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Drosera maanyaa-gooljoo, a new species of *Drosera* section *Arachnopus* (Droseraceae) from the Buccaneer Archipelago and Yampi Peninsula, northwest Kimberley region, Western Australia

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Abstract

Drosera maanyaa-gooljoo, a new annual species of *Drosera* section *Arachnopus* from the remote Buccaneer Archipelago and Yampi Peninsula in the northwest Kimberley region of Western Australia, is described and illustrated. *Drosera maanyaa-gooljoo* is a distinctive species that differs in morphology and indumentum from all previously known taxa of *D.* section *Arachnopus*. Comprehensive photo plates comparing all morphological details, as well as seed shape and structure, with those of the putatively related *D. barrettiorum* and *D. hartmeyerorum* are provided. Given *D. maanyaa-gooljoo* is only known from two small populations, a Priority One status under Conservation Codes for Western Australian Flora is recommended. Both populations occur within exclusive Native Title lands of the Dambimangari and Mayala Traditional Owners. This exciting new species discovery highlights the importance of both consultation with Indigenous people and herbarium revisions for alpha taxonomy and biodiversity research.

Key words: carnivorous plants, *Drosera barrettiorum*, *D. hartmeyerorum*, leaf trichomes, Nepenthales, non-core Caryophyllales, sundews, taxonomy

Introduction

Drosera Linnaeus (1753: 281) (Droseraceae Salisb., Nepenthales Dumort./non-core Caryophyllales) comprises ca. 260 species of predominantly perennial herbaceous carnivorous plants with greatest diversity in Australia (ca. 165 species, ca. 150 of which are endemic; Lowrie 2014, Fleischmann *et al.* 2018, Krueger *et al.* 2023). Globally, only 17 *Drosera* are annual therophytes (Fleischmann *et al.* 2018, Krueger & Fleischmann 2021), including all species from *Drosera* section *Arachnopus* Planchon (1848: 93) of *D.* subgenus *Drosera* (classification following Fleischmann *et al.* 2018). That section, confined in the Old World tropics, is also informally referred to as the *Drosera indica* Linnaeus (1753: 282) complex (e.g., Susandarini *et al.* 2002) and it so far comprises twelve annuals that are all commonly characterised by narrowly linear-lanceolate carnivorous leaves on stems with well-expressed internodes, and the presence of a unique, biseriate double-tipped trichome type of non-carnivorous indumentum (type 5 *pro parte sensu* Länger *et al.* 1995) (Lowrie 2014, Krueger & Fleischmann 2021). Species from *D.* section *Arachnopus* are distinguished based on their characteristic stem and petiole indumentum of non-carnivorous trichomes, leaf size, petiole length, floral characters (especially stamen shape), seed size and testa ornamentation (Planchon 1848, Schlauer 2001, Susandarini *et al.* 2002, Barrett & Lowrie 2013, Lowrie 2014, Krueger & Fleischmann 2021), as well as phytochemistry (Schlauer *et al.* 2018, 2021, Schlauer & Fleischmann 2022).

During examination of herbarium specimens housed at the Western Australian Herbarium (PERTH), two specimens appearing to represent a distinctive new taxon from *Drosera* section *Arachnopus* were encountered. These

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specimens both originated from a small area in the northwest Kimberley region of Western Australia, one from remote northern Yampi Peninsula collected during a 1994 expedition and one from an island in the Buccaneer Archipelago in the Yampi Sound collected during a floristic inventory for the Buccaneer Archipelago Survey in 1982. Both specimens were originally identified by the collectors as *D. indica* which, at the time, was the only accepted species of *D.* section *Arachnopus* (e.g., Diels 1906, Marchant *et al.* 1982, Lowrie 1998). Following taxonomic revisions of *D.* section *Arachnopus* by Barrett & Lowrie (2013) and Lowrie (2014), both specimens were placed under *D. fragrans* Lowrie (2014: 1271) with the annotation "*D. fragrans* Lowrie petiole glabrous form" (S. Coffey, in annot. 2018). However, the taxon displays striking morphological characteristics not observed in any other species from *D.* section *Arachnopus*, or elsewhere in the genus. It was immediately recognised as a distinctive new species when examined by the authors of this work in 2020, and a species description was prepared based on detailed studies of the herbarium material.

Following consultation with the Traditional Owners that possess exclusive Native Title over the lands on which the species occurs, the Dambimangari and Mayala Traditional Owners, a Dambimangari Ranger supported the researchers to locate and observe living specimens and take *in-situ* measurements and photographs during a guided trip to the northern Yampi Peninsula population in June 2022. It is crucial to recognise the knowledge, skills, and interest in land management of Indigenous peoples when conducting research on Country (Lincoln *et al.* 2017, Mathieson & Thompson 2020).

Materials & Methods

Herbarium specimens of *Drosera* section *Arachnopus* housed at PERTH (herbarium acronym following Thiers 2023+) were examined under a stereo microscope (Olympus SZ61, Olympus, Japan), with morphological measurements taken directly from specimens. Measurements of the new species were also taken from living plants *in-situ* at the northern Yampi Peninsula population, and a herbarium voucher (*T. Krueger & A. Fleischmann 51*) was collected and deposited at PERTH with the permission of the Dambimangari Traditional Owners (flora taking licence FT61000860 to TK; Aboriginal Affairs Planning Authority Permit PER024809). Seeds from herbarium material of *D. maanyaa-gooljoo* (destructive sampling permit from PERTH acquired) and from cultivated plants of *D. barrettiorum* Lowrie (2014: 1269) and *D. hartmeyerorum* Schlauer (2001: 104) were examined under a macroscope (Leica Z6 APO with objective Leica Planapo 2.0×, Leica, Germany) at 72× magnification and photographed with a mounted ILCE-6400alpha (Sony, Japan); each seed image was stacked from a series of 40 individual images at 2 µm step size (StackShot macro rail, Cognisys, USA) and composed using Helicon Focus Pro (Helicon Soft Ltd.). *In-situ* macro photographs of microscopic details of *D. maanyaa-gooljoo* were composed from stacking series taken with a Lumix DMC-FZ50 (Panasonic, Japan) with mounted macro close-up lenses (Raynox, Japan and Kenko, Japan) using a tripod and manual macro rail (Rollei, Germany). The distribution map was drawn based on open map source (OpenStreetMap) using Photoshop (Adobe, USA).

Taxonomy

Drosera maanyaa-gooljoo A.Fleischm. & T.Krueger, *sp. nov.* (Figs. 1–7).

Type:—AUSTRALIA. Western Australia: Buccaneer Archipelago, [precise locality withheld for conservation purposes], within 10 m of stream, 18 June 1982, *A.J.M. Hopkins BA 0248* (holotype PERTH 05615631!, isotype PERTH 09120807!).

Diagnosis:—*Drosera maanyaa-gooljoo* differs from all other known members of *Drosera* section *Arachnopus* by (contrasting characters in parentheses): 1) its long-petiolate leaves with petioles exceeding or equalling the lamina length, hence making up about 50% or more of the total leaf length (petiole absent or reaching at most ca. 15–20% of the total leaf length); 2) a patch at the petiole base of stalked, multicellular, non-carnivorous trichomes with translucent, drying pale yellowish-brown, transversely crescent-shaped heads (the only other two species of *D.* section *Arachnopus* with similar patches of relatively large non-carnivorous trichomes or modified tentacles at their petiole bases are *D. hartmeyerorum*, with moriform heads, and *D. barrettiorum* with elliptic to hyperbolic-paraboloid heads); and 3) the lack of any obvious indumentum on stems, petioles, and peduncles except for scattered, microscopic, sessile glands with flattened hemispherical, multicellular gland head (stalked glandular trichomes of various shapes and eglandular trichomes found on stems, petioles, and peduncles of all remaining members).

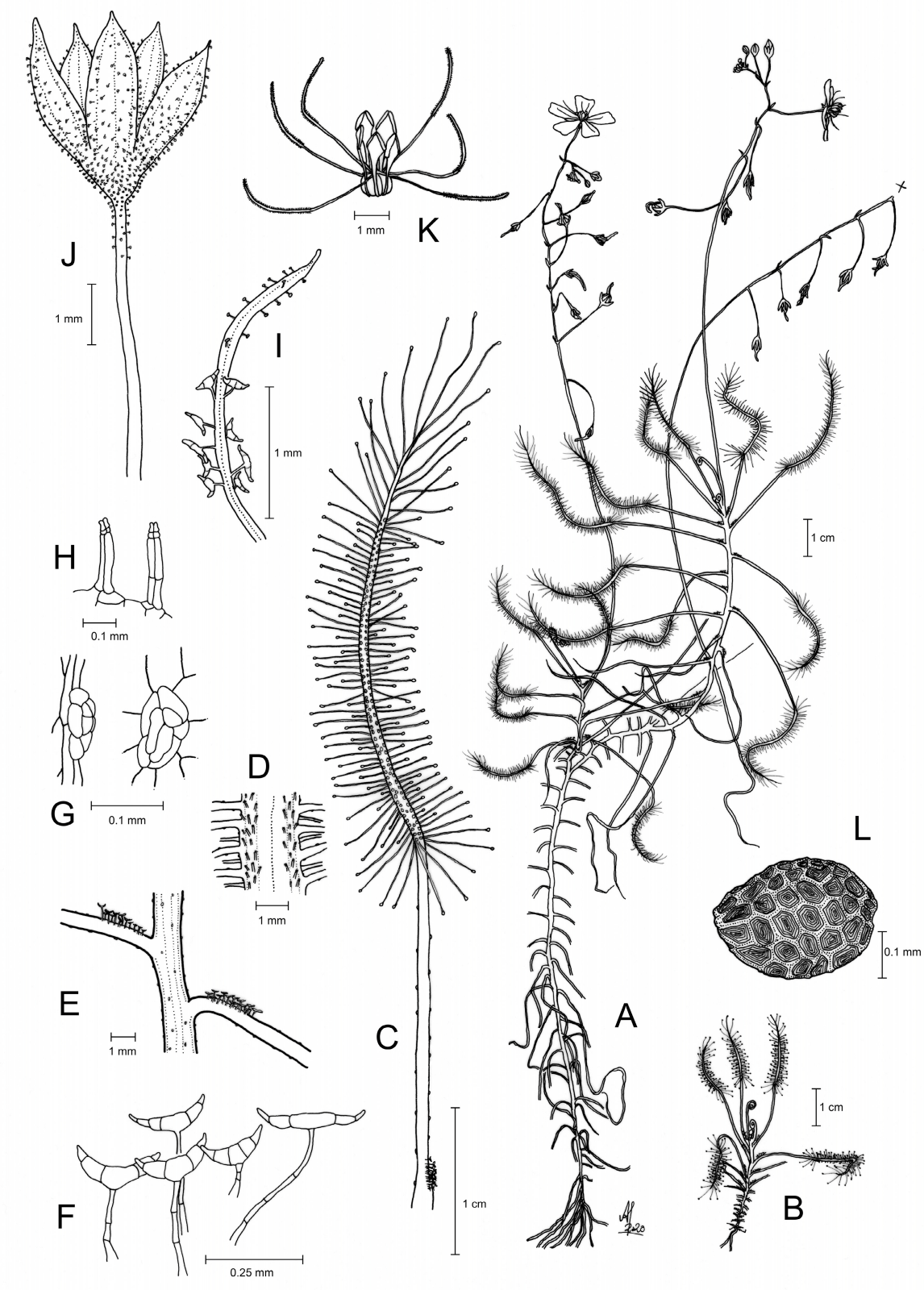

FIGURE 1. *Drosera maanyaa-gooljoo* A.Fleischm. & T.Krueger. **A.** Habit of flowering plant (not all senescent cauline leaves fully shown, flowers drawn from photographs of living plants). **B.** Habit of juvenile plant. **C.** Leaf, adaxial side. **D.** Lamina, indumentum of abaxial (lower) surface. **E.** Stem and petiole bases. **F.** Stalked transversely crescent-shaped trichomes from petiole base. **G.** Sessile glands from petiole (also present on stem and inflorescence), left lateral view, right top view. **H.** Biseriate double-tipped trichomes from lamina abaxial surface. **I.** Bract, abaxial view (stalked transversely crescent-shaped trichomes inserted on the adaxial surface) **J.** Pedicel and calyx with indumentum of capitate trichomes. **K.** Gynoecium and anthers. **L.** Seed. **A, C–F, I–L** from *A.J.M. Hopkins BA 0248* (holotype PERTH 05615631). **B** from *C. Done 847* (PERTH 03783715). **G, H** from *T. Krueger & A. Fleischmann 51* (PERTH 09546367). Drawing by A. Fleischmann.

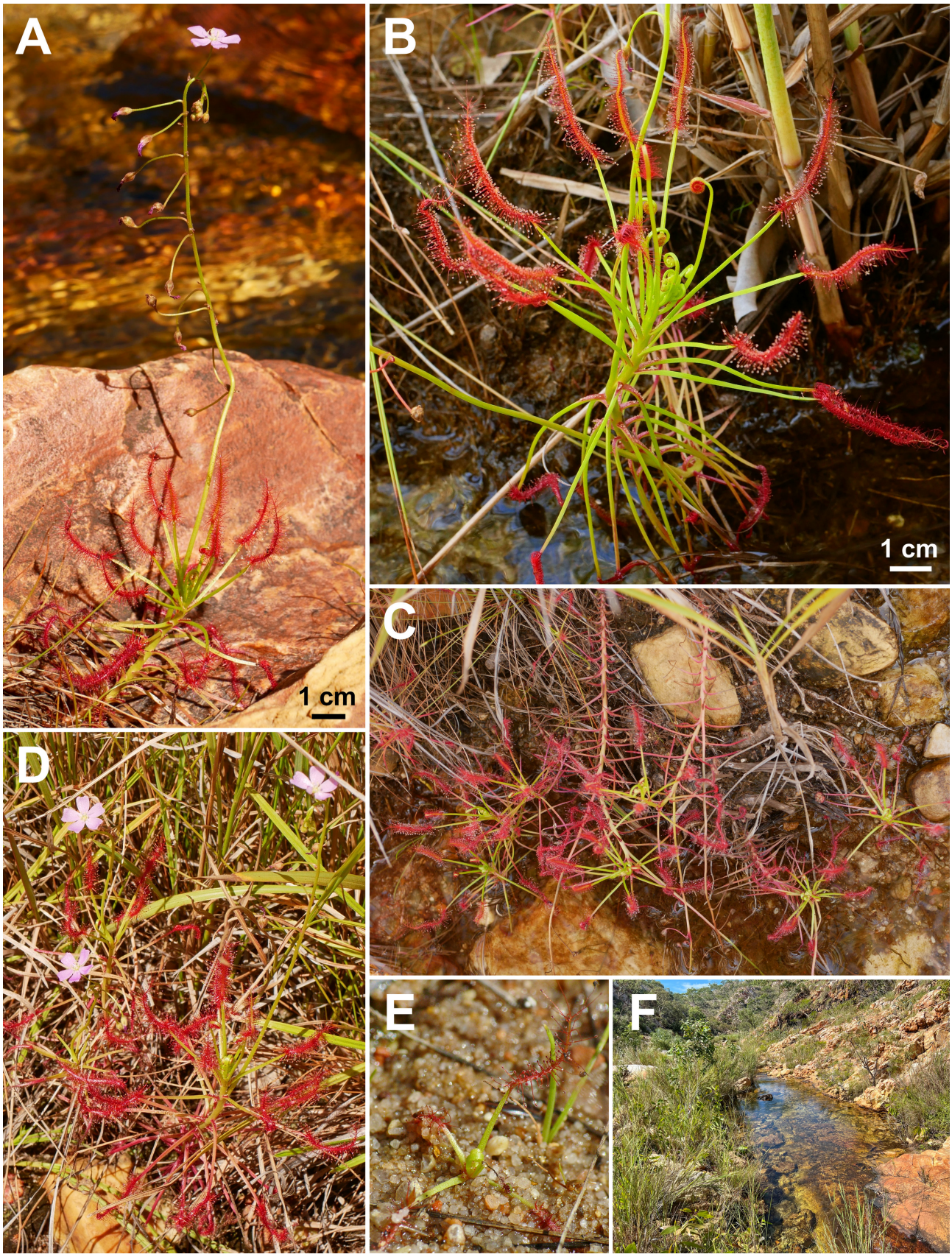

FIGURE 2. *Drosera maanyaa-gooljoo*. **A–D.** Habit of adult plants; note the long petioles and curved lamina shape. **E.** Habit of juvenile plant, already displaying the characteristic curved lamina shape. **F.** Habitat; plants grow within and adjacent to the creek. **A–D** by T. Krueger. **E–F** by A. Fleischmann. All from northern Yampi Peninsula, Western Australia, 09 June 2022.

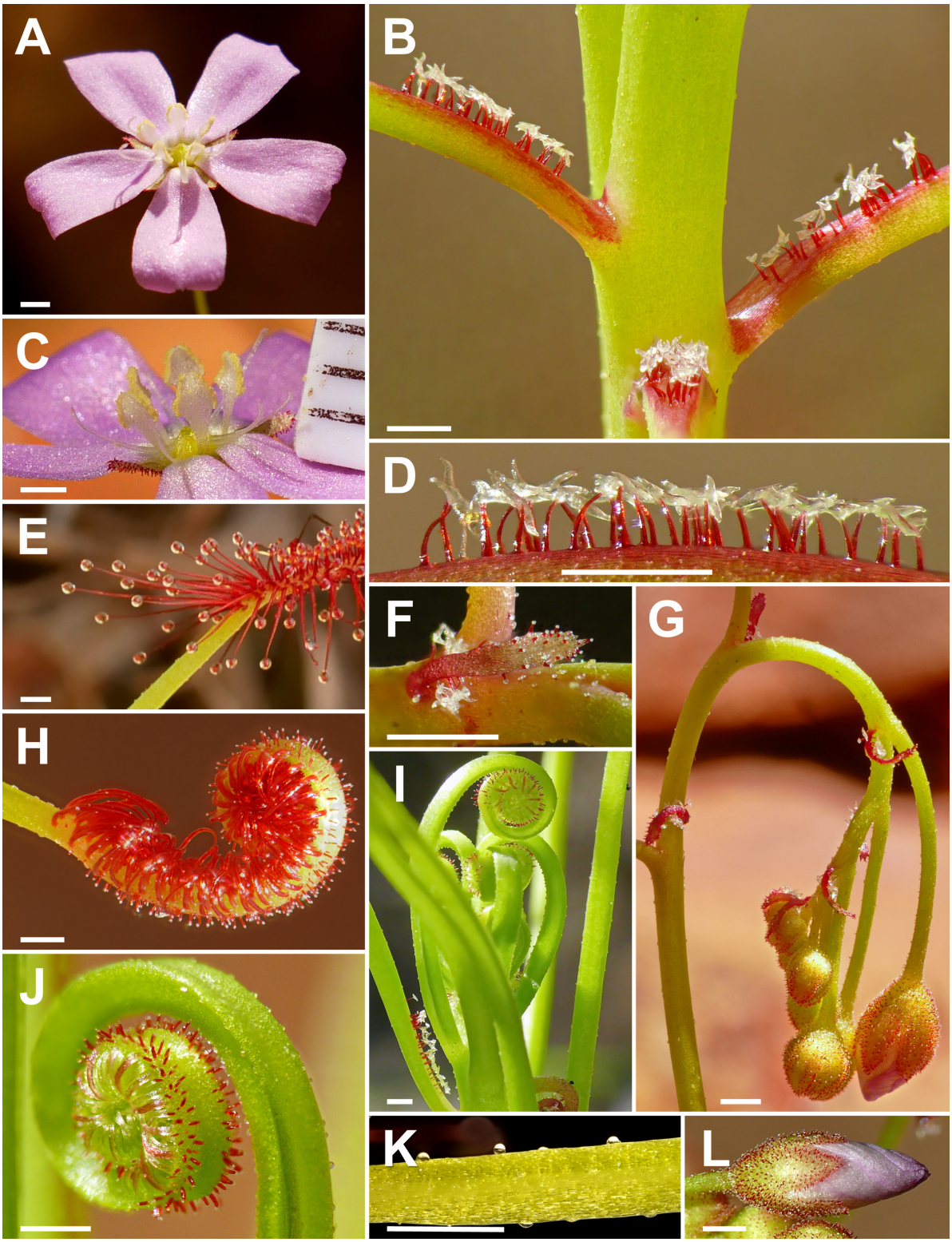

FIGURE 3. *Drosera maanyaa-gooljoo*. **A.** Flower. **B.** Stem and petiole bases, showing the stalked, transversely crescent-shaped trichomes. **C.** Stamens and gynoecium. **D.** Close-up of adaxial petiole surface showing the stalked transversely crescent-shaped trichomes; the trichomes towards the stem (right) are shorter-stalked than the distal ones (left). **E.** Lamina base, lateral view; note the angle between petiole and lamina and the very long carnivorous tentacles. **F.** Bract, abaxial view; note the stalked transversely crescent-shaped trichomes at the base. **G.** Inflorescence, upper part with bracts. **H.** Developing leaf; note the biseriate double-tipped trichomes on abaxial lamina surface. **I.** Stem apex with developing leaves and peduncle (right). **J.** Unfolding leaf with red-stalked biseriate double-tipped trichomes on abaxial lamina surface and the sessile glands on abaxial petiole surface. **K.** Close-up of petiole (lateral view) showing the secretive sessile glands. **L.** Calyx with indumentum of capitate trichomes. **A, C, E, G** by T. Krueger. **B, D, F, H–L** by A. Fleischmann. All from northern Yampi Peninsula, Western Australia, 09 June 2022. Scale bars = 1 mm.

Description:—Annual herb, 15–40 cm tall including inflorescence. *Roots* simple, short, slightly succulent, terete, poorly branched, one primary root and several lateral roots. *Stem* upright, self-supporting, leaning on nearby vegetation or becoming prostrate with age, up to at least 35 cm tall, simple or becoming branched from the middle in flowering individuals (four lateral branches, each floriferous, present in the holotype specimen), terete, 1.2–2.9 mm in diameter, yellowish green; stem, petioles and scape appearing glabrous by lacking any indumentum of stalked trichomes but covered with scattered sessile glands with flattened hemispherical, multicellular gland head (producing a hemispherical translucent secretion droplet in living individuals); internodes (0.1–)0.5–5.0(–8.0) mm long, much shorter in the lowermost 0.5–2.0 cm of stem. *Leaves* filiform, ca. 30–80 mm long in flowering-size specimens, straight but with an angle of ca. (10–)20–65(–80) degrees between petiole and lamina (angle often increasing with leaf age), vernation circinate; (10–)12–20(–26) active leaves present in flowering specimens; stipules absent; petiole linear, (14–)20–40(–45) mm long, 0.8–2.3 mm wide near base, gradually narrowing to 0.6–1.0 mm near lamina, green or yellowish green but adaxial base red (often also reddish near lamina), in section narrowly transversely triangular, 0.4–1.2 mm thick, abaxially convex, adaxial surface shallowly domed and with markedly raised midrib, senescent petioles persistent, patent; adaxial petiole surface glabrous except for a cluster of 20–38 stalked transversely crescent-shaped trichomes ("emergences") at the petiole base; trichome stalk terete, red or translucent, slightly tapering towards the tip, (0.1–)0.2–0.6(–0.7) mm long (trichomes with shorter stalk towards the petiole base, the distal ones with longer stalk), 0.03–0.07 mm wide at its base, uniseriate; trichome head transversely crescent-shaped, translucent (turning pale yellowish-brown in dried material), 0.2–0.5 mm long, 0.08–0.15 mm wide, 3–5(–7)-celled, distal cells horn-like with pointed tip; petiole surfaces additionally covered with scattered sessile glands of the same type as present on stem; lamina narrowly linear-lanceolate with long acuminate tip, curved, (14–)18–35 mm long (excluding tentacles), 0.6–1.5 mm at its greatest width (excluding tentacles), ca. 0.1 mm wide at the long-acuminate tip; lamina red (yellowish-green in freshly unfolded leaves, turning red with age), its adaxial surface covered with stalked, carnivorous, secretive capitate glands (tentacles), tentacle stalk red, gland head red, all tentacles with radially symmetric gland head, tentacles at lamina apex, base and lateral margins exceedingly long-stalked (longest towards tip and base of the lamina), 5–11 mm long, short-stalked tentacles on the inner lamina surface 0.1–0.3 mm long; lamina abaxial surface covered with two rows of biseriate double-tipped trichomes (type 5 *pro parte* s*ensu* Länger *et al.* 1995) ca. 0.1–0.3 mm long, with reddish stalk and translucent or yellowish tips. *Inflorescences* 1–4(7), each forming a many-flowered, bracteate scorpioid cyme ([13–]16–27 flowers per cyme); peduncle, rhachis and pedicels appearing glabrous, calyx and sepals glandular; scape 20–40 cm tall including peduncle, green to yellowish green; peduncle terete, 0.8–1.6 mm in diameter, ascending vertically (± parallel to the stem axis even in old inflorescences), glabrous except for the sessile glands; fruiting pedicels spaced by 2–18(–37) mm; pedicels terete, base often concaulescent, (7–)9–18(–23) mm long at anthesis and in fruit, 0.3–0.6 mm in diameter, covered with scattered sessile glands of the same type as on stem and petioles and additionally with few stalked capitate trichomes towards the calyx (corresponding to those found on sepals); pedicels straight at anthesis becoming more or less arcuated or reflexed in fruit (arcuated horizontal/slightly downwards from rhachis, then sharply curving upright near the seed capsule; pedicels of unfertilised flowers pendulous). *Bracts* very narrowly oblanceolate, lateral margins entire, apex obtuse or acute and irregularly crenate, (1.2–)1.5–2.7 mm long, 0.2–0.5 mm wide, adaxial surface glabrous but basally with 5–15 stalked transversely crescent-shaped trichomes (corresponding to those found at the petiole base; lowermost bracts on a scape occasionally lacking such trichomes), abaxial surface glabrous in the lower 2/3, upper 1/3 covered with capitate trichomes (corresponding to those found on the sepals); every pedicel except that of the lowermost flower subtended by a bract and bracts persistent in fruit. *Flowers* 11–15 mm in diameter. *Sepals* 5, lanceolate to elliptic, margins entire, with acute (rarely obtuse or acuminate) apex, 2.1–3.5 mm long, (0.5–)0.8–1.3 mm at their greatest width, abaxial surface densely covered with stalked capitate trichomes ca. 0.1–0.2 mm long with red (or rarely translucent), uniseriate stalk and translucent-white, spherical gland head ca. 0.05 mm in diameter; sepals basally adnate to form a flat-campanulate calyx. *Petals* 5, obovate to broadly obovate (sometimes cuneate), apical margin truncate or emarginate and finely crenulate, 5.2–7.5 mm long, 3.0–4.2 mm wide at their widest point, pink or pale pink; petal aestivation imbricate, contorted. *Stamens* 5, alternipetal, oblanceolate to spathulate, 2.0–2.5 mm long, 0.7–1.0 mm wide; filaments very narrowly cuneate, 1.1–1.5 mm long, 0.2–0.3 mm wide, white; anthers bithecate, 0.8–1.2 mm long, connective dilated, triangular, 0.6–0.8 mm wide, white, thecae pale yellow; pollen pale yellow. *Ovary* 3-carpellate, fused, subglobose, shallowly 3-lobate in outline, 1.0–1.2 mm in diameter, glabrous, yellowish green. *Styles* 3, each basally divided into 2 entire style-arms; style-arms flagelliform, terete, 1.7–2.2 mm long (excluding stigmatic portion), 0.08–0.12 mm in diameter, translucent white, glabrous, positioned horizontally or arcuately curved upwards, graduating into stigmatic part; stigmas 0.9–1.8 mm long, 0.08–0.20 mm in diameter, translucent white, papilliate.

Seeds numerous, 300–380(–410) µm long, 250–280 µm wide, broadly ellipsoidal, testa black with slightly iridescent shine of the periclinal walls, testa surface isodiametrically reticulate, with anticlines thin and pale brown, periclinal walls tabular, microscopically rugose.

Etymology:—The specific epithet "*maanyaa-gooljoo*" was selected by the Dambimangari and Mayala Traditional Owners. The word "*maanyaa*" means centipede in the Worrora language, and is the name given to this species by the Dambimangari Traditional Owners. It references the lamina of the species, which is covered with exceptionally long tentacles at the lamina base and tip, thus resembling certain long-legged centipedes (e.g., of Scutigeridae). The second word of the epithet, "*gooljoo*", was selected by the Mayala Traditional Owners and means grass in the Bardi language. Both words of the epithet stand independently, and thus the use of a hyphen is permitted in this case according to ICN rule 60.11 (Turland *et al.* 2018; Turland pers. comm. 2023).

FIGURE 4. Holotype of *Drosera maanyaa-gooljoo* (PERTH 05615631). **A.** Overview of specimen. **B.** Habit. **C.** Lamina apex, showing exceptionally long tentacles. **D.** Close-up of adaxial petiole surface showing the stalked transversely crescent-shaped trichomes (these trichomes are pale yellowish-brown in dried material); note that trichomes are shorter-stalked towards the stem (left) than the distal ones (right). **E.** Bract with stalked transversely crescent-shaped trichomes at base (the trichomes are translucent pale yellowish-brown in herbarium material). **A** kindly provided by the Department of Biodiversity, Conservation and Attractions, Western Australian Herbarium (PERTH). **B–E** by T. Krueger, published with permission from PERTH.

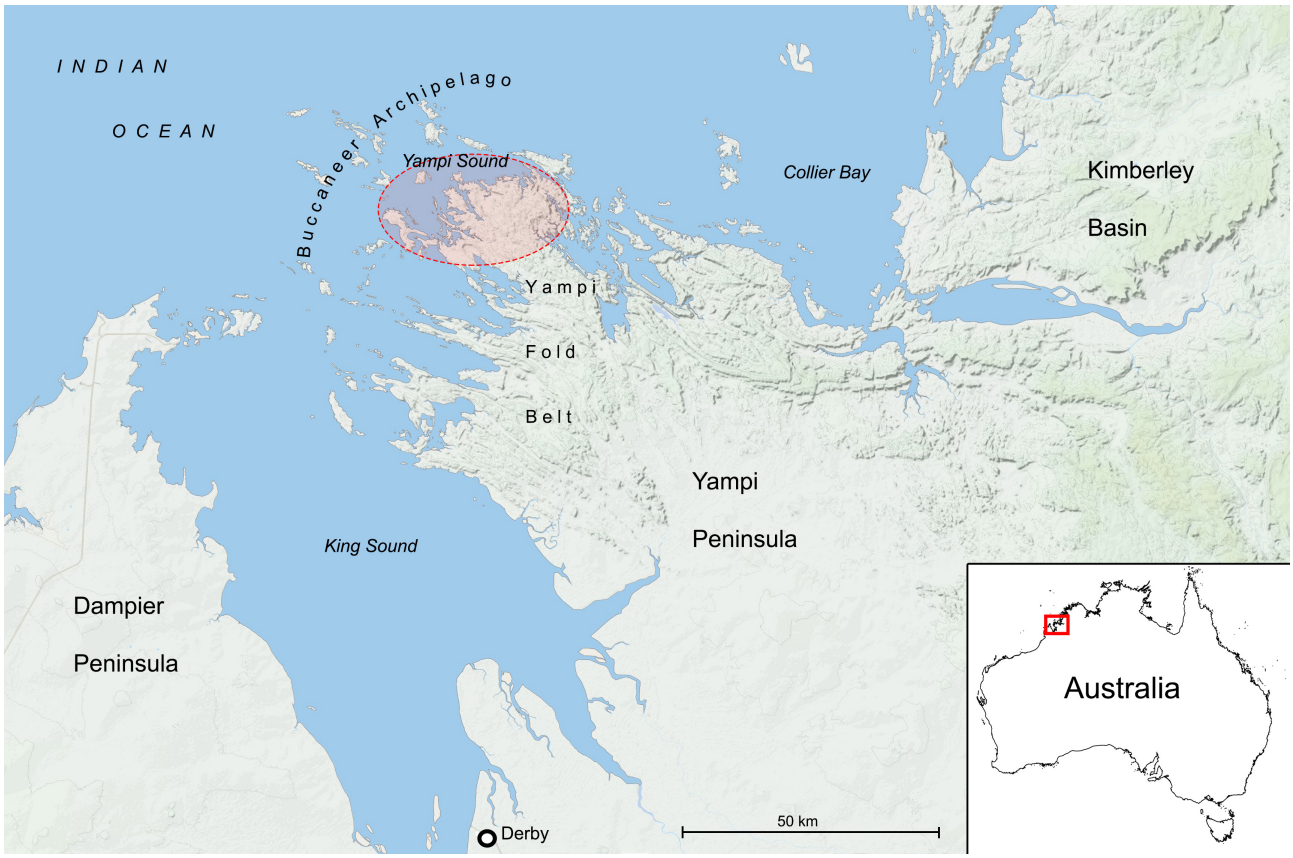

FIGURE 5. Map illustrating the geographical range of occurrence of *Drosera maanyaa-gooljoo* in the Kimberley region, Western Australia. Exact collection localities not shown for conservation purposes. Geographical names following Tyler & Griffin (1992). Source of background relief map and country boundaries map: ©OpenStreetMap (data is available under the Open Database License; https://www.openstreetmap.org/copyright [accessed 17 Jun 2020]). Illustration by A. Fleischmann.

Taxonomic notes:—*Drosera maanyaa-gooljoo* clearly belongs in *D.* section *Arachnopus*, as is evident from its overall habit of narrowly linear-lanceolate, exstipulate leaves spaced along elongated stems, as well as from floral morphology with six entire, long, flagelliform style-arms (Planchon 1848, Lowrie 2014) and the presence of biseriate double-tipped trichomes. However, the exact affinity to known species of that section is puzzling based on morphology alone. *Drosera maanyaa-gooljoo* is unique in several characters, such as (1) the long-petiolate leaves with an angulate transition between petiole and lamina, (2) very long marginal tentacles not only present towards the leaf tip (as realised in all other members of the affinity) but also present at the lamina base, and (3) lacking any obvious indumentum of stalked trichomes on stems, petioles and peduncles, which are instead covered by (4) unique, sessile glands with multicellular secretive gland head. These four characters are not paralleled in any other known species of *D.* section *Arachnopus*.

The presence of clusters of distinctive, multicellular, translucent- or yellow-headed "emergences" at the petiole base (and at the bases of the bracts along the scape) is also found in *Drosera barrettiorum* and *D. hartmeyerorum*, yet each species exhibits a very different, unique "emergence" type (Fig. 6; Table 1). While the "emergences" in *D. barrettiorum* and *D. hartmeyerorum* are clearly homologous and represent modified tentacles (their stalks being vascularised), the stalked transversely crescent-shaped trichomes of *D. maanyaa-gooljoo* are non-vascularised. While much larger in size, these trichomes of *D. maanyaa-gooljoo* also share morphological similarities with the T- or Y-shaped trichomes found in *D. serpens* Planchon (1848: 204–205) (Fig. 6) and *D. finlaysoniana* Wallich (1831: n. 3752) ex Arnott in Hooker (1837: 314) (Krueger & Fleischmann 2021). Seed shape, size, and ornamentation of *D. maanyaa-gooljoo* is similar to *D. barrettiorum* and *D. hartmeyerorum*: these three taxa share very small black seeds with regular isodiametric testa reticulation and thin, pale brown, shallowly raised anticlinal walls (Fig. 7), while all remaining species of *D.* section *Arachnopus* exhibit a different seed morphology and seed size (Susandarini *et al.* 2002, Barrett & Lowrie 2013, Lowrie 2014, Krueger & Fleischmann 2021; Fig. 7). However, only *D. barrettiorum* has an iridescent shine of the testa periclinal walls like *D. maanyaa-gooljoo*, while the seeds of *D. hartmeyerorum* are dull black (Fig. 7). *Drosera aurantiaca* Lowrie (2014: 1268) also produces seeds with isodiametrically reticulate testa with iridescent

shine of the periclinal walls, yet it has slightly larger seeds than the three above-mentioned species (Fig. 7), and lacks any clusters of conspicuous trichomes or modified tentacles on its leaves.

TABLE 1. Morphological comparison of the three *Drosera* species producing conspicuous clusters of translucent- or yellow-headed "emergences" at the base of petioles and bracts. These "emergences" are not homologous in the three species, they represent trichomes in *D. maanyaa-gooljoo* but modified tentacles in *D. barrettiorum* and *D. hartmeyerorum*. Data for *Drosera barrettiorum* and *D. hartmeyerorum* from Lowrie (2014) and Schlauer (2001), complemented by observations from the field and of herbarium specimens in PERTH.

	Drosera maanyaa-gooljoo	***Drosera barrettiorum***	***Drosera hartmeyerorum***
Shape of "emergences" at petiole base	stalked transversely crescent-shaped ("croissant-shaped")	flat elliptic hyperbolic-paraboloid ("potato-crisp-shaped")	globose, moriform ("mulberry- or blackberry-shaped")
Size of "emergences" at petiole base (including stalk, total length × width)	(0.1–)0.2–0.6(–0.7) mm × 0.2–0.5 mm	0.5–0.7 mm × 0.3–0.5 mm	0.5–1.0 mm × 0.3–0.4 mm
Colour of "emergences" at petiole base (heads)	translucent (drying pale yellowish-brown)	yellow	yellow
Number of "emergences" at petiole base	20–38	4–45 (but continued as multiple much smaller "potato-crisp emergences" along the entire midrib)	(4–)5–15
Number of "emergences" on bract	5–15	2–5	1–2
Stem indumentum	(sub)glabrous	short-stalked, translucent white or red, capitate trichomes	short-stalked, translucent white or red, capitate trichomes
Petiole length	(14–)20–40(–45) mm	absent (< 1 mm)	absent (< 1 mm)
Petiole indumentum	(sub)glabrous	N/A	N/A
Scape indumentum	(sub)glabrous	short-stalked, translucent white or red, capitate trichomes	short-stalked, translucent white or red, capitate trichomes, occasionally subglabrous

However, *Drosera maanyaa-gooljoo* displays very long petioles (the longest and most distinctly developed in any member of *D*. section *Arachnopus*) that exceed or equal the lamina length in juvenile as well as in flowering-size plants. This is strongly contrasting *D. barrettiorum* and *D. hartmeyerorum* whose petioles are absent (i.e., the tentacle-bearing part of the leaf reaches all the way to the stem; Fig. 6; Lowrie 2014). In this respect, *D. maanyaa-gooljoo* more closely resembles well-petiolate species like *D. serpens*. Interestingly, seedlings and juvenile plantlets of all species of *D*. section *Arachnopus* have petiolate leaves, even those which develop sessile laminae when reaching flowering size, e.g., *D. finlaysoniana* (A. Fleischmann & T. Krueger pers. obs.). Hence, petiolate leaves can most likely be considered symplesiomorphic in the section. However, in all previously known species with petiolate leaves, the petiole length only reaches a small fraction of the total leaf length (ca. 5–20%); the petiole in *D. maanyaa-gooljoo* exceeds or equals lamina length and thus comprises ≥ 50% of the total leaf length.

Another unique feature of *Drosera maanyaa-gooljoo* is the lack of any indumentum of stalked trichomes on stems, petioles, and scapes which thus appear fully glabrous. Only the sepals, bracts, and the uppermost part of the pedicels bear stalked capitate trichomes (Fig. 3F,G,L). This strongly contrasts with all remaining members of *D.* section *Arachnopus*, which have stems, petioles, and scapes covered with various types of indumentum of eglandular and glandular trichomes, often with species-specific patterns and trichome types (Barrett & Lowrie 2013, Lowrie 2014, Lowrie *et al.* 2017, Schlauer *et al.* 2018, Krueger & Fleischmann 2021). The only other species from that affinity which likewise has an entirely glabrous peduncle is *D. glabriscapa* Lowrie (2014: 1271). However, *D. glabriscapa* bears a dense indumentum of short hispid, conical, eglandular trichomes on its stems and petioles (Lowrie 2014).

Based on common seed characteristics, we hypothesise a close affinity of the four species *Drosera aurantiaca*, *D. barrettiorum*, *D. hartmeyerorum* and *D. maanyaa-gooljoo*. Additionally, all but *D. aurantiaca* are further united by the presence of conspicuous clusters of translucent- or yellow-headed "emergences" with species-specific shape of the gland head at the base of their petioles and bracts. A close phylogenetic affinity of *D. aurantiaca*, *D. barrettiorum* and *D. hartmeyerorum* is further corroborated by their common phytochemistry (presence of methyljuglone as the sole naphthoquinone compound; Schlauer *et al.* 2018, Schlauer & Fleischmann 2022).

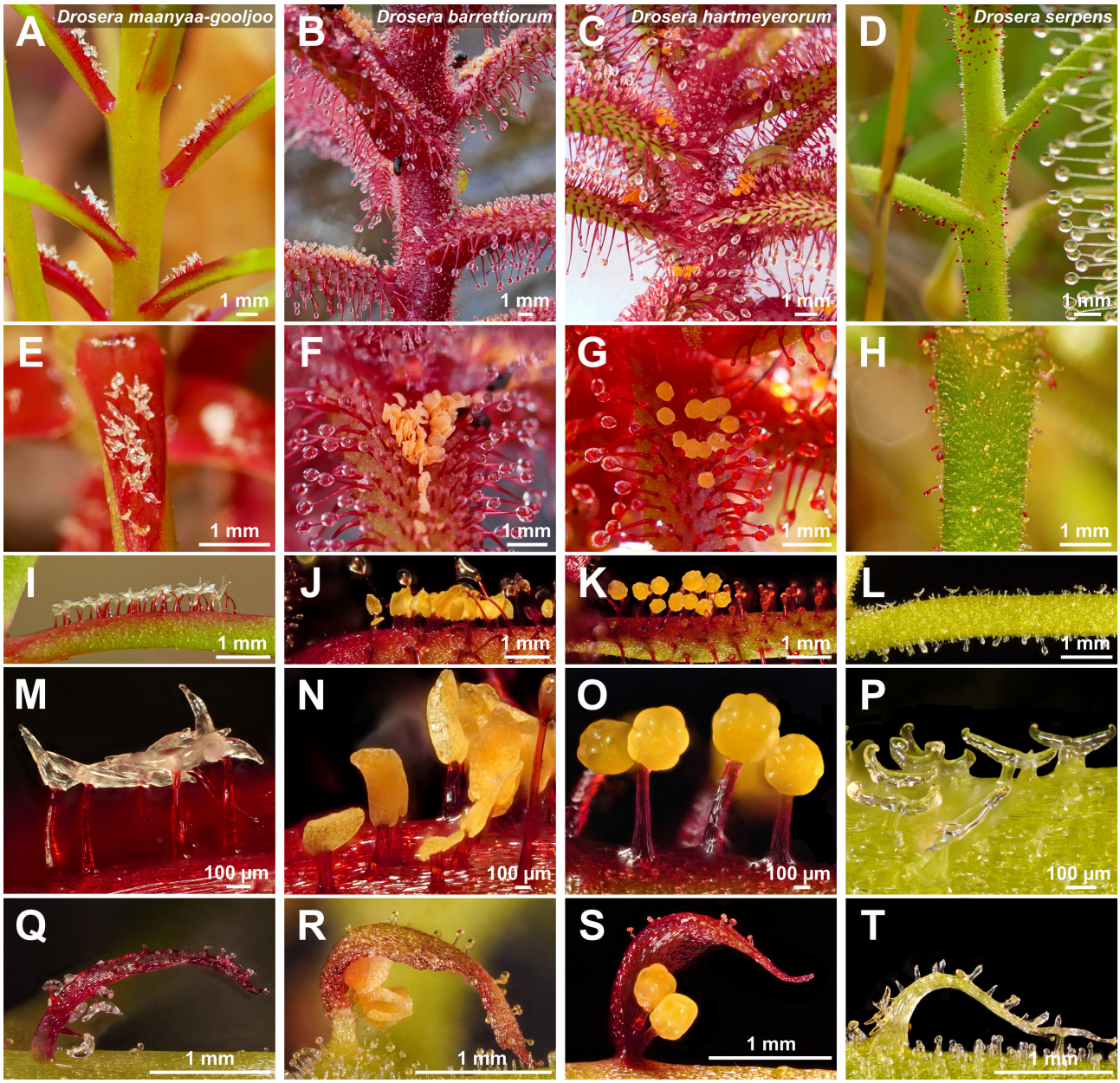

FIGURE 6. Comparison of petiole base "emergences" of *Drosera maanyaa-gooljoo* (left column), *D. barrettiorum* (centre-left column), *D. hartmeyerorum* (centre-right column), and *D. serpens* (right column). These "emergences" are not homologous in the four species, they represent trichomes in *D. maanyaa-gooljoo* and *D. serpens* but modified tentacles in *D. barrettiorum* and *D. hartmeyerorum*. **A–D.** Stem and petioles. The carnivorous tentacles of *D. barrettiorum* and *D. hartmeyerorum* reach all the way to the stem, slightly hiding their yellow "emergences" when viewed from side. **E–H.** Top view of petiole base. The "emergences" are clustered in a triangular pattern in *D. maanyaa-gooljoo*, *D. barrettiorum* and *D. hartmeyerorum* but not in *D. serpens s.l.* **I–L.** Lateral view of petiole base. **M–P.** Close-up of petiole base "emergences", showing the very different "emergence" head structures among the four species. **Q–T.** Bracts showing the same "emergences" as on petiole base in all four species. **A, E, I, M, Q** photographed *in-situ* at northern Yampi Peninsula, Western Australia, 09 June 2022. **B, F** photographed *in-situ* at Theda Station, Western Australia, 05 June 2022. **C.** photographed *in-situ* near Broome, Western Australia, 19 July 2020. **D, H** photographed *in-situ* near Katherine, Northern Territory, 12 March 2023. **G** photographed *in-situ* at Miluwindi Conservation Park, Western Australia, 10 April 2022. **J, N, R** from cultivated plants originating from Western Australia. **K, O, S** from cultivated material originating from near Kununurra, Western Australia. **L, P, T** from cultivated material originating from Japan. **A–H.** by T. Krueger. **I–T** by A. Fleischmann.

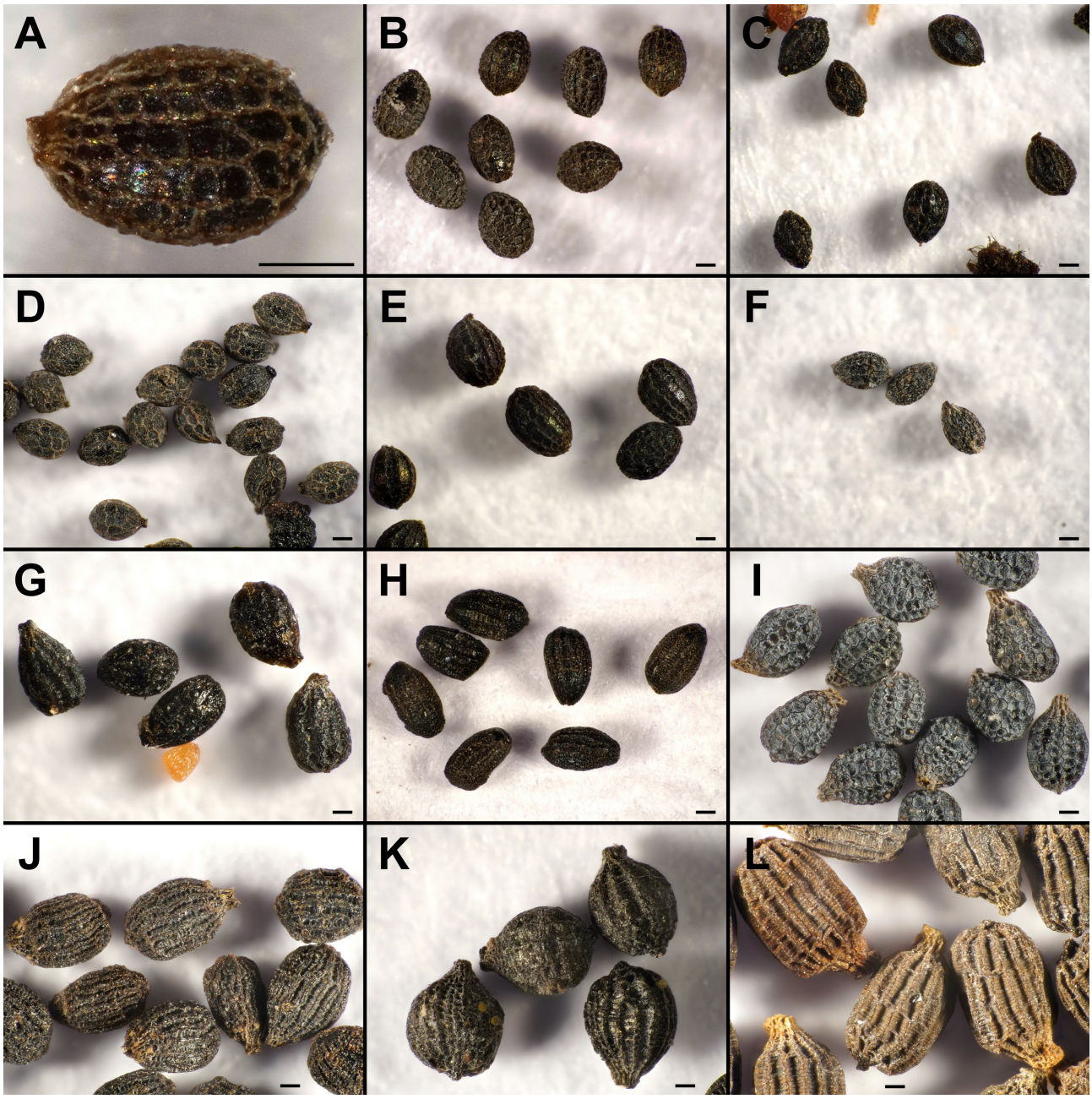

FIGURE 7. Seeds of *Drosera* section *Arachnopus*. **A, B.** *Drosera maanyaa-gooljoo* (from *A.J.M. Hopkins BA 0248*). **C.** *D. barrettiorum* (Kimberley, Western Australia). **D.** *D. hartmeyerorum* (Kununurra, Kimberley, Western Australia). **E.** *D. aurantiaca* (Kimberley, Western Australia). **F.** *D. nana* (Darwin, Northern Territory). **G.** *D. aquatica* (Darwin, Northern Territory). **H.** *D. glabriscapa* (Kimberley, Western Australia, from *Dunlop 5389*, PERTH 00657417). **I.** *D. indica* (Trang, Thailand). **J.** *D. fragrans* (Darwin, Northern Territory). **K.** *D. serpens* (Cairns, Queensland). **L.** *D. cucullata* (Kimberley, Western Australia). Scale bars = 1 mm, all images except A are at the same scale. All photographs by A. Fleischmann.

Distribution and habitat:—Endemic to the Kimberley Region of tropical northern Western Australia. *Drosera maanyaa-gooljoo* is known from only two localities ca. 20 km apart: one from an island in the Buccaneer Archipelago, and one from the northern Yampi Peninsula on the Australian mainland. Thus, the species is only known from areas located adjacent to the Yampi Sound of the Indian Ocean (Fig. 5). The species is most likely endemic to the northern Yampi Peninsula and the Buccaneer Archipelago, which are geologically and edaphically distinct from the neighbouring Dampier Peninsula and the Kimberley Plateau (Tyler & Griffin 1992, Wilson 2013).

At the northern Yampi Peninsula locality, *Drosera maanyaa-gooljoo* occurs in wet areas alongside and within the bed of a shallow sandstone creek in shallow sandy soil over sandstone. Accompanying plants denoted include *Grevillea* spp. (Proteaceae Juss.), *Corymbia polycarpa* (F.Muell.) K.D.Hill & L.A.S.Johnson, *Eucalyptus brachyandra*

F.Muell., *Melaleuca* sp. (Myrtaceae Juss.), *Templetonia hookeri* Benth. (Fabaceae Lindl.), *Owenia vernicosa* F.Muell. (Meliaceae Juss.), and *Distichostemon hispidulus* Baill. (Sapindaceae Juss.). The habitat of the type population in the Buccaneer Archipelago is assumed to be very similar, described on the specimen label as "within 10 m of [a] stream". At the northern Yampi Peninsula site, *D. maanyaa-gooljoo* was observed growing syntopically with the carnivorous plants *Drosera burmannii* Vahl (1794: 50) and *Utricularia caerulea* L. (Lentibulariaceae Rich.).

Other species of *Drosera* section *Arachnopus* recorded from Yampi Peninsula include *D. barrettiorum*, *D. margaritacea* Krueger & Fleischmann (2021: 57), and *D. serpens s.l.* (Western Australian Herbarium 1998+, Lowrie 2001 [all taxa from *D.* section *Arachnopus* were denoted as "*D. indica*" at the time], Krueger & Fleischmann 2021). Of these, only *D. barrettiorum* is known to inhabit similar periodically flooded habitats near or within sandstone creek beds.

Ecology and phenology:—Annual, like all species from *Drosera* section *Arachnopus*. Flowering has been recorded in June and July, but likely extends from May until at least September. The species likely germinates following declining water levels in its creek habitat towards the end of the wet season in March or April, with individuals probably continuing to grow and flower until either the habitat dries out or until the onset of seasonal wet season flooding (typically in December). In June 2022, adult plants in flower and fruit were observed alongside newly-germinated seedlings (Fig. 2); thus, this species may continuously regrow from seed if persistent wet to moist soil conditions occur. Similar observations have been made for other members of *D.* section *Arachnopus*, including *D. indica* (Ruan 1991) and *D. finlaysoniana* (Krueger & Fleischmann 2021).

Conservation status:—Listed as Priority One (poorly-known species) under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998+), under the phrase-name "*Drosera* sp. Yampi Peninsula (A.J.M. Hopkins BA 0248)". Data deficient (DD) following IUCN (2012), however, under possible category of threat because of small population sizes, and in need of further survey. *Drosera maanyaa-gooljoo* is currently only known from two localities, separated by ca. 20 km, both situated on exclusive possession Native Title lands belonging to Aboriginal peoples. Permission must be given by the Traditional Owners before the area can be accessed, and an Aboriginal Affairs Planning Authority (AAPA) permit must additionally be obtained for travel to the northern Yampi Peninsula. The type locality in the Buccaneer Archipelago is situated in the Mayala Traditional Owners' exclusive Native Title determination. The second locality in the northern Yampi Peninsula is located within the Wotjalum Part III Aboriginal Reserve and part of the Dambimangari Indigenous Protected Area (IPA) which is managed by the Dambimangari Traditional Owners and Dambimangari Rangers. Only the latter population has been recently confirmed, with ca. 300 plants observed by the authors in June 2022. Population size at the type locality is unknown. It is noteworthy that recent floristic surveys of the area failed to locate this distinctive taxon (Keighery *et al.* 1995, Barrett *et al.* 2001, Lowrie 2001, Lyons *et al.* 2014). Furthermore, a close examination of other *Drosera* specimens from the area in PERTH, as well as at national and international herbaria, did not identify any additional collections of this taxon. No populations occur on land managed by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA), and *Drosera maanyaa-gooljoo* (under the phrase-name "*Drosera* sp. Yampi Peninsula") has thus been listed as a possibly threatened species in urgent need of further survey effort (Priority One: Poorly-known species; Western Australian Herbarium 1998+). Potential threats to this species may include the projected increase in the magnitude of extreme flooding events (Moise *et al.* 2015) given the species' preferred creek bed habitat, but also inappropriate fire regimes. Illegal collection may pose an additional threat in the future given the small reported population size and the unfortunate propensity for such carnivorous plant species to be rapidly targeted by poachers to provide plants for the horticultural market (Cross *et al.* 2020).

Additional specimens examined:—*Drosera maanyaa-gooljoo* (paratypes):—AUSTRALIA. Western Australia: [northern Yampi Peninsula, precise locality withheld for conservation purposes], 02 August 1994, *C. Done 847* (PERTH 03783715!) [three juvenile individuals, sterile]; northern Yampi Peninsula [precise locality withheld for conservation purposes], 09 June 2022, *T. Krueger & A. Fleischmann 51* (PERTH 09546367!) [one fertile individual].

Discussion

Gland and indumentum patterns

The translucent, stalked, transversely crescent-shaped trichomes at the petiole bases of *Drosera maanyaa-gooljoo* are distinct from other *Drosera*, despite bearing superficial resemblance to the T- or Y-shaped trichomes (type 14 glands *sensu* Länger *et al.* 1995) on the petioles and leaf margins of *D. finlaysoniana* and *D. serpens s.l.* (Lowrie

2014, Schlauer *et al.* 2018, Krueger & Fleischmann 2021). On *D. finlaysoniana* and *D. serpens s.l.* these trichomes are smaller (0.05–0.40 mm; Krueger & Fleischmann 2021) and are usually distributed along the whole adaxial leaf surface and margins. In contrast, the translucent or yellow "emergences" of *D. maanyaa-gooljoo*, *D. barrettiorum* and *D. hartmeyerorum* are much larger (Table 1), and occur in conspicuous clusters near the adaxial petiole base (Fig. 6). However, the yellow "emergences" of *D. barrettiorum* and *D. hartmeyerorum* are very likely not homologous to those of *D. maanyaa-gooljoo*, as despite being clustered at the same area of the leaf base they are of different anatomy. As first pointed out by Diels (1906), the term "emergence" is useless for the morphological description of *Drosera* leaf outgrowths, of which two anatomically different ones can be found in the genus: tentacles (vascularised, multicellular secretory leaf emergences) and trichomes (non-vascularised epidermal outgrowths; Fenner 1904, Lloyd 1942). The "emergences" of *D. barrettiorum* and *D. hartmeyerorum* are vascularised (A. Fleischmann pers. obs.) and therefore represent modified, functionally divergent, non-secretory tentacles in the understanding of the authors of the present work. In contrast, the stalked transversely crescent-shaped trichomes of *D. maanyaa-gooljoo* (and all other trichomes found on stems, scapes, and leaves of *D.* section *Arachnopus*), constitute non-vascularised epidermal outgrowths (Fenner 1904, Diels 1906, Lloyd 1942, Länger *et al.* 1995).

Drosera maanyaa-gooljoo possesses a greater number (ca. 2–5 times as many) and distinctly different arrangement of "emergences" at the petiole base and bracts compared with its two putative relatives, *D. barrettiorum* and *D. hartmeyerorum* (Table 1, Fig. 6). The trichomes of *D. maanyaa-gooljoo* increase in size from the basal towards the distal part of the petiole, while the modified tentacles ("emergences") of *D. barrettiorum* and *D. hartmeyerorum* decrease or remain constant in size (Fig. 6). In *D. barrettiorum*, smaller modified tentacles ("emergences") are also present along the adaxial midrib, scattered among the tentacles (T. Krueger & A. Fleischmann pers. obs.; Fig. 6F).

The function of these conspicuous clusters of translucent or yellow "emergences" on the petiole base remains unknown. It has been hypothesised that they serve as optical prey attractants in *Drosera hartmeyerorum* (Hartmeyer & Hartmeyer 2010), or as osmophores for olfactory prey attraction in *D. barrettiorum* (Lowrie 2014). However, a comparative study of prey spectra from different species of *D.* section *Arachnopus* did not observe any significant difference in prey composition or amount between sympatric species with and without such clusters of yellow "emergences" (Krueger *et al.* 2020). For *D. maanyaa-gooljoo*, it seems rather unlikely that the stalked, transversely crescent-shaped trichomes play an obvious role in prey attraction, as they are situated at the petiole base, well-separated from the sticky tentacles of the lamina by ca. 1.0–3.5 cm.

Drosera maanyaa-gooljoo possesses among the highest number of active carnivorous leaves of species in *D.* section *Arachnopus* (ca. 10–30 in flowering individuals), similar only to *D. aurantiaca* and *D. barrettiorum* which can produce up to ca. 30 active leaves. As the number of prey captured appears to be a function of leaf length in *D.* section *Arachnopus* (Krueger *et al.* 2020), probably reflective of total trap surface area, greater numbers of active trapping leaves per individual may facilitate greater rates of prey capture.

The long-stalked marginal tentacles present at the tip and base of the lamina in *Drosera maanyaa-gooljoo* are the longest of all species in *D.* section *Arachnopus*. Indeed, within the genus they are equalled in size only by the marginal tentacles of *D. binata* Labillardière (1805: 78, t. 105) from *D*. section *Phycopsis* Planchon (1848: 93) and some species of "pygmy sundews" from *D*. section *Bryastrum* Planchon (1848: 94) (A. Fleischmann pers. obs.). *Drosera* sections *Phycopsis* and *Bryastrum* are of *D*. subgenus *Ergaleium* (Candolle 1824: 319) Drude (1888: 271) (following the classification of Fleischmann *et al.* 2018), and are thus only distantly related to *D.* section *Arachnopus* of *D.* subgenus *Drosera* (Rivadavia *et al.* 2003, Fleischmann *et al.* 2018).

Breeding mode

The breeding mode of *Drosera maanyaa-gooljoo*, at least at the type population, can be reliably inferred from the holotype material (*A.J.M. Hopkins BA 0248*; Fig. 4): only 11 out of 94 fruiting pedicels present along all cymes of the holotype specimen (ca. 12%) had developed into a fertile capsule at the time it was collected. The remainder bear post-anthesis calyces with small, aborted capsules resulting from lack of or unsuccessful pollination. This is not due to different stages of capsule maturation, as pedicels carrying undeveloped capsules can be found even at the base of some flower scapes. Almost all *Drosera* produce scorpioid cymes (inflorescences on which the flowers open in acropetal sequence, i.e., from the bottom to the top of the inflorescence), and thus the position along the infructescence corresponds with ontogenetic age or maturation of the seed capsule. Undeveloped capsules therefore likely result from lack of or unsuccessful pollination (or post-fertilisation damage). In contrast, the plants from the northern Yampi peninsula population showed more than 50% fruit (A. Fleischmann & T. Krueger pers. obs.). This indicates that *D. maanyaa-gooljoo* apparently is not autogamous.

Importance of herbarium research

At first sight, it might be considered astonishing that such a distinctive new species possessing unique morphology remained largely unnoticed in the herbarium for nearly 40 years after its initial collection. However, this fits the general trend for new species discoveries and descriptions. Bebber *et al.* (2010) extrapolated that only 16% of all newly-described plant taxa described from 1970 to 2010 were based on collections less than five years old, while more than 80% were derived from "historic" collections. Of those, a quarter were "discovered" in herbaria at least 50 years after they were first collected, and it is estimated that over half of all plant species still to be described are already represented in herbaria (Bebber *et al.* 2010) – just waiting to be uncovered by a taxonomic specialist. This highlights the importance of careful herbarium revisions for alpha taxonomy and biodiversity research, in addition to collection trips and fieldwork.

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