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CONTENTS

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Correction to:

"Modification of †Rica Erickson's common name sectionalisation of Stylidiaceae and some photographic examples of Triggerplants belonging to these sections" article by Allen Lowrie which appeared in ITPS Journal Vol. 1.

I mistakenly placed a photo of *Stylidium drummondianum* in the **Creeping Triggerplants** photograph section. *Stylidium drummondianum* should have been placed in the **Rosetted Triggerplants** photographic section. A photo of *Stylidium repens* was meant to be in the **Creeping Triggerplants** photographic section and *Stylidium drummondianum* was meant to replace the plant photo of *Stylidium ciliatum*. These corrections have now been made below.

Allen Lowrie

3: Creeping Triggerplants

Stilt-rooted plants that asexually reproduce additional plants on above ground stolon-like runners, often forming spreading plant mats.


Stylidium repens


Stylidium neglectum


Stylidium bulbiferum

5: Rosetted Triggerplants

Compact leafy basal rosettes adpressed to the soil surface or positioned above the soil on stilt roots.


Stylidium drummondianum


Stylidium ciliatum


Stylidium pulviniforme

An overview of the Australian *Levenhookia* (Stylidiaceae) complex, including a new species (*L. murfetii*) and observations on the triggering methods employed for pollination and outcrossing.

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Abstract

Lowrie, A. & Conran, J.G. An overview of the Australian *Levenhookia* (Stylidiaceae) complex, including a new species (*L. murfetii*) and observations on the triggering methods employed for pollination and outcrossing. *International Triggerplant Society* Vol 1. No. 2: 3-29 (2011). An overview of the Australian *Levenhookia* complex is presented. A new species of *Levenhookia* R. Br. (Stylidiaceae), *Levenhookia murfetii* Lowrie & Conran from south-west Western Australia is described and illustrated. Descriptions and illustrations of *L. chippendalei* F.L. Erickson & J. H. Willis (1966); *L. dubia* Sond. (1845); *L. leptantha* Benth. (1868); *L. octomaculata* Erickson & Willis (1956); *L. pauciflora* Benth. (1837); *L. preissii* (Sond.) F. Muell. (1864); *L. pulcherrima* Carlquist (1969); *L. pusilla* R. Br. (1810); *L. sonderi* (F. Muell.) F. Muell. (1858); and *L. stipitata* (Benth.) F. Muell. ex Benth (1864); are provided for comparison and to complete this review of *Levenhookia* R. Br. (Stylidiaceae)..

Key words *Levenhookia murfetii*, *Levenhookia* complex overview, Stylidiaceae, Australia, Robert Brown, Antony van Leeuwenhoek.

Introduction

The Stylidiaceae are a family of five largely Southern Hemisphere genera, four of which occur in Australia, along with the majority of the ~240 species in the family (Carolin 2007). However, only one genus, *Levenhookia* (styleworts), is endemic to Australia and this paper presents a taxonomic review of this genus which, with the addition of the new species, *Levenhookia murfetii* described herein, now comprises eleven species. *Levenhookia* and its sister genus *Stylidium* (triggerplants) differ from other Stylidiaceae by the possession of highly specialized pollination mechanisms (Wagstaff & Wege 2002). All *Levenhookia* species are characterized by having a sensitive, hood-like, mobile labellum (immobile in triggerplants); sheathing the immobile gynostemium column (gynostemium column mobile in triggerplants). However, whereas Triggerplants can re-set their triggered gynostemium columns continuously over a number of days, or until pollinated, the mobile labellum of *Levenhookia* can only be triggered once (Erickson 1958, Carlquist 1969). Although *Levenhookia* species are officially given the common name of *Styleworts*, both genera are also commonly referred to as triggerplants (Erickson 1958).

Pollination mechanisms

Stylidium species can trigger and reset their mobile gynostemium throughout their pollen and stigma phases until they are pollinated. In contrast, *Levenhookia* species have a sensitive labellum that can be triggered only once (Erickson 1958, Carolin 2007). Whereas *Stylidium* species are strictly regulated for outcrossing, *Levenhookia* species can perform outcrossing as well as self-pollination, with Carlquist (1969) speculating that evolution in the genus has proceeded from outcrossing to

increasingly self-pollinating. For example, in species such as *Levenhookia pusilla* the flowers are commonly arranged in rather compact clusters and pollen can be thrown from a triggered flower across to one or more flowers within the same cluster.

The arrangement of the *Levenhookia* pollination apparatus consists of a gynostemium (an erect column) that arises from a superior (forward of the corolla) nectary bucket-like sheath arrangement in the centre of a four-lobed corolla (flower). The pollen filled anthers are situated at the top of the gynostemium below which a forward curving finger-like stigma is attached. Above the anthers is another undeveloped finger-like stigma which will grow out and mature once the labellum has been triggered. The labellum (a modified fifth petal) is arranged in the shape of an ancient Roman legionary's helmet, with a slit down the front and complete with an apical triggering appendage, placed over the summit of the developing gynostemium (see **Fig. 48** for comparative labellum illustrations between all species except *L. sonderi*).

As the gynostemium grows upwards into the helmet-like labellum it is restrained by the helmet to the point that the gynostemium column is curved backward under force towards the labellum's attachment side. Once the gynostemium is fully mature it is now cocked and ready to be triggered. When a pollinator straddles the corolla to sip sweet nectar from the base of the nectary sheath, it invariably touches the sensitive knob-like appendage on the top of the labellum helmet. This causes the front of the helmet to open along a central split line like two outward swinging flaps, thus releasing the curved gynostemium at a rapid speed and ending in an erect stance sudden stop jolt within the nectary bucket sheath. When the triggered gynostemium comes to a sudden stop, the momentum generated throws the pollen with force from its anthers onto the lower parts of the pollinator. Once the labellum has been triggered it has served its purpose as it triggers once only. The labellum when triggered, bends all the way backwards, but soon repositions itself in an erect position alongside the gynostemium. Once this triggering action is carried out the gynostemium which is now straight is also now taller than the erect labellum, as when it was restrained by the labellum it was in its bent mode and thus shorter in overall height. The non-restrained gynostemium now grows out its second finger-like stigma but this time positioned above the spent anthers.

The *Levenhookia* pollen flinging action can be likened to the school boy prank, where a chewed paper wad missile is catapulted onto the classroom ceiling, using a bent wooden ruler held under tension (Erickson 1958); when released, the missile is launched to splatter on the ceiling by the stored energy and the ruler quickly returns to its straight position. The same principle is seen in *Levenhookia*, where the missile is a pollen mass and the target is the pollinator.

Nevertheless, it is still not known exactly what happens in *Levenhookia* pollination in relation to outcrossing and self-pollination. Before being triggered, a mature stigma often sticks outwards from the gynostemium, free of the labellum, but it is not known if this stigma is receptive or able to receive pollen from a triggered flower from the opposite side of a cluster (geitonogamy). Similarly, can individual flowers self-pollinate (autogamy) and if so, in how many species? Is the upper stigma that develops after the flower is triggered arranged purely to pick up pollen from a pollinator's belly, enforcing outcrossing, or do *Levenhookia* fruits contain a mixture of self-pollinated and outcrossing-derived seeds? Given the known complexity of pollination strategies in its evolutionary sister genus *Stylidium*, where protandry seems to be linked to a perennial habit (Carolin 2007) the reproductive biology of *Levenhookia* remains an area for ongoing study, particularly for species that appear to mimic some of *Stylidium* species with which they grow (Erickson 1958; Carlquist 1969).

Historical background

The botanist Robert Brown (**Fig. 1**) named *Levenhookia* in honour of Leeuwenhoek the spelling of whose name he simplified**.** Brown named *L. pusilla* in his *Prodromus* (1810) from plants that he and the botanical artist Ferdinand Bauer collected at King George Sound [Albany], south-west Western Australia between 8 December 1801 to 5 January 1802, 27 years before European colonisation and later illustrated (Bauer 1813). Brown may have thought of Leeuwenhoek when he and Bauer needed magnification to examine this tiny plant to see the details for Brown's Latin description (**Fig. 2**) and Bauer's plate (**Fig. 3**). The common name for *Levenhookia*, styleworts, was given to the genus by the late Rica Erickson (Erickson 1958).

Fig. 1: Robert Brown in his later years: born Montrose, Scotland 21 Dec. 1773. Died 10 June 1858 London.http://commons.wikimedia.org/wiki/Robert_Brown_(botanist)

Robert Brown (1773–1858)

LEVENHOOKIA.

Calyx 5-partitus, bilabiatus, *Corolla* limbo 5-partito, irregulari; quintâ laciniâ (Labello) dissimili, fornicatâ, columnâ longiore, cum tubo articulatâ, mobili. *Columna* erecta, infrà tubi lateri (ubi labellum) adnata. *Antheræ* lobis uno super alterum divaricatis. *Stigmata* 2, capillaria. *Capsula* unilocularis.

Herba *pusilla, glabra, facie et statura fere* Radiolæ. Folia *alte*

STYLIDEÆ. Levenhookia. 573

alterna, petiolata, ramorum summa conferta, floribus fasciculatis interstinctis.

Obs. In memoriam dixi Antonii Van Leeuwenhoek, micrographi celeberrimi, in cujus operibus plures et perpulchræ observationes de plantarum structurâ exstant.

Obs. Mobilitas articuli labelli irritabilitati columnæ Stylidii analoga est, et ad eandem finem, nempe organorum sexualium sub anthesi conservationem, tendit. In Levenhookiâ enim labellum, in flore expanso deflexum, causâ irritante admotâ cum impetu erigitur, et cochleariformi suâ laminâ columnam erectam immobilem tegit.

L. pusilla. (M.) *v. v.*

Fig. 2: Robert Brown's Latin description of *Levenhookia pusilla* from his *Prodromus Florae Novae Hollandiae,* published in 1810. (M.) = King George Sound; *v.v.(vidi vivam)* = the Latin abbreviation for "I have seen it in the living state".

Fig 3: Bauer's botanical illustration of *Levenhookia pusilla* (bottom illustration) with *Stylidium calcaratum* (upper left) and *Stylidium pygmaeum* (upper right), all collected at King George Sound, Western Australia. (Source: Ferdinand Bauer *Levenhookia pusilla* 1806–13 National Gallery of Australia, Canberra, purchased 2004)

Antony van Leeuwenhoek (1632–1723) (**Fig. 5**) was a cloth merchant of Delft [The Netherlands]. At this time small "glass beads" were in common use by Dutch cloth merchants to examine the weave of textiles. Only Leeuwenhoek thought of examining objects other than textiles with these spherical lenses. Being a naturalist and his desire to see more than with the naked eye led him to produce the finest and clearest lenses of the time. His hobby was making magnifying glasses. Each lens was only a few millimetres across. To which he fixed his subjects on a fine needle carried in a brass chassis with

adjustable thumb screws and threaded rods to position the specimen to be examined to the correct focal length for each lens (**Fig. 4**). Each new specimen remained set up and focused for later study. His collection of minute objects grew to many hundreds of mounted specimens each attached to its own individually manufactured Antony van Leeuwenhoek chassis and lens.

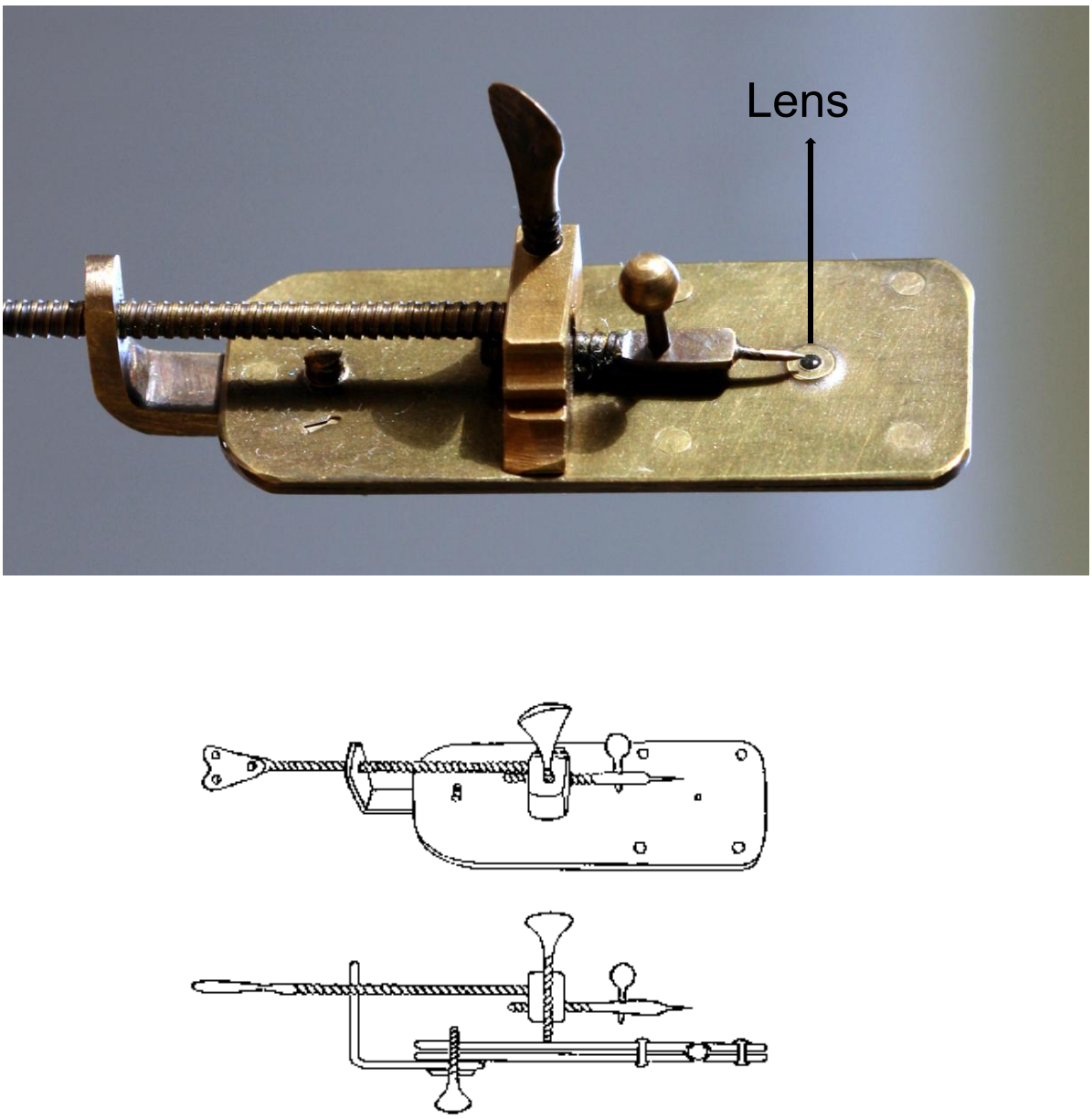

Fig. 4: Microscope made by Antony van Leeuwenhoek in the 17 century
(Source: Fun Science Gallery: http://www.funsci.com/fun3_en/usph/usph.htm#1)

Fig. 5: Portrait of Antonie van Leeuwenhoek (1632-1723) by Jan Verkolje (Source: Wikipedia http://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek)

Leeuwenhoek reported his microscopic findings to the Royal Society in England where many members were sceptical of his findings. Leeuwenhoek apparently would allow only scientific visitors to view his microscopic objects through his mounted lenses provided he held them.
To the day he died at ninety years of age, he never revealed how he made his lenses nor would he sell his lenses that were thousands of times clearer than the best lens of the time. Leeuwenhoek was the first to observe in a drop of canal water what he called "Wretched beasties one thousand times smaller than the eye of a large louse" that we now know to be microbes. The sceptics of the Royal Society in England would not believe that micro-organisms were present in canal water. Leeuwenhoek's observations were flawed according to these cynics.

The Society eventually commissioned two members to build the best microscope that they could at the time. With this newly commissioned microscope examination of a brew of the best pepper-water [microbe soup] was made. At a memorable meeting in 1677, members of the society peering through the new microscope could now see with their own eyes that Leeuwenhoek had not falsified his findings. They too could see [although not as clearly as through a Leeuwenhoek lens] and verify that Leeuwenhoek was correct, there were indeed "little animals" present in the water. Leeuwenhoek was vindicated and made a Fellow of the Royal Society. The sceptics of the Society on the other hand were shown to be wrong.

The world is indebted to the work of Leeuwenhoek who is credited as the first person to introduce scientists to the microscopic world. Without instruments of magnification, Science today as yesterday cannot function and move forward with ground breaking discoveries.

Taxonomy

Levenhookia R. Br.

1: *Levenhookia chippendalei* F.L. Erickson & J.H. Willis (1966). (**Fig. 6, 7 & 8**)

2: *Levenhookia dubia* Sond. (1845). (**Fig. 9, 10, 11 & 12**)

3: *Levenhookia leptantha* Benth. (1868). (**Fig. 13, 14 & 15**)

4: *Levenhookia murfetii* Lowrie & Conran (2011) (**Fig. Fig. 16, 17, 18 & 19**)

5: *Levenhookia octomaculata* F.L. Erickson & J.H. Willis (1956). (Fig. **20, 21, 22 & 23**)

6: *Levenhookia pauciflora* Benth. (1837). (**Fig. 24, 25, 26, 27 & 28**)

7: *Levenhookia preissii* (Sond.) F. Muell. (1864). (**Fig. 29, 30, 31 & 32**)

8: *Levenhookia pulcherrima* Carlquist (1969). (**Fig. 33, 34, 35 & 36**)

9: *Levenhookia pusilla* R. Br. (1810). (**Fig. 37, 38, 39& 40**)

10: *Levenhookia sonderi* (F. Muell.) F. Muell, (1858). (**41, 42 & 43**)

11: *Levenhookia stipitata* (Benth.) F. Muell. ex Benth. (1864). (**Fig. 44, 45, 46 & 47**)

1: **Levenhookia chippendalei** F.L. Erickson & J.H. Willis (**Fig. 6, 7 & 8**). Chippendale's Stylewort

A pink-flowered, annual herb branching from its base to form a small bush in older specimens, 7–15 cm tall, 7–20 cm diam. leaves oblanceolate, glandular; branching main stems, auxiliary branches, floral bracts, pedicels, hypanthium and sepals glandular. At the axil of the secondary branches and pedicels a pulvinus (a dome-like mound) is present. When the pedicels are in fruit they lower themselves downwards and the pulvinus supporting the fruit capsules appear to be larger in size. Perhaps these pulvini are a moisture storage organ, as this species flowers during the dry season. *Levenhookia chippendalei* is currently known only from arid areas growing in red sandy soils from the Pilbara in Western Australia across to Tennant Creek in the Northern Territory in central Australia. It is often found growing with *Stylidium desertorum* Carlquist.

Fig. 6: (left) *Levenhookia chippendalei* near Tennant Creek, flower close-up from Denzel Murfet photo print; **Fig. 7**: (right) Herbarium specimen voucher for photo *D. E. Murfet* 1809, 10 Jul. 1993 housed in *Herbarium Lowrieanum*. **Fig. 8**: (bottom) *Levenhookia chippendalei,* Carnarvon Ranges south-east of Newman, Western Australia. Digital photo from a slide film transparency by Mary Hancock of Nowra, N.S.W.

2: **Levenhookia dubia** Sond. (**Fig. 9, 10, 11 & 12**). Hairy Stylewort

A very small, erect annual herb, bearing small white flowers each with a white labellum throughout south-west Western Australia (**Fig. 9**); specimens from South Australia are taller plants and often have auxiliary branches arising from the base in the older specimens (**Fig. 10**); 2–3.5 cm tall, leaves elliptic, margins and abaxial (underside of leaf) surface glandular, adaxial (upper side of leaf) surface glabrous (smooth); floral bracts, pedicels, hypanthium and sepals glandular. *Levenhookia dubia* is currently known from summer dry areas of south-west Western Australia growing in clayey loam soils on the aprons of granite outcrops as well as on watersheds that lead down to creek lines in Wandoo forest. It is a common species at granite outcrops scattered throughout the wheatbelt region of south-west Western Australia. Also occurs in N.S.W, Vic., S.A. & Tas.

Fig. 9: (left) *Levenhookia dubia* Pinnacle Rock, Western Australia *A. Lowrie* 347, 29 Sep. 1991 (left); **Fig. 10**: (right) *L. dubia* Bangham Conservation Park *D. E. Murfet* 1670 & *R. L. Taplin*, 23 Nov. 1992 (right); Herbarium vouchers both housed in *Herbarium Lowrieanum.*

Fig. 11: *Levenhookia dubia* Bruce Rock Western Australia growing with *Centrolepis strigosa*

Fig. 12: A colony of *Levenhookia dubia* Bruce Rock Western Australia

3: **Levenhookia leptantha** Benth. (**Fig. 13, 14 & 15**). Trumpet Stylewort

A pink-flowered, long nectary-tubed, erect annual herb of the wheatbelt and further inland into the goldfields regions throughout south-west Western Australia (Fig. 15). 3–10 cm tall (Figs. 13 & 14), leaves fleshy, elliptic to lanceolate, margins, abaxial and adaxial surface glandular. Erect stem(s); floral bracts, pedicels, hypanthium and sepals glandular. *Levenhookia lepthantha* is common in summer dry areas of south-west Western Australia growing in sandy soils mixed with clayey loam amongst scrub thickets near the aprons of granite outcrops.

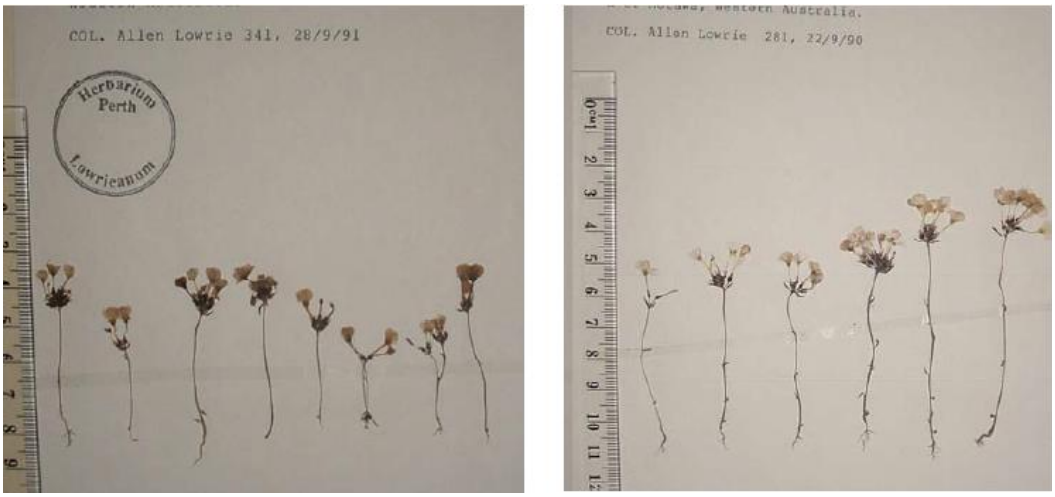

Fig.13: (left) *Levenhookia leptantha* Warriedar, Western Australia *A. Lowrie* 341, 28 Sep. 1991 (left); **Fig. 14**: (right) *L. leptantha* north of Mullewa *A. Lowrie* 281, 22 Sep. 1990 (right); Herbarium specimen voucher for both housed in *Herbarium Lowrieanum*.

It is also a common species in the arid gold and nickel greenbelt zone from Southern Cross in the north to Ravensthorpe in the south scattered throughout the gimlet forest. An interesting species in that continues to flower on its fleshy upper stem moisture reserves even when the soils are bone dry and the plants stem close to the soil surface has withered and died. Specimens placed in the herbarium press remain alive for two or three weeks, even when crushed.

Fig. 15: *Levenhookia leptantha* Morine Rock, Western Australia

4: **Levenhookia murfetii** Lowrie & Conran *sp. nov.* Murfet's Stylewort

Lowrie, A. & Conran, J.G. International Triggerplant Society Journal Vol 1. No. 2: 3-29 (2011); (**Fig. 16, 17, 18 & 19**)

Levenhookia pusilla R. Br. affinis sed caulis simplex, erectus; inflorescentia umbellulata, pauciflora; corollae lobae patens; labellum ad apicem appendiculatum glanduliferum.

Typus: Brand Highway near Marchagee Rd turn-off, Coomallo, Western Australia, 30° 13' 47" S, 115° 25' 35.1" E, 11 Sep. 2007, *A. Lowrie 3553 & J.G. Conran* (*holo:* PERTH; *iso:* MEL, *Herb. Lowrieanum*).

Annual herb, with reddish erect solitary stems 2–4 cm tall. Cauline *leaves* when present obovate, 3–4 mm long, 1.2–1.3 mm wide, and flabellate 2–2.5 mm long, 3–3.5 mm wide, terminal leaves lanceolate, 3–4 mm long, 1.2–1.3 mm wide, adaxial surface green, abaxial surface reddish maroon. *Inflorescence* umbellate, 1–8 (mostly 2–3)-flowered, pedicels reddish 1.5–1.7 mm long. *Hypanthium* reddish ± globose at anthesis, 1–1.3 diam., glandular. *Sepals* 4, green, subulate, free to base, 1.2–1.5 mm long, glabrous. *Corolla* very pale pink to darker pink with reddish throat marks at the petal bases and a greenish throat, with vertically-paired petal lobes; petals spreading and producing an open flower face, anterior lobes narrowly obovate, falcate, *c.* 2.5 mm long, *c.* 1.4 mm wide; posterior lobes obovate, *c.* 3.2 mm long, *c.* 1.6 mm wide. *Labellum* reddish maroon, hood-like, shaped like Roman legionary's helmet, *c.* 0.45 mm long, *c.* 0.45 mm wide, apical appendage *c.* 0.2 mm long, glandular. *Gynostemium* column *c.* 0.9 mm long; pollen pale yellow; stigmas 2, very short when juvenile (at time pollen is present), later growing longer, conical, curved with stigmatic tips. Figs. 16, 17, 18 & 19

Other specimens examined. WESTERN AUSTRALIA: Pithara just north on Great Northern Highway, 30° 23' 44" S, 116° 39' 55" E, 6 Sep. 1997, *A. Lowrie* 1841 *& D.E. Murfet* (PERTH, *Herb. Lowrieanum*); Wubin 1.4 km south on Great Northern Highway, 30° 07' 06" S, 116° 38' 36" E, 6 Sep. 1997, *A. Lowrie* 1843 *& D.E. Murfet* (PERTH, *Herb. Lowrieanum*); Wubin 10 km north east on Great Northern Highway, 30° 03' 24" S, 116° 41' 36" E, 6 Sep. 1997, *A. Lowrie* 1847 *& D.E. Murfet*

(PERTH, *Herb. Lowrieanum*); Wubin north-east of Town Water Catchment on Great Northern Highway, 30° 05' 59" S, 116° 38' 10" E, 6 Sep. 1997, *A. Lowrie* 1848 *& D.E. Murfet* (PERTH, *Herb. Lowrieanum*); Dookanooka Road, 29° 38' 41" S, 115° 39' 32" E, 6 Sep. 1997, *A. Lowrie* 1857 *& D.E. Murfet* (PERTH, *Herb. Lowrieanum*).

Distribution. A widespread species to the north and north-east of Perth in south-west Western Australia.

Habitat. grows in a variety of habitats: yellow sands; in deep silica sand; laterite pebbles and silica sand soils of the northern heathlands.

Flowering period. August–September. Carries over to the next growing season as seed only.

Conservation status. Common and currently not under threat.

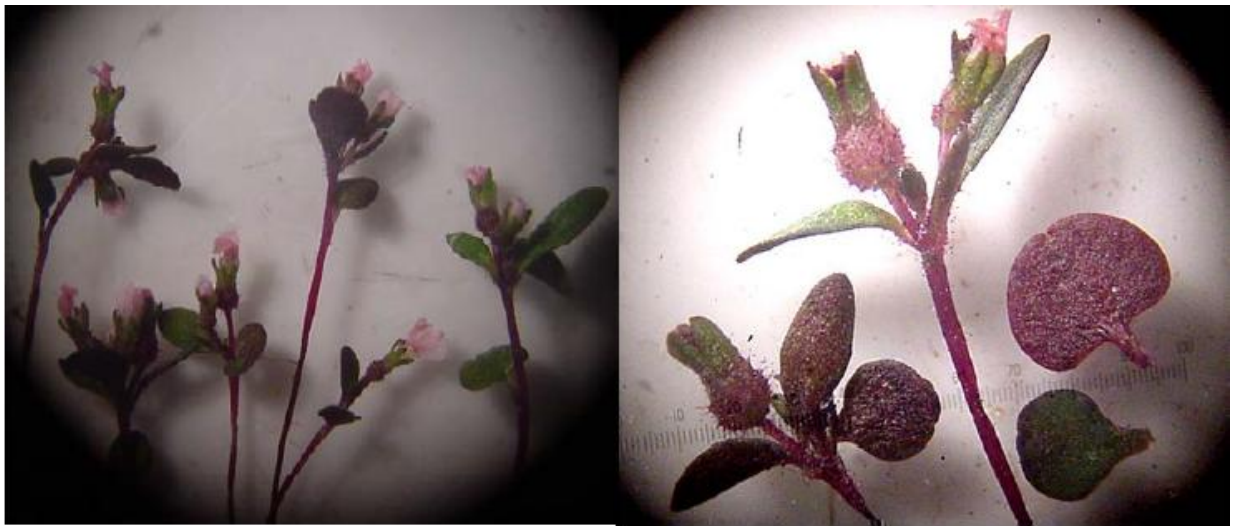

Fig. 16: (left) *Levenhookia murfetii*, Western Australia *A. Lowrie* 3553*& J.G. Conrna*, 11 Sep. 2007 (left) and **Fig. 17**: close-up photograph (right) Herbarium specimen vouchers housed in PERTH, Mel & *Herbarium Lowrieanum.*

Etymology. The epithet, *murfetii* is named in honour of AL's good friend and colleague Denzel E. Murfet, Port Elliot, South Australia, who has done much to increase our knowledge of the Australian flora with his Australia-wide botanical collections for the Adelaide Herbarium, South Australia. It is with pleasure that we name this plant that he discovered and brought to our attention after him. AL is also honoured to have undertaken numerous expeditions with Denzel to some of the wildest and botanically unexplored parts of Australia in pursuit of plants.

Affinities. The closest relative to *Levenhookia murfetii* is considered to be *L. pusilla* R. Br. However, *L. murfetii* is easily distinguished from *L. pusilla,* whose contrasting characters are given in (parenthesis) by its: solitary erect stem (stem branching even in short stature mature plants); inflorescence umbel a solitary cluster of pedicels without peduncle (2 or more umbels each arising on its own peduncle); petals spreading and producing an open faced flower (petals of corolla compact at the base with the petal apices slightly spread); labellum apical appendage bearing glands (apical labellum appendage glabrous).

Fig. 18: (top) *Levenhookia murfetii* Mount Lesueur, Western Australia

Fig. 19: (bottom) *Levenhookia murfetii* Mount Lesueur, Western Australia

5: **Levenhookia octomaculata** F.L.Erickson & J.H.Willis (**Fig. 20, 21, 22 & 23**). Eight-spotted Stylewort

A pink-flowered, annual herb with 8 reddish marks surrounding the nectary tube, presented as a pair on each of the four petals bases, often branching high above its base in older specimens, 4.5–9 cm tall. leaves oblanceolate, a little glandular near the base otherwise glabrous; branching main stems, auxiliary branches, floral bracts and pedicels sparsely glandular; hypanthium densely glandular; sepals glandular at the very base otherwise glabrous. *Levenhookia octomaculata* is currently known over a wide growing range in south-west Western Australia from the Jurien Bay area in the north to Perth in the south and east of Perth. It has been found growing near *L. stipitata* in the Bullsbrook area.

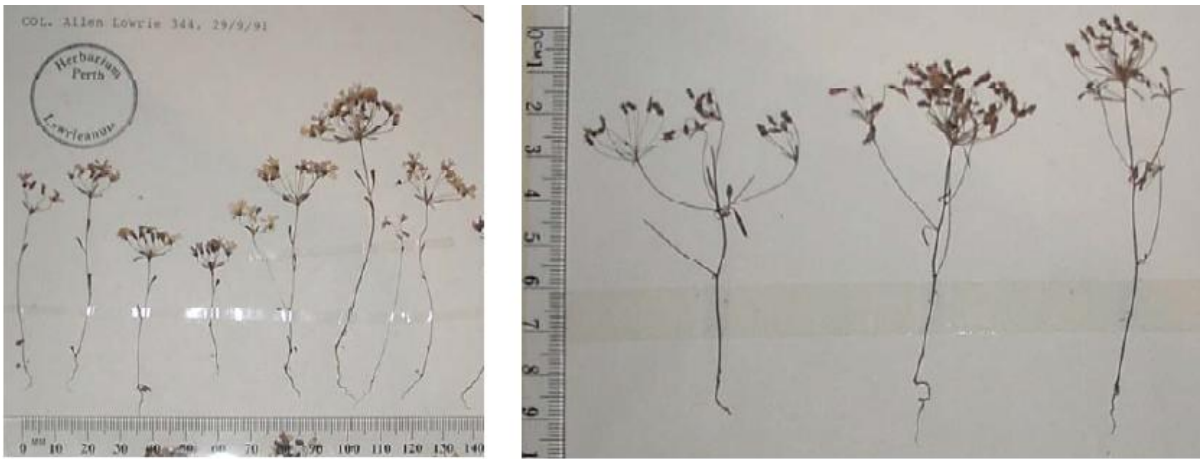

Fig. 20: (left) *Levenhookia octomaculata* Pinnicle Rock, Western Australia *A. Lowrie* 344, 29 Sep. 1991 (left); **Fig. 21**: (right) *L. octomaculata* Mount Lesueur, Western Australia *A. Lowrie s.n.* 24 Nov. 1988 (right); Herbarium specimen voucher for both housed in *Herbarium Lowrieanum*

Fig. 22: *Levenhookia octomaculata* Brookton, Western Australia

Fig. 23: *Levenhookia octomaculata* Brookton, Western Australia

6: **Levenhookia pauciflora** Benth. (**Fig. 24, 25, 26 & 27**). Deceptive Stylewort

A white-flowered, annual herb with a yellow throat, surrounded by reddish marks on the upper and lower petal margins, 2–10 cm tall. leaves ovate near base, glabrous, leaves above oblanceolate, a little glandular; main stem, floral bracts, pedicels, hypanthium and sepals densely glandular. *Levenhookia pauciflora* is currently known over a wide growing range in south-west Western Australia from the Jurien Bay area in the north, south to Augusta and eastwards to the Stirling Range and Albany onwards to Newdegate. Specimens growing on the silica sand heathlands in the Badgingarra area are pygmy size plants barely 1–2 cm tall with miniature flowers to match. *L. pauciflora* can be mistaken for a triggerplant, in particular those in the *Stylidium calcaratum* R. Br. complex, as the anthers and stigma(s) apparatus is triggered it travels between two closely placed petals that also act as the pollinator's landing platform, thus showering the pollinator's belly with pollen.

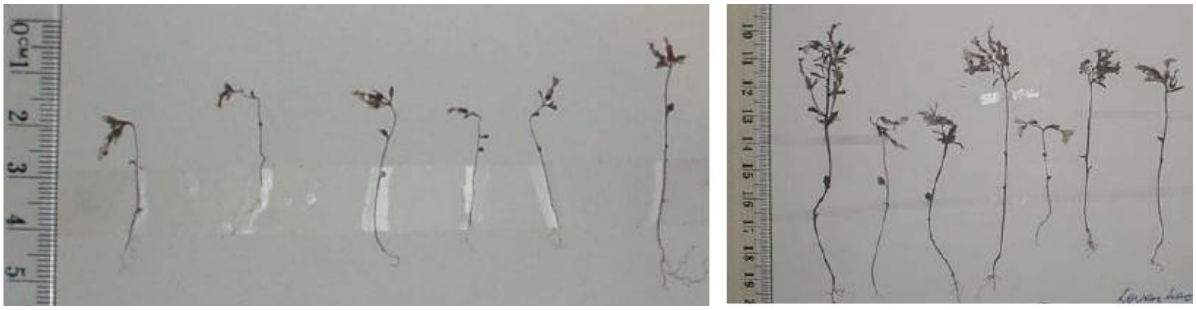

Fig. 24: (left) *Levenhookia pauciflora* Red Gully Rd, Western Australia *A. Lowrie s.n.* 19 Sep. 1989 (left); **Fig. 25**: (right) *L. pauciflora* Porongurup, Western Australia *P. Mann s.n.* 10 Oct. 1989 (right); Herbarium specimen vouchers for both housed in *Herbarium Lowrieanum.*

Fig. 26: *Levenhookia pauciflora* east of Newdegate, Western Australia.

Fig. 27: *Levenhookia pauciflora* Stirling Range, Western Australia

7: **Levenhookia preissii** (Sond.) F. Muell. (**Fig. 28, 29, 30, 31 & 32**).
Preiss's Stylewort

A spectacular, large, pink-flowered annual herb with a white throat, upper parts of petals pink, basal parts white, posterior basal petal white portions bearing reddish freckles, anterior petals plain white, 6–18 cm tall. Leaves oblanceolate, longitudinally canaliculate and boat-like, margins and abaxial surface densely glandular; main stem, floral bracts, pedicels, hypanthium and sepals densely glandular. *Levenhookia preissii* is currently known over a wide growing range in south-west Western Australia from the Perth area in the north, south to and east of Augusta. The preferred habitat of *L. preissii* is black sandy soils in winter wet, summer dry swampy heathlands.

Fig. 28: *Levenhookia preissii* (left): a variable range of specimen sizes from the same population, Scott River, Western Australia *A. Lowrie* 315, 25 Nov. 1990 (left); **Fig. 29**: (top right) rather small specimens of *L. preissii* Busselton, Western Australia *A. Lowrie s.n.* 17 Sep. 1996; **Fig. 30**: (bottom) somewhat compact specimens of *L. preissii* from Brennans Ford, Western Australia *A. Lowrie* 570 & *S. James*, 6 Jan. 1992; Herbarium vouchers in *Herbarium Lowrieanum.*

Fig. 31: *Levenhookia preissii* Busselton, Western Australia.

Fig. 32: *Levenhookia preissii* & *Lobelia* species (left) Busselton, Western Australia.

8: **Levenhookia pulcherrima** Carlquist (**Fig. 33, 34, 35 & 36**).
Beautiful Stylewort

A large impressive pink-flowered annual herb with a white throat, posterior basal petal bases with red W-shaped throat marking, anterior petals all pink, 8–12 cm tall, leaves ovate-spathulate, glabrous; main stem, floral bracts, pedicels, hypanthium and sepals sparsely glandular. *Levenhookia pulcherrima* is currently known in south-west Western Australia from the Ravensthorpe district. The preferred habitat of *L. pulcherrima* is white silica sand soils in winter wet, summer dry heathland.

Fig. 33: (left) *Levenhookia pulcherrima* Fitzgerald, Western Australia *A. Lowrie* 842, 27 Nov. 1993 (left); **Fig. 34**: (right) *L. pulcherrima* Fitzgerald, Western Australia *A. Lowrie* 124, 17 Oct. 1990 (right); Herbarium vouchers for both housed in *Herbarium Lowrieanum.*

Fig. 35: *Levenhookia pulcherrima*, north of Ravensthorpe, Western Australia.

Fig. 36: *Levenhookia pulcherrima* north of Ravensthorpe, Western Australia.

9: **Levenhookia pusilla** R. Br. (**Fig. 37, 38, 39 & 40**). Midget Stylewort

A annual herb with tiny pink flowers with a white throat, 2–9 cm tall. Specimens from the south coast regions are taller plants and often have auxiliary branches arising from their base. Leaves ovate, glabrous; main stem, floral bracts and sepals glabrous; pedicels very sparsely glandular; hypanthium glandular. *Levenhookia pusilla* is a widespread species throughout south-west Western Australia. *Levenhookia pusilla* appears to have no special preferred habitat and is found in most soil types and soil combinations. Depending on location specimens less than 1 cm tall can be found in arid locations, whereas in wetter areas this species can grow into large impressive plants. It also occurs in South Australia.

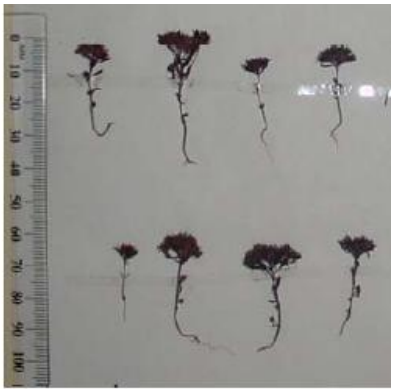

Fig. 37: (left) *Levenhookia pusilla* Bornholm, Western Australia *A. Lowrie s.n.*, 11 Nov. 1990 (left);
Fig. 38: (right) *L. pusilla* Busselton, Western Australia *A. Lowrie* 204, 24 Nov. 1990 (right);
Herbarium specimen vouchers for both housed in *Herbarium Lowrieanum.*

Fig. 39: *Levenhookia pusilla* Porongurup, Western Australia

Fig. 40: *Levenhookia pusilla* Brookton, Western Australia.

10: **Levenhookia sonderi** (F. Muell.) F. Muell. (**Fig. 41, 42 & 43**).
Slender Stylewort

A annual herb with white flowers and purple labellum, 4–5 cm tall. Leaves ovate, sparsely glandular; main stem, floral bracts, pedicels, hypanthium and sepals sparsely glandular. *Levenhookia sonderi* occurs in South Australia and Victoria, Australia. Mildbraed (1908) treated this species as a variety, *L. dubia* var. *sonderi*. (F. Muell.) Mildbr. All that is known about this species by the authors has been obtained from pressed and photographic material from South Australia. It is quite clear however that *L. sonderi* has a number of distinctive characters that differentiate it from its closest considered relative *L. dubia*. *L. sonderi* differs from *L. dubia* (whose contrasting characters are in (parenthesis): plants 4–5 cm tall (2–3.5 cm tall); leaves ovate (elliptic); indumentum glandular (sparsely glandular); labellum purple (white).

Further field research to gather additional details about this species such as seed characteristics, along with applied sharp tool technology such as chromosome and DNA sequencing studies, may show other differences between these two species. *Levenhookia dubia* occurs in W.A., S.A., Vic., N.S.W. & Tas. In contrast, *L. sonderi* has only been recorded from S.A. & Vic.

Fig. 41: *Levenhookia sonderi,* fruiting specimens, Penola Forest Reserve, South Australia, *D. Hunt*, 1964, voucher in (Adelaide Herbarium).

Fig. 42: (top) *Levenhookia sonderi* Reedy Creek Conservation Park, South Australia digital photo from a slide transparency by Denzel Murfet; **Fig. 43**: (bottom) overhead photo same location same source by Denzel Murfet. Herbarium specimen voucher for both photos *D. E. Murfet* 3317, 1 Oct. 1998 housed in AD.

11: **Levenhookia stipitata** (Benth.) F. Muell. ex Benth. (**Fig. 44, 45, 46 & 47**). Common Stylewort

A pink-flowered annual herb, often branching high above its base in older specimens, 5–10 cm tall. Leaves oblanceolate, margins, abaxial surface glandular, adaxial surface glabrous. Erect stem, floral bracts, pedicels, hypanthium and sepals glandular. *Levenhookia stipitata* is currently known over a wide growing range in south-west Western Australia growing in sandy soils. It is also found in parts of South Australia where it has been recorded growing in dry areas on granite outcrop hills as well as on rocky hill sides in ironstone with mallee.

Fig. 44: (left) *Levenhookia stipitata* Carappee Hill Conservation Park, South Australia *D. E. Murfet* 1303a, 11 Oct. 1991 (left); **Fig. 45**: (top right) *L. stipitata* Bullsbrook, Western Australia *A. Lowrie* 49, 9 Nov. 1991; **Fig. 46**: (bottom right) *L. stipitata* Yanchep, Western Australia *A. Lowrie* 137, 23 Oct. 1990; Herbarium vouchers in *Herbarium Lowrieanum.*

Fig. 47: *Levenhookia stipitata* Muchea, Western Australia.

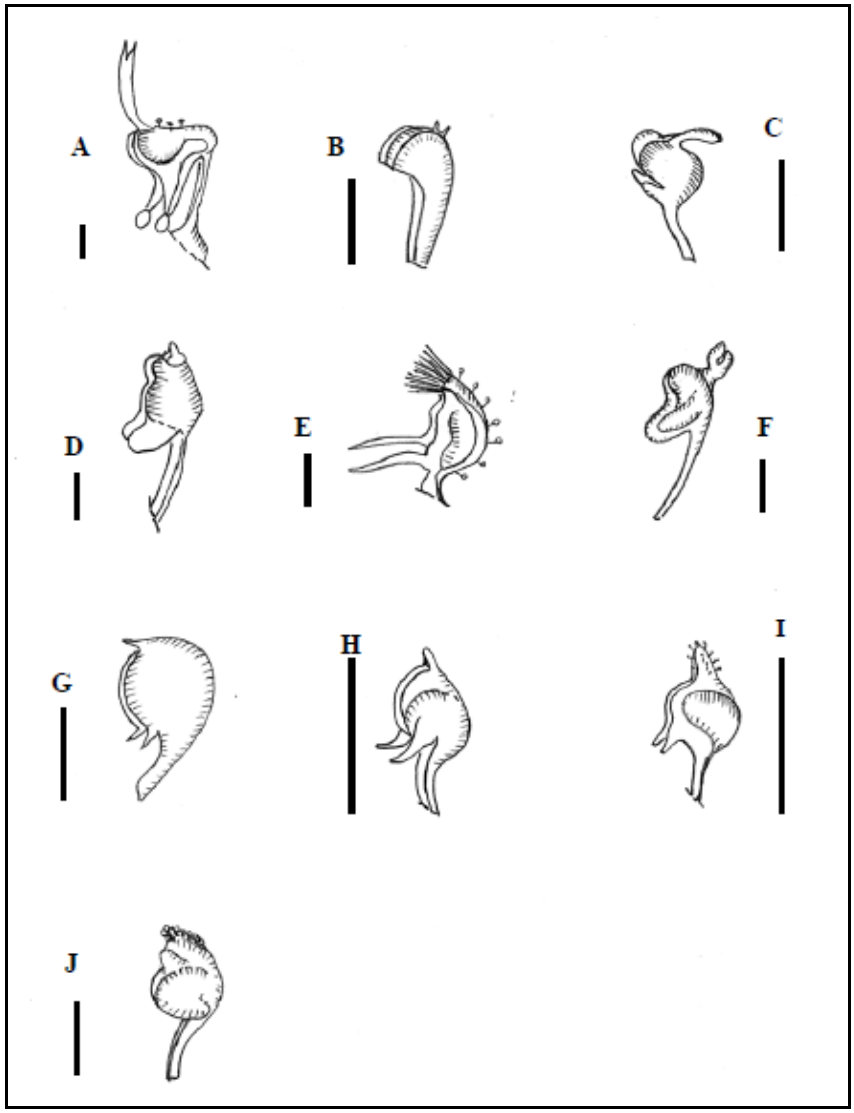

Fig. 48: Labellum comparison illustrations between all *Levenhookia* species (except *L. sonderi*). A: *L. chippendalei*; B: *L. dubia*; C: *L. leptantha*; D: *L. octomaculata*; E: *L. pauciflora*; F: *L. preissii*; G: *L. pulcherrima*; H: *L. pusilla*; I: *L. murfetii*; J: *L. stipitata.*
Scale bars for all = 1 mm. Drawn by Allen Lowrie 8 Feb. 2010.

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Acknowledgements

The late Rica Erickson; the late Professor Sid James; Sherwin Carlquist; Mary Hancock; Phill Mann; Denzel Murfet and Rosemary Taplin are thanked for sharing their knowledge, field observations and field collected specimens with us to better understand the *Levenhookia* complex. Rosemary Taplin is also thanked for her editorial comments.

Stylidium desertorum in South Australia

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Stylidium desertorum was described by Sherwin Carlquist (1978) from specimens collected in south-west region of the Northern Territory by D.K. Latz on the 22 July 1973. Holotype.—D.K. Latz 4085 (Holotype, AD; Isotypes, BRI, CANB, DNA, NSW, NT, PERTH) Salt Beef Lake, Tanami [Desert], N.T. [Northern Territory] 20° 53' S, 130° 25' E.

Stylidium desertorum Carlquist was first recorded in South Australia after its discovery on the 19 August 1991. It was located in the far north-east corner of the state at Bloodwood Bore, about 120 km north-east of Innamincka (27° 43' S, 140° 46' E). Since this original collection it has only been recorded twice more and in the same area.

In September 2007 I was invited on a South Australian Botanic Gardens seed collection trip to the area where these earlier collections were made. Several likely areas were searched but we found just a few dead plants on the edge of one dried clay-pan.

I revisited this location again in August 2008 as there had been good rainfall in June 2008. Even though we searched around several lakes containing water and some lakes that had already dried up, there was no sign of any *Stylidium desertorum*.

After a very wet 2010 and start to 2011, a flora search for rare species in the far north-east region of South Australia was again undertaken by the Botanical Gardens. I was again invited on this expedition to help search for rare plants, including the elusive *Stylidium desertorum*.

In this region some of the ephemeral lakes amongst the sand hills still retained water; others were just drying out with their ephemeral plants just coming through. It was at one of these recently dried out sandy areas that we first discovered many mature specimens of *Stylidium desertorum* in flower (**Fig. 1 & 2)**. Further along this same track on the shores of a large, flat, dried lake, several hundred possibly more plants were found in flower. Further along the same track another population of over 50 plants was discovered.

From my field observations: *Stylidium desertorum* likes to grow in reddish gritty sand soils (**Fig. 3**) near low lying areas that have been inundated with shallow waters for several weeks after summer rainfall.

I would expect that there would be many more populations of *Stylidium desertorum* to be found throughout this area, as there are many more drying lakes scattered along the track we part travelled as well as the many side tracks in this region.

Reference.

Carlquist, S. (1978) *Aliso* 9:317-321

Fig. 1: *Stylidium desertorum* at Bloodwood Bore, South Australia.

In **Fig. 1:** the gynostemium (trigger) has been fired and is now in its triggered position. Note the 4 anthers (in rows of 2) at the gynostemium tip. The anthers are just breaking open to reveal their pollen within.

Once this pollen is spent after being placed on the bodies of visiting pollinators, a stigma develops between these empty anthers and will now be in a position to pick up pollen from the pollinator's body from another flower and possibly from another plant to complete its out-crossing strategy.

To the right near the base of the lower smaller petal, the labellum, a modified fifth petal, can be seen. The top part of the smooth boss of the labellum as well as one of its two reddish basal appendages, are visible in the photo.

The gynostemium will rest against the boss of this labellum when it has reset and readies itself once more to be triggered when another pollinator visits the flower. The basal appendages of the labellum insure the gynostemium is steered onto and not off the boss of the labellum when it is being reset. The rather long gynostemium to its much smaller flower size also suggests a larger pollinator maybe involved as the preferred pollinator of this species.

Fig. 2: *Stylidium desertorum* at Bloodwood Bore: Overhead photo showing the branching inflorescence arrangement and active flowers with its cluster of leafy basal rosettes all arising on branches from the same rootstock. Note the rather long gynostemium (triggers) in the cocked and ready to be triggered position illustrated by the 3 upper flowers in the photo to the centre right.

Fig. 3: *Stylidium desertorum* at Bloodwood Bore: Overall photo showing the habit of the whole plant growing in its preferred habitat of reddish gritty sand soils.

Stylidium ramosissimum – An unusual Cape York plant.

By: John Beasley

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August of 2006 I was traveling in Cape York and photographing plants for possible inclusion in a plant guide for the region. I had stopped just south of Laura to take a look at the sandstone ridges that outcrop there, and discovered a most unusual looking plant (**Fig. 1)**. It looked like an old fashioned floor mop, turning orange, with the handle buried in the earth and just the mop head emerging. I had no idea what it could be, though a botanist friend suggested I look at the possibility that it was a *Stylidium*. Having looked, it seemed very unlikely, but in the event he proved correct.

Stylidium ramossisimum was apparently first collected east of Laura in 1962 by an L.S. Smith. It was described in Austrobaileya (5.2, p 328) in 1999 by A.R. Bean, but still has not appeared in the APNI list of Australian plants. Unfortunately only a part of the plant was used for the photograph and description in Austrobaileya, which has resulted in some errors occurring – the photograph is described as a "whole plant", and the number of scapes, which can be up to 100 in specimens I have seen, was listed as 1 – 5 per plant, a very low number. Also virtually nothing was known of the phenology of this trigger plant, and it was suggested that it "possibly flowers and fruits sporadically throughout the year". Only half a dozen collections have been made for the Queensland Herbarium, all from the Sandstone ridges between Cooktown and Laura, and west to Jowalbinna, an Aboriginal art access point and camp site. These sandstone ridges are famous for the Quinkan rock art that they preserve. I have found it also on the Battle Camp Road close to Cooktown.

Fig. 1: *Stylidium ramossisimum* looking like an old fashioned floor mop.

The plants I saw were clearly drying off, and there was no sign of flowers or fruit. A later visit at the end of the dry season showed almost no sign of the plants, though it is probable that the woolly butt remains viable for the following season. As Laura is in a particularly hot and dry part of Cape York, the trip to the top of the steep sandstone ridge in 37 degree heat remains very clear in my memory.

The first impression is of the numerous rather 'leafy' scapes (a scape being defined as a leafless stalk in plants that arises from a rosette of leaves and bears one or more flowers). The 'leaves' on the scapes are probably bracts, as the true leaves do form a rosette at ground level that is well hidden by the mop above. The butt of the plant is thick and densely woolly.

Fig. 2: Tiny pink flowers occur at the tip of each scape.

Fig. 3: *Stylidium ramossisimum* in fruit.

I returned in March 2007 to look for flowers, and sure enough they were present (**Fig. 2).** The plants were now, in the Wet, a vivid green, and several tiny pink flowers occurred at the tip of each scape. The triggers seemed unusually long for the size of the flower.

In May I returned and found the fruits **(Fig. 3)**, mostly still immature, though a few were ripe. These were mainly five ribbed 'capsules' with finger like projections at the tip, coloured a mottled green and red brown. It seems likely that these plants flower during the Wet, set fruit early in the dry, then dry off and virtually disappear before the first rains of the next wet season. In my book, 'Plants of Cape York – The Compact Guide', I give directions to locate these unusual plants about 10 km south of Laura. They have also been recorded at nearby 'Split Rock', an Aboriginal art gallery open to the public for a small fee. It is worth stopping by next time you pass Laura on the way to 'The Tip', to see these strange plants.

Are some members of Stylidiaceae obtaining nutrients by similar methods to that employed by carnivorous plants?

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Near on 40 years ago, Steve Rose, a pioneer in the discovery of many new species of carnivorous plants in Western Australia put forward to one of us (AL) that he thought that the glands found on many members of the genus Stylidiaceae in Western Australia may possibly be used to capture insects from which beneficial nutrients could be obtained.

Steve had observed on many occasions small flying insects caught by the glands on many of the *Stylidium* species in south-west Western Australia. He thought at that time that these *Stylidium* species had carnivorous tendencies, similar to that confirmed scientifically in carnivorous plants of the Droseraceae and Byblidaceae families.

Since those discussions by one of us (AL) with Steve all those years ago, (AL) has gone on to study the genus Stylidiaceae (Triggerplants) in depth and detail and can confirm that Steve's observations of possible carnivory of all the species Steve studied in south-west Western Australia is accurate.

Furthermore observations by (AL) have shown that some of the tropical triggerplant species that occur in the Kimberley of far north Western Australia and the adjoining Northern Territory as well as eastwards to far north Queensland also capture small flying insects on their glandular indumentum.

In one particular case (AL) observed *Stylidium lobuliferum* (a tropical Triggerplant) near Kununurra in the Kimberley region not only capturing small flying insects but small flakes of carbon as well. The carbon flakes were the thermal-flying and wind-driven byproduct of grass fires in the district.

Fires are a natural part of Australia's diversity and have been occurring by the ignition of lightning strikes well before human habitation of island Australia. The capture of these carbon flakes have highlighted yet another question, is this species using its captured carbon flakes as a usable nutrient source.

Observations of cultivated *Stylidium* species in greenhouse conditions in Japan by (IT) have shown that insect capture by Stylidiaceae bearing glands is a common event. Small flying insects are regularly caught on any part of the plant that has a glandular indumentum (covering).

Two insects in particular whitefly *Trialeurodes vaporarium* (**Fig. 1, 2 & 3)** and either the tomato leaf miner *Liriomyza sativae* or the Serpentine leaf miner *Liriomyza trifolii* (**Fig. 4)** have been regularly observed by one of us (IT) caught on the glandular indumentum of cultivated Triggerplants plants in greenhouse conditions in Saitama-Pref. in Japan. Clearly these captured insects have been well mired in the glandular viscous secretions as they have struggled to escape.

In the genus Stylidiaceae, glands are common and can be found covering the basal leaves or the whorls of leaves (or bracts) on the scape (**Fig. 5)**; various parts or all of the peduncle (scape) (**Fig. 6, 7 & 8)**; throughout the inflorescence **(fig. 9 & 10**); hypanthium (ovary) including the calyx lobes (sepals)(**Fig. 11)**. Even the back of the petals of the corolla (flower) (**Fig. 12)** on many species is glandular. These glands too are capable of capturing insect prey as illustrated in (**Fig. 11).**

The glands are made up of a trichome (stalk) with an apical gland which produces a viscous fluid that surrounds it. It is this fluid that the flying insects get caught by and restrained until they die. After this event no studies have been undertaken to prove or disprove whether the captured prey is further processed by enzymes in the glandular fluid and whether or not these refined products from the insect carcass are use by the plant to obtain beneficial nutrients.

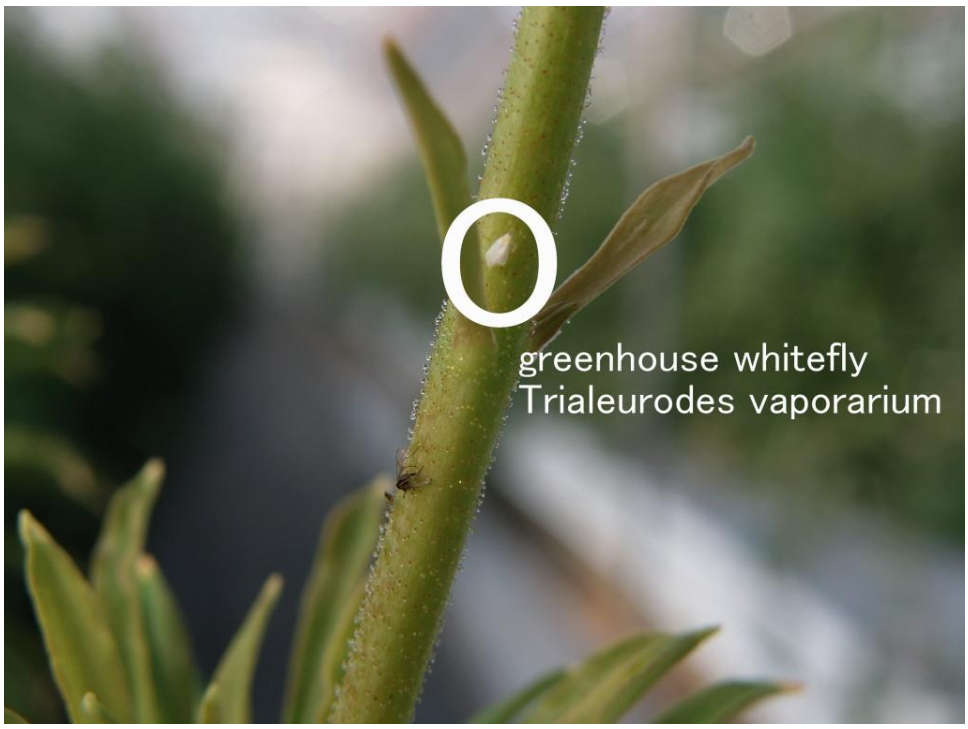

Fig. 1: *Stylidium carlquistii***.** The greenhouse whitefly *Trialeurodes vaporarium* circled in white. The insect caught below is either the tomato leaf miner *Liriomyza sativae* or the Serpentine leaf miner *Liriomyza trifolii*

In the majority of cases where Stylidiaceae are found in Australia they commonly grow along side a veritable array of Carnivorous plants. It is a well known fact that carnivorous plants abound in poor soils where competition for growing space is guaranteed from the higher order plants that require nutrient rich soils to grow well.

It is therefore probable that those Triggerplants that grow along side carnivorous plants in these same poor soils must also have a need to obtain their nutrients, that all plants need, to maintain healthy growth. The question is, do the triggerplants derive their nutrient requirements from captured insect prey. Perhaps the Triggerplant species that we have observed both in the wild as well as in cultivation are indeed acting in a similar manner to that found and proven to be so in Droseraceae and Byblidaceae families.

Maybe the extra nutrients obtained from captured prey especially those found throughout the inflorescence is also used to nurture the developing ovules to produce good healthy seeds.
Perhaps the glands throughout the inflorescence are just a simple defense system to ward of attacked by chewing and sucking insects as well as those nuisance insects that do not take part in the pollination process and are simply thieves of the Triggerplant species nectar supply. Or maybe it is a combination of both these hypothesis.

Fig. 2: *Stylidium turleyae***.** Greenhouse whiteflies *Trialeurodes vaporarium* have been caught on the major axis of the inflorescence (photo centre) as well as the branching peduncle (photo right).

Fig. 3: *Stylidium turleyae*. Greenhouse whitefly *Trialeurodes vaporarium* caught on the branching peduncle.

Fig. 4: *Stylidium carlquistii*. The captured insect circled in white is either the tomato leaf miner *Liriomyza sativae* or the Serpentine leaf miner *Liriomyza trifolii.*

Fig. 5: *Stylidium albolilacium.* Insects caught on the whorls of leaves (or bracts) on the scape. The basal leaves of this species are similar.

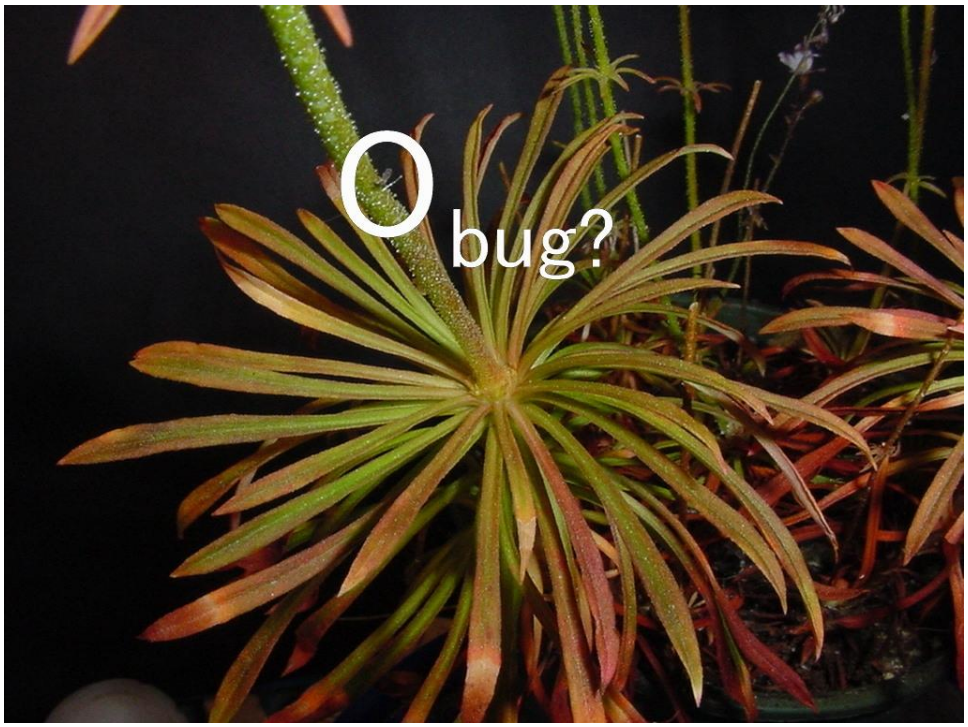

Fig. 6: *Stylidium carlquistii*. An unidentified insect caught on the scape of plant grown in Western Australia.

Fig. 7: *Stylidium dichotomum.* Insect prey caught on the scape of plant grown in Japan.

Fig. 8: *Stylidium carlquistii***.** Two flying insects trapped and held fast by the glands covering the major axis (also known as the peduncle or scape).

Fig. 9: *Stylidium ciliatum.* The very dense inflorescence indumentum of this species consists of both long and short stalked glands.

Fig. 10: *Stylidium carlquistii*. The dense glandular indumentum can be seen in the photo throughout the inflorescence structure. These glands cover the major axis (stem); the secondary peduncles and branching pedicels; as well as the hypanthium (ovary) and calyx lobes (sepals).

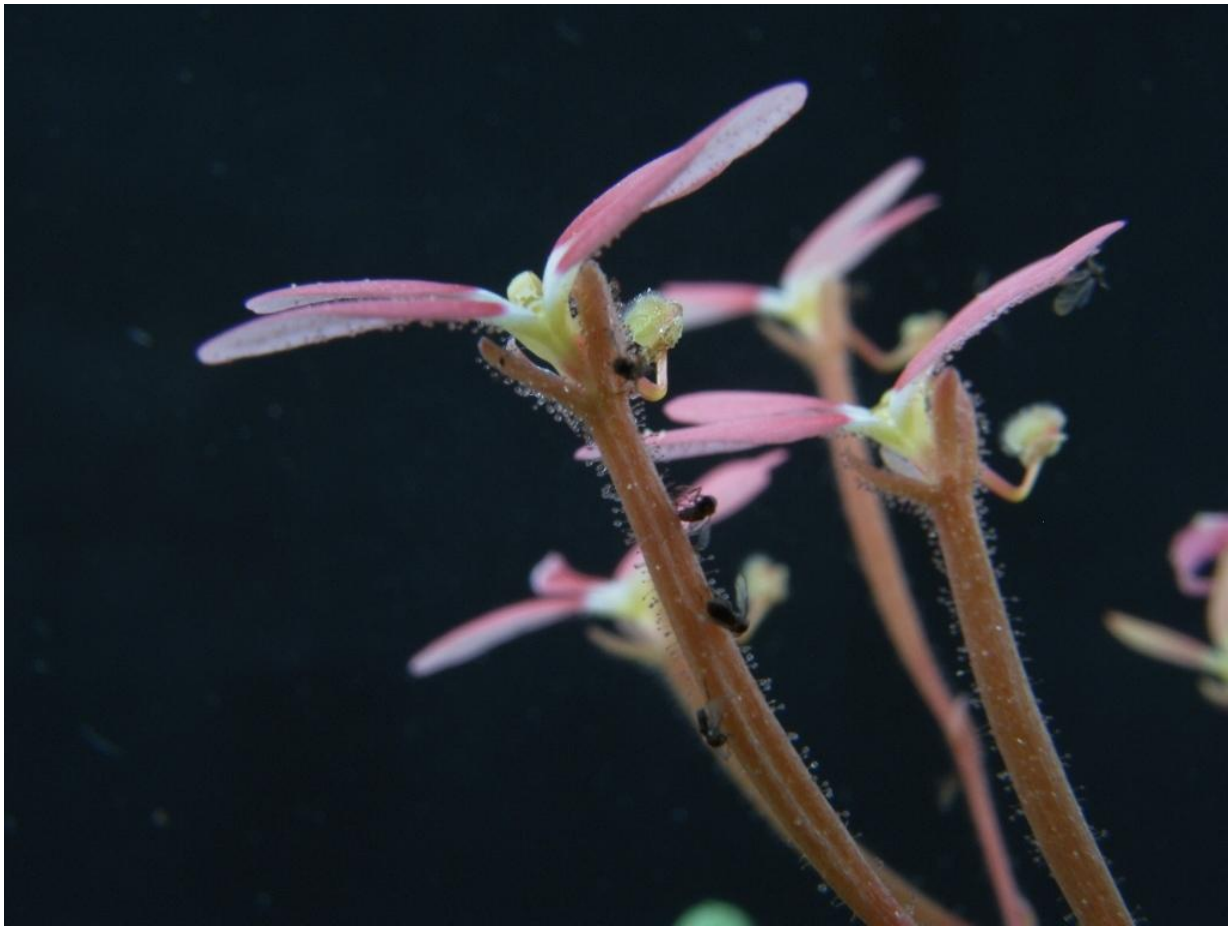

Fig. 11: *Stylidium bulbiferum.* The glands on the hypanthium (ovary) photo centre have caught three insect prey and one insect prey at the base of a calyx lobe (sepal). To the right in the photo, the glandular abaxial (lower) surface of the corolla (flower) has also caught insect prey.

It is quite clear that there are numerous unanswered questions regarding triggerplant genetics and their biology that need to be addressed in the near future. It is the wish of both authors that botanical students of the future will take up this challenge to uncover and answer all the unknowns of Stylidiaceae.

One of the first challenges that needs to be undertaken is to establish whether members of the genus Stylidiaceae are acting as carnivorous plants to obtain beneficial nutrients to produce robust and healthy growth. It maybe, with the aid of cutting-edge-technology that is now present in the research facilities of the world, that will used to answer this question.

Radioactive markers could possibly be introduced into prey. The prey could then be fed to live triggerplants in the laboratory greenhouse to establish whether or not nutrients from the captured prey are being taken up by the plant.

Fig. 12: *Stylidium turleyae***.** Close-up photo (left) showing the glands on the abaxial surface of the petals of the corolla just before it opens. These same glands can just be seen hanging down on the abaxial surface of the open flower on the right.

Some observations on the pollination of *Stylidium* in captivity

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Abstract

The presence of suitable insect pollinators for *Stylidium* grown away from their habitat has been investigated. Several species from Western Australia have been found to set viable seed when grown in South-Eastern Australia, some 3000km from their habitat. The seed of most species tested came true to the parent, but evidence of hybridisation was observed. This poses problems for the distribution of seed collected from 'captive' or nursery grown specimens.

Introduction

Although *Stylidium* are readily propagated vegetatively, it is relatively slow and limits the genetic variation. Propagation from seed quickly produces the many plants needed for the study of *Stylidium* horticulture, but fresh seed is not always readily available. *Stylidiums* are slowly being made available to enthusiasts by organizations such as the Kings Park Gardens in Perth and the Australian Native Plants Society (Australia), and such plants can supply seed if there are suitable insect pollinators where the plants are grown. The rather specialised pollination mechanism in *Stylidiums* is said to mitigate against hybridisation but when many species from different areas are grown together, hybridisation may occur. Since 2006 I have been studying the propagation and horticulture of *Stylidiums* from both sides of the continent. Part of this exercise has been observations of whether the flowers are successfully pollinated, in that they produce seed capsules, and whether the seed is true to the parent. I have not attempted to assess the proportion of fertile seed nor to identify the pollination agents. The principal reason for presenting this paper is the discovery of hybrids among my seedlings.

Procedures

The site of the 'nursery' is Melton, some 40km west of Melbourne, the capital of Victoria and is on a volcanic plain in a relatively low average rainfall of 375-450 mm. The town is now much developed so that the insect population is probably much larger and more varied than it was in the past. Seed has been collected over the past five years from plants grown under 'nursery' conditions in that they are grouped together for convenience of watering etc. Mature capsules that were just beginning to split were harvested over several days to a couple of weeks until enough seed accumulated.

Fresh seed was sown during Autumn (March-April here) on to a bed of coarse sand over a suitable seed raising mix. The seed was covered with a little fine sand to minimise 'washing out' and it was watered in with smoked water once a day for three days. Thereafter the pots were placed in a shade house and watered normally by misting twice daily. Germination occurred within 4-5 weeks and the seedlings were potted on at the 4-5 leaf-pair stage of growth. Flower and leaf characteristic of some specimens were recorded by macro-photography with a Nikon Coolpix 4800 digital camera.

Results

Species that have come true from seed include: *Stylidium adnatum, S. affine, S. araeophyllum, S. assimile, S. caespitosum, S. laricifolium, S. megacarpum, S. rigidulum, S. spathulatum and S. spinulosum. S dichotomum* has set fertile seed but there is some evidence of cross pollination of colour forms.

Stylidium ireneae

The seedlings from *S. ireneae* show evidence of hybridisation. Seeds were sown on 23 April 2008, germination began on June 2nd, 2008 and the seedlings were potted on in October 2008. By the time the plants reached flowering size in November 2009, it was clear that these were not *S. ireneae*, but a hybrid.

S. ireneae leaves appear quite shiny and are sparsely hairy, with glandular hairs below and non-glandular above (**Fig. 1**). Those of the seedlings are glandular hairy on both sides and different in shape from *S. ireneae* (**Fig. 2**). The scape of *S. ireneae* is glandular hairy except for the calyx lobes whereas that of the seedlings is glandular hairy to the base of the calyx, with only occasional hairs on the calyx (**Fig. 3**).

Fig. 1: Rosette of *S. ireneae*, showing stemmed habit and shiny, sparsely hairy leaves.

Fig. 2: Rosettes of seedlings from *S. ireneae*. Stemmed habit, hairy leaves

Fig. 3: Flower of *S. ireneae*, showing glandular hairs on calyx, glabrous lobes, and bracts at base of pedicel. No yellow in throat.

The bracts and bracteoles of *S. ireneae* are glandular and sit at the base of the pedicel, those of the seedlings are glabrous and the bracteoles are distinctly separated along the pedicel from the bracts. The inflorescence has a glaucous appearance (**Fig. 4**).

The flowers of *S. ireneae* are pink with darker pink marks and colourless mounds in the throat. Those of the seedlings are similar but have yellow in the throat and the mounds are somewhat different (**Fig 5)**. Overall, the plant has the same stilt-growth habit as *S. ireneae* and the stems are dark coloured. The differences suggest hybridisation, but the seedlings have also set fertile seed. These have not yet flowered so comparison is not yet possible.

The most likely source of foreign pollen is *S. spathulatum* (**Fig. 6**), which has flowers (**Fig. 7**) of similar morphology to those of *S. ireneae* but differs from it in having the stems at or near ground level, in contrast to the stemmed habit of *S. ireneae*. There are several pots of *S. spathulatum* close to that of the *S. ireneae* plants. *S. spathulatum* has leaves that are glandular hairy on both sides and cream flowers with yellow and white throat mounds. The scape is glandular in the lower half and glabrous above and the bracteoles tend to be some distance from the bract at the base of the pedicel (**Fig. 8**).

Fig. 4: Inflorescence of seedling showing glabrous calyx, and bracteoles some distance from base of pedicel.

Fig. 5: Flower of seedling, showing yellow throat.

Fig 6: Rosette of *S. spathulatum*, showing non-stemmed habit.

Fig 7: Flower of *S. spathulatum*, showing yellow in throat.

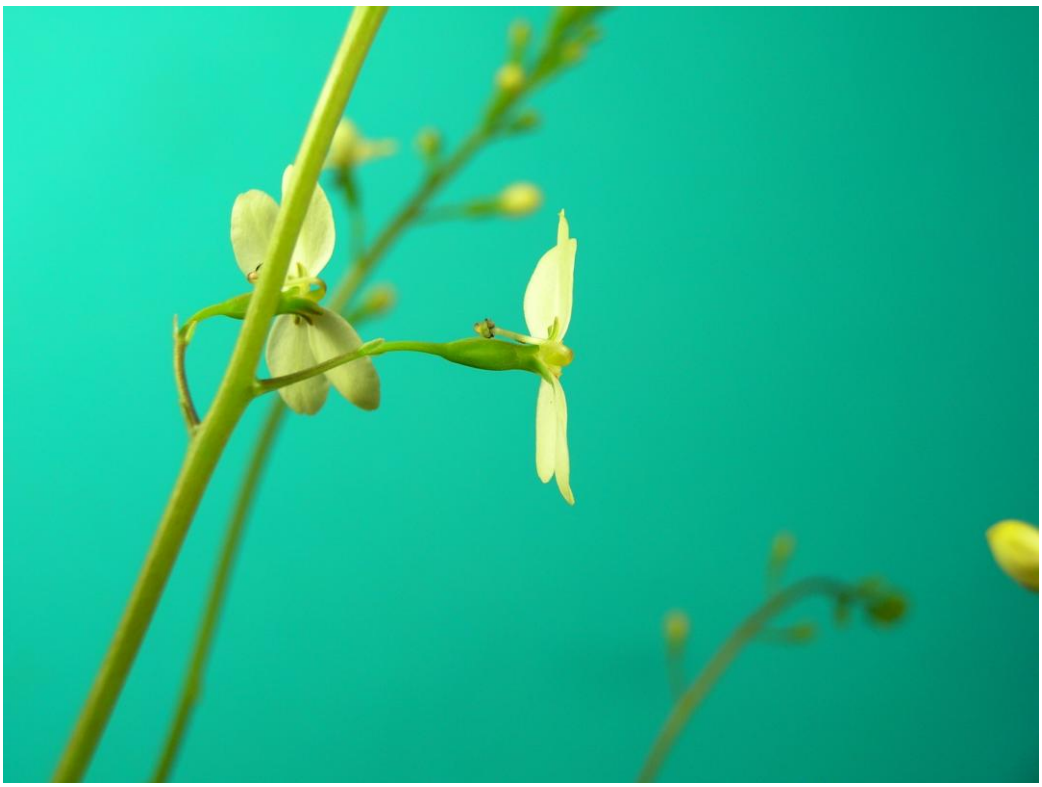

Fig 8: Inflorescence of *S. spathulatum* showing bracteoles well separated from base of pedicel and all-over glabrous character.

Fig 9. Plant of *S. spathulatum*, parent of hybrid No 2.

Fig 10. View of hybrid No 2 showing stemmed habit.

Hybrid No 2

Seed collected in 2009/10 from what appears to be a typical plant of *S. spathulatum* **Fig. 9** produced seedlings with pink flowers and a distinctly stemmed habit **Fig. 10.** The leaves are less hairy than *S. spathulatum*, in contrast to those of the *S. ireneae* hybrid. This hybrid has not yet been fully investigated; there are two plants nearby with pink flowers of similar morphology, *S. ireneae* and an as yet unidentified species with affinities to *S. ireneae.* The appearance of pink flowers was quite unexpected and I did not take detailed photographs, a failure that will be remedied when they flower in October-November.

Discussion

As more *Stylidium* are grown by enthusiasts, the probability of seed exchange will increase. The possibilities for hybridisation shown above indicate that all seed should be tested for purity to type before being passed on. But though I consider it inadvisable to distribute hybrid seed, if it is distributed it should be accompanied by as much detail as possible about the likely second parent. Similarly, I would advise against distribution of hybrid plants in order to minimise complication of an already complex genus.

Articles wanted on any triggerplant subject

Stylidium oriopodum Darling Range, Western Australia (photo A. Lowrie)

Tell other ITPS members about the triggerplant plants that you are growing in your collection. Photograph them and share your observations with other members.

Send in your reports of triggerplants you have seen in the wild. Tell us about your expeditions along with the triggerplants habitat preferences as well as their photographs.

Share your cultivation knowledge, observations and findings such as results with your seed germination trials, vegetative propagation, best pot sizes and soil mixes that work for you. We want to know everything that you have discovered cultivating triggerplants.

Please provide your text in MS WORD compatible format and your digital photos at a minimum resolution 300dpi. Email your articles to doug@triggerplants.org

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Stylidium debile photos of plants in my collection.

By Alejandro Linconao.

Top left: Basal rosettes growing in sphagnum moss.

Top right: Flowering plant. Flowers open from the bottom of the inflorescence towards the apex.

Bottom left: Note the adventitious leafy rosettes growing on basal section of the scape.

Bottom right: Close-up of the laterally paired flowers.

Growing *Stylidium spathulatum*

By Hazel E. Dempster

Email: dempster@starwon.com.au

Description

Stylidium spathulatum

Stylidium sub genus Tolypangium (Endl.) Mildbr section Saxifragoidea.

Basal rosette, glandular hairy leaves and racemose inflorescence, creamy yellow flowers with laterally paired corolla lobes.

Variable growth habit displaying both inter and intra populations, with variations in scape length, basal rosette diameter, leaf size and the degree to which the stem is elongated.

Diagnostic features include loose tufted rosettes of oblanceolate to spathulate leaves, glandular trichomes with turbinate heads that are restricted to the leaves, lower scape and sometimes the pedicels and creamy yellow corolla with red throat markings and small yellow throat appendages (**Fig 1**).

Fig. 1: *Stylidium* aff. *spathulatum* flower spike

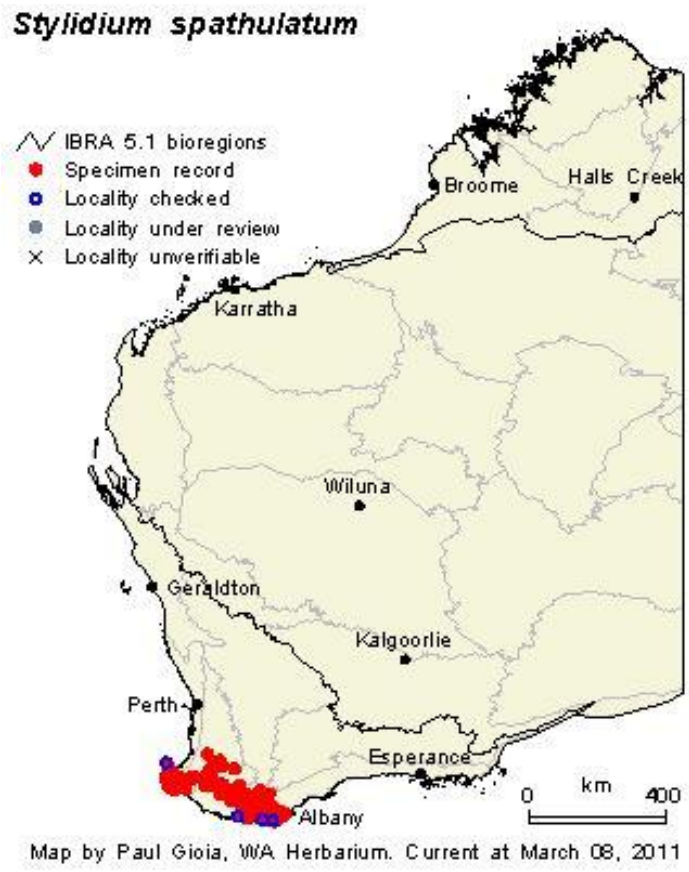

Fig. 2: *Stylidium spathulatum* locations.

Distribution

The *Stylidium spathulatum* group comes from the south-west of Western Australia forest areas and is found in moist shady areas often amongst coarse leaf litter. See location map (**Fig 2).**

Horticultural value of *Stylidium spathulatum*

The forms of *Stylidium spathulatum* from the *Stylidium* group Saxifragoidea do emulate the genus *Saxifrage* with their attractively formed rosettes forming mounding cushions. In the wild, the rosette forms are very variable as are their flower spikes. Creamy yellow flowers remain the dominate flower colour. Flowering spikes up to 25cm tall appear in late winter-spring.

Propagation of the *Stylidium spathulatum* group.

Plants grown from seed initiated by smoked water, form rosettes and within a season or two several new shoots appear from the swollen fleshy roots to form an attractive mound of rosettes presenting their spikes or creamy yellow flowers in spring.

Depending on growing conditions these plants become dormant during the dry season which can last for up to five months. Temperatures averaging above 30 degrees C. When the weather temperatures cool in March-April or the Aboriginal seasons called *Bunuru* to *Djeran*, new rosettes arise from the original stems and fleshy roots with new aerial roots forming at the base of each of the new rosettes (**Fig. 3 & Fig. 4**).

Fig. 3: *Stylidium* aff. *spathulatum* collections ready for division.

Fig. 4: *Stylidium spathulatum* selection 1.

Fig. 5: *Stylidium spathulatum* showing new seasons roots.

Fig. 6: *Stylidium spathulatum* selection 1 divided into sections

Fig. 7: *Stylidium spathulatum* selection 1 sections pulled apart.

Fig. 8: *Stylidium spathulatum* selection1 1 with swollen stems.

These rosettes can then be divided along with the roots system to form new plants (**Fig. 5**). All old previous season roots and damaged leaves are removed **(Fig. 6, 7, 8 & 9).** The new divisions are then potted up into tubes or pots using a well drained neutral to slightly acid potting mix with low phosphate slow release fertiliser. The fleshy roots can be also potted on to re-shoot. Coarse river sand can be added and used as surface mulch .Plants are kept in a shade house or protected area. Cuttings and leaf cuttings can also be taken using hormone gel e.g. Purple Clonex.

Fig. 9: *Stylidium spathulatum* selection1 sections with old roots and leaves removed.

Fig. 10: *Stylidium spathulatum* selection 1 potted up.

Fig. 11: *Stylidium* aff. spathulatum selection 2 smaller rosettes.
Fig. 12: *Stylidium* aff. *spathulatum* selection 2 showing new seasons roots.
Fig. 13: *Stylidium* aff. *spathulatum* selection 2 dividing sections.
Fig. 14: *Stylidium* aff. *spathulatum* selection 2 swollen stems.
Fig. 15: *Stylidium* aff. *spathulatum* selection 2 with old roots and leaves removed.

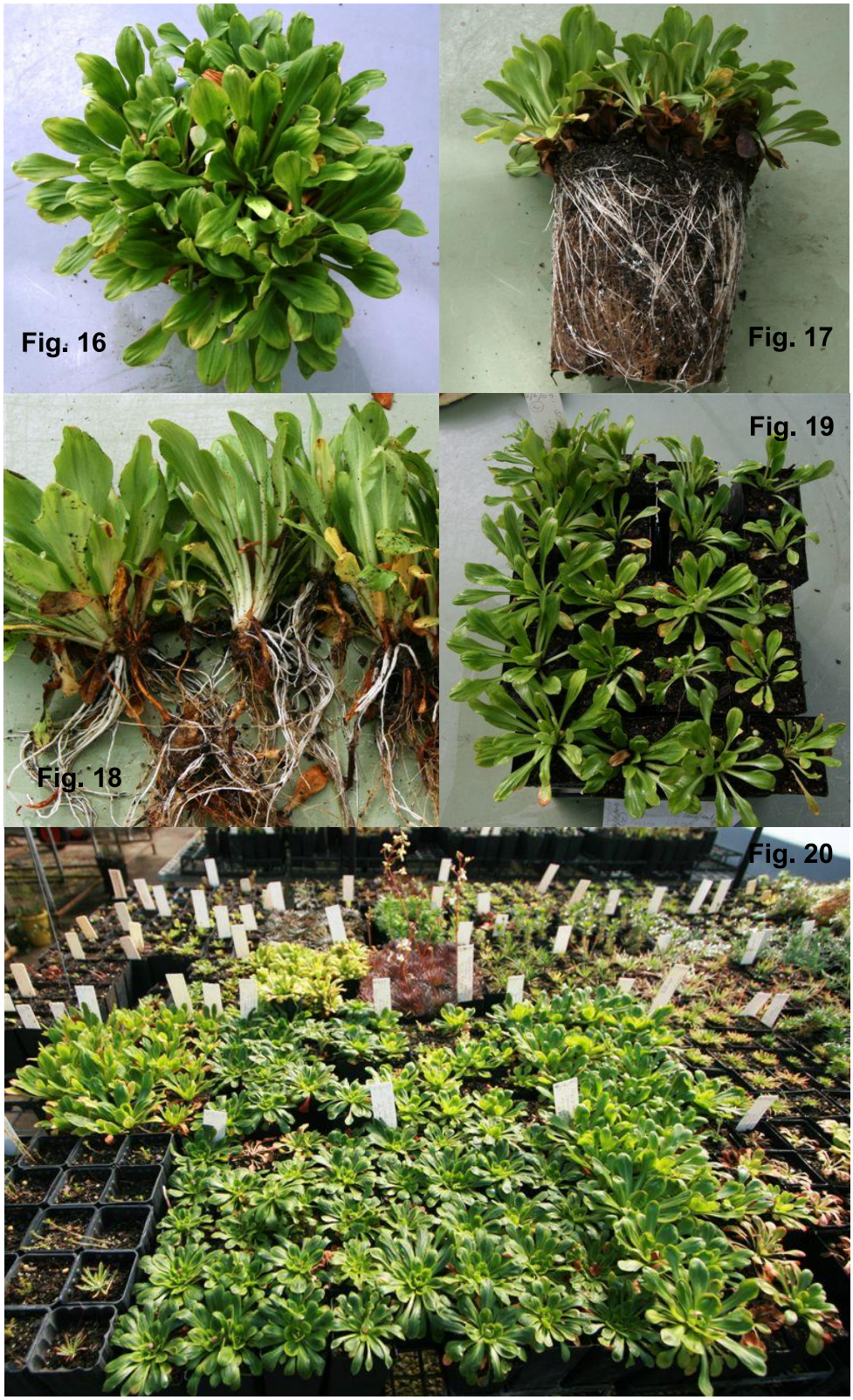

Fig. 16: *Stylidium* aff. *spathulatum* selection 3 Large leaf rosettes.
Fig. 17: *Stylidium* aff. *spathulatum* selection 3 showing new seasons roots.
Fig. 18: *Stylidium* aff. *spathulatum* selection 3 dividing sections.
Fig. 19: *Stylidium* aff. *spathulatum* selection 3 potted up.
Fig. 20: *Stylidium* aff. *spathulatum* selections growing on.

Use for plants

Like *Saxifrage* plants, *Stylidium* do well in pots, baskets and well drained raised beds but do not tolerate frost and cold temperatures and need to be sheltered in cold winter climates. The first flowering spike can be removed as soon as flowers start fading to promote more flower spikes for a longer overall flowering period.

Care of plants

Do not over water this Stylidium species especially from overhead as the tight rosettes will rot easily. Plants can be susceptible to mealy bug and scale, removing old leaves can help to keep them away.

Completely remove flower spikes after seed collection or flowering. Pots need to retain some moisture during the semi dormant dry season. Saucers placed under the pots during the dry season will maintain this soil moisture content.

References

Wege, J.A. (2006) Taxonomic observation on Stylidium spathulatum (Stylidiaceae), with the descriptions of three allied species from section Saxifragoidea. Nuytsia Vol 16:1:

Acknowedgements

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All photographs by Hazel E. Dempster
