulate, with 8–18 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface somewhat bullate; hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderately dense to dense, extending 0.5–1 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence globose, 10–16 mm long and 10–13 mm wide at anthesis, 0.9–1.2 times longer than wide; side branchlets never continuous, at 30–90°; peduncles to 7 mm long. Outer involucral bracts 1.8–2.4 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surface, glabrous or with hairs on the distal end of inner surface; glands absent; apex obtuse. Inner

bracts white to straw coloured (sometimes tinged pink) on dorsal surface; longest ones linear, 3.4–4.3 × 0.2–0.4 mm, apex acute, upper margins with some small teeth; cilia 7–15, up to 2.9 mm long, attached along the proximal half and consistently extending to the distal one third, and some exceeding the bract apex. Filiform (female) florets 16–23, pink or straw-coloured, corolla 2.2–3 mm long, styles extending 0.2–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.9–3.5 mm long; corolla lobes 0.35–0.5 mm long, globose sessile glands present, eglandular trichomes absent or present. Achenes narrowly ellipsoidal, 0.7–0.9 mm long, obscurely quadrangular, dark brown, with 25–50 twin hairs each <0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.3–3.1 mm long. **Figs. 2B, 4E–H, 5.**

Additional selected specimens examined: **Indonesia.** Flores, May 1967, *Schmutz* 1545 (L); Manggarai, Flores, Jul 1983, *Schmutz* 5996 (L). **Australia: Northern Territory.** Blue Mud Bay, 10 km N of Harris Creek crossing, Sep 1987, *Russell-Smith* 3117 & *Lucas* (DNA); Tanumbirini Station, Apr 1991, *Wilson* 522 (BRI, DNA); 50 miles [80 km] S of Borroloola Road – Anthonys Lagoon Road junction, Jun 1971, *Latz* 1539 (DNA); c. 21 km W of ‘Wollogorang’ on the Calvert Hills Road, May 1974, *Pullen* 9214 (CANB, DNA); 8.7 miles [14.0 km] S of ‘Dunmurra’, Sep 1957, *Chippendale* 3751 (BRI, CANB, DNA); Goulburn Island, Anyiminali Point, May 1992, *Coleman* 280 (DNA); Caledon Bay, Jun 1972, *Latz* 2691 (DNA). **Queensland.** BURKE DISTRICT: 38.5 km NW of ‘Bowthorn’ Homestead on Bowthorn Station, Jun 2006, *Thompson* WES745 & *Hogan* (BRI). COOK DISTRICT: 4.4 km S of ‘Fairlight’ on the Palmerville Road, Jun 1992, *Clarkson* 9607 & *Neldner* (BRI, CNS, K, MEL); Palm Cove, Cairns, Jul 1995, *Jago* 3526 (BRI, DNA); Spear Creek, c. 1 mile [1.6 km] north of Mt Molloy, Aug 1963, *Schodde* 3355 (A, AD, B, BRI, E, L). NORTH KENNEDY DISTRICT: Hook Island, Whitsunday Group, Jul 1985, *Warrian* CW712 (BRI); Mt Abbot, 50 km W of Bowen, Aug 1992, *Bean* 4893 (BRI); May’s firebreak, W of Ravenshoe, Aug 2010, *Bean* 29858 & *McDonald* (AD, BRI, L). SOUTH KENNEDY DISTRICT: Brampton Island, Sep 1988, *Batianoff* 5114 (BRI); 5.4 km from ‘Redcliffe Vale’ Homestead on road to Turrawallah, May 1997, *Thompson* 266 (BRI). LEICHHARDT DISTRICT: Grey Rock, Glenlea Road, WNW of Springsure, Jul 1989, *O’Keeffe* 894 (BRI); 10 km S of Isla Gorge lookout, 37 km S of Theodore, Jun 1971, *Johnson* 7169 & *Briggs* (BRI, NSW). PORT CURTIS DISTRICT: Hill W of Mt Couti-Outi, Stanage Bay area, N of Rockhampton, Jul 1997, *Bean* 12069 (BRI); 4 km SW of Mt Castletower, c. 40 km SW of Gladstone, Jun 1977, *Crisp* 2739 (BRI, CANB). BURNETT DISTRICT: Near junction of Delubra and Cadarga Creeks, 35 km SW of Mundubbera, Sep 2008, *Bean* 27963 (BRI).

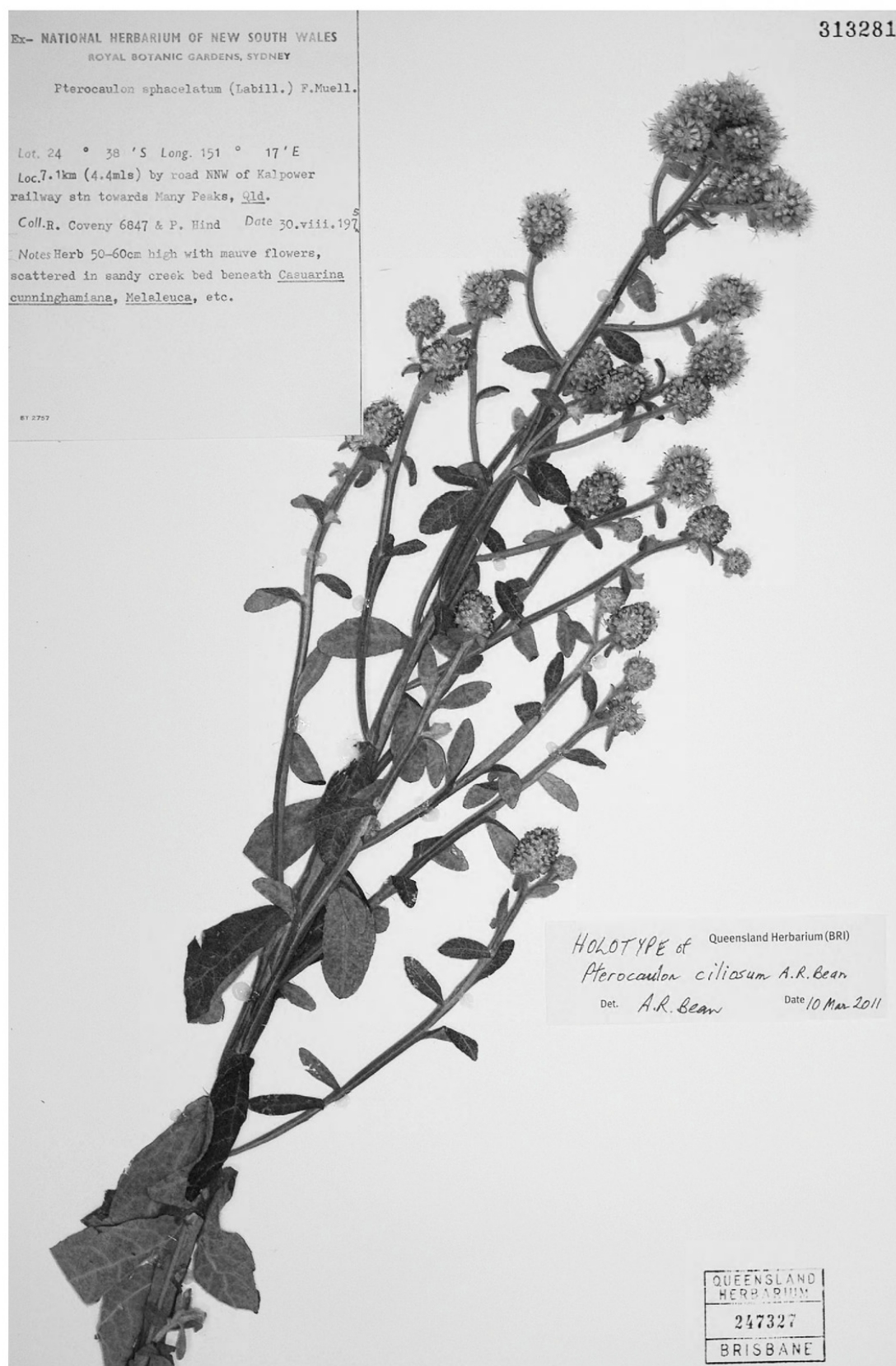


Fig. 5. Holotype of *Pterocaulon ciliosum* (Coveny 6847 & Hind [BRI]).

WIDE BAY DISTRICT: Fairlies Knob, Seaview Range, May 2000, *Phillips 389 & Phillips* (BRI); Western edge of Mt Walsh N.P., near Biggenden, Sep 2002, *Bean 19221* (BRI). MORETON DISTRICT: Upper Ithaca Creek, Aug 1887, *Simmonds s.n.* (BRI); Mermaid Mt, NW of Brookfield, May 1970, *Telford 1590* (CANB).

Distribution and habitat: *Pterocaulon ciliosum* is a widely distributed species. It has been collected on the island of Flores in Indonesia; it occurs in the north-east of Northern Territory (extending to far north-west Queensland), and is widespread in eastern Queensland from Murray Island in the Torres Strait to Brisbane (**Map 2**). It is found in eucalypt woodland, mainly on well-drained sandy to loamy soils, including sites near the ocean.

Phenology: Flowers and fruits have been recorded from April to October.

Affinities: *Pterocaulon ciliosum* is similar to *P. sphacelatum*, but differs by the leaves 2.1–3.4 times longer than wide (3.3–5 times for *P. sphacelatum*); the straw-coloured inner bracts on dried material (white or pink for *P. sphacelatum*); abundant cilia visible on the protruding part of inner bracts (few or no visible cilia for *P. sphacelatum*); the upper margins of the inner bracts with small teeth (strongly toothed or lacerate for *P. sphacelatum*); and the peduncles to 7 mm long (to 22 mm long for *P. sphacelatum*).

Notes: Distinctive features for this species are the abundant cilia visible on the protruding part of inner bracts, straw-coloured inner bracts on dried material and the short corolla lobes of the hermaphrodite floret.

Etymology: The specific epithet is from the Latin *cilia* meaning ‘full of cilia’ and refers to the numerous cilia on the margins of the inner bracts.

3. *Pterocaulon discolor* A.R.Bean **species nova** affinis *P. tricholobae* sed alis caulinis angustioribus, foliis valde discoloribus, foliorum dentibus paucioribus, flosculis femineis paucioribus in capitulo quoque numeris majoribus pilorum in achenis differens. **Typus:** Australia: Northern Territory. 3 km N of Adelaide River bridge on Stuart Highway, 3 May 1983, *J.D.Briggs 819* (holo: CANB; iso: MEL).

Forb 50–80 cm high, aromatic properties unknown; stems one to several from woody rootstock, densely lanate but without globose sessile glands; stem wings entire, 1–2.5 mm wide. Leaves elliptical, 35–68 × 13–31 mm, 2–2.7 times longer than wide, apex obtuse or mucronate; margins not recurved, denticulate to crenulate, with 10–16 pairs of small teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface not or slightly bullate; hairs erect to spreading, sparse, basal cell short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, very dense, obscuring surface, extending 0.2–0.3 mm from the surface, basal cells not very short; globose sessile glands not visible. Capitulescence globose to ellipsoidal, 12–15(–19) mm long and 11–13 mm wide at anthesis, 1–1.2(–1.5) times longer than wide; side branchlets sometimes continuous, at 0–60°; peduncles absent or up to 12 mm long. Outer involucre bracts oblong-spathulate, 2.1–2.4 mm long, with dense spreading lanate hairs on outer surface, sparse to moderately dense hairs on the distal end of inner surface, glands few, apex obtuse. Inner bracts white or greenish-white on dorsal surface; longest ones linear, 4.5–5 × 0.3–0.4 mm, apex acute, upper margins entire or with some small teeth; cilia 8–12, up to 3.3 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 7–14, white or straw-coloured, corolla 2.7–3.2 mm long, styles extending 0.3–0.7 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.3–4 mm long; corolla lobes 0.7–1.1 mm long, globose sessile glands present, eglandular trichomes 1–5 per lobe. Achenes narrowly ellipsoidal, 0.8–0.9 mm long, faintly ribbed, dark brown, with 25–50 twin hairs each 0.1–0.2 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.6–3.4 mm long. **Figs. 4I–L, 6.**

Additional specimens examined: **Australia: Northern Territory.** Tipperary, May 1963, *Muspratt 575* (DNA); 0.5 miles [0.8 km] E of Stuart Highway, 60 miles [98 km] [from Darwin?], Apr 1964, *Robinson R343* (DNA); Nitmiluk N.P., eastern boundary, May 2002, *Michell 3875* (DNA); Nitmiluk N.P., Apr 2001, *Michell 3329* (DNA); Nitmiluk N.P., Edith Falls, May 2002, *Kerrigan*

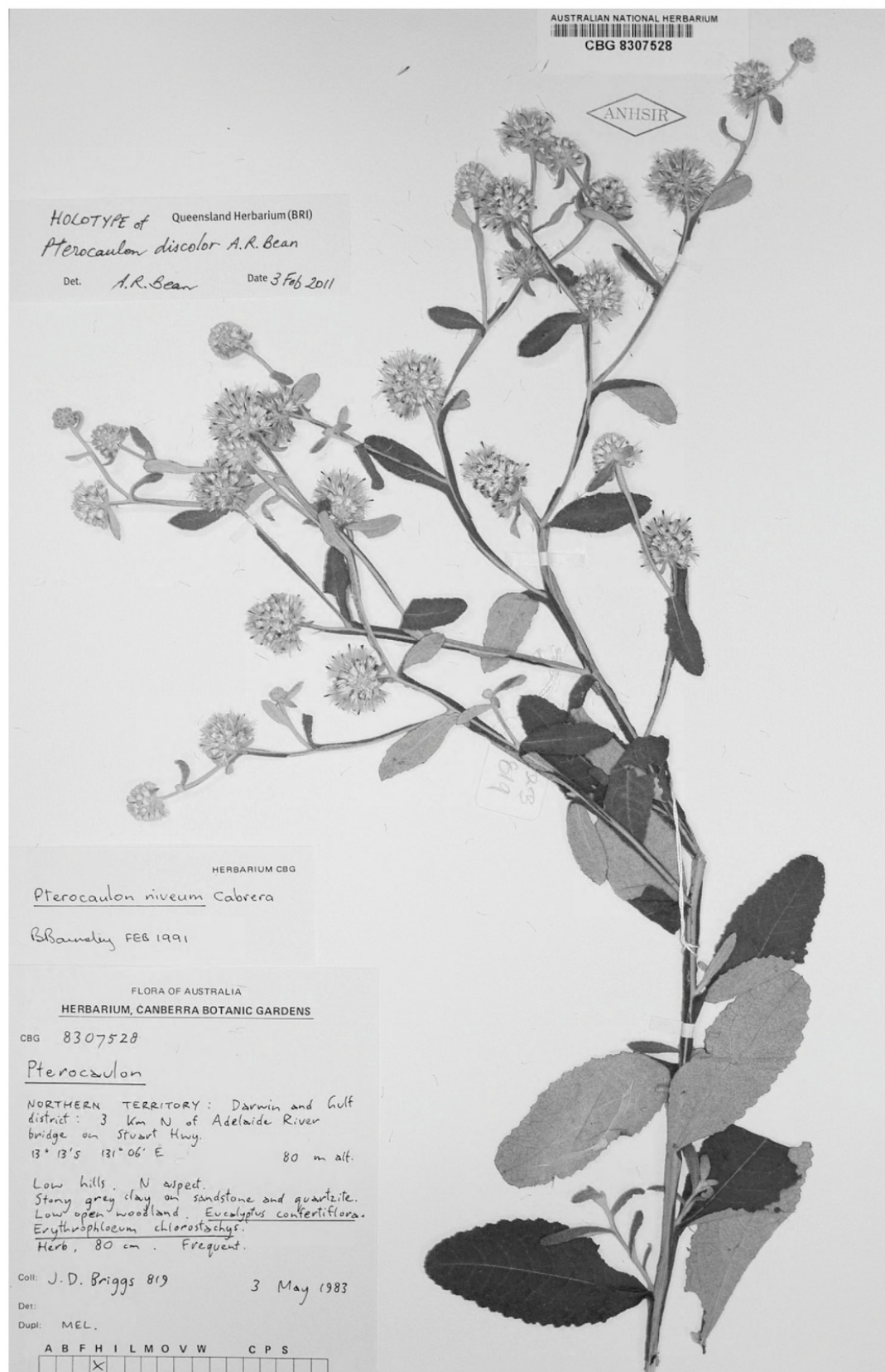


Fig. 6. Holotype of *Pterocaulon discolor* (Briggs 819 [CANB]).

579 (DNA); Tin Camp Creek, c. 20 miles [32 km] S of Nabarlek mining camp, May 1973, *Hartley 13824* (CANB [2nd sheet only], DNA, L); 11 km E of Katherine Gorge ranger station, May 2009, *Latz 24367 & Quarmby* (DNA, K, NT).

Distribution and habitat: *Pterocaulon discolor* is known from a few scattered locations in the 'Top End' of the Northern Territory, including Nitmiluk N.P. (**Map 3**). It grows on sandstone and quartzite hills and ridges in mixed open forest or open woodland, in sandy soil.

Phenology: Flowers and fruits have been collected in April and May.

Affinities: *Pterocaulon discolor* is similar to *P. tricholobum*, but differs by the stem wings 1–2.5 mm wide (2.8–5.5 mm for *P. tricholobum*); the lanate indumentum of the lower leaf surface 0.2–0.3 mm high (0.4–0.8 mm high for *P. tricholobum*); the 10–16 pairs of readily observed leaf teeth (15–30 pairs of obscure leaf teeth for *P. tricholobum*); the 7–14 female florets per capitulum (15–21 for *P. tricholobum*); and the 25–50 hairs on the achene (0–25 hairs for *P. tricholobum*).

Notes: This species is distinctive in the strongly discolorous leaves, few female florets per capitulum, conspicuous leaf teeth, white or greenish-white inner bracts and the trichomes on the corolla lobes of hermaphrodite floret.

Etymology: From the Latin *discolor*, meaning 'of different colours'. This refers to the leaves, which in this species are strikingly green on the upper surface and snowy white on the lower surface.

4. *Pterocaulon globuliflorum* W.Fitzg., *J. & Proc. Roy. Soc. Western Australia* 3: 223 (1918), (as "*globuliflorus*"). **Type:** Australia: Western Australia. Devil's Pass, Napier Range, May 1905, *W.V.Fitzgerald 607* (holo: PERTH; iso: K373285; NSW *n.v.*).

Shrub to 60 cm high; aromatic properties unknown; stems sparsely to densely lanate and with a few globose sessile glands; stem wings entire, 0.3–1.5 mm wide. Leaves elliptical, 18–51 × 7–24 mm, 2–2.6 times longer than wide, apex acute or obtuse; margins not recurved, denticulate, with 7–15 pairs of blunt teeth. Indumentum comprising lanate multi-

cellular hairs, glandular hairs absent. Upper surface not or slightly bullate, hairs sparse, flexuose, basal cells not short; globose sessile glands absent. Lower surface with lanate hairs flexuose, dense to very dense, extending 0.15–0.25 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart, but usually obscured by indumentum. Capitulescence globose or globose-truncate, 6–10 mm long, 8.5–10 mm wide at anthesis, 0.7–1.1 times longer than broad; side branchlets 0–50°, often continuous, peduncles 0–4 mm long. Outer involucre bracts oblong, 0.8–1.9 mm long, with dense spreading lanate hairs on the distal one-half of outer surface, and glabrous on the inner surface; apex obtuse or truncate. Inner bracts white on dorsal surface, sessile glands absent; longest ones linear, 3.1–3.5 × 0.2–0.25 mm, apex acute, upper margins with small teeth; cilia 5–8, up to 1.6 mm long, mostly attached proximally and extending to the distal one third. Filiform (female) florets 16–20, colour unknown, corolla 1.7–2 mm long, styles extending 0.3–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.5–2.8 mm long; corolla lobes 0.7–1.2 mm long, globose sessile glands present, eglandular trichomes absent or with 1 or 2 per lobe. Achenes narrowly ellipsoidal, 0.7–0.8 mm long, slightly longitudinally ribbed, dark brown, with 25–50 twin hairs each c. 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 1.3–1.8 mm long. **Figs. 7, 8A–D.**

Additional specimens examined: **Australia: Western Australia.** Windjana Gorge, Napier Range, Jul 1974, *Carr 3882 & Beaglehole 47660* (PERTH); Windjana Gorge, Napier Range, Jul 1974, *Carr 4036 & Beaglehole 47814* (PERTH); Yammera Gap, Napier Range, 9 km NE of Lennard River crossing on Gibb River Road, May 1988, *Streimann 8269* (A, B, CANB, L); Old Fossil Downs Station, May 1970, *Wolfe & Martin 72* (CANB).

Distribution and habitat: Endemic to the Napier and Geikie Ranges, Kimberley region, Western Australia (**Map 3**). It is confined to limestone ranges and hills, growing in grassland or low open woodland.

Phenology: Flowers and fruits have been recorded in May and July.

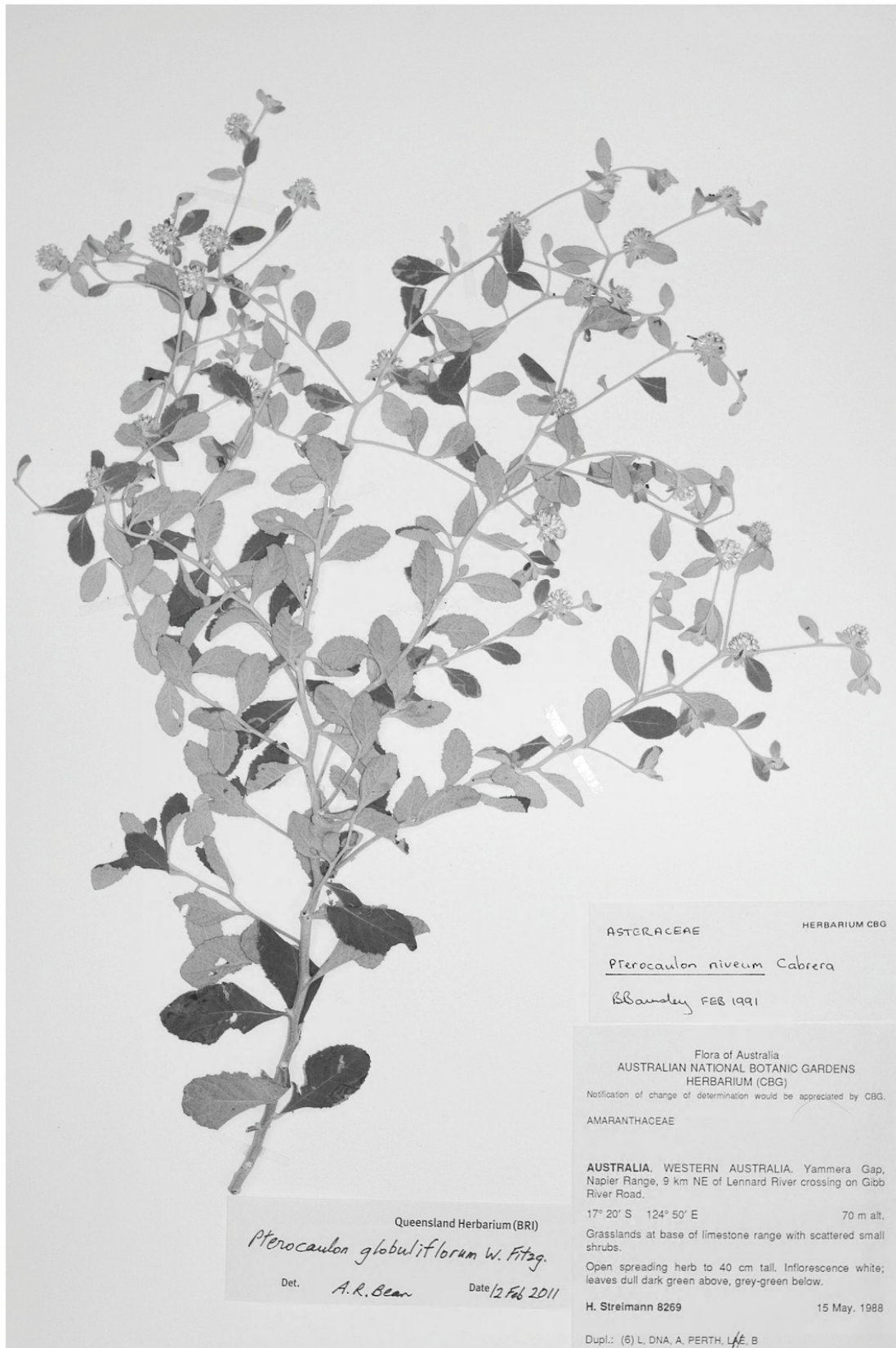


Fig. 7. Representative specimen of *Pterocaulon globuliflorum* (Streimann 8269 [CANB]).

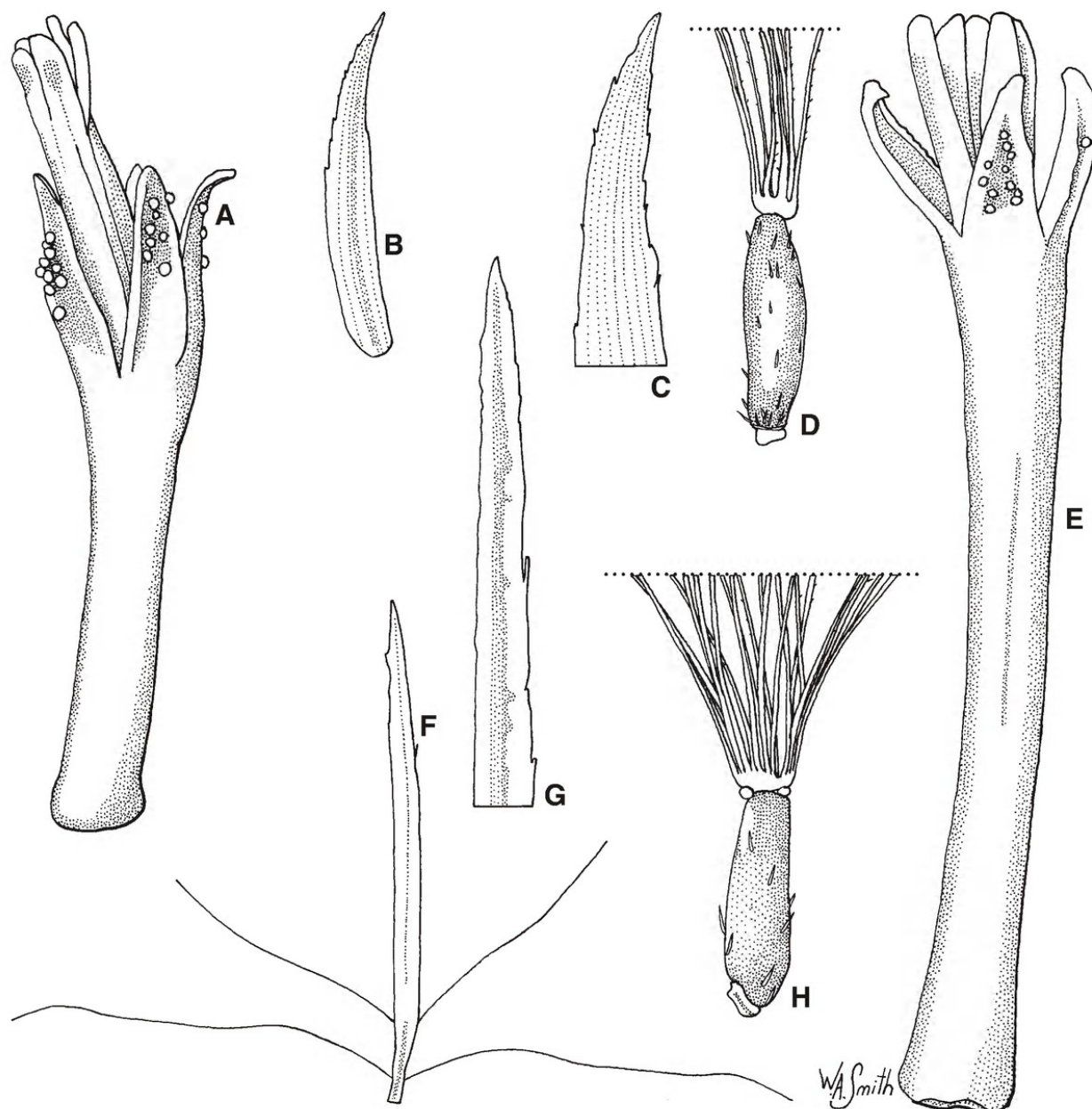


Fig. 8. *Pterocaulon globuliflorum*. A. hermaphrodite floret $\times 32$. B. inner involucre bract (cilia not shown) $\times 16$. C. upper portion of inner involucre bract $\times 32$. D. mature achene and basal portion of pappus $\times 32$. *P. intermedium*. E. hermaphrodite floret $\times 32$. F. inner involucre bract (cilia shown) $\times 16$. G. upper portion of inner involucre bract $\times 32$. H. mature achene and basal portion of pappus $\times 32$. A–D from Carr 4036 & Beaglehole 47814 (PERTH); E–G from Bean 12186 (BRI); H from Clarkson 4854 (BRI).

Affinities: *Pterocaulon globuliflorum* appears to be allied to *P. tricholobum* and *P. niveum*, on the basis of the long corolla lobes of the hermaphrodite floret, and the often ‘continuous’ branchlets giving rise to lateral capitulescences.

Typification: Fitzgerald wrote the location ‘Devil’s Pass’ on the label of his specimen. In the protologue, he used the locality ‘Wingrah Pass’. According to an annotation by Annette

Wilson on the holotype, both of these terms are equivalent to Windjana Pass or Windjana Gorge.

Notes: Distinctive features for this species include the small capitulescences (8.5–10 mm diameter) that are often lateral; leaves short and broad, 2–2.6 times longer than wide, strongly discolourous; stem wings very narrow and the very short pappus.

5. *Pterocaulon intermedium* (DC.) A.R.Bean comb. nov.; *Monenteles intermedius* DC., *Prodr.* 5: 456 (1836). **Type:** [Australia: Queensland. NORTH KENNEDY:] Sandy shores of Cape Cleveland, 14 June 1819, *A. Cunningham* 52 (holo: G-DC [G214737]; iso: K373284).

Monenteles globiferus DC., *Prodr.* 5: 455 (1836). **Type:** [Australia: Queensland. MORETON DISTRICT:] Lockyer's Creek, Brisbane River, Moreton Bay, July 1829, *A. Cunningham* 51 (holo: G-DC [G214749]; iso: K373282).

Pterocaulon sp. A; Wilson (1992: 954).

Pterocaulon sp. A Kimberley Flora (B.J.Carter 599); Paczkowska & Chapman (2000: 172).

Pterocaulon sp. (Yarrowmere Station E.J. Thompson+ BUC340); Bostock & Holland (2007: 30); Bostock & Holland (2010: 25).

Illustration: Kenneally *et al.* (1996: 67), as '*Pterocaulon* sp. A, Kimb. Flora'

Aromatic perennial shrub 20–60 cm high; stems sprouting from a woody rootstock, sparsely to densely lanate and sometimes with a few globose sessile glands; stem wings entire, 0.2–1.4 mm wide. Leaves lanceolate, narrowly-elliptic or elliptic, 12–52 × 3.5–18 mm, 2.6–4.6 times longer than wide, apex acute; margins not recurved, entire or denticulate, with 2–20 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface not bullate, hairs moderately dense to very dense, erect near base then antrorse, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderately dense to dense, extending 0.5–1 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence globose or almost so, 10–15 mm long, 10–14 mm wide at anthesis, 1–1.2 times longer than broad; side branchlets never continuous, at 30–90°; peduncles (5–)7–25 mm long. Outer involucre bracts oblong to spatulate, 1.7–2.4 mm long, with dense spreading lanate hairs on the distal one-third of outer surface, and glabrous or with a few hairs distally on the inner surface, glands absent; apex acute, obtuse or truncate. Inner

bracts pink to violet on dorsal surface; longest ones linear, 4–4.8 × 0.2–0.4 mm, apex acute, upper margins with small teeth; cilia 1–7, up to 2.8 mm long, mostly attached proximally and not extending to the distal one third. Filiform (female) florets 8–17, pink, corolla 2.7–3.6 mm long, styles extending 0.3–0.8 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.1–3.8 mm long; corolla lobes 0.6–0.9 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.6–0.75 mm long, longitudinally ribbed, dark brown, glabrous or with 1–25 twin hairs each <0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.5–3.1 mm long. **Figs. 8E–H, 9.**

Additional selected specimens examined: **Indonesia.** Kisar Island [just N of Timor], Apr 1939, *Bloembergen* 3852 (A, L). **Papua New Guinea.** MOROBE PROVINCE: Sialum Station, May 1975, *Henty & Katik* NGF49770 (BRI, CANB, L). **Australia: Western Australia.** Fence line at junction of Pindan, Calanjadie and Cardingy paddocks, Anna Plains Homestead, Sep 2004, *Byrne* 1266 (PERTH); Sir Graham Moore Island, Jul 1973, *Wilson* 11263 (PERTH); adjacent to Telecom tower, c. 5 km E of Broome, Oct 1993, *Dureau* DD150 (BRI, PERTH); 4 km SSE of Cape Bertholet, Dampier Peninsula, Aug 1992, *Carter* BJC599 (PERTH); Pender Bay at Weedong Lake, Dampier Peninsula, Jun 1984, *Forbes* 2435 & *Kenneally* (L, MEL). **Northern Territory.** Elcho Island, Warangaya, Sep 1987, *Russell-Smith* 3282 & *Lucas* (BRI, DNA); Elcho Island, Refuge Bay, Aug 1995, *Cowie* 6002 (BRI, CANB, DNA, MEL); Howard Island, Jun 1996, *Booth* 1789 (DNA); Maria Island, Gulf of Carpentaria, Jul 1972, *Dunlop* 2803 (BRI, DNA); Homestead Creek, Bing Bong Station, Jun 1971, *Dunlop* 2245 (DNA). **Queensland.** BURKE DISTRICT: Karumba, Jun 1901, *Bailey s.n.* (BRI [AQ270420]); Pandanus Ridge, 20 km NE of Burketown, May 2005, *Booth* 4281 & *Thompson* (BRI); Settlement Creek, 2 miles [3 km] from coast, Gulf of Carpentaria, Jun 1948, *Perry* 1217 (BRI, CANB, DNA); Sweers Island, South Wellesley group, Gulf of Carpentaria, Nov 2002, *Thomas* SW1111 (BRI). COOK DISTRICT: Lakefield N.P., Jane Table Hill, Jun 1983, *Clarkson* 4854 (BRI); near California Creek, NW of Mt Garnet, Aug 1997, *Bean* 12186 (BRI); 1.5 km N of the North Kennedy River on the Laura – Musgrave Road, May 1989, *Clarkson* 7996 & *Neldner* (BRI, DNA, K, L); on southern bank of Nassau River 0.5 km upstream from junction with Rocky Creek, Jun 1990, *Neldner* 3001 (BRI, L). NORTH KENNEDY DISTRICT: 15 miles [25 km] NW of Bowen towards Townsville, May 1970, *Fagg* 698 (CANB, L). SOUTH KENNEDY DISTRICT: 22.5 km S of 'Yarrowmere' Homestead, Apr 1992, *Thompson* BUC340 & *Simon* (AD, BRI). PORT CURTIS DISTRICT: 'Galloway Plains', c. 28 km SW of Calliope, Mar 1989, *Anderson* 4623 (BRI); S.F.60 Rundle Range, 37 km NW of Gladstone, Aug 1989, *Gibson* TO1683 (BRI). BURNETT

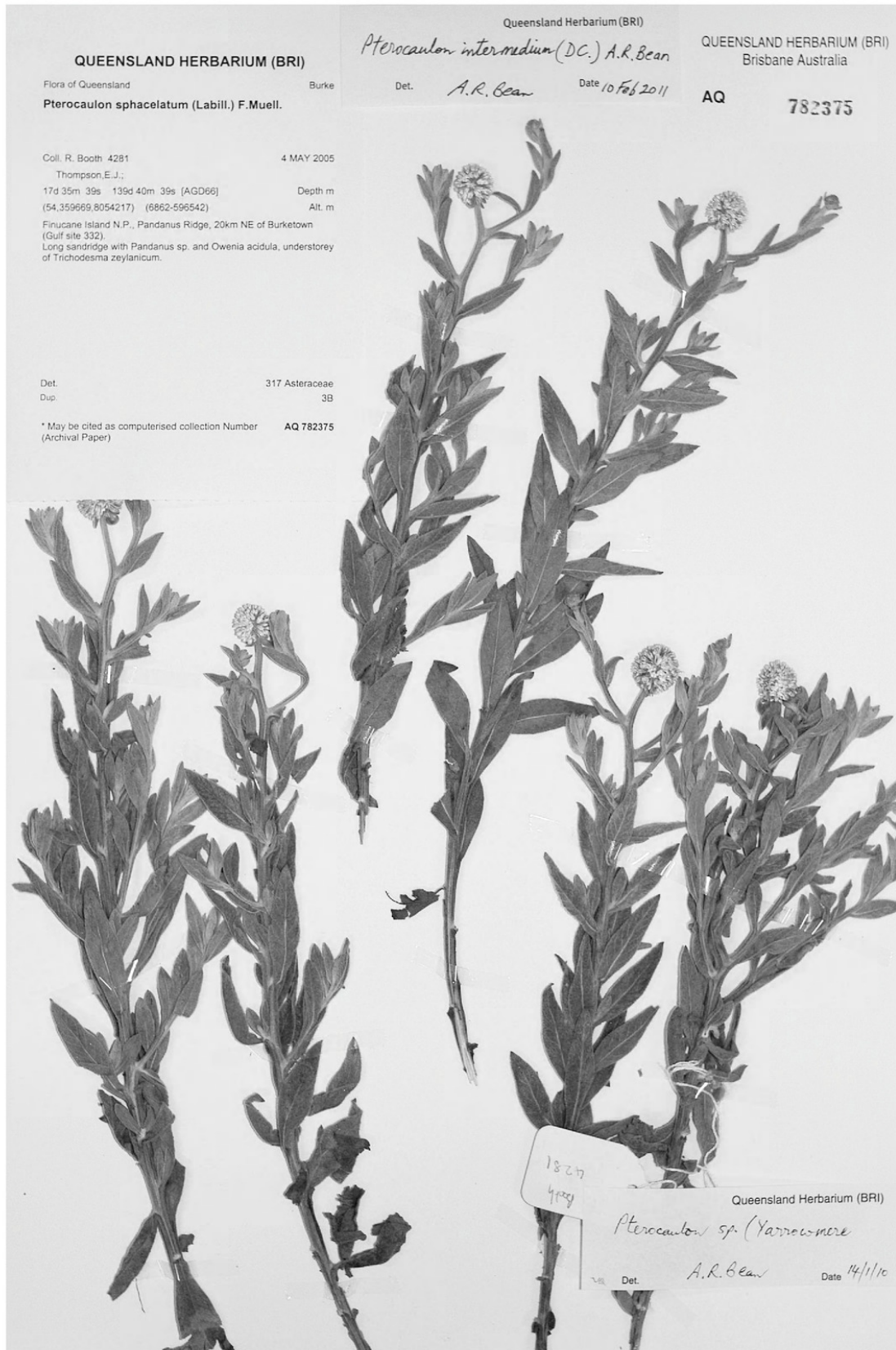


Fig. 9. Representative specimen of *Pterocaulon intermedium* (Booth 4281 & Thompson [BRI]).

DISTRICT: Brian Pastures near Gayndah, Mar 1952, *Blake 18894* (BRI); Wetheron, Apr 1980, *Forster PIF739* (BRI). DARLING DOWNS DISTRICT: 'Rockwood', 60 miles [98 km] W of Dalby, Apr 1969, *Dunlop 337* (CANB). MORETON DISTRICT: Ipswich, 1909, *Hall s.n.* (BRI [AQ270443]).

Distribution and habitat: *Pterocaulon intermedium* is widely distributed in northern Australia from Port Hedland (Western Australia) to Ipswich (Queensland). It is often found close to the coast, but it may occur up to 250 km inland. Outside Australia, it is known from the island of Kisar in Indonesia, and from one location in Papua New Guinea (**Map 4**). In coastal areas it favours sandy swales or dunes, in shrubland or low woodland, and is sometimes adjacent to saline tidal areas. In the more inland areas, it grows in eucalypt woodland with sandy soil.

Phenology: Flowers and fruits are recorded from April to October.

Affinities: *Pterocaulon intermedium* is perhaps closest to *P. paradoxum*, but differs by the leaves being broadest near the midpoint, the upper surface not bullate, the indumentum of the upper surface as dense as or denser than the lower, the shorter achenes and the fewer female florets per capitulum.

Typification: The original label of the holotype of *Monenteles intermedius* gives the date of collection as "June 14 1829". This is incorrect. The isotype at K bears the correct date of 14 June 1819, as confirmed by Curry & Maslin (1990).

Notes: Distinctive features for *Pterocaulon intermedium* are the narrow stem-wings; consistently long peduncles; a consistently $\pm$ globose capitulescence, inner bracts pink or violet; relatively few female florets per capitulum; elliptical leaves; upper leaf surface indumentum as dense as or denser than lower surface; and few hairs on the achene.

One specimen label reports that *Pterocaulon intermedium* has an "apple juice smell".

6. *Pterocaulon niveum* Cabrera & A.M.Ragonese, *Darwiniana* 21: 249 (1978).

Type: Australia: Western Australia. Mt Amherst, 13 May 1951, *C.A.Gardner 10206* (holo: PERTH; iso: SI).

Illustration: Cabrera & Ragonese (1978: 248).

Spreading shrub 40–100 cm high; stems very densely lanate; stem wings entire, 0.5–1.5 (–2.5) mm wide. Leaves elliptical or obovate, 39–70 $\times$ 21–38 mm, 2.1–2.6 times longer than wide, apex acute or obtuse; margins not recurved, denticulate, with 9–20 pairs of blunt teeth. Indumentum comprising lanate multicellular hairs, glandular hairs absent. Upper surface with hairs erect to spreading, very dense; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, very dense, extending 0.5–1 mm from the surface; globose sessile glands sparsely present, but hidden by hairs. Capitulescence globose to globose-truncate, 10–15 mm long and 10–15 mm wide at anthesis, 0.7–1.1 times longer than wide; side branchlets sometimes continuous, at 0–70°; peduncles 0–8 mm long. Outer involucral bracts 2.2–3.2 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surface, inner surface glabrous; glands absent; apex acute or obtuse. Inner bracts pink to violet on dorsal surface; longest ones linear, 4.5–5.4 $\times$ 0.2–0.35 mm, apex acute; upper margins entire or with a few small teeth; cilia 8–14, up to 3 mm long, attached mainly along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 11–17, pink, corolla 3–3.7 mm long, styles extending 0.4–1.2 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.3–4 mm long; corolla lobes 0.7–1.1 mm long, globose sessile glands present, eglandular trichomes present, 2–8 per lobe. Achenes narrowly ellipsoidal, 0.9–1 mm long, terete or slightly angular, dark brown, with 25–50 or >50 twin hairs each c. 0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2–3.1 mm long. **Figs. 10, 11A–D.**

Additional specimens examined: Australia: Western Australia. 19 miles [31 km] NW of Turner River Station, Jul 1949, *Perry & Lazarides 2410* (CANB, DNA); China Wall, Jun 1983, *MacDonald 234* (BRI); Mt Amherst Range, 1 mile [1.6 km] E of Mt Amherst Station, July 1959, *Lazarides 6341* (BRI); 9 km SSW of Bungle Bungle outcamp, East Kimberley, Jul 1984, *Kenneally 9264* (BRI, CANB, PERTH); S slopes of Mt North, May 1988, *Goble-Garratt 525* (BRI, PERTH); Mt House

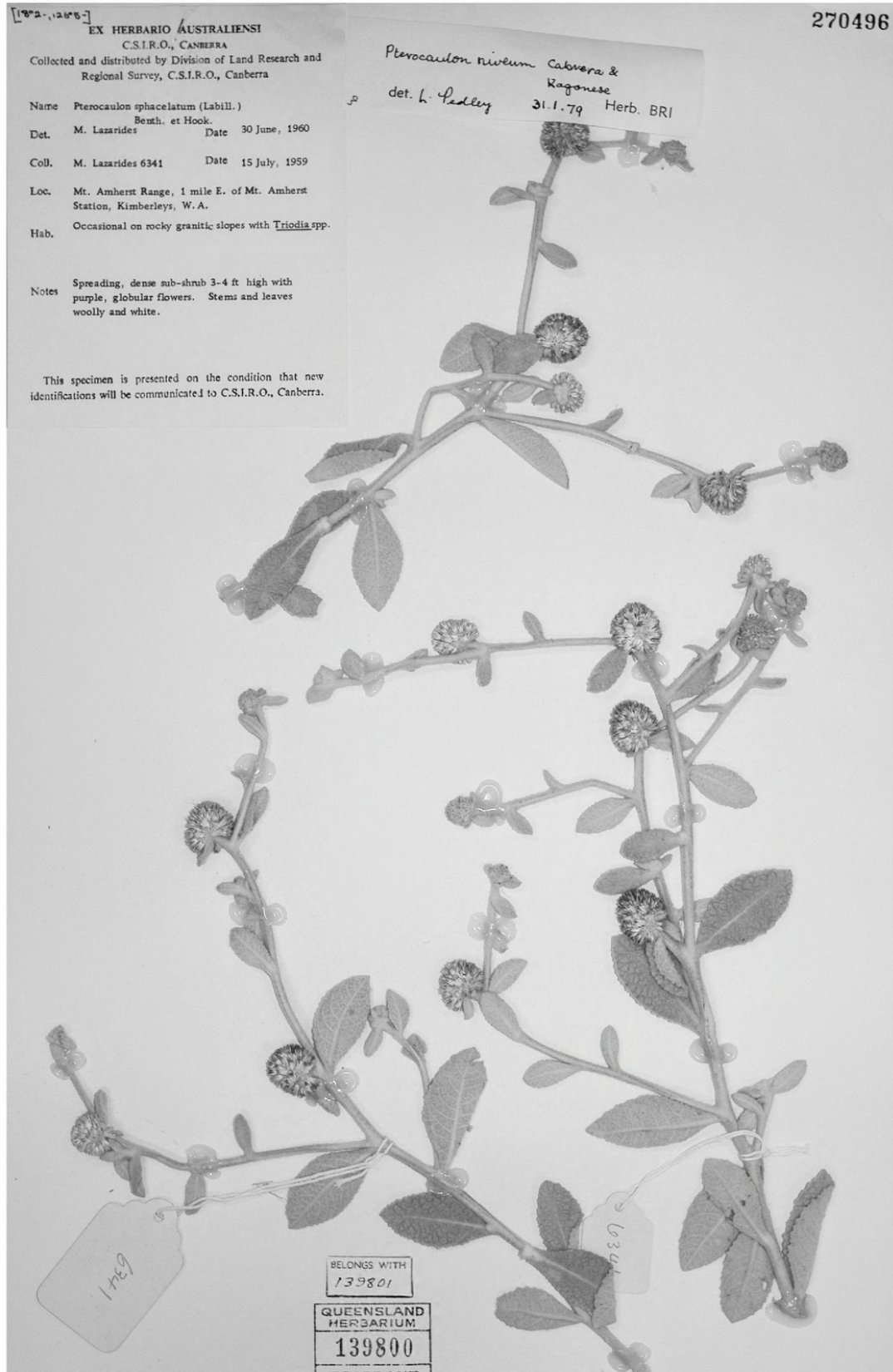


Fig. 10. Representative specimen of *Pterocaulon niveum* (Lazarides 6341 [BRI]).

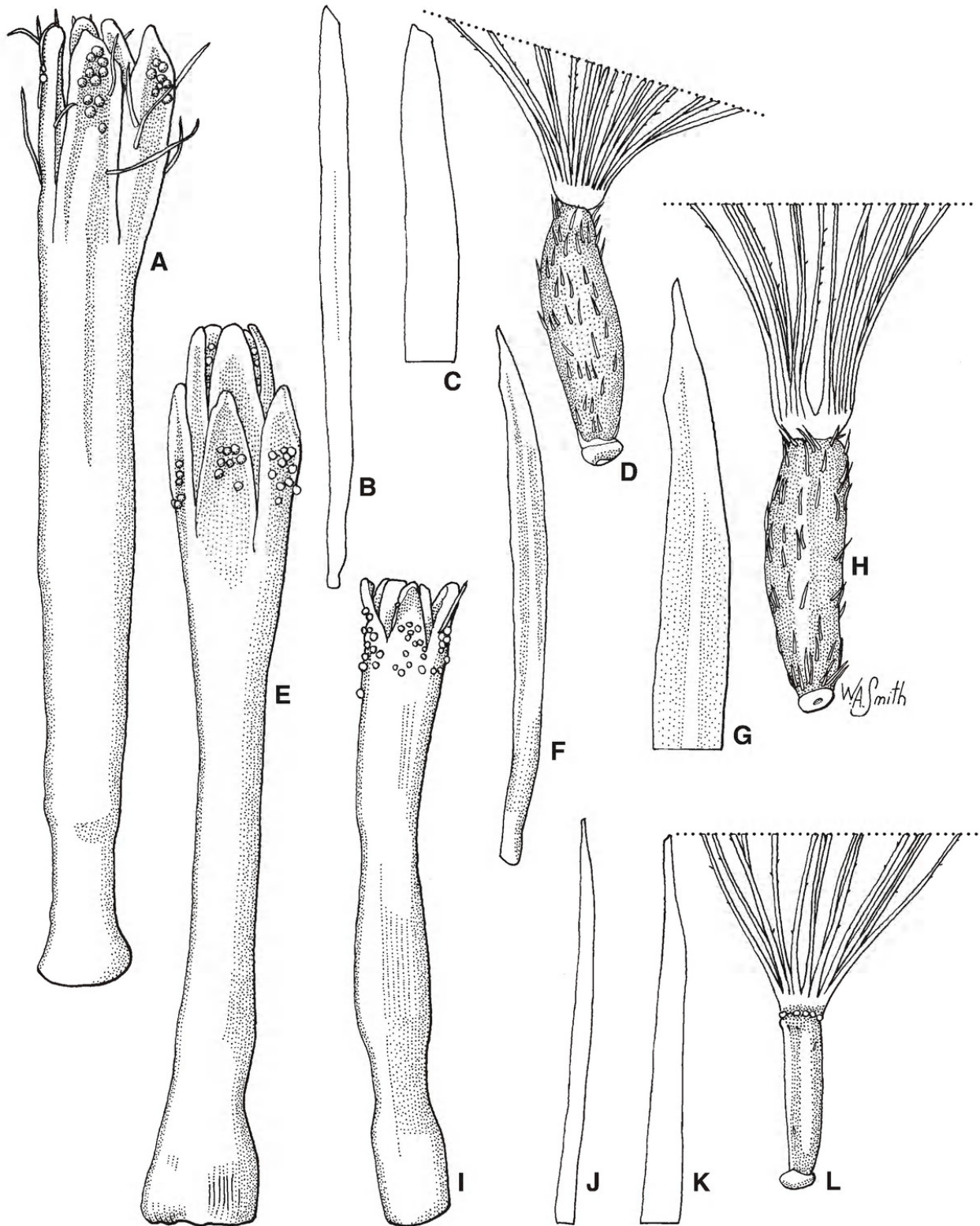


Fig. 11. *Pterocaulon niveum*. A. hermaphrodite floret $\times 32$. B. inner involucre bract (cilia not shown) $\times 16$. C. upper portion of inner involucre bract $\times 32$. D. mature achene and basal portion of pappus $\times 32$. *P. paradoxum*. E. hermaphrodite floret $\times 32$. F. inner involucre bract (cilia not shown) $\times 16$. G. upper portion of inner involucre bract $\times 32$. H. mature achene and basal portion of pappus $\times 32$. *P. redolens*. I. hermaphrodite floret $\times 32$. J. inner involucre bract (cilia not shown) $\times 16$. K. upper portion of inner involucre bract $\times 32$. L. mature achene and basal portion of pappus $\times 32$. A–D from Brocklehurst 372 (DNA); E–G from Keighery 9018 (PERTH); H from George 13582 (PERTH); I–K from Rodd & Hardie 4378 (BRI); L from McKee 10198 (CANB).

Station, Aug 1950, *Royce 3304* (PERTH); Caroline Pool, 8 km E of Halls Creek, Jun 1976, *Beaglehole ACB53312* (PERTH); 48.5 km N of 'Springvale' Homestead, 86 km N of Halls Creek, Jun 1976, *Beaglehole ACB53527* (BRI, PERTH); Palm Springs, S of Halls Creek, Aug 2000, *Handasyde & Start TH00287* (PERTH); McSpeery Gap, Napier Range, Jun 1971, *Maconochie 1298* (BRI, DNA); between Njitparriya and Djimbitjba, 3 km SE of Bungle Bungle Outcamp, Jul 1984, *Forbes 2597* (BRI, CANB, DNA, MEL, PERTH); Mt Broome, May 1971, *Byrnes 2253* (K). **Northern Territory.** Calcite flow stop, Limestone Gorge, Gregory N.P., Jun 2000, *Kerrigan & Risler 171* (DNA); Mt Napier area, May 1974, *Dunlop 4066* (DNA); Gregory N.P., Fire plot 41, May 1999, *Michell & Johnson 2449* (DNA, NT); Gregory N.P., 28 km SW of Bullita outstation, Apr 1996, *Coles 28 & Barritt* (DNA, MEL); Gregory N.P., Humbert River road, Aug 1991, *Brocklehurst 372* (DNA).

Distribution and habitat: *Pterocaulon niveum* is widespread in the Kimberley region of Western Australia, occurring in the Napier Range (western Kimberley) and from Mt Amherst (south-eastern Kimberley) eastwards to the Gregory N.P. in the Northern Territory (**Map 2**). It grows in *Triodia* grassland or low open eucalypt woodland, on rocky slopes or in gullies with shallow sandy soils. The geological substrate may be sandstone, quartzite or limestone.

Phenology: Flowers and fruits have been collected from April to August.

Affinities: *Pterocaulon niveum*, *P. tricholobum*, *P. discolor* and *P. globuliflorum* appear to be related, based on similarity in morphology of the hermaphrodite floret, i.e. corolla lobes long (0.7–1.2 mm long) with eglandular trichomes present, and the presence of lateral capitulescences.

Sterile specimens of *Pterocaulon niveum* and *P. verbascifolium* may be confused, as they have leaves of similar size, shape and tothing, and the indumentum is extremely dense for both. However, the much broader stem wings of *Pterocaulon verbascifolium* allow them to be easily distinguished.

Notes: Distinctive features of *Pterocaulon niveum* are the indumentum of the lower leaf surface being extremely dense and obscuring the surface, the continuous branchlets with lateral capitulescences present, narrow stem wings and long corolla lobes on the hermaphrodite floret.

7. *Pterocaulon paradoxum* A.R.Bean **species nova** affinis *P. sphacelato* sed alis caulinis latoribus, glandibus sparsius in pagina inferiore folii distributis, dentibus parvis in marginibus superioribus bractearum interiorum, capitulescentiarum plus elongatarum et lobis longioribus corollae flosculi hermaphroditi differens. **Typus:** Australia: Western Australia. 15 km ESE of Winnama yards by Samin mining exploration track, c. 8 km E of Palms yard, SE Kimberley, 15 May 1984, *S.J.Forbes 2017* (holo: DNA; iso: CANB, MEL).

Illustration: Kenneally *et al.* (1996), as *P. sphacelatum*.

Shrub 60–120 cm high, aromatic properties unknown; stems one or more from non-woody rootstock, sparsely to densely lanate but without globose sessile glands; stem wings entire, 1.5–4.5 mm wide. Leaves elliptical to oblanceolate, 30–65 × 10–20 mm, 2.6–4.6 times longer than wide, apex obtuse; margins recurved, denticulate, with 13–23 pairs of very small teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface slightly bullate; hairs erect to spreading, moderate to very dense, basal cell short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, dense to very dense, extending 0.4–0.7 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, moderately dense, 3–6 diameters apart. Capitulescence ovoid to ellipsoidal, 14–28 mm long and 12–15 mm wide at anthesis, 1.2–2.1 times longer than wide; side branchlets never continuous, at 20–50°; peduncles 0–20 mm long. Outer involucral bracts spatulate, 2.4–2.7 mm long, with dense spreading lanate hairs on outer surface, sparse hairs on the distal end of inner surface; glands absent; apex obtuse or truncate. Inner bracts white to greenish (occasionally tinged pink) on dorsal surface; longest ones linear, 3.5–4.8 mm long and 0.2–0.4 mm wide, apex acute, upper margins entire or with some small teeth; cilia 6–12, up to 3.1 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 18–24, pink,

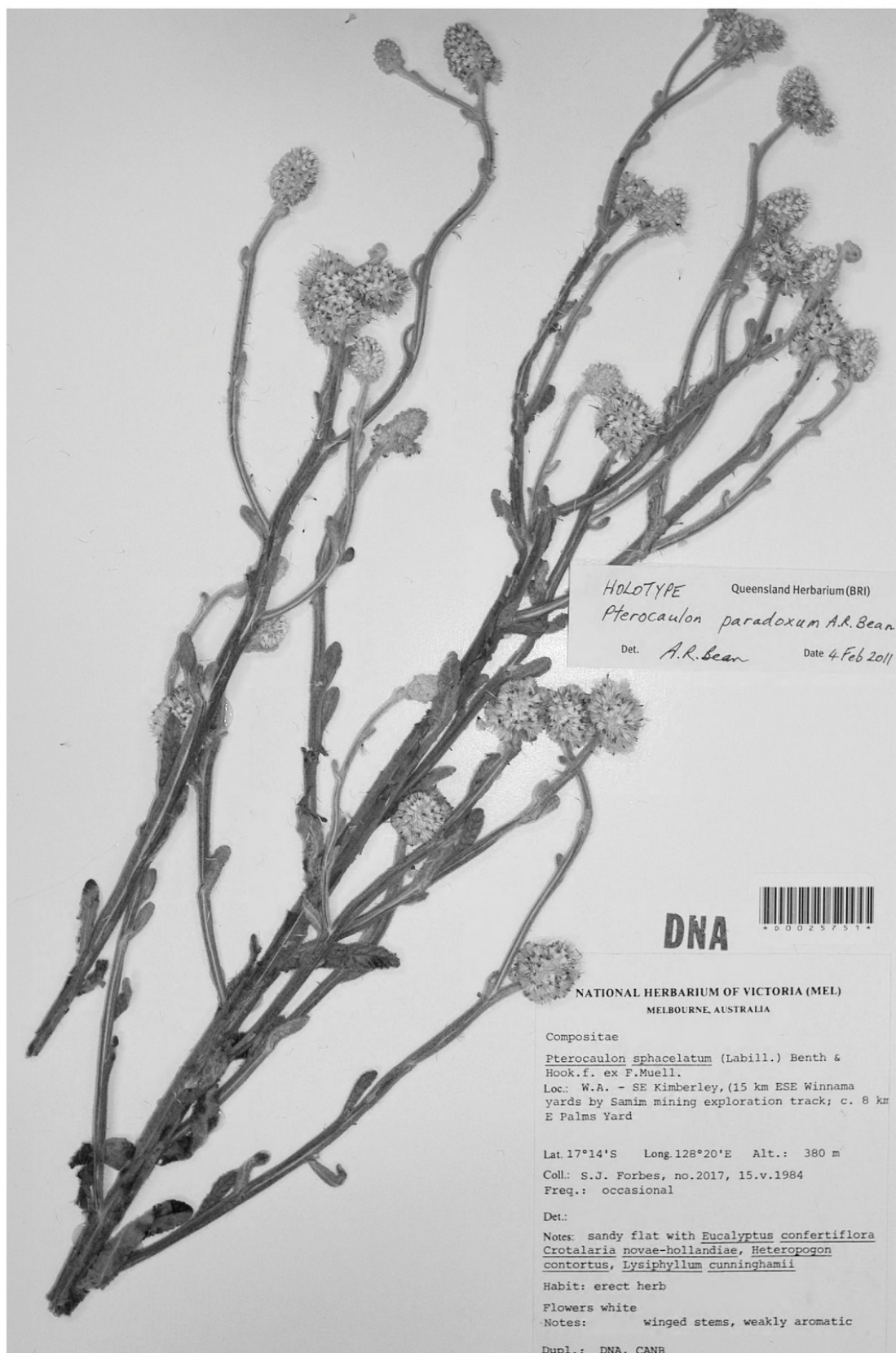


Fig. 12. Holotype of *Pterocaulon paradoxum* (Forbes 2017 [DNA]).

corolla 2.5–3.4 mm long, styles extending 0.3–0.7 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.9–3.7 mm long; corolla lobes 0.5–0.8 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.9–1.2 mm long, obscurely quadrangular, dark brown, with 25–50 or >50 twin hairs each c. 0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus occasionally present; pappus 2.5–3.5 mm long. **Figs. 11E–H, 12.**

Additional selected specimens examined: **Papua New Guinea.** CENTRAL PROVINCE: Rogers Airstrip, c. 8 miles [13 km] W of Kanosia Plantation, Kairuku subdistrict, July 1962, *Darbyshire 647* (A, BRI, CANB, L). **Australia:** **Western Australia.** Adjacent to King Edward River, 8.7 km NW of Gibb River – Kalumburu road intersection, along old Mitchell River Station Road, Jun 1987, *Koch 506* (PERTH); S side of Cockburn Range, c. 13 km W of King River, Jul 1974, *Carr 3338 & Beaglehole 47116* (CANB); King Edward River, 100 km S of Kalumburu, Jun 1987, *Keighery 9018* (PERTH); King Edward River, Mitchell Plateau road, c. 200 km W of Wyndham, Jun 1976, *Beaglehole ACB51933* (PERTH); ‘Beverley Springs’ Homestead, May 1979, *Muir et al. 757* (PERTH); near Dromaius Creek, near southern end of Ashton Range, Drysdale River N.P., Aug 1975, *George 13191* (PERTH); Mogurnda Creek, near Drysdale River, Drysdale River N.P., Aug 1975, *George 13582* (PERTH); upper reaches of Barker River, 2 km N of ‘Mount Hart’ Homestead, Jun 1987, *Edinger 423* (BRI, PERTH); Oobraguma Road, 5 km E of Stuart River, 74 km NNE of Derby, Jun 1976, *Beaglehole ACB52918* (PERTH); c. 100 m W of Taylor’s Lagoon, Sep 2005, *Byrne 1639* (PERTH); One Arm Point, Dampier Peninsula, Jul 1989, *Carter 410* (PERTH); Mornington Station, Trapline 1, May 2004, *Handasyde 2099* (PERTH). **Northern Territory.** Middle Beach swamp, West Alligator Head, Jul 1990, *Brennan Bre646* (DNA); Near Maningrida, Anamayirra Creek, Aug 1995, *Cowie 5909* (CANB, DNA, MEL); Danger Point, Coburg Peninsula, Jul 1961, *Chippendale 8244* (BRI, CANB, DNA); Grant Island, north side, May 1987, *Clark s.n.* (DNA); Ramingining area, W of Dhabla Road, Aug 1998, *Cowie & Dunlop 7922* (DNA); Wunyu Beach in Aurari Bay, c. 30 km SE of Murganella, Jun 1988, *Weber 10102* (AD, DNA).

Distribution and habitat: *Pterocaulon paradoxum* is relatively widespread in the Kimberley region of Western Australia, is scattered along the north coast of Northern Territory, and there is one record from Papua New Guinea (**Map 5**). It inhabits eucalypt woodland on alluvial flats (species including *Eucalyptus miniata* A.Cunn. ex Schauer, *E. tetradonta* F.Muell., *Corymbia confertiflora* (F.Muell.) K.D.Hill & L.A.S.Johnson), on

sheltered sandstone scree slopes, or on coastal dunes. Soils include red-brown clayey sand, red loam, and grey sand.

Phenology: Flowers and fruits are recorded from April to September.

Affinities: *Pterocaulon paradoxum* appears to be most closely allied to *P. sphacelatum*. It differs by the stem wings 1.5–4.5 mm wide (0.7–2 mm wide for *P. sphacelatum*); the corolla lobes of the hermaphrodite floret (0.5–)0.6–0.8 mm long (0.4–0.6 mm long for *P. sphacelatum*); the globose sessile glands on the lower leaf surface moderately dense, 3–8 diameters apart (dense, 0–3 diameters apart for *P. sphacelatum*); the upper margins of the inner bracts with small teeth (strongly toothed or lacerate for *P. sphacelatum*); and the capitulescences usually more elongated.

The capitulescences of this species provide a link between the ‘spicate’ group (*Pterocaulon redolens*, *P. verbascifolium*, *P. serrulatum*) and the ‘globose to ovoid’ group (*P. sphacelatum*, *P. ciliosum*, *P. sphaeranthoides*, *P. intermedium*). The capitulescences are more elongated than other species in the ‘globose to ovoid’ group, but not clearly cylindrical as in the ‘spicate’ group. One or more separate clusters of capitula can usually be seen at the base of the capitulescence, as in the spicate species *Pterocaulon redolens*. In some areas, particularly the Dampier Peninsula (Western Australia), the capitulescences appear consistently almost globose, although the floret dimensions and other features appear to be the same as in the type.

Notes: Distinctive features of *Pterocaulon paradoxum* are the capitulescences often markedly ellipsoidal, the medium length corolla lobes on the hermaphrodite floret and the long achenes.

Two forms of this species exist. The typical form is endemic to the Kimberley, mainly away from the coast, and is a densely hairy plant with corolla lobes on the hermaphrodite floret 0.6–0.8 mm long. The second form (e.g. *Cowie 5909*) is found along the northern coast of the Northern Territory, often in littoral areas, and one specimen from Papua New

Guinea is rather doubtfully included here. The indumentum on vegetative parts is much sparser in this form than the typical one, there are few cilia visible on protruding part of inner bracts, the corolla lobes on the hermaphrodite floret are shorter (0.5–0.6 mm long) and the capitulescences are narrower. Both forms can have ellipsoidal capitulescences, where separate clusters of capitula are discernable.

Etymology: From the Latin *paradoxus*, meaning ‘contrary to expectations, puzzling’. This species is puzzling because of its sometimes $\pm$ globular and sometimes markedly ellipsoidal capitulescences, and the different forms within the species.

8. *Pterocaulon redolens* (Willd.) Fern.-Vill., *Nov. App.* ed. 3, 4(3): 116 (1880); *Conyza redolens* Willd., *Sp. Pl.* ed. 3(3), 1951 (1804); *Tessaria redolens* (Willd.) Less., *Linnaea* 6: 151 (1831); *Monenteles forsteri* Endl., *Ann. Wiener Mus. Naturgesch.* 1: 168 (1836), *nom. illeg.*; *Monenteles redolens* (Willd.) DC., *Prodr.* 5: 455 (1836). **Type:** New Caledonia. in 1774, J.R. Forster & J.G.A. Forster (holo: B-W No. 15639; iso: K373288, 1st, 2nd and 4th pieces from the left).

Monenteles spicatus Labill., *Sert. Austro-Caledon.* 43 (1825); *Pterocaulon billardiarei* F. Muell., *Descr. Notes Papuan Pl.* 8: 43 (1886), *nom. nov.*; *Pterocaulon spicatum* (Labill.) Domin, *Biblioth. Bot.* 89: 664 (1930), *nom. illeg. non DC.* (1836). **Type:** New Caledonia. [June 1792], J.J.H. Labillardière (lecto: FI [FI-W92604], here designated; isolecto: FI [FI-W92605], right hand specimen only, FI [FI-W92611], P537803).

Sphaeranthus elongatus Blanco, *Fl. Filip.* 636 (1837), *fide* Merrill (1918: 379).

Pterocaulon cylindrostachyum C.B. Clarke, *Compos. Ind.* 98 (1878), *nom. illeg.* (*Monenteles spicatus* is listed as a synonym).

Gnaphalium cylindrostachyum Wallich, *Num. List* [Wallich] 2931 (1831), *nomen nudum*.

Illustrations: Cabrera & Ragonese (1978: 240); Porteners (1992: 204); Stanley & Ross (1986: 532).

Weakly aromatic shrub 40–100 cm high; stems

one to several from non-woody rootstock, sparsely to densely lanate and sometimes with a few globose sessile glands; stem wings entire, 1.4–3.3 mm wide. Leaves oblanceolate to obovate, 16–45 $\times$ 6.5–16 mm, 2.1–3.4 times longer than wide, apex acute or obtuse; margins recurved, denticulate, with 7–16 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface somewhat bullate; hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderately dense to dense, extending 0.5–1 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence spiciform, 33–75 mm long and 8–14 mm wide at anthesis, 2.8–5.8 times longer than wide; side branchlets never continuous, at 20–45°; peduncles 5–25 mm long. Outer involucre bracts 1.6–2 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surface, glabrous on inner surface; glands absent; apex obtuse. Inner bracts white to straw coloured (sometimes tinged pink) on dorsal surface; longest ones linear, 3–3.6 $\times$ 0.1–0.25 mm wide, apex attenuate, upper margins entire or with an occasional small tooth; cilia 5–9, up to 2.5 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 27–45, white or straw-coloured, corolla 2.3–2.8 mm long, styles extending 0.1–0.7 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.5–3 mm long; corolla lobes 0.25–0.5 mm long, globose sessile glands always present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.5–0.7 mm long, terete or slightly angular, dark brown, with 0–25 or 25–50 twin hairs each *c.* 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus usually present; pappus 2.2–3 mm long. **Figs. 11I–L, 13.**

Additional selected specimens examined: **China.** Ch’ang-kiang District, Hainan Island, Feb 1934, *Lau* 3261 (GH); Taichow, Hainan Island, Jan 1938, *How & Chun* 70001 (GH). **India.** Ghariajhor, 11 miles [18 km] from Sundargarh, Orissa, Mar 1950, *Mooney* 3748 (K). **Myanmar.** Pegu, *s.dat.*, *Kurz* 2263 (K); Prome, Ava,

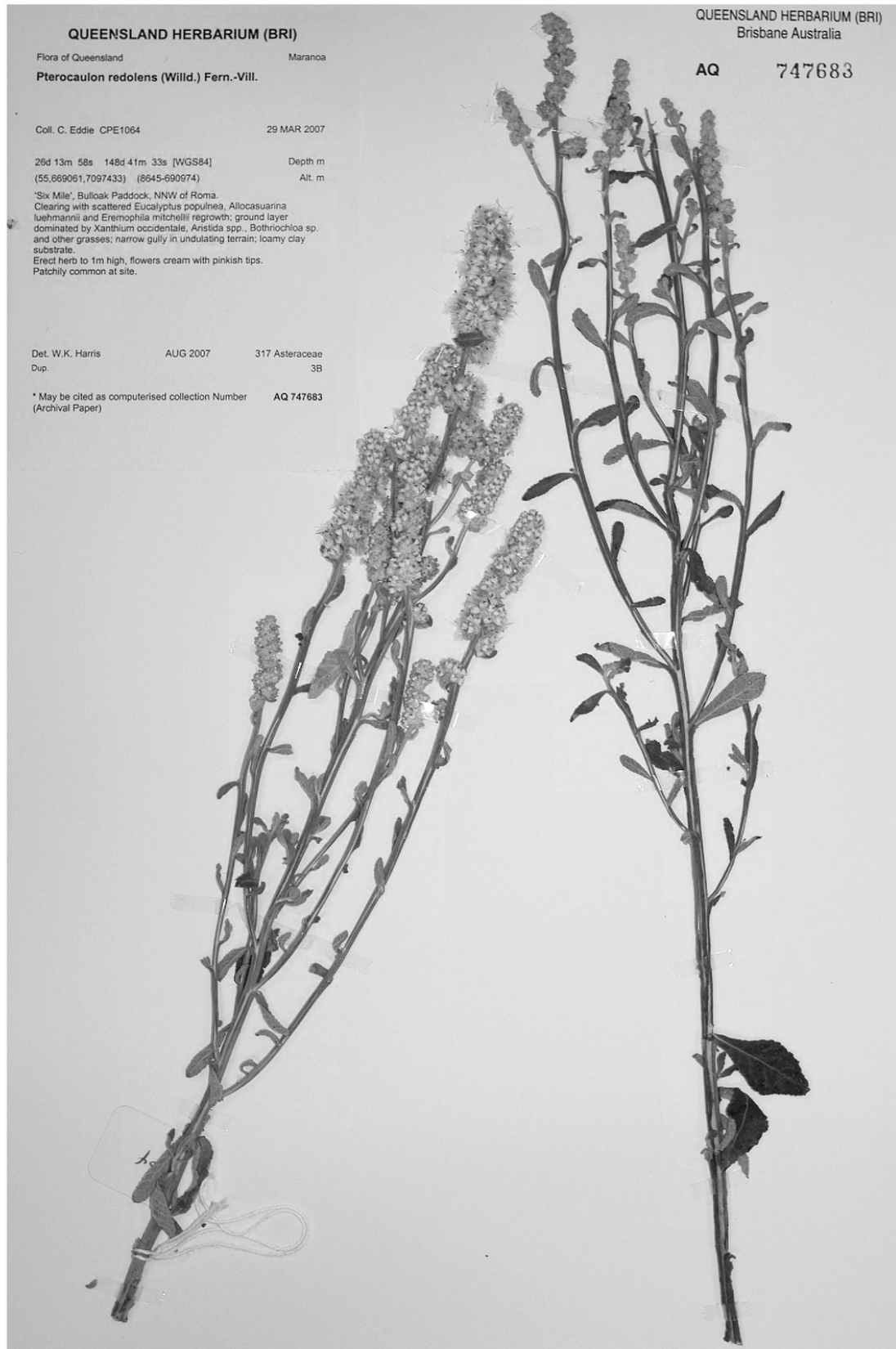


Fig. 13. Representative specimen of *Pterocaulon redolens* (Eddie CPE1064 [BRI]).

s.dat., Hance 17401 (K). **Thailand.** Ban Huay Nam Kow, Chiang Mai Province, Feb 1993, *Radanachalesa* 1 (A). **Indonesia.** near Palu, Celebes, Apr 1975, *Meijer* 9173 (A, L). **Philippines.** BATAAN PROVINCE: Luzon, Jul 1913, *Merrill* 341 (AMES, L). **Papua New Guinea.** MOROBE PROVINCE: Erap, Jan 1958, *Henty* NGF9481 (BRI, CANB, K). CENTRAL PROVINCE: Tupuseleia, Port Moresby subdistrict, Aug 1967, *Kairo & Streimann* NGF30803 (BRI, CANB, L). **New Caledonia.** Ilé Pott, Mouane, Aug 1968, *McKee* 19366 (NOU); Plateau central, Ilé des Pins, Jul 1970, *McKee* 22304 (NOU); Noumea, 1868–1870, *Balansa* (A). **Vanuatu.** Tableland, Eromanga, Jul 1896, *Morrison s.n.* (K). **Australia: Queensland.** COOK DISTRICT: Dimbulah, Apr 1935, *Flecker* 398 (CNS); Ravenshoe – Hughenden Road, c. 150 km N of Hughenden, Apr 1975, *Halliday* 418 (BRI); Bulleringa N.P., 80 km NW of Mt Surprise, Apr 1998, *Forster* PIF22541 & *Booth* (BRI, DNA, MEL). NORTH KENNEDY DISTRICT: Barrabas Scrub, May 1972, *Hyland* 6085 (CNS); 13.5 km W of the Dry Swamp, May 1991, *Neldner* 3268 & *Thompson* (BRI, K); 6 miles [10 km] N of Craigie Station, Jul 1953, *Lazarides* 3718 (BRI, CANB); Townsville, Aug 1916, *White s.n.* (BRI [AQ270344]). LEICHHARDT DISTRICT: Springsure, Apr 1961, *Jones* 1870 (BRI, CANB); Twenty Mile Yards, ‘Rookwood’, Apr 1991, *Forster* PIF7881 & *McDonald* (BRI, MEL). PORT CURTIS DISTRICT: Rundle Range, S.F. 60, 37 km NW of Gladstone, Aug 1989, *Gibson* TO1698 (BRI). BURNETT DISTRICT: 9 km SE of Mt Perry (town), Apr 1985, *Rodd & Hardie* 4378 (BRI, CANB, NSW); Windera, Apr 1963, *McKee* 10198 (BRI, CANB). MARANO DISTRICT: Boatman Station, Mar 1947, *Everist* 2813 (BRI); ‘Six Mile’, Bulloak Paddock, NNW of Roma, Mar 2007, *Eddie* CPE1064 (BRI). WARREGO DISTRICT: Yanna Siding, via Charleville, May 1949, *Heinemann s.n.* (BRI [AQ270369]). MORETON DISTRICT: Rifle Range Reserve, Goodna, E of Ipswich, Apr 1990, *Bean* 1512 (BRI).

Distribution and habitat: *Pterocaulon redolens* is widespread, with occurrences in China (Hainan), India, Myanmar, Thailand, Philippines, Indonesia, Papua New Guinea, Australia, New Caledonia and Vanuatu. Cabrera & Ragonese (1978) reported seeing specimens also from Laos, Cambodia and Vietnam. In Australia, it is widely distributed in eastern Queensland, south from Lakefield National Park (**Map 6**), and was reported by Porteners (1992) to occur in the far north-east of New South Wales. It inhabits grassy areas at low altitudes in hilly or flat terrain, with sandy to clay-loam soil. In Australia, it is found in various eucalypt woodlands or on the edge of vine thickets in shallow or deep soils, sometimes behind coastal dunes. The geological substrate may be granite, sandstone, basalt or serpentinite.

Phenology: Flowers and fruits are recorded for every month of the year, with most records between April and September.

Affinities: *Pterocaulon redolens* is not obviously allied to any other species. However, sterile specimens of *Pterocaulon redolens* are indistinguishable from the sympatric *P. ciliosum*.

Typification: The isotype of *Conyza redolens* at K [K000373288] has a blue hand-written label stating “Gnaphalium redolens (Forster)/ Habitat in New Caladonia”, and next to that, a printed label saying “The Forster Herbarium. Presented by the Corporation of Liverpool, August 1885”. There are five separate branches mounted on the sheet; three are *Pterocaulon redolens* and two are *P. sphacelatum*.

Notes: This species is distinctive in the spicate, interrupted capitulescence; ring of glands often present at apex of achene; upper margins of inner bracts entire and many female florets (27–45) per capitulum.

The author has seen a single specimen of this species from India, as cited above. *Pterocaulon redolens* must be a relatively recent arrival in India, as Hooker (1882) recorded it only from “Burma and the Eastern Peninsula”. It was not recorded by Haines (1961) as present in Bihar or Orissa. Rath & Priyadarshini (2005) reported *Pterocaulon redolens* from an abandoned manganese quarry, a highly modified habitat. I conclude that this species is very likely not native to India, but naturalised.

9. *Pterocaulon serrulatum* (Montrouz.) Guillaumin, *Bull. Soc. Bot. France* 84: 56 (1937); *Monenteles serrulatus* Montrouz., *Mém. Acad. Roy. Sci. Lyon, Sect. Sci.* 10: 225 (1860). **Type:** New Caledonia. Art Island, *s.dat.*, *J.X. Montrouzier* 125 (holo: LY, destroyed).

Monenteles glandulosus Benth., *Fl. Austral.* 3: 523 (1867); *Pterocaulon glandulosum* (Benth.) F.Muell., *Syst. Census Austral. Pl.* 79 (1883); *P. glandulosum* var. *glandulosum*, Ewart & Davies, *Fl. N. Territory* 277 (1917). **Type:** Australia: Queensland. COOK DISTRICT: Gilbert River, October 1856, *F. Mueller s.n.* (lecto: K373279, *fide* Cabrera & Ragonese [1978: 254]).

Strongly aromatic perennial shrub 35–150 cm high; stem onetoseveral from woody rootstock, with sparse to dense lanate eglandular hairs, globose sessile glands and sometimes stalked glandular hairs; stem wings serrate, 2.5–8 mm wide. Leaves elliptical, ovate or broadly-lanceolate, 20–82 × 8–28 mm, 2.1–4.3 times longer than wide, apex acute; margins flat or recurved, serrulate, with 13–45 pairs of teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs present or absent. Upper surface smooth or slightly bullate; hairs erect to spreading, sparse to dense, basal cells short; globose sessile glands present. Lower surface with lanate hairs erect to spreading, sparse to very dense, extending 1–1.5 mm from the surface, basal cells not very short; globose sessile glands yellow and shining or pale yellow and opaque, dense, touching or up to 3 diameters apart. Capitulescence ellipsoid or cylindrical, sometimes ‘interrupted’, rarely almost globose, 14–52 mm long and 13–17 mm wide at anthesis, 1.1–3.5 times longer than wide; side branchlets never continuous, at 20–45°; peduncles 0–15 mm long. Outer involucre bracts 2.3–3.7 mm long, oblong, with sparse to moderately dense spreading lanate hairs on margins, glandular-hairy on both surfaces; apex obtuse. Inner bracts white to greenish-white on dorsal surface; longest ones linear, 3.9–6.3 × 0.3–0.5 mm, apex acute, upper margins with small or large teeth; cilia 6–14, up to 2.4 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 29–52, white to straw coloured, corolla 2.8–4.2 mm long, styles extending 0.3–0.5 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.6–4.7 mm long; corolla lobes 0.4–0.6 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoidal, 0.7–1 mm long, terete or almost so, dark brown, with 25–50 twin hairs each *c.* 0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus absent; pappus 2.8–4.5 mm long.

Affinities: *Pterocaulon serrulatum* is a distinctive species, but is sometimes confusable with *P. sphacelatum* and *P. ciliosum*. These are perhaps its closest

relatives, and postulated hybrid specimens are reported in this paper.

Typification: Vegter (1976) reported that Montrouzier’s types are at LY, and Guillaumin & Beauvisage (1914) reported seeing the type of *Monenteles serrulatus* there. However, it appears that Montrouzier’s collection at LY was destroyed or lost in the 1950’s (P. Morat, *pers. comm.* June 2010), and the curator at LY has confirmed that the type of *Monenteles serrulatus* is not present there now. Duplicates of some of Montrouzier’s collections are held at MPU, but no type material of *Monenteles serrulatus* can be found there (P. Schafer, *pers. comm.* June 2010), nor is there an isotype at P (P. Morat, *pers. comm.* June 2010). This is in accord with the information provided by Guillaumin & Beauvisage (1914), i.e. that there was only a single type specimen for this name, the specimen at LY.

There seems little doubt about the application of the name *Pterocaulon serrulatum*. The protologue is fairly detailed and the description matches the plant currently called *Pterocaulon serrulatum* var. *serrulatum* in Australia. Guillaumin & Beauvisage (1914) reported that the type was very similar to *Pterocaulon glandulosum* F. Muell., but that it differed by being totally glabrous.

Notes: *Pterocaulon serrulatum* is distinctive in the cylindrical to ovoid capitulescence; broad serrated stem wings; many female florets per capitulum; outer involucre bracts glandular hairy on both surfaces and the sessile glands on upper leaf surface.

Varietal rank is appropriate for the taxa included within *Pterocaulon serrulatum*. The two varieties differ only in their indumentum, but these characters do not vary continuously in Australian material, and a useful geographical separation is achieved through their use. All eastern Queensland material can be readily assigned to var. *serrulatum*, and all Northern Territory material is referable to a more broadly circumscribed var. *velutinum*, as outlined in the key. Some specimens from the Kimberley region are assigned here to var. *serrulatum*. Some specimens from the Jericho and Hughenden districts of Queensland are difficult to assign to either variety; for example,



Fig. 14. Representative specimen of *Pterocaulon serrulatum* var. *serrulatum* (Bean 22120 [BRI]).

Smyrell GS69 has broad based glandular hairs (a feature of var. *serrulatum*) and also has lanate hairs on the upper leaf surface (a feature of var. *velutinum*). Similarly, in the

Pilbara region of Western Australia, there are specimens referred to here as var. *velutinum*, but which closely approach var. *serrulatum* e.g. *Byrne 2807*.

Key to varieties

- Lanate hairs absent from upper leaf surface; broad based glandular hairs common on leaves, stems and stem wings **9a. *P. serrulatum* var. *serrulatum***
- Lanate hairs present on upper leaf surface; broad based glandular trichomes absent, but globose sessile hairs common on leaves, stems and stem wings **9b. *P. serrulatum* var. *velutinum***

9a. *Pterocaulon serrulatum* var. *serrulatum*

Winged stems and leaf surfaces with many broad-based glandular hairs 0.1–0.2 mm long; erect or spreading eglandular multicellular lanate absent from upper leaf surface, sparse or absent on lower leaf surface, stem wings and stems. **Figs. 1B, 14, 16A–D.**

Illustration: Stanley & Ross (1986: 532).

Additional selected specimens examined: Australia: Western Australia. Bell Gorge parking area, Aug 2005, *Byrne 1619* (PERTH); western base of Mt Hamilton, Jul 1905, *Fitzgerald 1209* (PERTH); Little Island, off Long Island, Buccaneer Archipelago, Jun 1982, *Hopkins BA0115* (PERTH); Around ‘Beverley Springs’ Homestead buildings, Jun 1992, *Mitchell 2556* (PERTH). **Queensland.** COOK DISTRICT: Fossilbrook Creek, ‘Burlington’, N of Mount Surprise, Aug 1997, *Bean 12229* (BRI); along Kuranda Highway, c. 10 miles [16 km] E of Mareeba, Jun 1962, *Hoogland 8486* (BRI, CANB). NORTH KENNEDY DISTRICT: 22.5 km (by road) SW of Herberton, on the Silver Valley road, May 1983, *Conn & Clarkson 1178* (AD, BRI, CANB, CNS, DNA, HO, NSW, PERTH); Road from Camel Creek to Greenvale, Aug 1998, *Fox 25 & Bean* (BRI); base of Frederick Peak, 25 km SW of Townsville, May 1991, *Bean 3215* (BRI); Lookout, on eastern slopes of Mt Kelly, c. 14 km south-west of Ayr, May 2009, *Bean 28848* (BRI); Bowen, reserve near reservoir, Nov 1978, *Ross s.n.* (BRI [AQ297444]). MITCHELL DISTRICT: ‘Grant’, c. 70 km ENE of Barcaldine, Jul 1994, *Smyrell GS89* (BRI). SOUTH KENNEDY DISTRICT: Redcliff Island, Seaforth, Aug 1992, *Batianoff 9208129* (BRI); 19 km E of ‘Doongmabulla’, N of Jericho, Apr 2002, *Bean 18984* (BRI, MEL). LEICHHARDT DISTRICT: 60 miles [97 km] N of Comet township, Jul 1962, *Story & Yapp 185* (BRI, CANB); 118 km from Springsure, on road to Tambo, May 2004, *Bean 22120* (BRI); Ka Ka Mundi section, Carnarvon N.P., on fire trail from Salvator Rosa, Aug 2008, *Thomas MBT3780 & Leggett* (BRI). PORT CURTIS DISTRICT: ‘Corisande Hills’, Stanage Bay road, N of Rockhampton, Jul 1997, *Bean 12063* (BRI, MEL); 32

km N of Miriam Vale, Jul 1996, *Thompson MIR136A & Turpin* (BRI). BURNETT DISTRICT: Gayndah, May 1917, *White s.n.* (BRI [AQ2703920]); ‘Dykehead’, 70 km W of Mundubbera, Jun 1998, *Robinson JR-1* (BRI). WIDE BAY DISTRICT: Degilbo Creek, near Biggenden, Aug 1980, *Johnson s.n.* (BRI [AQ343756]); Rossmore Road, 10 km SE of Kilkivan, May 2006, *Webb s.n.* (BRI [AQ619054]).

Distribution and habitat: Found on Art Island, New Caledonia, and throughout the eastern half of Queensland in Australia, from Cooktown to Kilkivan. It also occurs in the western Kimberley region of Western Australia (**Map 7**). It grows on a wide range of sites (include coastal headlands) where drainage is good, usually in eucalypt woodland or grassland. Soils range from sands to clay-loams.

Phenology: Flowers and fruits are borne between April and November.

9b. *Pterocaulon serrulatum* var. *velutinum* (Ewart & O.B.Davies) Guillaumin, *Bull. Soc. Bot. France* 84: 57 (1937); *Monenteles glandulosum* var. *velutinum* Ewart & O.B.Davies, *Fl. N. Territory* 277 (1917). **Type:** Australia: Northern Territory. Haast’s Bluff, 17 May 1911, *G.F.Hill 184* (holo: MEL).

P. serratum O.Schwarz, *Repert. Spec. Nov. Regni Veg.* 24: 108 (1927). **Type:** Australia: Northern Territory. Port Darwin, 10 miles NE, *s.dat.*, *F.A.K.Bleeser 712* (holo: B, destroyed).

Illustrations: Cabrera & Ragonese (1978: 253); Wheaton (1994: 112); Barrs (1999: 118) as *P. serrulatum* var. *serrulatum*.

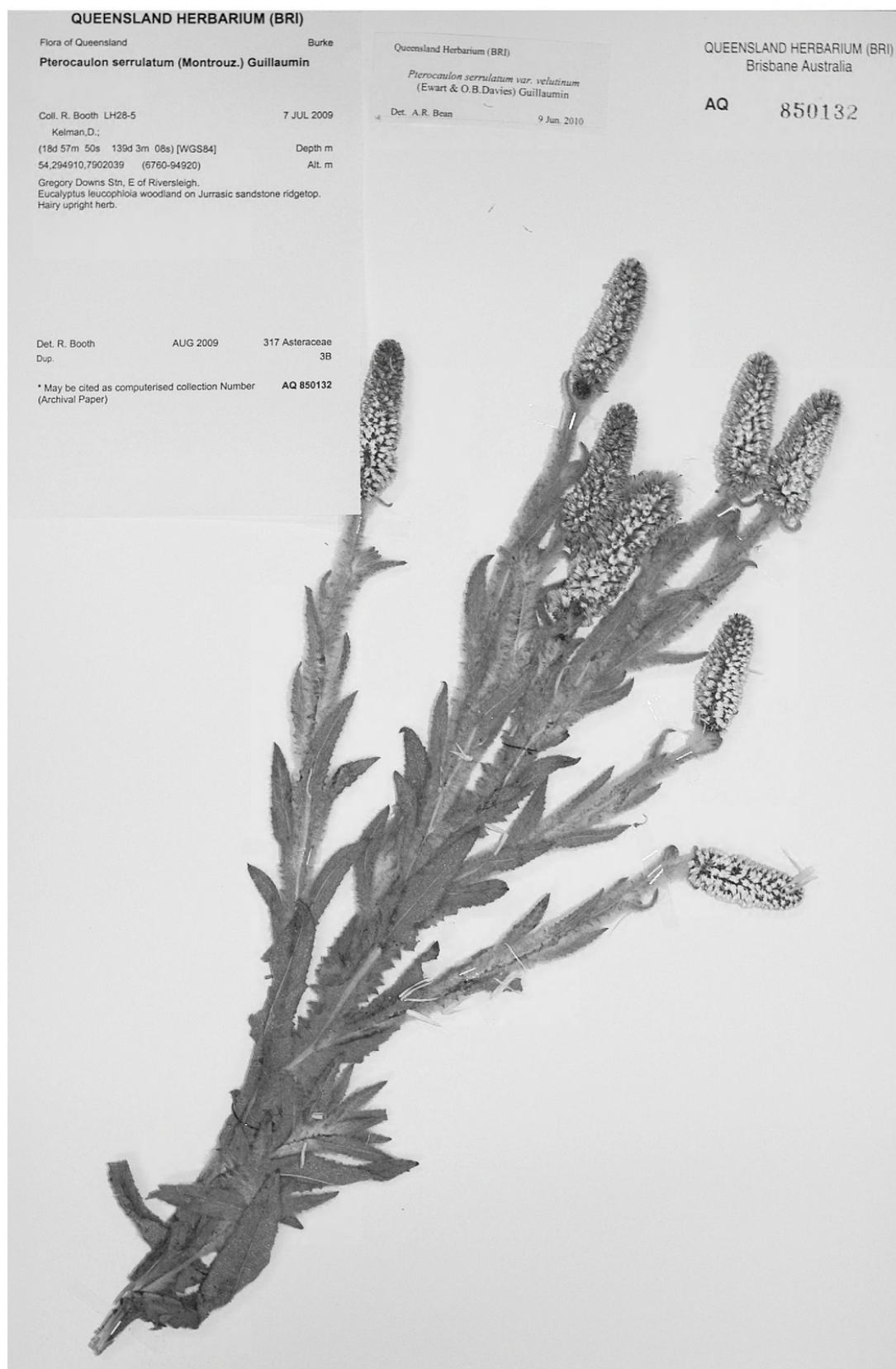


Fig. 15. Representative specimen of *Pterocaulon serrulatum* var. *velutinum* (Booth LH28-5 & Kelman [BRI]).

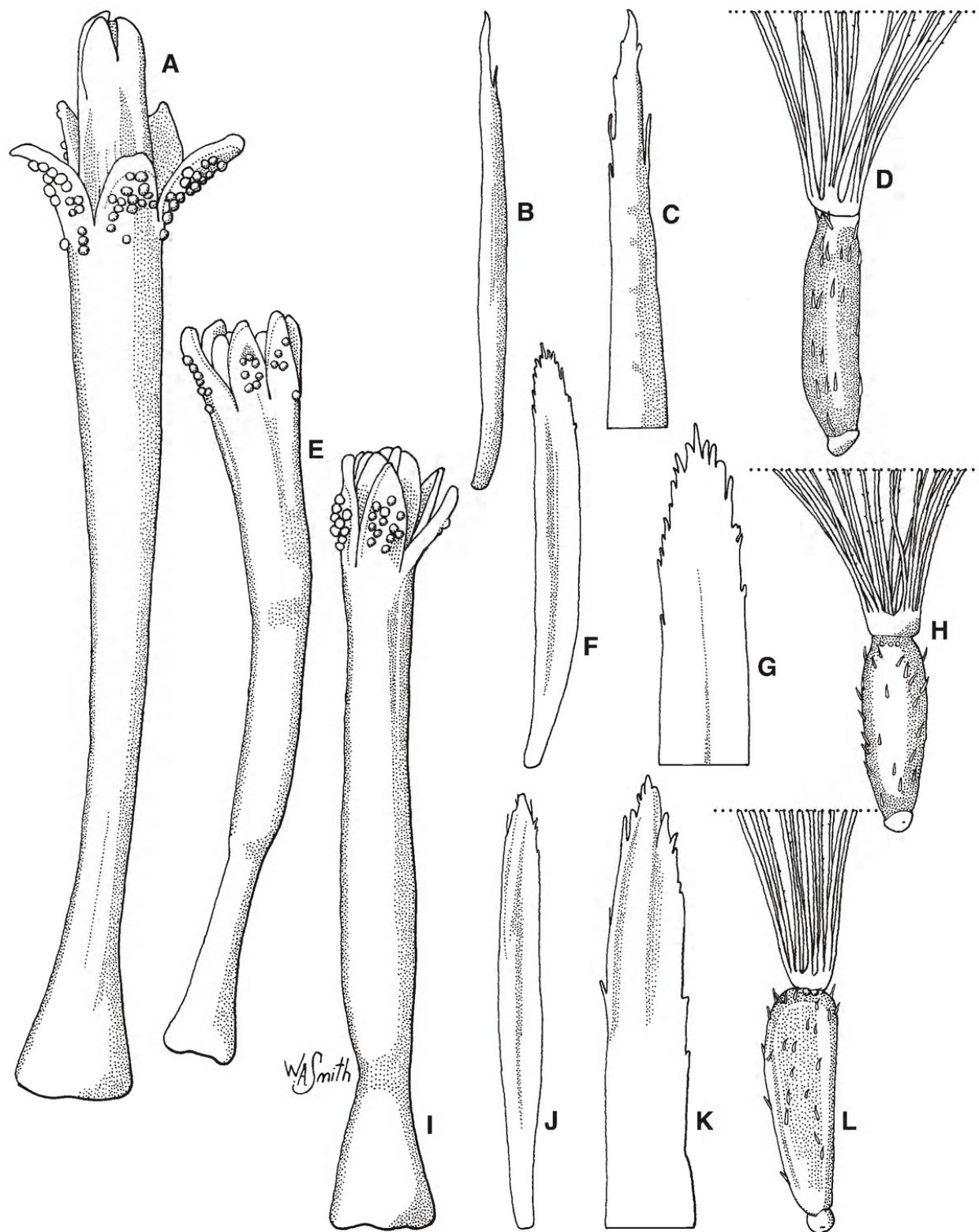


Fig. 16. *Pterocaulon serrulatum* var. *serrulatum*. A. hermaphrodite floret $\times 32$. B. inner involucre bract (cilia not shown) $\times 16$. C. upper portion of inner involucre bract $\times 32$. D. mature achene and basal portion of pappus $\times 32$. *Pterocaulon sphacelatum*. E. hermaphrodite floret $\times 32$. F. inner involucre bract (cilia not shown) $\times 16$. G. upper portion of inner involucre bract $\times 32$. H. mature achene and basal portion of pappus $\times 32$. *Pterocaulon sphaeranthoides*. I. hermaphrodite floret $\times 32$. J. inner involucre bract (cilia not shown) $\times 16$. K. upper portion of inner involucre bract $\times 32$. L. mature achene and basal portion of pappus $\times 32$. A–C from Bean 28848 (BRI); D from Ross s.n. (BRI [AQ297444]); E, H from Piercey 51 (DNA); F–G from Halford Q2626 (BRI); I–K from van Leeuwen 0099 (PERTH); L from van Leeuwen 0092 (PERTH).

Winged stems and leaf surfaces without broad-based glandular hairs; globose sessile glands *c.* 0.05 mm long, abundant; erect to tangled eglandular multicellular lanate hairs sparse to very dense on leaves, wings and stems. **Figs. 1A, 15.**

Additional selected specimens examined: **New Caledonia.** Voh, presqu'île de Gatope, Aug 1970, *McKee* 22393 (NOU); Mt Yallein, Jul 1968, *Jaffré* 57 (NOU); Presqu'île d'Arama, Aug 1965, *Schmid* 619 (NOU); West face of Massif de Koniambo, Oct 1963, *Green* 1288 (A, K, NOU). **Australia: Western Australia.** Gibb River Road, 117 km E of Derby, Aug 2001, *Courtney* 40 (PERTH); Honeymoon Beach, 25 km N of Kalumburu, Jun 1990, *Edinger* 713 (PERTH); 37.6 km NW of 'Bonney Downs' Homestead on road to Hillside, Oct 1995, *Mitchell* PRP971 (DNA, PERTH); McLarty Hills, Great Sandy Desert, Aug 1977, *George* 14625 (CANB, PERTH); 12 km SSW of Two Sisters, *c.* 150 km SE of Shay Gap, Jul 1984, *Newbey* 10407 (PERTH); E of junction of Kununurra – Wyndham – Halls Creek roads, Jul 1974, *Carr* 3203 & *Beaublehole* 46981 (BRI, CANB, PERTH); Roy Hill, Aug 2007, *Byrne* 2807 (PERTH); Meentheena Conservation Reserve, 6.5 km SSE of 'Meentheena' Homestead, May 2001, *van Leeuwen* 4797 (PERTH). **Northern Territory.** 4.5 km from Stuart Highway on Edith Falls Road, Jul 2003, *Elick* 222 (CANB, CNS); 23 miles [37 km] NW of Rabbit Flat, Tanami, Apr 1971, *Dunlop* 2131 (BRI, DNA); base of Meyers Hill, Alice Springs, Aug 1957, *Chippendale* 3587 (BRI, CANB, DNA); Mt Bundy, Oct 1968, *Harpley* NB982 (BRI, DNA); 269 km N of 'Barkly' Homestead towards Borroloola, Jun 1999, *Bean* 15047 (BRI, DNA); Channel Island, Darwin Harbour, Jul 1995, *Cowie* 5880 (DNA, MEL). **Queensland.** BURKE DISTRICT: 3 miles [5 km] from Mount Isa towards Lake Moondarra, Jul 1974, *Ollerenshaw* 1142 & *Kratzing* (BRI, CANB, L); Gregory Downs Station, E of Riversleigh, Jul 2009, *Booth* LH28-5 & *Kelman* (BRI). COOK DISTRICT: Ortona Station, 102 km by road S of Forsayth, Aug 2010, *Bean* 29878 & *McDonald* (BRI, MEL, NSW). MITCHELL DISTRICT: Bessie's Castle, Silsoe Road, *c.* 100 km W of Longreach, May 2004, *Bean* 22246 (BRI); 19.7 km E of Jericho, Jul 1975, *Chapman* 1281 (AD, BRI, CANB, K, L). GREGORY NORTH DISTRICT: Winton – Jundah Road, 23.9 km N of 'Elvo' Homestead, May 2004, *Bean* 22561 (BRI).

Distribution and habitat: A widespread taxon, occurring in New Caledonia, Australia in central and north-western Queensland, throughout the Northern Territory, and the northern half of Western Australia as far west as the Hamersley Range (**Map 7**). It is also recorded for a few locations in northern South Australia (Anon. 2011). It inhabits a wide range of habitats; the vegetation can be *Acacia* woodland, mallee shrubland, eucalypt open woodland or *Triodia* grassland. Soils can vary greatly, including beach sand, red sandy

loam, or basaltic clay-loams, and it may grow on sandstone, limestone or quartzite hills, or on flats.

Phenology: Flowers and fruits have been recorded from April to October.

Notes: Cabrera & Ragonese (1978) stated that *Pterocaulon glandulosum* var. *velutinum* Ewart & O.B.Davies is a *nomen nudum*, but that is incorrect. Ewart and Davies provided an adequate description and the name is validly published.

The type of *Pterocaulon serrulatum* var. *velutinum* has a very dense cover of lanate eglandular hairs, and the two varieties have in the past been distinguished on the density of these hairs (based on herbarium specimen determinations). In this paper, I have placed more emphasis on the presence or absence of stalked glandular hairs in dividing the varieties. This provides a useful geographic separation between the varieties, but it means that a wide range of lanate hair densities is included within var. *velutinum*. The density of lanate hairs can vary at a single location, e.g. *Latz* 7950 comprises pieces collected from two plants growing at the same place; on one the lanate hairs are sparse, and on the other they are very dense.

No type material of *Pterocaulon serratum* O.Schwarz has been seen, but from the description given in the protologue, there seems little doubt that it is this variety.

10. *Pterocaulon sphacelatum* (Labill.) F.Muell., *Syst. Census Austral. Pl.* 79 (1882); *Monenteles sphacelatus* Labill., *Sert. Austro-Caledon.* 43 (1825). **Type:** [New Caledonia] Nova Caledonia. [June 1792], *J.J.H.Labillardière s.n.* (lecto: FI [FI-W 92608], here designated, image!; isolecto: FI [FI-W 92605, left hand specimen only], P537804, image!).

Illustrations: Cabrera & Ragonese (1978: 246); Porteners (1992: 204); Milson (2000: 21); Moore (2005: 126).

Strongly aromatic shrub 40–100 cm high, often almost as wide; stems single or numerous, densely lanate and sometimes with a few globose sessile glands; stem wings entire or sparsely toothed, 0.7–2 mm wide.

Leaves oblanceolate or spatulate, 20–66 × 4–15 mm, 3.3–5.8 times longer than wide, apex obtuse or acute; margins recurved, denticulate, with 6–14 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface moderately to strikingly bullate; hairs erect to spreading, sparse to moderately dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, moderate to dense, extending 0.4–0.7 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence globose or ellipsoidal, 10–15 mm long, 10–14 mm wide at anthesis, 1–1.4 times longer than wide; side branchlets never continuous, at 30–60°; peduncles 0–22 mm long. Outer involucral bracts 2.2–3.7 mm long, spatulate, with dense spreading lanate hairs throughout on the outer surface, sparse hairs at distal end of the inner surface; glands absent; apex acute. Inner bracts violet, pink or white on dorsal surface; longest ones linear, 3.5–4.6 × 0.3–0.5 mm; apex acute, upper margins conspicuously toothed, or upper margins lacerate with no single distinct apex; cilia 6–18, up to 1.7 mm long, mostly attached in proximal half and few extending to the distal one third. Filiform (female) florets 17–29, pink, corolla 2.4–3.2 mm long, styles extending 0.4–0.6 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.5–3.7 mm long; corolla lobes 0.4–0.6 mm long, globose sessile glands present, eglandular hairs absent. Achenes narrowly ellipsoid, 0.7–1 mm long, terete or slightly quadrangular, dark brown, with 25–50 twin hairs each *c.* 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus rarely present; pappus 2.3–3.3 mm long. *Fruit salad plant, Apple bush.* **Figs. 2A, 16E–H, 17.**

Additional selected specimens examined: **Timor-Leste.** Plateau of Baucau, Dec 1953, *Van Steenis 18030a* (L). **New Caledonia.** Baie Maa, Oct 1982, *Suprin 2059* (NOU); *s.loc.*, Oct 1965, *MacKee 13525* (K, L). **Australia: Western Australia.** Eagle Bore Study site, Plot 9, Gibson Desert Nature Reserve, Aug 2002, *Bragg 118* (MEL, PERTH); Rocky Pool, Gascoyne River, *c.* 850 km N of Perth, Oct 1975, *Kenneally 4641* (PERTH); Northern end of Windjana Gorge, Jul 1974, *Carr 4281 & Beaulehole 48059* (PERTH); Elder Creek, 2 km W of Warburton, Aug 1962, *George 3828* (PERTH); Anna Plains Station, Jul 1941, *Burbidge 1462* (PERTH);

Lacrosse Island, at head of Cambridge Gulf, Jun 1992, *Kenneally 11328* (DNA, CANB, PERTH). **Northern Territory.** Auvergne Station, 35 km NW of Timber Creek, Jul 1977, *Must 1620* (CANB, DNA, SI); *c.* 4.5 km by road N of Gilbert Creek crossing by Stuart Highway, between Wauchope and Tennant Creek, Aug 1978, *Donner 6232* (AD, CANB, NT); Junction Reserve, Jul 1982, *Piercey 51* (DNA); Oenpelli, Sep 1948, *Specht 1083* (BRI, L); Burt Creek, 4 miles [6 km] S of Yambah Station, Mar 1953, *Perry 3372* (BRI, CANB); 3.2 miles [5.1 km] N of Alice Springs, Dec 1962, *Nelson 559* (CANB, DNA); Andado Station, Mac Clarke Reserve, Sep 1992, *Latz 12706* (DNA, MEL); Horse paddock, 'Tobermorey', Oct 1954, *Chippendale 418* (DNA); Barkly Tablelands, N of Telegraph bore, Mittibah Station, Jul 2001, *Mangion 1534 & Risler* (DNA). **Queensland.** BURKE DISTRICT: East bank of Leichhardt River, 72 km SE of Burketown, Burke Development Road, Jul 1991, *Jobson 1490* (BRI, HO, MEL). COOK DISTRICT: Topsy Creek, Kowanyama Aboriginal Reserve, Aug 1980, *Clarkson 3392* (BRI, CNS). GREGORY NORTH DISTRICT: 32 km N of Bedourie along road to Boulia, Jul 1995, *Halford Q2626* (BRI). MITCHELL DISTRICT: Silsoe Road, 4.1 km W of 'Morella' turnoff, W of Longreach, May 2004, *Bean 22250* (BRI). WARREGO DISTRICT: 99.3 km from Blackall towards Adavale, near Listowel Downs Station, Oct 1983, *Canning 6192 & Rimes* (CANB, BRI, DNA, MEL, NSW). GREGORY SOUTH DISTRICT: 20.2 km WSW of Eromanga, on Cooper Developmental Road, Aug 2010, *Bean 30023* (A, BRI, BRIT, MO). **New South Wales.** 113 km W of Wanaaring on Milparinka Road, Nov 1971, *Blaxell 613* (BRI, NSW); Lake Pinaroo near Fort Grey camping area, NW of Tibooburra, Sep 1989, *Coveny 13477 et al.* (AD, BRI, CANB, NSW, MEL, PERTH); Homestead Gorge, Mootwingee N.P., 112 km NE of Broken Hill, Oct 1988, *Crawford 1028* (AD, CANB, NSW). **South Australia.** around Nent Oura Research unit, Mount Freeling Station, Oct 1987, *Foster 227* (AD, DNA); Stuart Creek, 18 km WSW of 'Stuart Creek' Homestead, Dec 1984, *Badman 1597* (AD, DNA); Bunyeroo Gorge, Flinders Ranges N.P., Nov 1982, *Symon 13040* (AD, CANB, MO).

Distribution and habitat: *Pterocaulon sphacelatum* is the most widespread Australian *Pterocaulon* species, occurring in all mainland states except Victoria, and extending from the west coast of Western Australia to within 150 km of the Queensland east coast. It occurs throughout much of Northern Territory and South Australia, and in the north-west of New South Wales. It also occurs in Timor and New Caledonia (**Map 8**). It grows on a range of sandy to clay-loam soils, on stony hillsides (higher rainfall areas) or creek-beds (arid areas), in grassland (often dominated by *Triodia* spp.), eucalypt woodland or low open woodland with *Acacia aneura* or other *Acacia* spp.

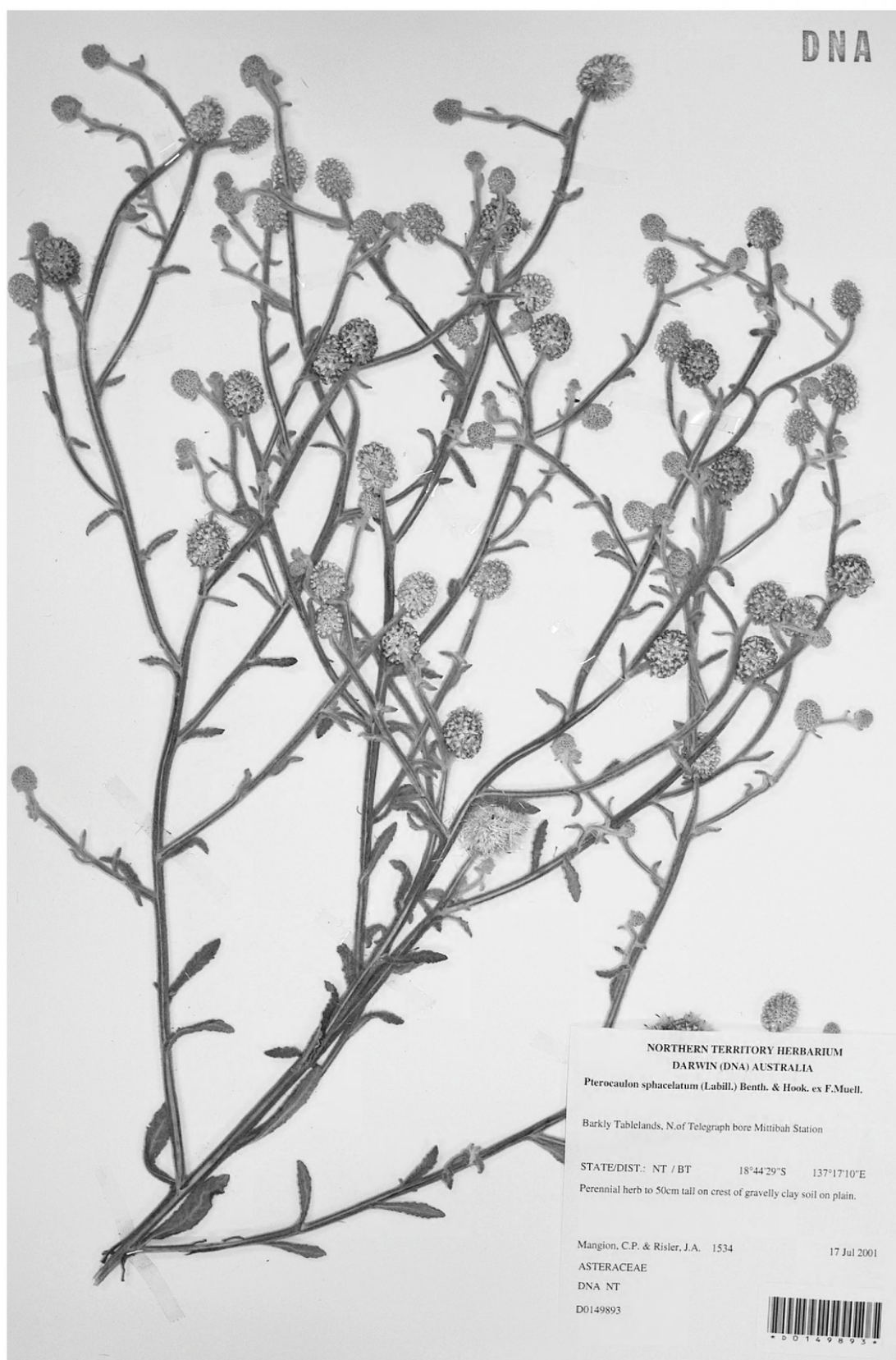


Fig. 17. Representative specimen of *Pterocaulon sphacelatum* (Mangion & Risler 1534 [DNA]).

Phenology: Flowers and fruits occur from June to October in northern parts of its range, and from August to December in southern parts.

Affinities: *Pterocaulon sphacelatum* is closely related to *P. ciliolum*, but differs by the narrower leaves, and the bright pink inner bracts with few visible cilia on protruding parts, and strongly toothed to lacerate upper margins.

Typification: There are two sheets at FI bearing material that matches the protologue of *Monenteles sphacelatus*. On one sheet (FI-W 92605), specimens of both *Pterocaulon sphacelatum* and *P. redolens* are present, but neither specimen is named; on the other sheet (FI-W 92608), there is a single specimen of *P. sphacelatum* accompanied by a detailed description written by Labillardière and headed *Monenteles sphacelatus*; this description agrees perfectly with the protologue. This latter sheet is selected as the lectotype.

Notes: This species is distinctive in the upper margins of the inner bracts often lacerate; capitulescences often ellipsoidal, up to 1.4 times longer than wide; the inner bracts always partly pink to violet, often predominantly so; leaves oblanceolate in shape, 3.5–5.8 times longer than wide; leaf upper surface bullate; corolla lobes of hermaphrodite floret short and none or few cilia visible on protruding part of inner bracts.

11. *Pterocaulon sphaeranthoides* (DC.) F. Muell., *Syst. Census Austral. Pl.* 79 (1882); *Monenteles sphaeranthoides* DC., *Prodr.* 5: 456 (1836). **Type: Australia: Western Australia. Enderby Island, Dampier Archipelago, 25 February 1818, *A. Cunningham s.n.* (holo: G-DC; iso: PERTH; BM, K n.v.).**

Illustration: Cabrera & Ragonese (1978: 250).

Strongly aromatic shrub 30–120 cm high; stems numerous, densely glandular-hairy and sometimes with sparse lanate eglandular hairs; stem wings prominently toothed, 0.5–3(–4) mm wide. Leaves narrowly oblanceolate to linear, 12–48 × 2–10 mm, 3.5–13 times longer than wide, apex acute; margins recurved to revolute, serrate with

10–16 pairs of teeth. Indumentum comprising broad-based glandular hairs, globose sessile glands and sometimes lanate eglandular hairs. Upper surface strikingly bullate; glandular hairs erect, sparse to moderately dense, 0.1–0.2(–0.4) mm long, broad-based; lanate hairs absent or sparse; globose sessile glands present. Lower surface glabrous or with sparse, erect to spreading lanate hairs, basal cells not very short; globose sessile glands yellow and shining, dense, touching or up to 3 diameters apart. Capitulescence ± globose, 11–16 mm long, 11–14 mm wide at anthesis, 1–1.2 times longer than wide; side branchlets never continuous, at 30–60°; peduncles 1–20 mm long. Outer involucral bracts 2.2–2.7 mm long, linear-spathulate to oblong, with dense spreading lanate hairs throughout on the outer surface, glabrous on inner surface; glands present; apex acute or obtuse. Inner bracts violet, pink or white on dorsal surface; longest ones linear, 3.5–4 × 0.2–0.5 mm, upper margins with large teeth, or lacerate with no distinct single apex; cilia 5–12, up to 1.5 mm long, mostly attached in proximal half and few extending to the distal one third. Filiform (female) florets 14–20, pink, corolla 2.3–2.8 mm long, styles extending 0.2–0.9 mm beyond corolla. Hermaphrodite floret solitary or very rarely two, corolla pink, 2.7–3.4 mm long; corolla lobes 0.4–0.5 mm long, globose sessile glands present, eglandular trichomes absent. Achenes narrowly ellipsoid, 0.8–0.95 mm long, slightly quadrangular, dark brown, with 25–50 twin hairs each 0.05–0.1 mm long, evenly distributed; globose sessile glands at junction between achene and pappus occasionally present; pappus 2.2–2.9 mm long. **Figs. 16I–L, 18.**

Additional specimens examined: **Australia: Western Australia.** Hermite Island, Montebello Islands, Oct 2000, *Kenneally 11558* (PERTH); Depuch Island, NE of Roebourne, May 1962, *Royce 7131* (PERTH); Charles Knife Road, between picnic area and Cape Range N.P., Aug 1978, *Perry 845* (BRI, PERTH); Legendre Island, Dampier Archipelago, Jun 1962, *Royce 7264* (PERTH); Barrow Island, Aug 1973, *Butler 47* (PERTH); Rosemary Island, Dampier Archipelago, Jun 1962, *Royce 7451* (PERTH); Barrow Island Nature Reserve, 11.3 km WNW of Town Point, Nov 1991, *van Leeuwen 1086* (PERTH); 48.6 km NW of ‘Bonney Downs’ Homestead on road to Hillside, Nov 1995, *Mitchell PRP977* (DNA, PERTH); Lower end of Upper Bee Gorge, Hamersley Range N.P., Aug 1973, *Weston 8443* (PERTH); Python

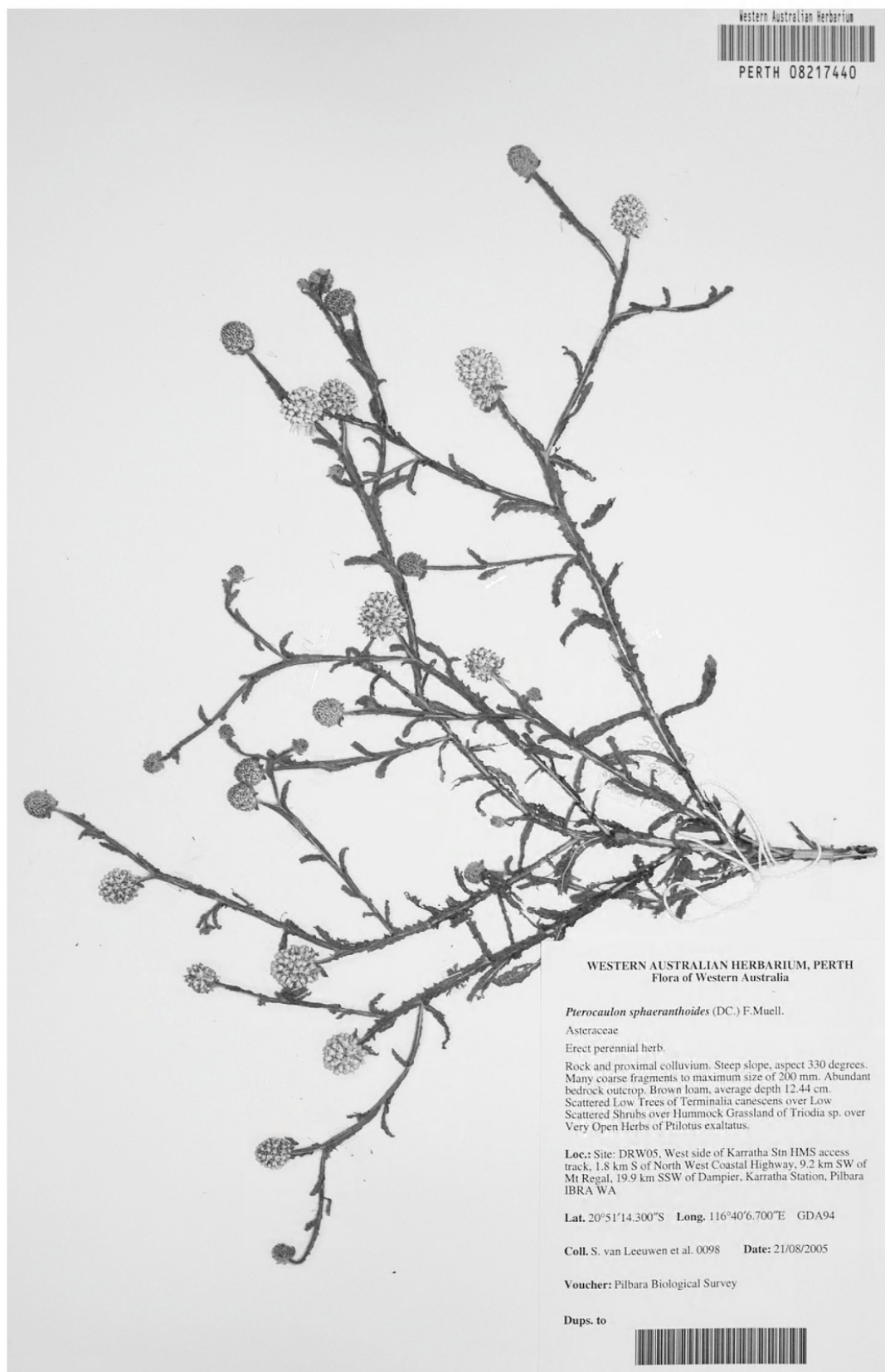


Fig. 18. Representative specimen of *Pterocaulon sphaeranthoides* (van Leeuwen et al. 0098 [PERTH]).

Pool, Chichester-Millstream N.P., Oct 1989, *Nordenstam & Anderberg 302* (PERTH); Yardie Creek, Cape Range N.P., Dec 1986, *Alford 816* (PERTH); Cleaverville Creek, Roebourne, Jul 2004, *Byrne 1075* (PERTH); W of Mt Leal, on Roebourne to Wittenoon Highway, Sep 1981, *Lander 1132* (PERTH); Karrawingina Pool, Harding River, Sep 1981, *Weston 12772* (PERTH); Site OYE04, 3.4 km E of Pannawonica – Cape Lambert railway crossing on Pannawonica – Millstream Road, Aug 2006, *van Leeuwen et al. 0102* (PERTH); Site PW17, 13.4 km N of ‘Mt Flora’, 71.1 km E of Pannawonica, Sep 2006, *van Leeuwen et al. 0092* (BRI, PERTH); Durba Hills, Kertland district, Jun 1984, *Morse 180* (CANB); 3.1 km SSE of Pulgorah Cone, Warrawagine Station, Pilbara, Aug 2004, *van Leeuwen 0090* (PERTH); West side of Karratha Station Homestead access track, 1.8 km S of North West Coastal Highway, Aug 2005, *van Leeuwen 0098* (PERTH); North side of Fortescue River Mouth access track, 6.8 km W of North West Coastal Highway, Aug 2005, *van Leeuwen 0099* (PERTH).

Distribution and habitat: This species is endemic to Western Australia. It is common along coastal parts of the Pilbara region, including offshore islands, from the Cape Range to Depuch Island, east of Roebourne. It also occurs away from the coast, to the south and south-east of Port Hedland, as far east as the Durba Hills (**Map 3**). It grows in *Triodia* grassland, or in *Acacia* shrubland with *Triodia* understorey, on coastal sand dunes, rocky hillsides or rocky watercourses. Soils are often red sandy-loams. The substrate may be limestone, sandstone or granite.

Phenology: Flowers and fruits have been recorded from June to December.

Affinities: This species has affinities with *Pterocaulon sphacelatum*; however, that species has stem wings that are entire or sparsely toothed, lanate hairs frequent and glandular hairs absent from the upper leaf surface.

Notes: This species is distinctive in the blistered bright green narrow leaves; serrated stem wings; lanate hairs absent or sparse and the short broad-based glandular hairs present on upper leaf surfaces.

Pterocaulon sphaeranthoides and *P. sphacelatum* are very closely related and some specimens are hard to identify, suggesting that they do intergrade in some areas. For example, *Trudgen & Parnell 11608* (PERTH), *Backhouse et al. BEM50* (PERTH), and *Lander 1132* (PERTH), all from the

Hamersley Ranges, while assigned here to *Pterocaulon sphaeranthoides*, are also close to *P. sphacelatum*. In other areas, they are apparently sympatric; typical specimens of both species have been seen from Barrow Island, for example.

I have been unable to confirm the observation made first by Bentham (1867) that the involucre of *Pterocaulon sphaeranthoides* have “Usually 2, very rarely 1 or 3” disc (hermaphrodite) florets. Cabrera & Ragonese (1978) stated “male florets 1–3”, as did Wilson (1992), both presumably paraphrasing Bentham. Of the hundreds of capitula examined by the present author, all except one had a solitary hermaphrodite floret. The exceptional capitulum had two hermaphrodite florets.

12. *Pterocaulon tricholobum* A.R.Bean **species nova** affinis *P. globulifloro* sed alis caulinis multo latioribus, bracteis interioribus longioribus, pilis numerosis in lobis corollarum flosculorum hermaphroditum, achenarum pilis paucioribus et pappis longioribus differens. **Typus:** Australia: Northern Territory. East Alligator, 10 June 1971, *G.C.Taylor 75* (holo: BRI; iso: CANB, DNA).

Aromatic shrub 50–120 cm high; stems one to several from woody rootstock, densely lanate but without globose sessile glands; stem wings entire, 2.8–5.5 mm wide. Leaves elliptical to obovate, 25–92 × 8–30 mm, 2.1–3.7 times longer than wide, apex obtuse or rarely acute; margins recurved, denticulate, with 15–30 pairs of very small teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface not or slightly bullate; hairs erect to spreading, sparse to moderately dense, basal cell short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, dense to very dense, extending 0.4–0.8 mm from the surface, basal cells not very short; globose sessile glands yellow and shining, moderately dense, 3–6 diameters apart. Capitulescence globose to broadly ellipsoidal, rarely truncate-globose, (8–)10–16 mm long and 10–14 mm wide at anthesis, (0.7–)0.9–1.3 times longer than wide; side branchlets very often

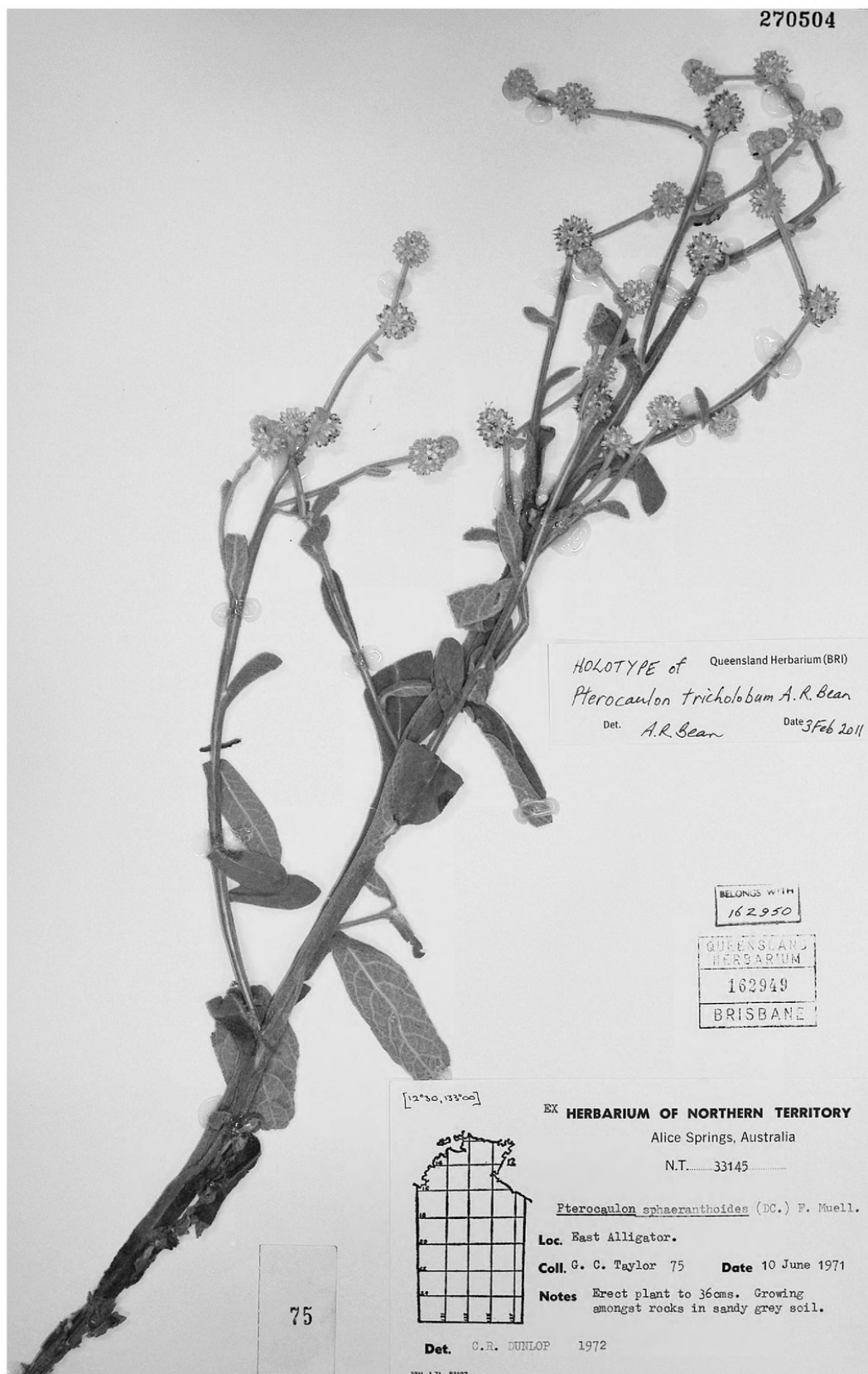


Fig. 19. Holotype of *Pterocaulon tricholobum* (Taylor 75 [BRI])

continuous, at 0–80°; peduncles often absent, but sometimes up to 11 mm long. Outer involucre bracts oblong-spathulate, 2.5–3 mm long, with dense spreading lanate hairs on outer surface, sparse to moderately dense hairs on the distal end of inner surface; glands absent; apex obtuse. Inner bracts white, rarely tinged pink on dorsal surface; longest ones linear, 4–4.8 × 0.2–0.35 mm, apex acute, upper margins with some small or large teeth; cilia 11–22, up to 2.5 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 15–21, white or straw-coloured, corolla 2.3–2.9 mm long, styles extending 0.6–1 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 2.9–3.6 mm long; corolla lobes 0.8–1.2 mm long, globose sessile glands present, eglandular trichomes 2–8 per lobe. Achenes narrowly ellipsoidal, 0.8–0.9 mm long, faintly ribbed, dark brown, with 0–25 twin hairs each <0.1 mm long, evenly distributed or mostly in distal half; globose sessile glands at junction between achene and pappus absent; pappus 2.1–3 mm long. **Figs. 19, 20A–D.**

Additional selected specimens examined: Australia:
Western Australia. S side of Cockburn Range, c. 13 km W of King River, Jul 1974, *Carr 3338 & Beaulehole 47116* (PERTH); Langi, 4 km S of Prior Point and 33 km SSW of Kuri Bay, Jul 1990, *Kenneally 11055* (PERTH); Python Cliffs, Marigui Promontory, Prince Regent River Reserve, Aug 1974, *Kenneally 2138* (CANB, PERTH); The Grotto, Deception Ranges, near Kimberley Research Station, Jul 1952, *Lazarides 3071* (BRI, CANB, DNA); Mt Trafalgar, Prince Regent River Reserve, Aug 1974, *George 12698* (CANB, PERTH); Inglis Gap, Gibb River Road, west Kimberley, Jun 1988, *Wilson 12959* (PERTH); Mirima [Hidden Valley] N.P., Jun 1989, *Kenneally 10947* (DNA, PERTH); Sunday Island, Buccaneer Archipelago, Jun 1982, *Kenneally 8250* (DNA, MEL, PERTH); Bungle Bungle N.P., Bull Creek, Jun 1989, *Cowie 874* (DNA, MEL, PERTH); Gibb River Road, Home Valley Station, East Kimberley, Jun 1992, *Menkhorst 1067* (DNA, MEL, PERTH).
Northern Territory. South Bay, Bickerton Island, Gulf of Carpentaria, Jun 1948, *Specht 617* (A, BRI, CANB, PERTH); Victoria River Gorge, May 2001, *Leach & Cowie 4659* (DNA); Gregory N.P., S of Victoria River pub, May 2001, *Risler & Smith 687* (DNA); Spirit Hills Conservation Area; Nancy's Gorge, Aug 1996, *Cowie 7136* (DNA); 2 km S of Myra Falls, Jun 1993, *Brennan 2355* (DNA); Fitzmaurice River, May 1994, *Barritt 1270* (DNA, MEL); Keep River Gorge, Jun 1995, *Egan 5004* (DNA); Bartelumba Bay, Groote Eylandt, Aug 1975, *Levitt 437* (CANB, DNA, NE, NT); Mt Brockman near Koongarra Saddle, 2 km N of Koongarra, May 1980,

Lazarides 8905 (CANB, DNA); Nitmiluk N.P., eastern boundary, May 2002, *Michell 3877* (DNA); Gregory N.P., c. 29 km NW of Bullita Outstation, Apr 1996, *Coles 103 & Duretto* (DNA, MEL); Keep River N.P., Apr 1982, *King 65* (DNA); Bauhinia Downs Station, Alligator Stockyards, May 1985, *Wightman 1835 & Leach* (CANB, DNA, NT); Limmen Bight, May 1996, *Egan 5396 & Michell* (DNA). **Queensland.** BURKE DISTRICT: 'Westmoreland', Big Amphitheatre, May 1997, *Forster PIF21039 & Booth* (BRI, DNA).

Distribution and habitat: A widespread species distributed in the northern Kimberley of Western Australia, the 'Top End' of the Northern Territory, and extending to the north-west of Queensland (**Map 9**). The occurrences of *Pterocaulon tricholobum* are strongly associated with sandstone hills, escarpments, scree slopes and gorges. The vegetation type is variously recorded as *Triodia* grassland, open savannah or shrubby woodland. Soils are sandy.

Phenology: Flowers and fruits have been recorded from May to September.

Affinities: *Pterocaulon tricholobum* is most closely allied to *P. globuliflorum*, but differs by the stem wings 2.8–5.5 mm wide (0.4–1.5 mm wide for *P. globuliflorum*); the longest inner bracts 4–4.8 mm long (3.2–3.5 mm long for *P. globuliflorum*); trichomes always present on corolla lobes of hermaphrodite floret (usually absent for *P. globuliflorum*); achene hairs 0–25 (achene hairs 25–50 for *P. globuliflorum*); and pappus 2.1–3 mm long (1.3–1.7 mm long for *P. globuliflorum*).

Notes: This species is distinctive in the broad stem wings, rather small white globose capitulescences that are often laterally and the obvious trichomes on corolla lobes of hermaphrodite floret.

The label of *Coles 103 & Duretto* records that the plant "smells like Granny Smith apples".

Carr 3338 & Beaulehole 47116 is a mixed gathering. All pieces on the CANB sheet are *Pterocaulon paradoxum*; both pieces on the PERTH sheet are *P. tricholobum*.

Etymology: From the Greek *trichos* meaning hair or thread, and *lobus* meaning lobes. This is in reference to the conspicuous unicellular hairs consistently borne on the corolla lobes of

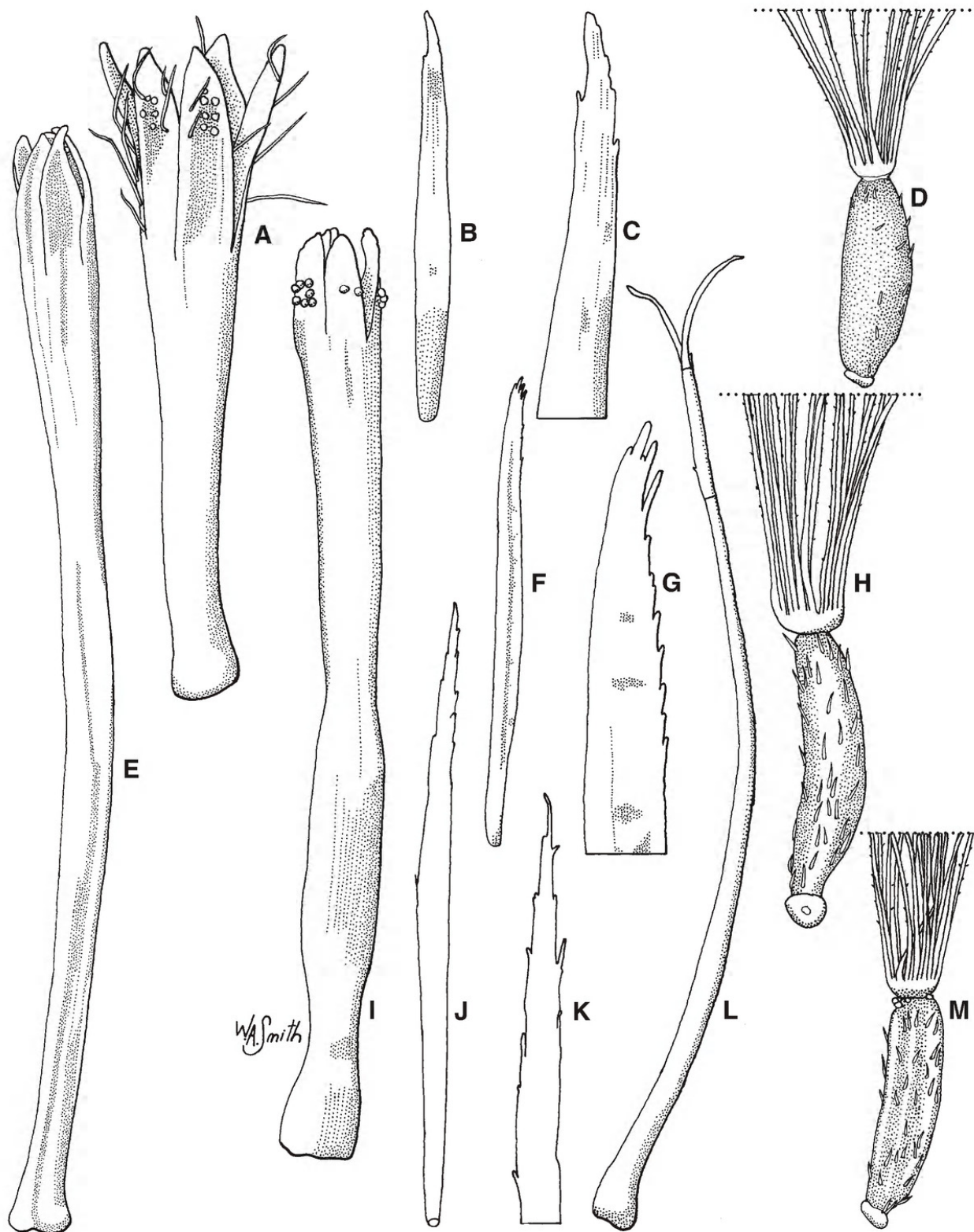


Fig. 20. *Pterocaulon tricholobum*. A. hermaphrodite floret $\times 32$. B. inner involucre bract (cilia not shown) $\times 16$. C. upper portion of inner involucre bract $\times 32$. D. mature achene and basal portion of pappus $\times 32$. ***Pterocaulon verbascifolium*.** E. hermaphrodite floret $\times 32$. F. inner involucre bract (cilia not shown) $\times 16$. G. upper portion of inner involucre bract $\times 32$. H. mature achene and basal portion of pappus $\times 32$. ***Pterocaulon xenicum*.** I. hermaphrodite floret $\times 32$. J. inner involucre bract (cilia not shown) $\times 16$. K. upper portion of inner involucre bract $\times 32$. L. female floret $\times 32$. M. mature achene and basal portion of pappus $\times 32$. A–C from Egan 5004 (DNA); D from Cowie 7136 (DNA); E–H from von Oertzen 116 (DNA); I–L from Dunlop 1830 (DNA); M from George 14628 (PERTH).

the hermaphrodite floret. Other species have this feature, but in this species the trichomes are consistently present and obvious.

13. *Pterocaulon verbascifolium* (Benth.) F.Muell., *Syst. Census Austral. Pl.* 79 (1882); *Monenteles verbascifolius* Benth., *Fl. Austral.* 3: 523 (1867). **Type:** Australia: Northern Territory. Fitzmaurice River, *s.dat.*, F.Mueller *s.n.* (lecto: K373286), *fide* Cabrera & Ragonese (1978: 245).

Illustration: Cabrera & Ragonese (1978: 243).

Non-aromatic shrub 50–130 cm high; stems very densely lanate; stem wings entire, 2.5–6(–8) mm wide. Leaves elliptical, ovate or obovate, 37–70 × 20–43 mm, 1.6–2.3 times longer than wide, apex acute; margins recurved, denticulate, with 5–24 pairs of blunt teeth, sometimes obscure. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface with hairs erect to spreading, very dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs adpressed to spreading, very dense, extending 0.5–0.9 mm from the surface, basal cells not very short; globose sessile glands sparsely present, but hidden by hairs. Capitulescence spiciform or cylindrical, 35–105 mm long and 17–30 mm wide at anthesis, 1.8–4.3 times longer than wide; side branchlets never continuous, at 30–90°; peduncles 3–40 mm long. Outer involucre bracts 3.3–5.5 mm long, oblong to oblong-spathulate, with dense spreading lanate hairs on outer surfaces, inner surface glabrous or lanate; glands absent; apex acute. Inner bracts white on dorsal surface; longest ones linear, 5.3–9.2 × 0.3–0.6 mm, apex acute, upper margins with numerous small teeth; cilia 12–30, up to 5.5 mm long, attached along the proximal half and consistently extending to the distal one third, not exceeding the bract apex. Filiform (female) florets 25–58, straw-coloured, corolla 3.7–7.5 mm long, styles extending 0.4–0.9 mm beyond corolla. Hermaphrodite floret 1(–2), corolla pink, 4–6.5 mm long; corolla lobes 0.6–1 mm long, globose sessile glands absent, eglandular trichomes absent. Achenes narrowly ellipsoidal, 1.1–1.3 mm long, terete or slightly

angular, dark brown, with 25–50 or more than 50 twin hairs each *c.* 0.1 mm long; globose sessile glands at junction between achene and pappus absent; pappus 3.5–6.9 mm long. **Figs. 20E–H, 21.**

Additional specimens examined: **Indonesia.** Sumbawa, *s.dat.*, Zollinger 3421 (GH, L). **Australia: Western Australia.** Dillie Gorge, Charnley River Station, Jul 2005, Byrne 1584 (PERTH); Carlton Hill Station, close to Ningbing Site 3, Jun 2001, Handasyde & Start TH01137 (DNA, PERTH); Sir Graham Moore Island, Jul 1973, Wilson 11317 (PERTH); SW from Mt Trafalgar, margin of Saint George Basin, Jul 1990, Willing 212 (PERTH); Fenelon Island, off Admiralty Gulf, Jul 1977, Kenneally 6412 (PERTH); Inglis Gap, King Leopold Range, May 1905, Fitzgerald 752 (PERTH); Bushfire Hill, Prince Regent River Reserve, Aug 1974, George 12261 (PERTH); around 'Beverley Hills' Homestead buildings, Jun 1992, Mitchell 2557 (PERTH); Euro Gorge, Drysdale River N.P., Aug 1975, Kenneally 4349 (PERTH). **Northern Territory.** Aerodrome paddock, Manbulloo Station, Apr 1971, Kruizinga *s.n.* (BRI, CANB); 7 miles NE of Wilton River – Bulman Crossing, Jun 1972, Maconochie 1437 (BRI); 'Bupa', 4 km S Jarrong Yards, May 1994, Leach 4269 & Walsh (BRI, DNA, MEL); Kakadu N.P., Coronation Hill, Jul 1988, von Oertzen 116 (DNA); Cave Creek Station, Snake Track, Jul 2002, Risler 1908 (DNA). **Queensland.** [unlocalised], *s.dat.*, Bowman *s.n.* (K373287). **BURKE DISTRICT:** Gorge Creek gorge, Bowthorn Station, 100 km W of Doomadgee, Aug 2001, Addicott EPA1034 (BRI, CNS). **COOK DISTRICT:** 21.1 km S of Georgetown, Aug 2010, Bean 29874 & McDonald (BRI, CANB); 100 m from Georgetown – Forsayth Road, 13 km S of Georgetown, Aug 2010, Bean 29861 & McDonald (AD, BRI, NSW); 5.7 km E of Chillagoe, Ramparts section, Chillagoe–Mungana Caves N.P., Jun 2011, McDonald 11687 & McDonald (BRI).

Distribution and habitat: *Pterocaulon verbascifolium* is found commonly in the northern Kimberley, including offshore islands, and occasionally well inland. It is widespread though sporadic in sub-coastal (but not coastal) areas of the Northern Territory, extending into northern Queensland, as far east as Petford. Outside Australia, it is known only from the island of Sumbawa in Indonesia (**Map 10**). It inhabits lateritic plateaux or rocky hill-slopes in eucalypt or *Terminalia* dominated open woodland. Soil type varies, and the geological substrate may be basalt or sandstone.

Phenology: Flowers and fruits are recorded between May and August.

Affinities: The species is not obviously allied to any other.

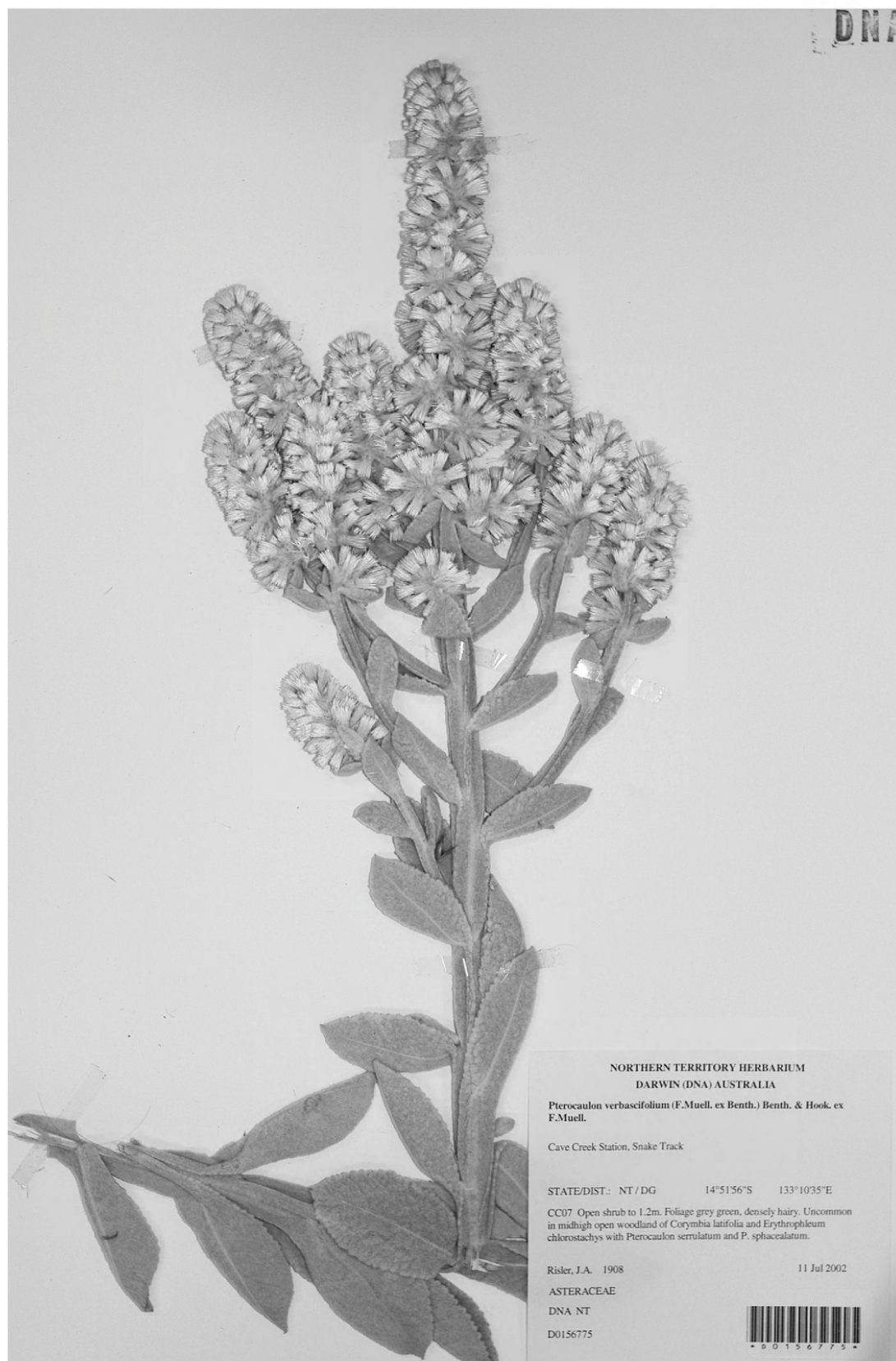


Fig. 21. Representative specimen of *Pterocaulon verbascifolium* (Risler 1908 [DNA])

Notes: This species is distinctive in the dense cylindrical capitulescences; corollas, achenes and pappus longer than in other species; no globose sessile glands on corolla lobes of hermaphrodite floret; indumentum of leaves extremely dense, obscuring surfaces; stem wings broad and the foliage not aromatic.

Pterocaulon verbascifolium is remarkable for the large variation between collections in the sizes of the floral parts. In some collections, the female florets (for instance) are only 3.7 mm long, and in other collections they are up to 7.5 mm long. There are correlated differences in other floral parts; however, there does not appear to be any geographical or ecological pattern to this variation.

There is a specimen of *Pterocaulon verbascifolium* at K collected by E.M. Bowman, with the locality given merely as "Queensland". It is of interest because Bowman did not travel any further north or west than the upper reaches of the Flinders River, near present-day Hughenden (Blake 1955). Hughenden is more than 200 km beyond the currently known extent of the species.

14. *Pterocaulon xenicum* A.R.Bean species nova affinis *P. niveoaliscaulinis angustioribus*, numero majore flosculorum femineorum in quoque capitulo, lobis brevioribus corollae flosculorum hermaphroditum et pappis longioribus differens. **Typus:** Australia: Western Australia. McLarty Hills, Great Sandy Desert, 5 August 1977, A.S. George 14628 (holo: PERTH; iso: CANB).

Shrub 25–40 cm high; stems numerous, densely lanate and sometimes with a few globose sessile glands; stem wings entire, 0.3–0.5 mm wide. Leaves oblanceolate or obovate, 18–52 × 7–17 mm, 2.6–4.7 times longer than wide, apex obtuse or acute; margins recurved, denticulate, with 10–21 pairs of blunt teeth. Indumentum comprising lanate multi-cellular hairs, glandular hairs absent. Upper surface moderately bullate; hairs erect to spreading, sparse to dense, basal cells short; globose sessile glands absent. Lower surface with lanate hairs erect to spreading, very dense, extending 0.4–0.7 mm from the surface, basal cells not very short; globose sessile glands yellow and

shining, moderately dense, 3–8 diameters apart, but usually obscured by indumentum. Capitulescence globose to ellipsoidal, 13–18 mm long, 13–16 mm wide at anthesis, 1–1.3 times longer than wide; side branchlets never continuous, at 30–80°; peduncles 0–14 mm long. Outer involucral bracts 2.5–2.9 mm long, spatulate, with dense spreading lanate hairs throughout on the outer surface, glabrous on the inner surface or with sparse hairs at distal end; glands absent; apex lacerate to fimbriate (fimbriae 0.1–0.35 mm long). Inner bracts pink or white on dorsal surface; longest ones linear, 4.8–5.6 × 0.25–0.4 mm; apex acute, upper margins conspicuously toothed or with small teeth; cilia 6–9, up to 3.8 mm long, mostly attached in proximal half and few extending to the distal one third. Filiform (female) florets 26–44, pink, corolla 3.2–4.1 mm long, styles extending 0.2–0.4 mm beyond corolla. Hermaphrodite floret solitary, corolla pink, 3.5–4.3 mm long; corolla lobes 0.3–0.5 mm long, globose sessile glands present, eglandular hairs absent or present. Achenes narrowly ellipsoidal, 0.8–0.9 mm long, terete or slightly angular, dark brown, with 25–50 or >50 twin hairs each c. 0.05 mm long, evenly distributed; globose sessile glands at junction between achene and pappus sparsely present; pappus 3.3–4.2 mm long. **Figs. 201–M, 22.**

Additional specimens examined: **Australia: Northern Territory.** 46 miles [74 km] WSW of The Granites, Aug 1970, Dunlop 1830 (DNA). **Western Australia.** just N of Dragon Tree Soak, Great Sandy Desert, Aug 1977, George 14748 (PERTH); 21.1 km ESE of Warrawagine Station Homestead, Pilbara IBRA (Site PHYE07), Aug 2006, van Leeuwen et al. 0028 (BRI, PERTH); 13.3 km W of Warrawagine Station Homestead, Pilbara IBRA (Site PHYE06), Aug 2006, van Leeuwen et al. 0027 (BRI, PERTH); E of Cherrabun Station, Oct 1952, s.coll. (PERTH536415).

Distribution and habitat: Known from a few localities in northern Western Australia, extending from Warrawagine Station to the Tanami Desert in Northern Territory (**Map 4**). At the type locality it occurs on open plains in association with shrubs including *Acacia* spp., *Senna* spp., *Solanum lasiophyllum* Dunal ex Poir. and *Grevillea juncifolia* Hook. The understorey is dominated by spinifex (*Triodia* spp.)



Fig. 22. Holotype of *Pterocaulon xenicum* (George 14628 [PERTH]).

Phenology: Flowers and fruits are recorded for August and October.

Affinities: The species shows affinity with *Pterocaulon sphacelatum* and *P. niveum*. *Pterocaulon xenicum* differs from *P. niveum* by the stem wings 0.3–0.5 mm wide (0.5–1.5 mm for *P. niveum*); the 26–44 female florets (11–17 for *P. niveum*); the corolla lobes of the hermaphrodite floret 0.3–0.5 mm long (0.7–1.1 for *P. niveum*); and the pappus 3.3–4.2 mm long (2–3.1 mm for *P. niveum*).

Pterocaulon xenicum differs from *P. sphacelatum* by the stem wings 0.3–0.5 mm wide (0.7–2.0 mm for *P. sphacelatum*); the longest inner bracts 4.8–5.6 mm long (3.5–4.6 mm for *P. sphacelatum*); the female florets 3.2–4.1 mm long (2.4–3.2 mm for *P. sphacelatum*); the hermaphrodite florets 3.5–4.3 mm long (2.5–3.7 mm long for *P. sphacelatum*); the pappus 3.3–4.2 mm long (2.3–3.3 mm for *P. sphacelatum*); and the outer bracts with lacerate or fimbriate apices (acute apices for *P. sphacelatum*).

Notes: This species is distinctive for the stem wings being very narrow and almost redundant; leaf indumentum very dense on lower surface; corolla lobes of hermaphrodite floret short; none or few cilia visible on protruding part of inner bracts; apices of outer bracts lacerate to fimbriate and the relatively long hermaphrodite florets.

Etymology: Derived from the Greek word *xenos* meaning ‘stranger, foreigner’ and the suffix *-icus* ‘belonging to’. This alludes to the specimens of this species found in amongst collections of *Pterocaulon sphacelatum*, and looking like ‘strangers’.

Postulated hybrids

Pterocaulon intermedium × *P. paradoxum*.

Specimens examined: Australia: Western Australia. 9 km N of Bunda Bunda Mill on Baldwin Creek track, Dampier Peninsula, Jun 1984, *Kenneally* 9078 (PERTH).

This specimen has broad stem wings, somewhat ellipsoidal capitulescences, achenes c. 0.8 mm long and scarcely acute leaves. These features do not fit *Pterocaulon intermedium*, nor do they quite fit *P. paradoxum*, although the specimen has similarities to both. This

specimen is probably a hybrid between these two species, both of which occur on the Dampier Peninsula.

Pterocaulon serrulatum var. *velutinum* × *P. sphacelatum*.

Specimens examined: Australia: Western Australia. 4.8 km E of Donkey Creek, on the Gibb River Road, Sep 2006, *Sweedman* 6984 (PERTH); 6.5 km NE of Mary River Crossing, Great Northern Highway, 92 km SW of Halls Creek, Jun 1976, *Beaublehole* ACB53238 (PERTH); Site PHYE09, 10.3 km SW of Warrawagine Station Homestead, Pilbara, Aug 2006, *van Leeuwen et al.* 0035 (PERTH).

These specimens have glandular outer involucre bracts as in *Pterocaulon serrulatum*, but the leaves are smaller and rather more bullate than is usual for that species. Furthermore, the stem wings are almost entire, with just the occasional tooth.

Pterocaulon ciliosum × *P. serrulatum* var. *serrulatum*.

Specimens examined: Australia: Queensland. NORTH KENNEDY DISTRICT: 22.5 km (by road) SW of Herberton, on the Silver Valley road, May 1983, *Conn & Clarkson* 1177 (BRI, CANB, DNA, NSW).

This specimen has narrower stem wings than *Pterocaulon serrulatum*, and the toothing is less than usual for that species. The capitulescences are almost globose and the protruding part of inner bracts has many long cilia, both features of *Pterocaulon ciliosum*.

Excluded names

Pterocaulon tomentosus Boerl., *Handl. Fl. Ned. Ind.* (Boerlage) 2(1): 240 (1891).

This is a *nomen nudum*.

Monenteles tomentosus Sch. Bip., *Syst. Verz.* (Zollinger) 122 (1854).

This is a *nomen nudum*.

Gnaphalium redolens G.Forst., *Fl. Ins. Austr.* 91 (1786).

This is a *nomen nudum*.

Acknowledgements

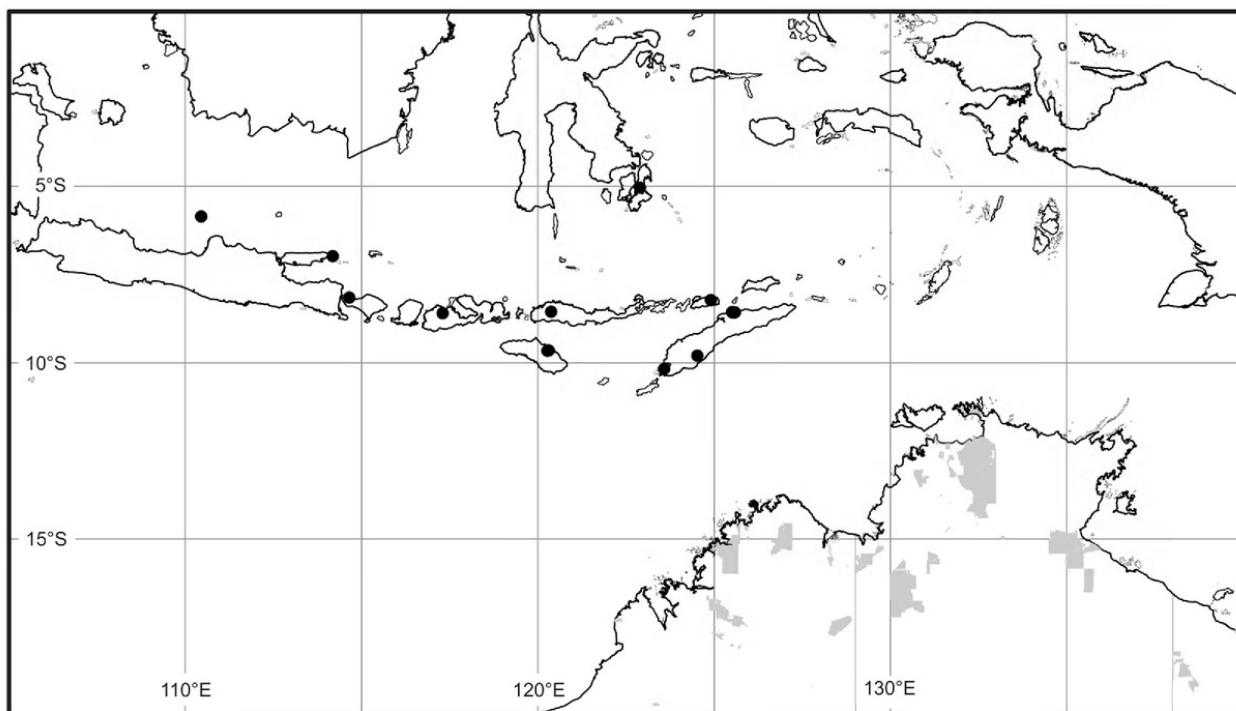
The Directors of several Herbaria have kindly sent specimens on loan from their institutions. I gratefully acknowledge G.Rouhan (P), M.Pignal (P), P.Morat (P)

and P.Schäfer (MPU) for their assistance or advice regarding type specimens collected from New Caledonia. I am grateful to N. Hind (K) who dealt with my loan request promptly and efficiently. V.Fonjallaz (G) and C.Nepi (FI) kindly sent images of type specimens held at those institutions. I thank G.von Poser of Porto Alegre, Brazil, for sending a reprint of a *Pterocaulon* chemistry paper. K.McDonald, R.Booth and D.Kelman have collected additional *Pterocaulon* material at my request. W.Smith (BRI) provided the illustrations of florets, bracts and achenes, and P.Bostock (BRI) expertly translated the diagnoses into Latin.

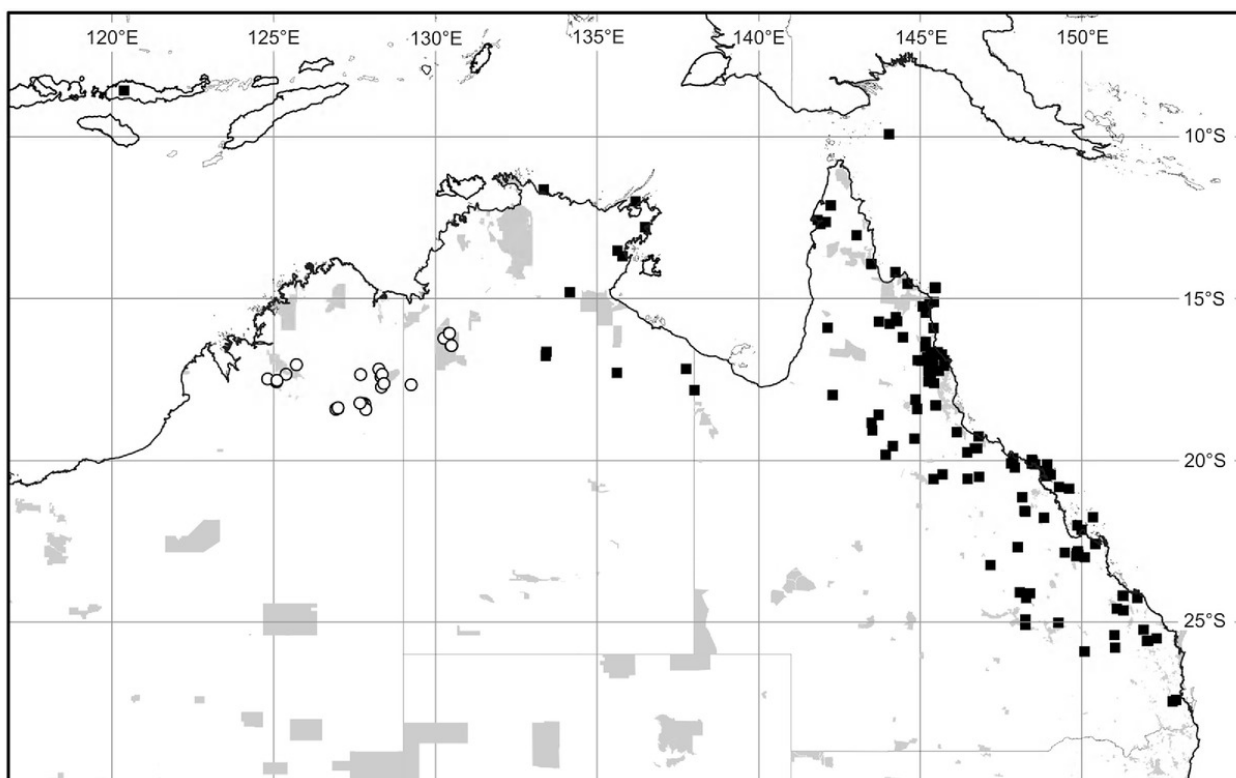
References

- ANDERBERG, A.A. (1989). Phylogeny and reclassification of the tribe *Inuleae* (Asteraceae). *Canadian Journal of Botany* 67: 2277–2296.
- (1991). Taxonomy and Phylogeny of the tribe *Plucheeae* (Asteraceae). *Plant Systematics and Evolution* 176: 145–77.
- (1994). Tribe *Plucheeae*. In K. Bremer (ed.), *Asteraceae, Cladistics and classification*, pp. 293–303. Timber Press: Portland, Oregon.
- ANDERBERG, A. A., ELDENAS, P., BAYER, R.J. & ENGLUND, M. (2005). Evolutionary relationships in the Asteraceae tribe *Inuleae* (incl. *Plucheeae*) evidenced by DNA sequences of *ndhF*; with notes on the systematic position of some aberrant genera. *Organisms, Diversity & Evolution* 5: 135–146.
- ANONYMOUS (2011). *Electronic Flora of South Australia*. Department of Environment and Natural Resources, Government of South Australia. <http://www.flora.sa.gov.au> Accessed 19 February 2011.
- BARR, A., CHAPMAN, J., SMITH, N., WIGHTMAN, G., KNIGHT, T., MILLS, L., ANDREWS, M. & ALEXANDER, V. (1993). *Traditional Aboriginal Medicines in the Northern Territory of Australia*. Aboriginal Communities of the Northern Territory & Conservation Commission of the Northern Territory: Darwin.
- BARRS, S. (1999). *Plants of the Outback - A field guide to the Native Plants around Mount Isa*. Mount Isa Mines Ltd.: Mount Isa.
- BENTHAM, G. (1867). *Monenteles*. In *Flora Australiensis* 3: 522–524. L. Reeve & Co.: London.
- (1873). *Compositae*. In G. Bentham & J.D. Hooker, *Genera Plantarum* 2(1): 163–533. L. Reeve & Co.: London.
- BLAKE, S.T. (1955). Some pioneers in plant exploration and classification. *Proceedings of the Royal Society of Queensland* 66: 1–19.
- BOSTOCK, P.D. & HOLLAND, A.E. (2007). *Census of the Queensland Flora 2007*. Queensland Herbarium, Environment Protection Agency: Brisbane.
- (2010). *Census of the Queensland Flora 2010*. Queensland Herbarium, Department of Environment and Resource Management: Brisbane. <http://www.derm.qld.gov.au/wildlife-ecosystems/plants/pdf/qld-flora-census.pdf> Accessed 4th February 2011.
- CABRERA, A.L. & RAGONESE, A.M. (1978). Revisión del género *Pterocaulon* (Compositae). *Darwiniana* 21: 185–257.
- CURRY, S. & MASLIN, B. (1990). Cunningham's collecting localities while botanist on Lieutenant Philip Parker King's survey of coastal Australia, December 1817 to April 1822. In P.S. Short (ed.), *History of systematic botany in Australasia*. Australian Systematic Botany Society Inc.: South Yarra, Victoria.
- DANIEL, O., MEIER, M.S., SCHLATTER, J. & FRISCHKNECHT, P. (1999). Selected phenolic compounds in cultivated plants: ecologic functions, health implications, and modulation by pesticides. *Environmental Health Perspectives* 107: 109–114.
- DE CANDOLLE, A.P. (1836). *Monenteles*. In *Prodromus systematis naturalis regni vegetabilis* 5: 455–456. Treuttel & Wurtz: Paris.
- GUILLAUMIN, A. & BEAUVISAGE, G. (dated 1913, published 1914). *Species Montrouzierianae seu Enumeratio Plantarum in Nova Caledonia terrisque adjacentibus A.R.P. Montrouzier lectarum. Annales de la Société botanique de Lyon* 38: 75–132.
- HAINES, H.H. (1961). *The Botany of Bihar and Orissa*, Vol. 2, reprinted edition. Botanical Survey of India: Calcutta.
- HOOKE, J.D. (1882). *Compositae*. In *Flora of British India* 3: 219–419. L. Reeve & Co.: London.
- JOHNS, S.R., LAMBERTON, J.A., PRICE, J.R. & SIOUMIS, A.A. (1968). Identification of Coumarins isolated from *Lepiniopsis ternatensis* (Apocynaceae), *Pterocaulon sphacelatum* (Compositae), and *Melicope melanophloia* (Rutaceae). *Australian Journal of Chemistry* 21: 3079–3080.
- KENNEALLY, K.F., EDINGER, D.C. & WILLING, T. (1996). *Broome and Beyond - Plants and people of the Dampier Peninsula, Kimberley, Western Australia*. Department of Conservation and Land Management: Como.

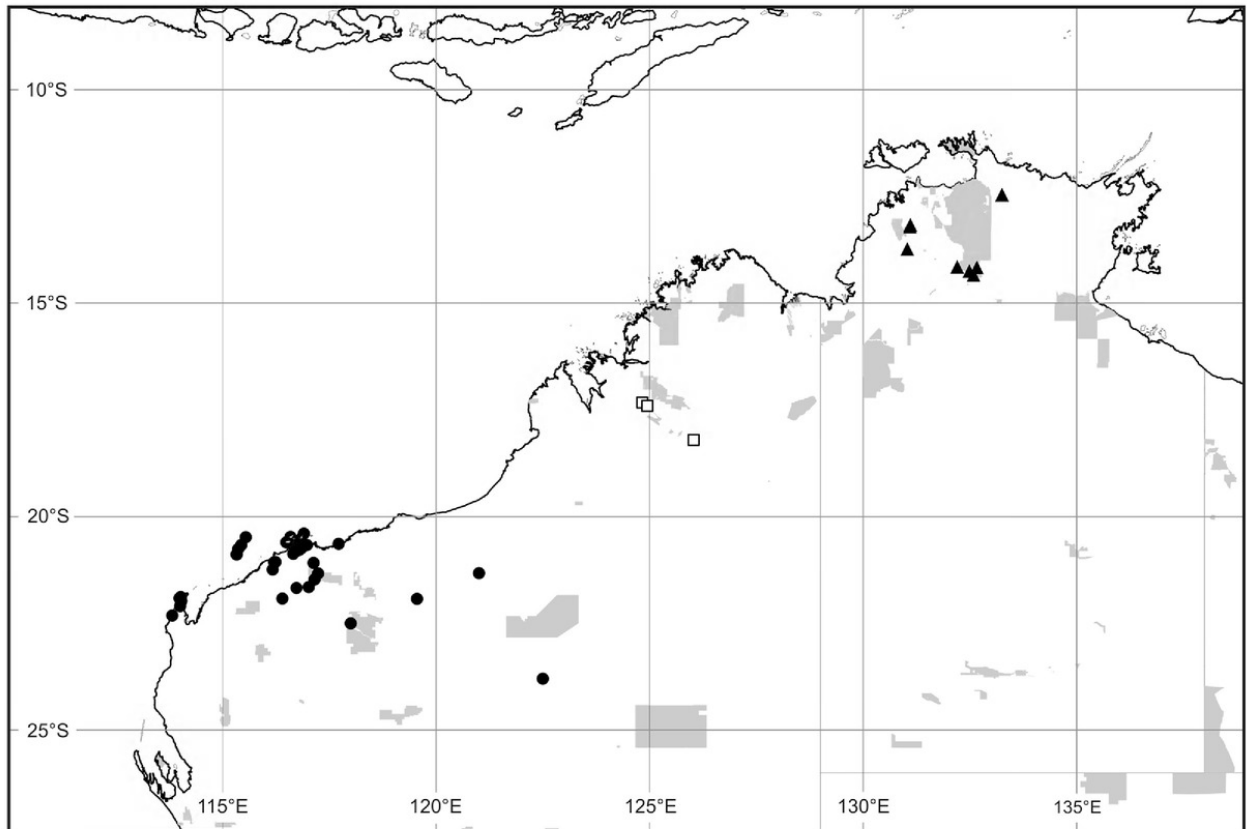
- KUNTZE, C.E.O. (1903). *Lexicon generum phanerogamarum inde ab anno MDCCXXXVII*. Deutsche Verlags-anstalt: Stuttgart.
- LABILLARDIÈRE, J.J.H. (1825). *Sertum Austro-Caledonicum*. Huzard: Paris.
- LATZ, P.K. (1995). *Bushfires and Bushtucker. Aboriginal Plant use in Central Australia*. IAD Press: Alice Springs.
- MACLEOD, J.K. & RASMUSSEN, H.B. (1999). A hydroxy-B-caryophyllene from *Pterocaulon serrulatum*. *Phytochemistry* 50: 105–108.
- MERRILL, E.D. (1918). *Species Blancoanae, A Critical Revision of the Philippine species of plants described by Blanco and by Llanos*. Bureau of Science: Manila.
- MILSON, J. (2000). *Pasture plants of north-west Queensland*. Department of Primary Industries: Brisbane.
- MOORE, P. (2005). *A Guide to Plants of Inland Australia*. New Holland Publishers: Sydney.
- MUELLER, F. (1882). *Systematic Census of Australian Plants*. Victorian Government: Melbourne.
- NESOM, G.L. (2006). *Pterocaulon*. In *Flora of North America* 19: 476–477. Oxford University Press: New York.
- PACZKOWSKA, G. & CHAPMAN, A.R. (2000). *The Western Australian Flora – A Descriptive Catalogue*. Wildflower Society of Western Australia: Perth.
- PORTENERS, M.F. (1992). *Pterocaulon*. In G.J. Harden (ed.), *Flora of New South Wales* 3: 204. New South Wales University Press: Sydney.
- RATH, B. & PRIYADARSHINI, P. (2005). Threat Status of Plants of Conservation Concern in Orissa (India): A compilation. http://www.vasundharaorissa.org/Research%20Reports/Threats_Status%20of%20Plants%20of%20Conservation.pdf Accessed on 13 March 2011.
- SEMPLE, S.J., NOBBS, S.F., PYKE, S.M., REYNOLDS, G.D. & FLOWER, R.L.P. (1998). Antiviral flavonoid from *Pterocaulon sphacelatum*, an Australian Aboriginal medicine. *Journal of Ethnopharmacology* 68: 283–288.
- STANLEY, T.D. & ROSS, E.M. (1986). *Flora of South-eastern Queensland*, Vol. 2. Queensland Department of Primary Industries: Brisbane.
- STEIN, A.C., FRITZ, D., PAIVA LIMA, L.F., MATZENBACHER, N.I., SCHRIPEMA, J., PIRES, V., SONNET, P. & VON POSER, G. (2007). Distribution of Coumarins in the Tribe Plucheeae, Genus *Pterocaulon*. *Chemistry of Natural Compounds* 43: 691–693.
- VAN STEENIS-KRUSEMAN, M.J. (2006-onwards). *Cyclopaedia of Malesian Collectors*. <http://www.nationaalherbarium.nl/FMCollectors/> Accessed 8th October 2010.
- VEGTER, I.H. (1976). *Index Herbariorum, Collectors*, Part II(4). *Regnum Vegetabile* 93: 553.
- WATANABE, K., SHORT, P.S., DENDA, T., KONISHI, N., ITO, M. & KOSUGE, K. (1999). Chromosome numbers and karyotypes in the Australian *Gnaphalieae* and *Plucheeae* (Asteraceae). *Australian Systematic Botany* 12: 781–802.
- WHEATON, T. (ed.) (1994). *Plants of the Northern Australian Rangelands*. Northern Territory Government: Darwin.
- WILSON, A.J.G. (1992). *Pterocaulon*. In J.R. Wheeler (ed.), *Flora of the Kimberley Region*, pp. 951–954. Western Australian Herbarium: Perth.



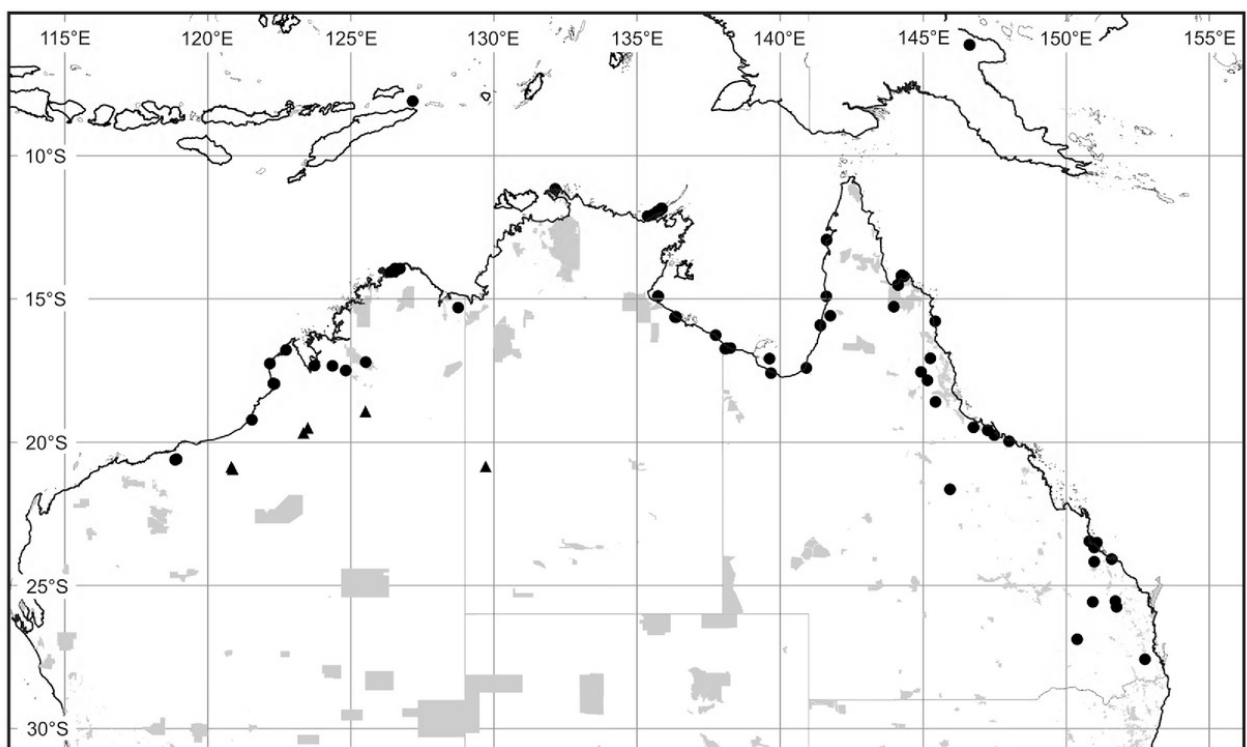
Map 1. Distribution of *Pterocaulon brachyanthum*



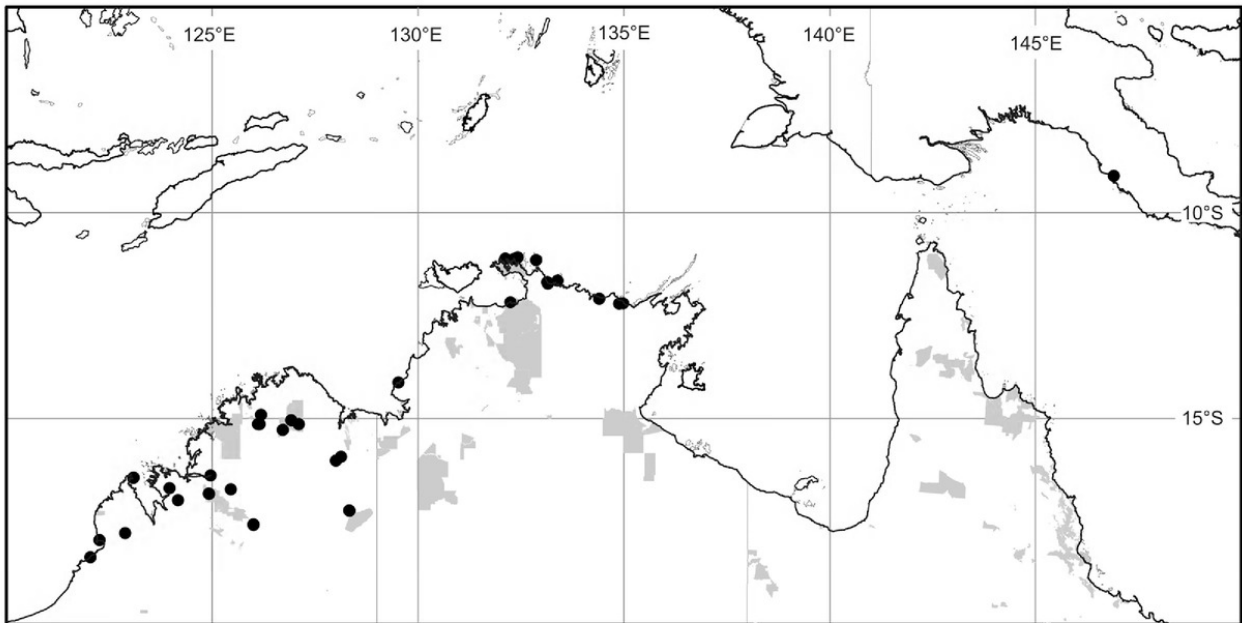
Map 2. Distribution of *Pterocaulon ciliosum* ■, *P. niveum* ○



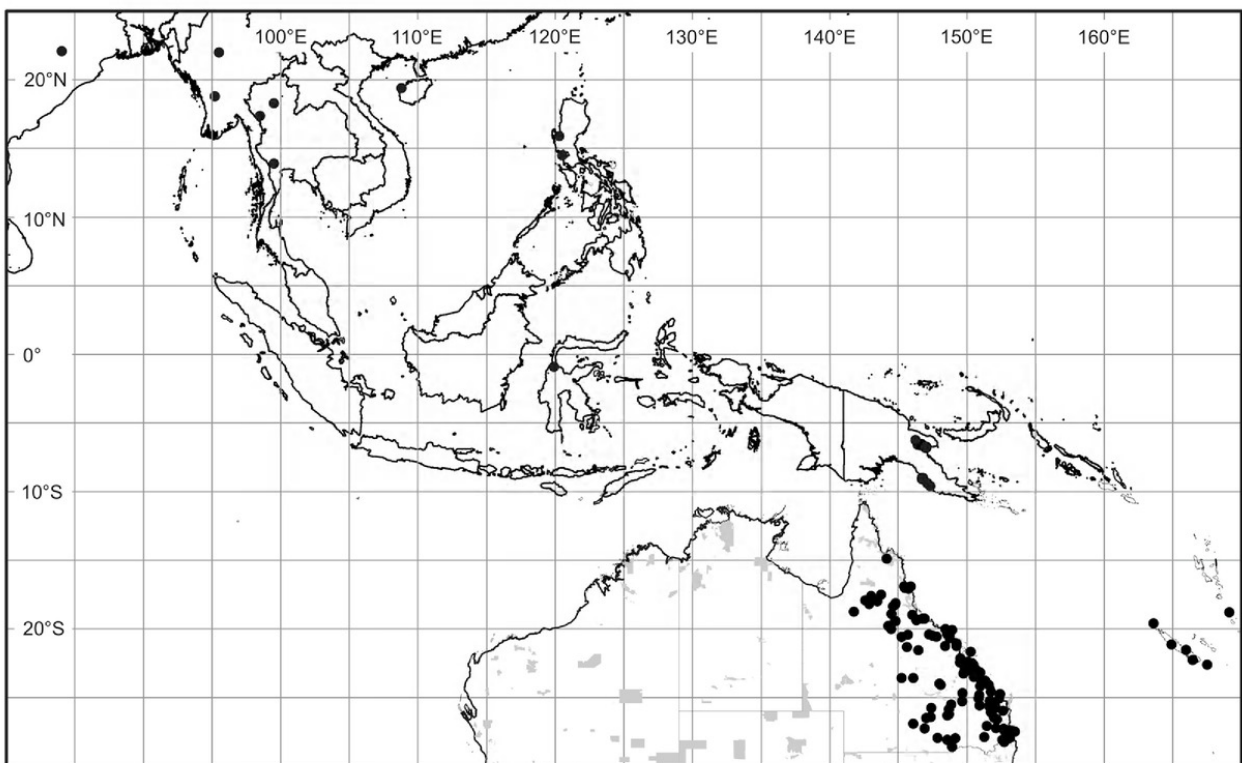
Map 3. Distribution of *Pterocaulon discolor* ▲, *P. globuliflorum* □, *P. sphaeranthoides* ●



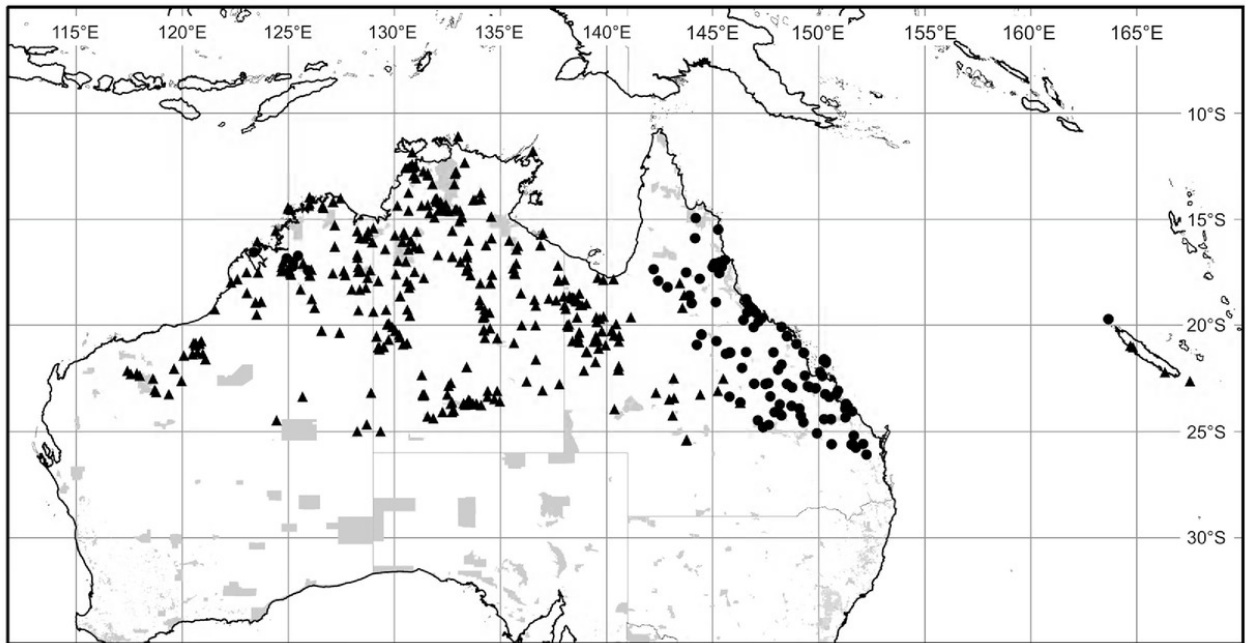
Map 4. Distribution of *Pterocaulon intermedium* ●, *P. xenicum* ▲



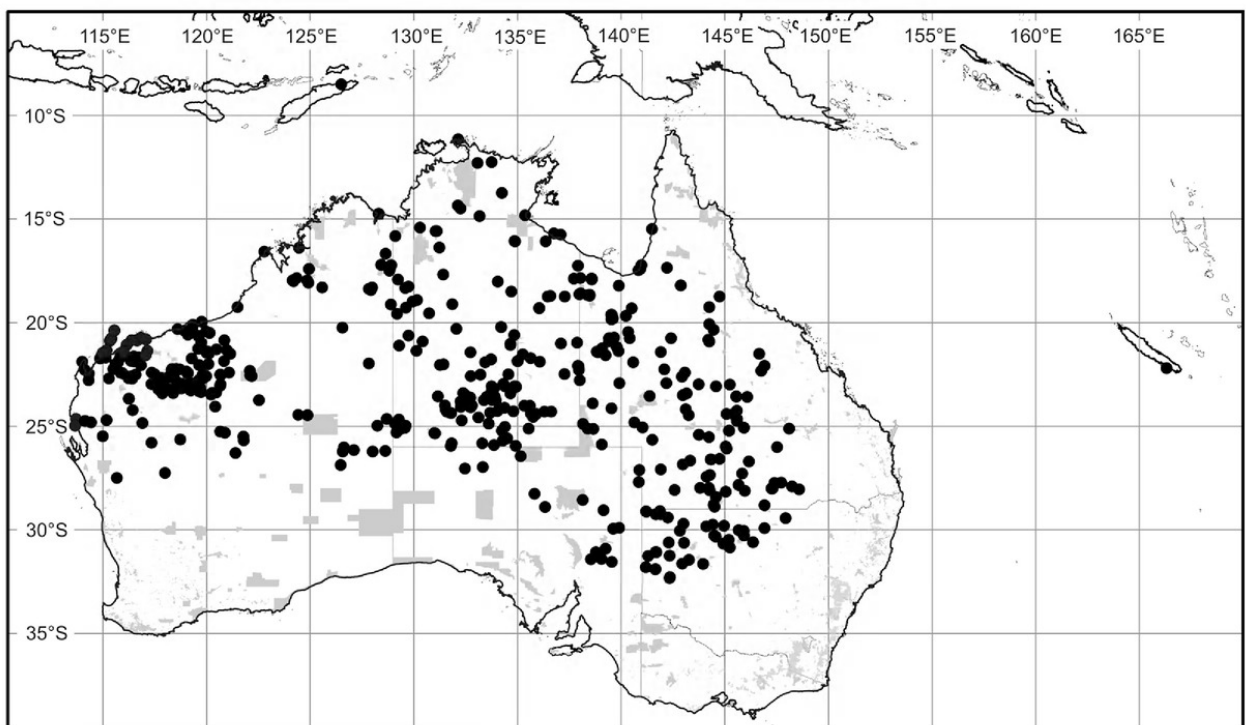
Map 5. Distribution of *Pterocaulon paradoxum*



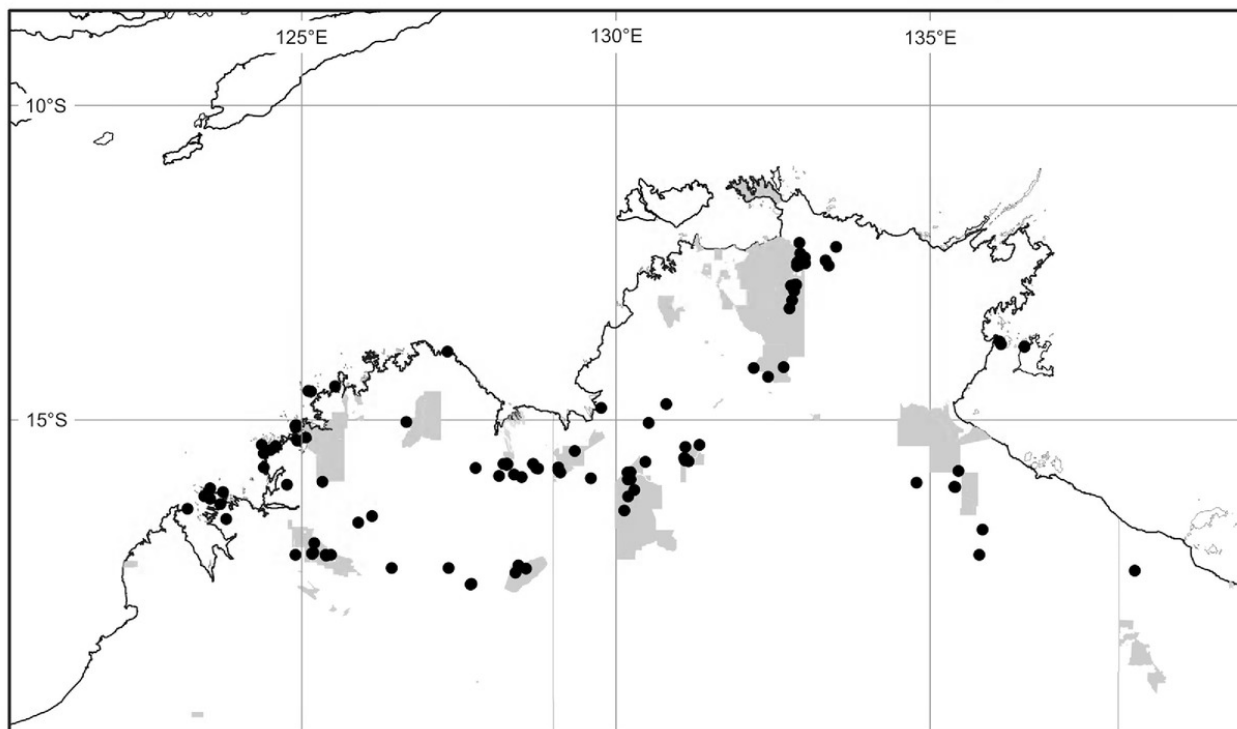
Map 6. Distribution of *Pterocaulon redolens*



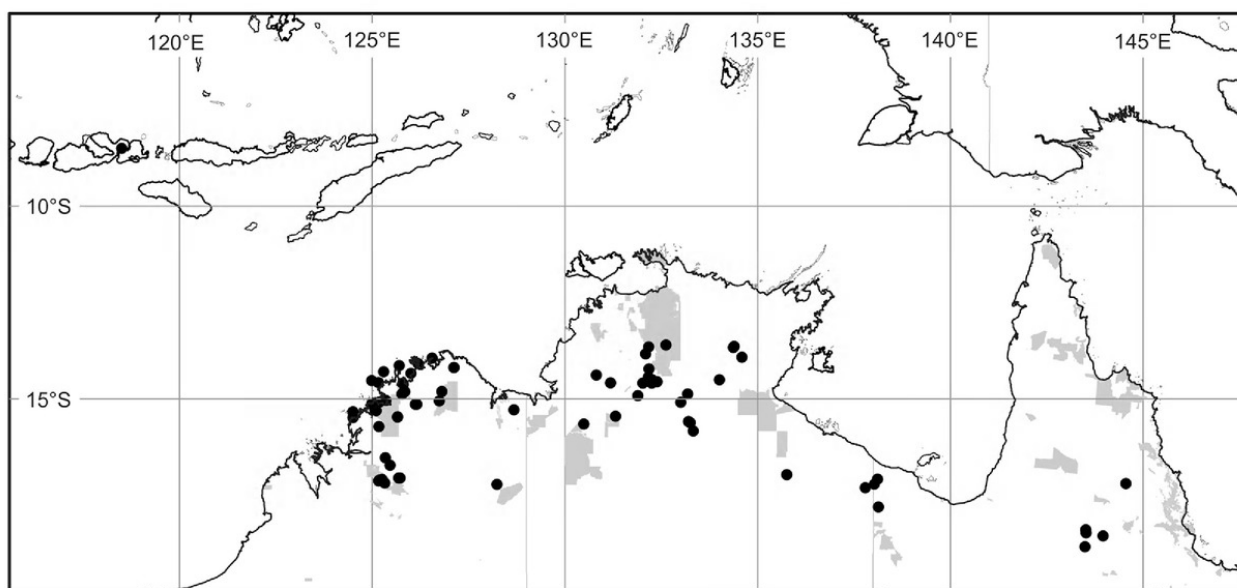
Map 7. Distribution of *Pterocaulon serrulatum* var. *serrulatum* ●, *P. serrulatum* var. *velutinum* ▲



Map 8. Distribution of *Pterocaulon sphacelatum*



Map 9. Distribution of *Pterocaulon tricholobum*



Map 10. Distribution of *Pterocaulon verbascifolium*



Bean, A. R. 2011. "A taxonomic revision of *Pterocaulon* section *Monenteles* (Labill.) Kuntze (Asteraceae: Inuleae–Plucheinae)." *Austrobaileya: A Journal of Plant Systematics* 8(3), 280–334. <https://doi.org/10.5962/p.299809>.

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