



Gomphrena axillaris and *G. longistyla* (Amaranthaceae), new species of *Gomphrena* from central and northern Australia

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Abstract: Two species of *Gomphrena* L. (Amaranthaceae) are here described as new, *G. axillaris* R.W.Davis & J.Palmer and *G. longistyla* R.W.Davis, J.Palmer & T.Hammer. *Gomphrena longistyla* occurs in the northern Kimberley region of Western Australia, and *G. axillaris* is distributed across the arid interior of Northern Territory, Western Australia and Queensland. Modifications are provided to the previously published species key to Australian *Gomphrena* species to enable identification of the two new species.

Keywords: Amaranthaceae, Australia, new species, *Gomphrena*, taxonomy

Introduction

Gomphrena L. is one of the largest genera in Amaranthaceae, with approximately 120 species native to tropical and subtropical North America, South America and Australia (Müller & Borsch 2005; Townsend 1993). In Australia, there are currently 32 endemic species, which occur in northern arid and monsoonal parts of the Northern Territory, Queensland, South Australia and Western Australia (Palmer 1998). *Gomphrena celosioides* Mart. is naturalised in all states and territories of mainland Australia. The highest species diversity occurs in the Northern Territory and Western Australia, with 23 and 20 native species, respectively. Additionally, three phrase-named taxa are currently listed on the national census (APC 2020) and one phrase-named taxon in FloraBase (Western Australian Herbarium 1998–). The present study formally describes three of these phrase-names as two distinct species: *G. sp.* Cambridge Gulf (*K.F. Kenneally 11899 K*) from the Kimberley region of Western Australia as *G. longistyla* R.W.Davis, J.Palmer & T.Hammer and *G. sp.* Martins Well (*K.F. Kenneally 6116*) from arid Northern Territory and Western Australia, as well as *G. sp.* Doongmabulla (*E.J. Thompson+ GAL137*) from Queensland as *G. axillaris* R.W.Davis & J.Palmer.

Material and Methods

This study is based on the examination of dried specimens housed at PERTH and CANB, including specimens on loan to CANB from AD, BRI, MEL,

NT and PERTH. The terminology used in this study follows Palmer (1998), with two notable exceptions.

The first exception is the replacement of the term ‘tepals’ with ‘sepals’, due to recent studies (e.g. Ronse De Craene 2013; Vrijdaghs *et al.* 2014) showing the perianth of Amaranthaceae, among other families within the Caryophyllales, being unambiguously of calycine origin. Taxonomic studies of other genera within subfamily Gomphrenoideae and other clades within the family (e.g. *Ptilotus* R.Br.) have recently adopted this change in terminology for the perianth of Amaranthaceae (Borsch *et al.* 2018; Hammer *et al.* 2019; Sánchez-del Pino *et al.* 2019). Secondly, Palmer (1998) described the staminal filaments as united around the ovary in a tube or cup and the projections on the tube that alternate with the stamens as ‘pseudostaminodes’. This study follows the terminology of Sánchez-del Pino *et al.* (2019) in describing this tube-like structure as an ‘androecial tube’ and associated appendages as ‘androecial tube appendages’.

Taxonomy

Gomphrena longistyla R.W.Davis, J.Palmer & T.Hammer, *sp. nov.*

Holotypus: [precise locality withheld for conservation reasons] Kununurra, Western Australia, 30 Jan. 2008, *G. Byrne 3025* (PERTH08098131). **Isotypus:** CANB.

Gomphrena sp. Cambridge Gulf (*K.F. Kenneally 11899 K*) Western Australian Herbarium, FloraBase <https://florabase.dbca.wa.gov.au/> [accessed: 13 February 2020].

Modified key to *Gomphrena* in Australia

Couplets 14–17 and 21–22 of the key provided by Palmer (1998) require modifications as follows.

14. Androecial tube shorter than fruit**17.** Androecial tube appendages present, much shorter than staminal filaments

17a. Bracteoles 1.8–3.5 mm long; sepals c. equal in length, 1.6–2.8 mm long; style to 1 mm long, not exceeding sepal apex *Gomphrena leptophylla*

17a: Bracteoles 3.0–4.5 mm long; sepals unequal, outer 3 sepals 2.8–4.6 mm long; style >2 mm long exceeding sepal apex *Gomphrena longistyla*

17: Androecial tube appendages absent**21:** Spikes 5–9 mm wide; sepals up to 3.4 mm long

22. Bracteoles distinctly shorter than sepals, translucent throughout, style 0.7–0.9 mm long . . . *Gomphrena conica*

22: Bracteoles equal to or slightly longer or shorter than sepals

22a. Bracteoles opaque white for half their length or at apex only; style 0.3–0.9 mm long, stigma 0.2–0.5 mm long *Gomphrena sordida*

22a: Bracteoles translucent or rarely opaque for one third of length; style 0.1–0.5 mm long, stigma 0.05–0.2 mm long *Gomphrena axillaris*

Annual herb, open or semi-erect to erect, (7–) 10–30 cm high, up to c. 40 cm wide, appearing multi-stemmed at ground level. *Stems* terete, with sparse, soft, spreading or crimped, hairs, glabrescent. *Leaves* cauline, sessile, narrowly obovate to elliptic or linear, (11–) 15–65 mm long, 1–4 mm wide; upper surface glabrous or with sparse, soft, spreading hairs, lower surface glabrous or with sparse, soft, spreading hairs. *Inflorescence* terminal, pedunculate or rarely sessile, solitary, globose to ovoid to cylindrical, pink, (6–) 8–15 (–20) mm long, 6–12 mm wide, elongating as mature flowers fall. *Bracts* broadly ovate, persistent after flowers shed, 1.8–2.8 mm long, 1.4–2.0 mm wide, sessile to subsessile, entire, glabrous, white opaque for up to half of length; mid-nerve faint. *Bracteoles* narrowly ovate to ovate, falling with flowers, 3.0–4.5 mm long, 1.0–2.5 mm wide, slightly shorter than sepals, white opaque up to two thirds of length, entire, glabrous, acute; mid-nerve faint. *Sepals* 5; *outer sepals* 3, oblong to slightly narrowly ovate, pink or mauve, 2.8–4.6 mm long, 0.7–1.1 mm wide; margin entire; apex broadly acute to rounded, entire; mid-nerve terminating before sepal apex; outer surface with dense white or pale brown, tangled, woolly hairs, covering the lower half of the sepals or to the end of the sepal mid-nerve; inner surface glabrous; *inner sepals* 2, narrowly obovate, pink or mauve, smaller than outer sepals, 2.2–4.3 mm long, 0.4–1.0 mm wide; margin entire; apex acute, entire; mid-nerve terminating before sepal apex; outer surface with dense white or pale brown, tangled, woolly hairs, covering the lower half of the sepals or to the end of the sepal mid-nerve; inner surface glabrous. *Stamens* 5, 2.3–4.0 mm long; *androecial tube* pink, shorter than fruit, 0.5–1.1 mm long; *androecial tube appendages* present, shorter than filaments; apex truncate, acute or toothed; *filaments* pink, 1.1–3.0 mm long, apex apiculate; anthers 0.6–1.1 mm long, yellow-orange. *Style* 2.0–2.6 mm long, pink; stigma 0.1–0.3 mm long. *Fruit* ovoid, pink, 1.0–1.5 mm long, 0.8–1.2 mm wide. *Seed* compressed, ovoid, brown, 0.9–1.3 mm long, 0.9–1 mm wide. **Fig. 1.**

Diagnostic characters. *Gomphrena longistyla* differs from all other Australian species in the genus in being a lax, open, herb with bright pink ovoid to cylindrical spikes to 12 mm wide, androecial tube shorter than fruit, androecial tube appendages present, staminal filaments to 3.0 mm long, and style to 2.6 mm long, exerted well beyond sepal apex.

Phenology. Collections suggest flowering dates are varied, with the majority collected in the wet season, December, January and February, however, other collections have been made in March, April, June, July and August.

Distribution and habitat. *Gomphrena longistyla* is currently known only from the Cambridge Gulf, from Wyndham, and to the south-west of Kununurra in Western Australia (Fig. 3). Cambridge Gulf populations are found behind supratidal flats near Kununurra and Wyndham populations near wetlands and seasonal creeks.

Conservation status. *Gomphrena longistyla* is listed as Priority 2 under Conservation Codes for Western Australian Flora and Fauna, under the name *G. sp.* Cambridge Gulf (Smith & Jones 2018).

Etymology. The epithet is from the Latin *longus* (long) and *stylus* (style) in reference to this species having a relatively long style protruding from the sepal apex.

Notes. First recognised as a possible new species in 2004 by J. Palmer as having similarities to *G. connata* J. Palmer, but differed in its stamens, staminal appendage and tube. *Gomphrena sp.* Cambridge Gulf was subsequently given a phrase-name by R. Davis in 2020.

Other specimens examined [precise localities withheld for conservation reasons]

WESTERN AUSTRALIA. Parry Lagoons Nature Reserve, 11 Nov. 1997, *Anonymous s.n.* (PERTH); Durack River

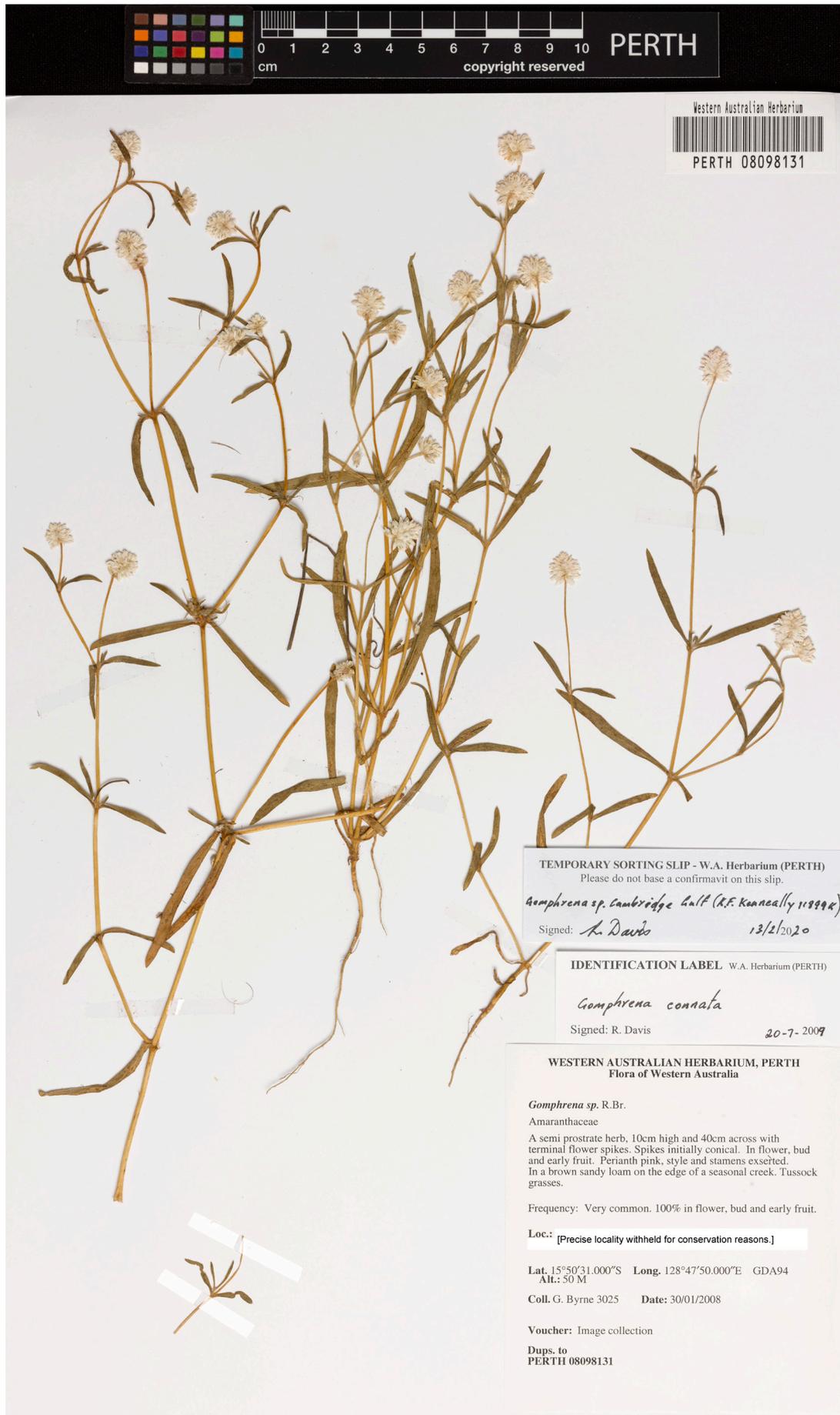


Fig 1. Holotype of *Gomphrena longistyla*, G. Byrne 3025 (PERTH08098131).

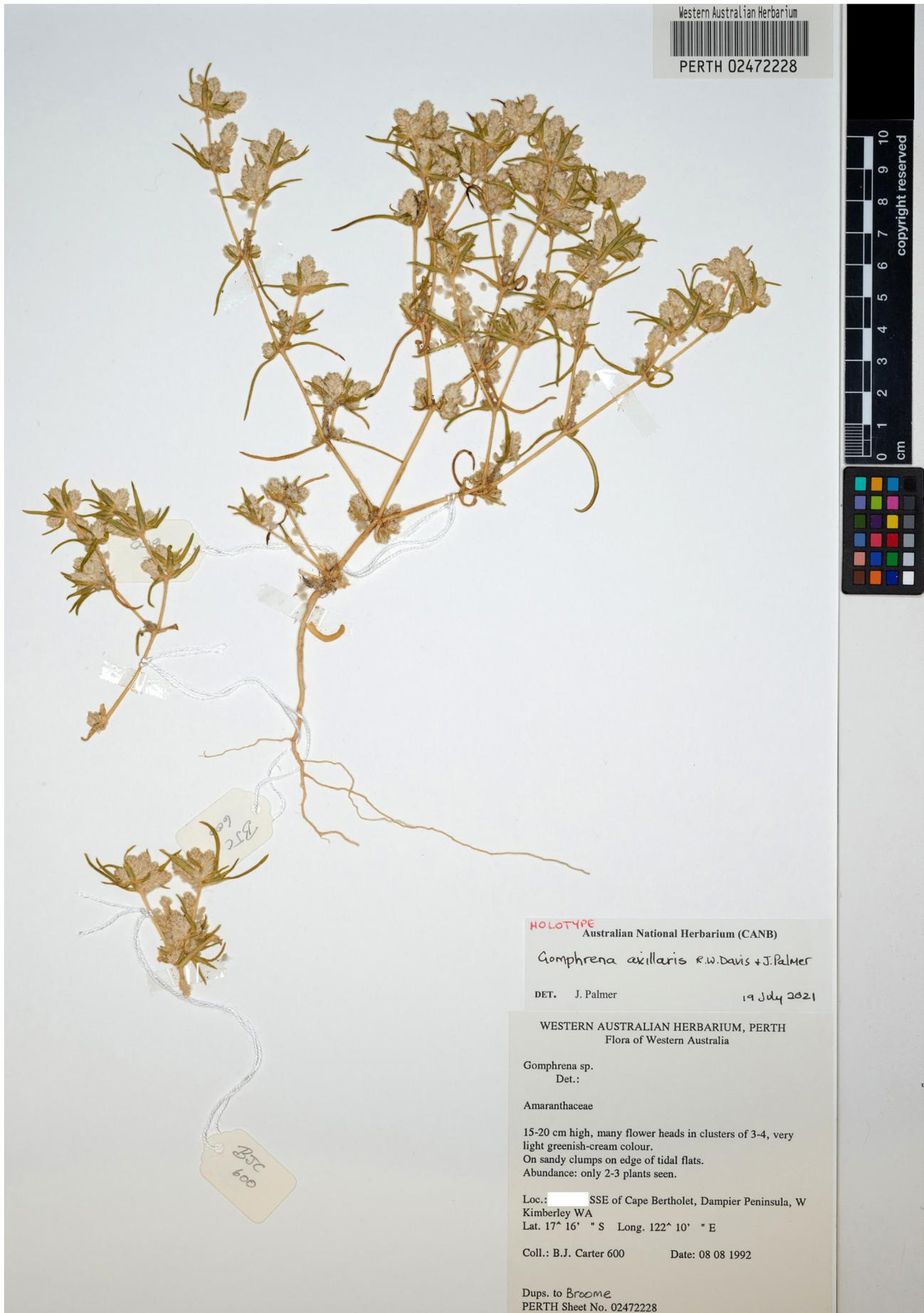


Fig 2. Holotype of *Gomphrena axillaris*, B.J. Carter 600 (PERTH02472228).

Station, 5 June 2014, *R. Butcher & A.N. Start RB 1957* (PERTH); SE of New Wyndham Post Office, 25 Apr. 1977, *Hj. Eichler 22495* (CANB, PERTH); Adolphus Island, 10 Aug. 2008, *T. Handasyde TH 4083* (CANB, PERTH); Adolphus Island, 9 Feb. 2009, *T. Handasyde TH 6232* (CANB, PERTH); Adolphus Island, 9 Feb. 2009, *T. Handasyde TH 6255* (CANB, PERTH); Adolphus Island, 9 Feb. 2009, *T. Handasyde TH 6256* (CANB, PERTH); Nicholls Point, Adolphus Island, Cambridge Gulf, 15 June 2003, *K.F. Kenneally 11899 K* (CANB, PERTH); Near Grant Creek Bore, 70 km N of Kununurra and c. 31 km NNW of Point Springs, 8 Mar. 1978, *M. Lazarides 8432* (CANB, PERTH); SSE of Kununurra, 10 Mar. 1978, *K. Pajmans 2226* (CANB, PERTH); NNE of Wyndham, 14 Mar. 1978, *K. Pajmans 2229* (CANB, PERTH).

Gomphrena axillaris R.W.Davis & J.Palmer, *sp. nov.*

Holotypus: [precise locality withheld for conservation reasons] SSE of Cape Bertholet, Dampier Peninsula, W. Kimberley, Western Australia, 8 August 1992, *B.J. Carter 600* (PERTH02472228).

Gomphrena sp. Martins Well (*K.F. Kenneally 6116*). Western Australian Herbarium, *FloraBase* <https://florabase.dbca.wa.gov.au/> [accessed: 14 February 2020].

Gomphrena sp. O (J.Palmer) in Kenneally, D.C. Edinger & T. Willing, *Broome & Beyond Pl. People Dampier Penins.* 57 (1996).

Gomphrena sp. Doongmabulla (*E.J. Thompson + GAL137*) in Henderson, R.J.F. (ed.), *Names Distrib. Queensl. Pl. Algae Lichens* 14 (2002).

Annual or occasionally biennial herb, erect, 10–30 cm high, up to 20 cm wide, single or multi-stemmed at ground level. *Stems* terete, glabrous or with sparse to dense, tangled, white cottony hairs especially on younger stems and in leaf axils. *Leaves* cauline, sessile, linear to very narrowly ovate, 10–35 (–40) mm long, 0.9–2.3 (–3) mm wide; margins recurved to revolute, entire; upper and lower surface glabrous; apex acute, mucronate. *Inflorescences* axillary, sessile, solitary or in clusters of 2–3, ovoid to shortly cylindrical, pink or white, 5–16 (–20) mm long, 4–8 mm wide, elongating as mature flowers fall. *Bracts* ovate, persistent after flowers shed, 1.0–2.2 mm long, 1.0–2.0 mm wide, sessile to subsessile, entire, glabrous, apex acute, translucent or slightly opaque on the distal portion; mid-nerve faint. *Bracteoles* broadly ovate to ovate, falling with flowers, 2.0–3 (–3.5) mm long, 1.2–2.6 mm wide, equal or slightly longer or shorter than sepals, translucent or rarely opaque for a third of length, entire, glabrous, apex acute; mid-nerve faint. *Sepals* 5; *outer sepals* 3, oblong to narrowly ovate, pink or light greenish-cream or white, 2.0–3.4 mm long, 0.5–1 mm wide; margin entire; apex tapering to a short tip, obtuse to rounded, entire; mid-nerve terminating before sepal apex or rarely faintly terminating at apex; outer surface with dense white or pale brown, tangled, woolly hairs, covering three quarters to almost full length of the sepals; inner surface glabrous; *inner sepals* 2, oblong to narrowly ovate, smaller than outer sepals, 1.5–2.9 mm long, 0.2–0.7 mm wide, margin entire; apex gradually

tapering, acute to obtuse, entire; outer surface with dense white or pale brown, tangled, woolly hairs, covering over three quarters to almost full length of the sepals; inner surface glabrous. *Stamens* 5, 0.8–1.7 mm long; *androecial tube* shorter than fruit, 0.4–0.8 mm long; *androecial tube appendages* absent; *filaments* pink, 0.2–0.6 mm long; apex apiculate; *anthers* 0.2–0.6 mm long. *Style* 0.1–0.5 mm long, pink; *stigma* 0.05–0.2 mm long. *Fruit* oblong, ovoid or ellipsoid, 1.2–1.7 mm long, 0.8–1.1 mm wide. *Seed* compressed, ovoid, brown, 0.7–1.2 mm long, 0.6–0.9 mm wide. **Fig. 2.**

Diagnostic characters. *Gomphrena axillaris* can be distinguished from all other Australian species of the genus in being an erect, annual herb, with mostly axillary, sessile, clustered, pink, ovoid to shortly cylindrical spikes (4–8 mm wide), the staminal appendages absent, a style 0.1–0.5 mm long and a stigma 0.05–0.2 mm long.

Phenology. From the specimens examined, flowering occurs in autumn and winter, from March to May and July to August; however, it is likely *G. axillaris* would respond to ephemeral rain events.

Distribution and habitat. *Gomphrena axillaris* is currently known from several localities (Fig. 3), in Western Australia (near Karratha, the Dampier Peninsula and Lake Disappointment), the Northern Territory (near the Western Australian border, 60 km south-east of Lake Mackay, in the Tanami Sanctuary and near Lake Caroline Station, west of the Queensland border), and central Queensland (Yarrowmere Station in the north, down to east of Barcaldine in the south). The collection labels suggest it prefers sub-saline habitats or margins of salt-lakes and hummock or tussock grasslands on sand.

Conservation status. *Gomphrena axillaris* is listed as Priority 1 under Conservation Codes for Western Australian Flora and Fauna, under the name *G. sp.* Martins Well (Smith & Jones 2018). In Western Australia it is known from five locations, in the Pilbara near Karratha and Lake Disappointment in the Little

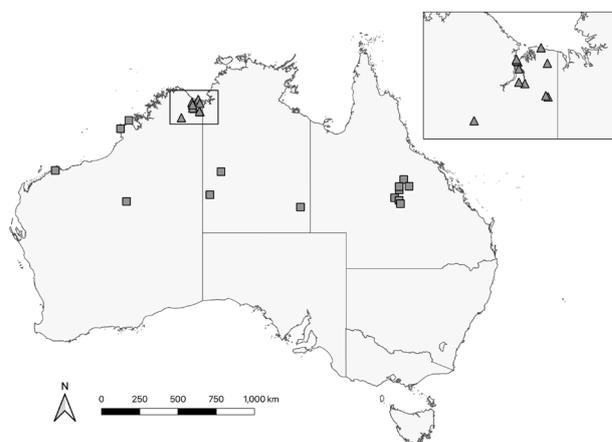


Fig 3. The distribution of *Gomphrena longistyla* (triangles) and *G. axillaris* (squares).

Sandy Desert and the Dampier Peninsula. With the recent discoveries of populations on the Dampier Peninsula the current priority listing for Western Australia will likely be re-evaluated. In the Northern Territory and Queensland, it is not conservation listed, however, it is noted as data deficient for the Northern Territory.

Etymology. The specific epithet derives from the Latin *axillaris* (of an axil), referring to the axillary inflorescences.

Related species. Using the Australian key to *Gomphrena*, *G. axillaris* keys out closest to *G. sordida*. Both species prefer saline habitats, but *G. axillaris* has an erect habit with clearly elongated inflorescences, of which are 2–4 commonly clustered together, whereas *G. sordida* has a prostrate or decumbent habit, commonly single inflorescences or occasionally 2 or 3 clustered and barely elongated. *G. sordida* is restricted to the Pilbara and Carnarvon bioregions, *G. axillaris* is distributed from the Pilbara across to the Northern Territory and central western Queensland. *Gomphrena axillaris* is also similar to *G. leptophylla*, but that species has a more prostrate habit, longer style (0.2–1.0 mm) and stigma (0.1–0.4 mm) and has androecial tube appendages.

Other specimens examined [precise localities withheld for conservation reasons]

WESTERN AUSTRALIA. Sherlock River, 1878, *Forrest s.n.* (MEL); SW of Martins Well, Dampierland, N of Broome, 22 Apr. 1977, *K.F. Kenneally 6116* (PERTH); Lake Disappointment, 23 Aug. 2004, *W.P. Muir WPM 713* (PERTH); Site DAM06-13, Dampier Salt Site between Dampier and Karratha, 2006, *R. Orifici s.n.* (CANB); S of Dampier, 13 July 2008, *R. Orifici BES 00491* (PERTH).

NORTHERN TERRITORY. NE Mt Morris, 15 Apr. 1997, *D.E. Albrecht 8172* (CANB); Near E edge of first major lake, South of Lake Caroline, North Simpson Desert, 10 July 2007, *D.E. Albrecht & A. Duguid 12347* (CANB); Tanami Sanctuary, 25 May 1976, *P. Latz 6482 p.p.* (CANB).

QUEENSLAND. Geera, E of Barcardine, 6 Dec. 1935, *S.T. Blake 10385* (AD, BRI, NT); Corinda, c. 100 km N of Aramac (DEU site 531), 31 Mar. 2004, *R.J. Cumming 22473 & E.J. Thompson* (BRI); Thornhill east of Barcardine, June 1995, *J. Emsol s.n.* (BRI); 93 km E of Muttaborra on stock route through Sumana Station, 4 Apr. 2011, *E.J. Thompson MUT475* (BRI); 104 km NE of Muttaborra on Corinda Station, SE of Corinda homestead, 31 Mar. 2005, *E.J. Thompson MUT196 & R.J. Cumming* (BRI); S of Doongmabulla homestead, 197 km N of Jericho, 18 Mar. 1993, *E.J. Thompson GAL137 & E.J. Henderson* (BRI); Yarrowmere Station, SW of Yarrowmere homestead, 2 May 2006, *E.J. Thompson BUC2206 & G.W. Wilson* (BRI).

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References

- Australian Plant Census* [APC] (continuously updated). IBIS database. (Centre for Australian National Biodiversity Research & Council of Heads of Australasian Herbaria: Canberra). <http://www.chah.gov.au/apc/index.html> [accessed: 16 May 2020].
- Borsch, T., Flores-Olvera, H., Zumaya, S. & Müller, K. (2018). Pollen characters and DNA sequence data converge on a monophyletic genus *Iresine* (Amaranthaceae, Caryophyllales) and help to elucidate its species diversity. *Taxon* 67: 944–976.
- Hammer, T.A., Zhong, X., Colas des Francs-Small, C., Nevill, P.G., Small, I.D. & Thiele, K.R. (2019). Resolving intergeneric relationships in the aroid clade and the backbone of *Ptilotus* (Amaranthaceae): Evidence from whole plastid genomes and morphology. *Taxon* 68(2): 297–314.
- Müller, K. & Borsch, T. (2005). Phylogenetics of Amaranthaceae based on *matK/trnK* sequence data: Evidence from parsimony, likelihood, and Bayesian analyses. *Annals of the Missouri Botanical Garden* 92: 66–102.
- Palmer, J. (1998). A Taxonomic Revision of *Gomphrena* (Amaranthaceae) in Australia. *Australian Systematic Botany* 11: 73–161.
- Ronse De Craene, L.P. (2013). Reevaluation of the perianth and androecium in Caryophyllales: Implications for flower evolution. *Plant Systematics and Evolution* 299: 1599–1636.
- Sánchez-del Pino, I., Vrijdaghs, A., de Block, P., Flores-Olvera, H., Smets, E. & Eliasson, U. (2019). Floral development in Gomphrenoideae (Amaranthaceae) with a focus on androecial tube and appendages. *Botanical Journal of the Linnean Society* 190: 315–332.
- Smith, J. & Jones, A. (2018). *Threatened and Priority Flora list for Western Australia*. (Department of Biodiversity, Conservation and Attractions: Kensington).
- Townsend, C.C. (1993). Amaranthaceae. In: Kubitzki, K., Rohwer, J.G. & Bittrich, V. (eds.), *The families and genera of vascular plants* 2: 70–91. (Springer: Berlin).
- Vrijdaghs, A., Flores Olvera, H. & Smets, E. (2014). Enigmatic floral structures in *Alternanthera*, *Iresine*, and *Tidestromia* (Gomphrenoideae, Amaranthaceae): A developmental homology assessment. *Plant Ecology and Evolution* 147: 49–66.
- Western Australian Herbarium (1998–). *FloraBase—the Western Australian Flora*. (Department of Biodiversity, Conservation and Attractions: Perth). <https://florabase.dpaw.wa.gov.au/> [accessed: 15 June 2021].

