

anther. It is a green, hairy structure, subglobose but somewhat flattened above, and has an obscure front-facing central depression that leads down into the stylar canal. Its hairs are not simple, nor are they typical round-ended stigmatic papillae — they are quite long (c. 0.2 mm) and thick-walled, and their apex is bent, hooked, or even coiled (Figs. 1, 4). To the naked eye they have a fuzzy appearance.

Discussion

A mention of the anther's viscid hairs has been made by the great German floral biologist Stefan Vogel (1925–2015), in an essay accompanying the third

volume of an encyclopaedia of flowering plant taxonomy (Vogel 1998).

The above observations were made when I was trying, unsuccessfully, to draw the flowers; it is not always enough just to “draw what you see”.

It seems that nothing much is known about these plants' pollinators in their Indian homeland. Presumably these are large moths or butterflies, with tongues long enough to reach the nectar at the base of the corolla tube. Perhaps the unusual stigmatic hairs give greater adhesion to a globule of pollen-viscin brought in by pollinators.

References

- Healy, A.J.; Edgar, E.E. 1980: *Flora of New Zealand*. Vol. 3. Government Printer, Wellington.
- Vogel, S. 1998: Floral biology. Pp. 34–48 in K. Kubitzki K. (ed.), *The families and genera of vascular plants* III: Flowering plants/Monocotyledons (Liliana). Springer, Berlin. [All the volumes of this essential work (it includes keys to the genera) are at the University of Auckland library, but, like most of the science books here, have recently been taken from the shelves and placed offsite, “On Demand”. Who will demand their return?]

The flowers of *Lobelia pedunculata* R.Br. (Campanulaceae)

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Introduction

In October last year I came across a seemingly wild colony of *Lobelia pedunculata*, in a damp grassy place by a waterway in Mt Roskill (Fig. 1). An Australian species, this pretty little herb is widely promoted by nurseries as a groundcover, and is known to persist for years in Auckland's lawns and road verges, even without watering (Ewen Cameron pers. comm.). Herbarium records, nearly all from cultivated plants, indicate that it has been in our country for more than forty years.

There was no sign that my colony was making fruit, so I dug up a portion to grow at home, to see if there was anything unusual about its pollination mechanism (and by extension, that of its relatives, including the familiar *Lobelia angulata* of northern streamsides). It turns out there is, but one would not know so from the floristic or phylogenetic literature, nor even from the usually perceptive Moore & Irwin (1978). Some of the notable floral features of these plants (mainly *L. pedunculata*), are shown in Fig. 2; see Appendix for specimens examined.

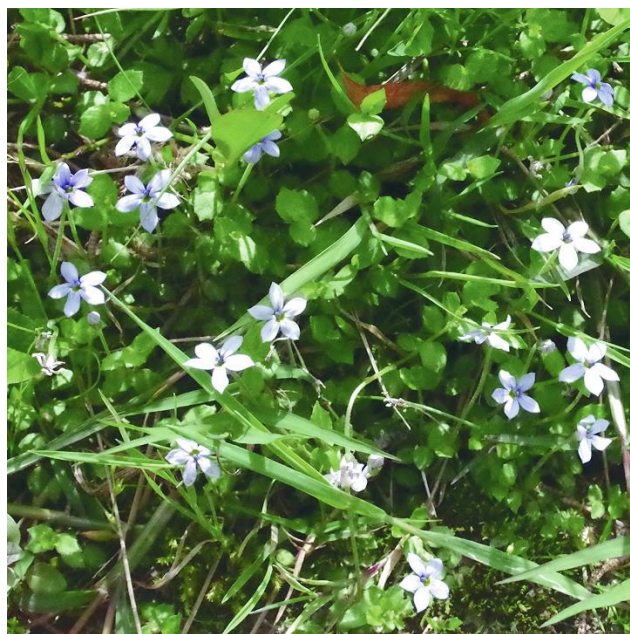


Fig. 1. *Lobelia pedunculata*. Wild colony (ROG 11453); corollas approx. 13 mm diam.; leaves to 1 cm diam. Photo ROG 20 Oct 2021. Voucher: ROG 11453. All photos by the author.

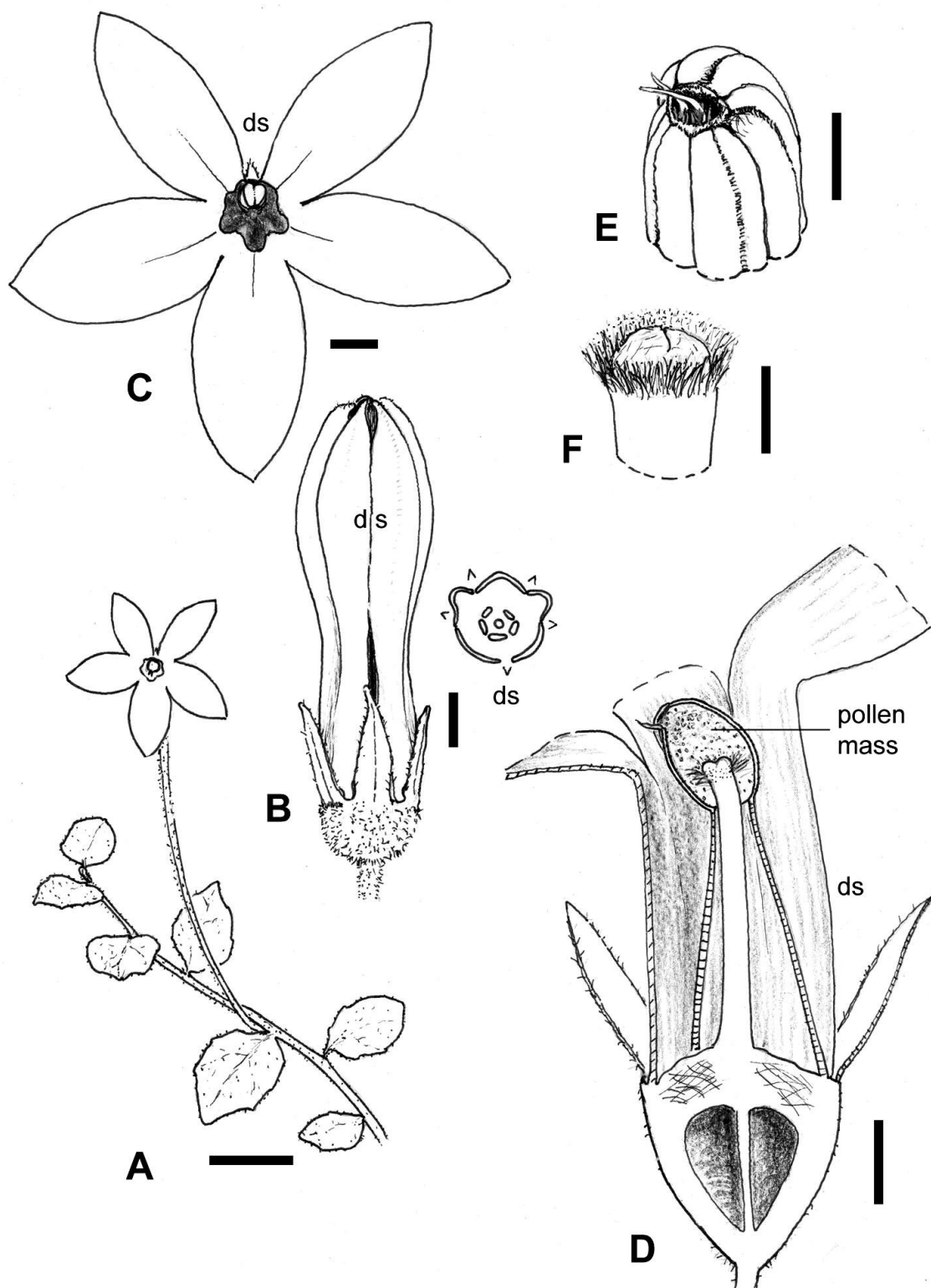
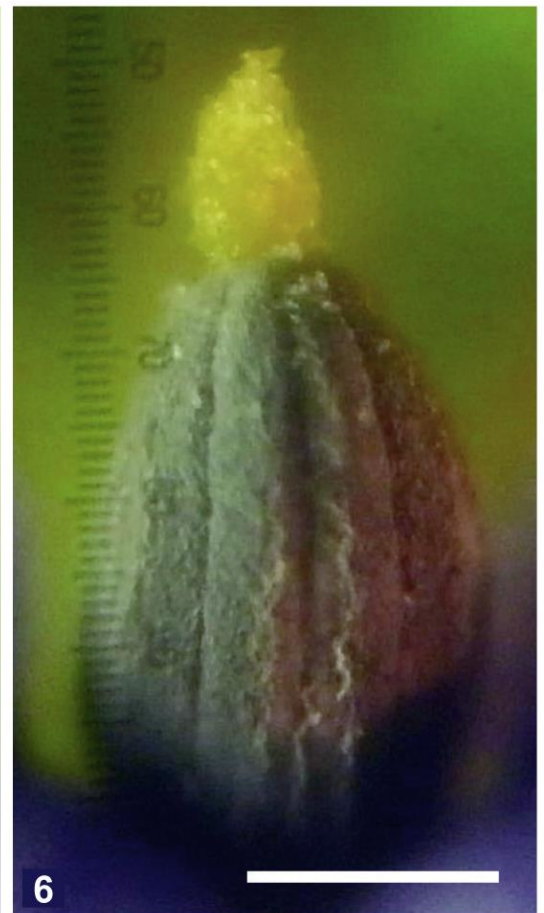
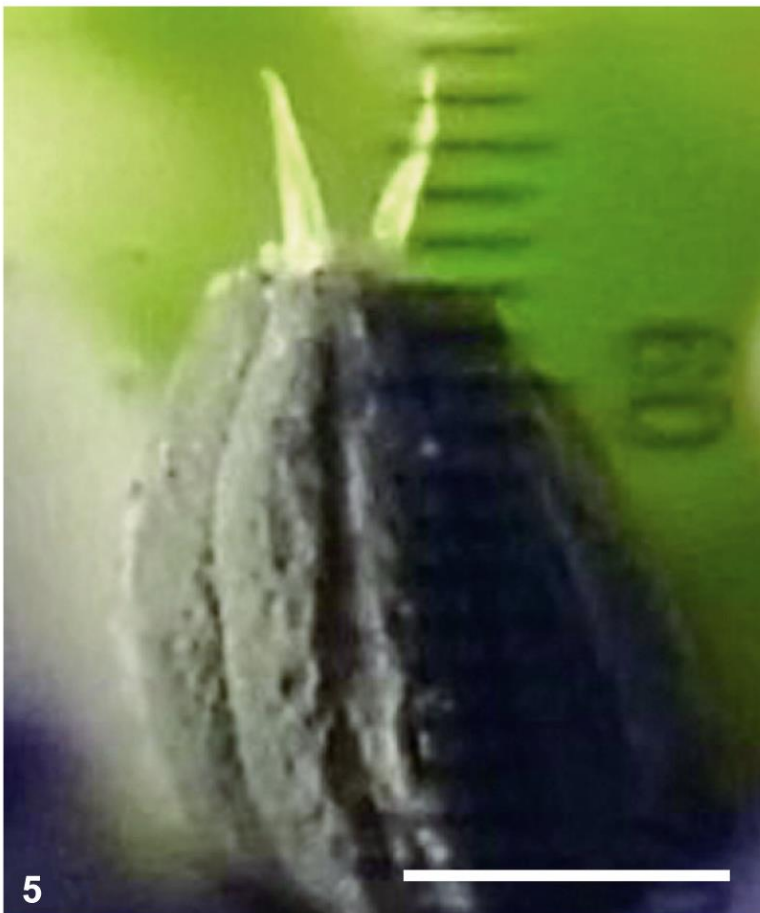
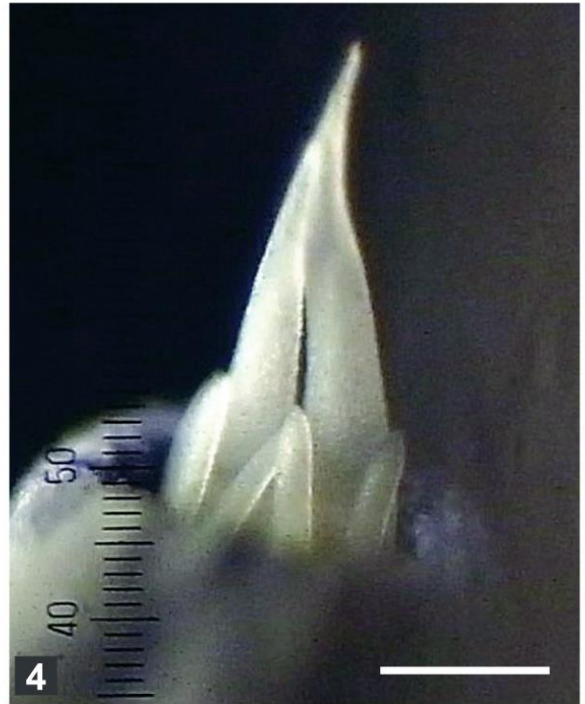


Fig. 2. *Lobelia pedunculata*, details. All based on *ROG 11453*. Drawn by the author. In B, C and D, 'ds' denotes the dorsal split in the corolla, the two dorsal corolla segments free to base. **A.** Flowering shoot. Scale bar = 1 cm. **B.** Bud (8 mm long); the dorsal split of the corolla beginning to open. On right, a transverse section halfway up corolla (2 mm diam.), showing corolla's fluting. Scale bar = 1 mm. **C.** Corolla (13 mm diam.), slightly asymmetrical, the lower three (ventral) lobes the largest. Scale bar = 1 mm. **D.** Flower in longitudinal section. Pollen mass held under pressure between the hairs around the stigma and the bristles of the lower pair of anthers at the anther-head's terminal pore. Cross-hatching indicates pale orange (glandular, nectar-secreting?) apex of ovary. Note lack of ovules in ovary. Hatching indicates cut tissues, but ovary, style and stigma, and pollen mass left unhatched for clarity. Scale bar = 1 mm. **E.** Upper part of the anther-head, the five anthers fused except at the terminal polygonal pore, this obstructed by the bases of the two trigger bristles and several smaller erect hairs. Scale bar = 0.5 mm. **F.** Stigma (hemispherical, non-functional, surrounded below by a corona of 'pollen-pushing' hairs. Scale bar = 0.5 mm.



Figs. 3–6. *Lobelia pedunculata*, floral details. All based on *ROG 11453*. **3.** Flower from above, showing colour and channelled form of corolla throat. Scale bar = 1 mm. **4.** Anther-head, viewed from below, showing the opaque pale hairs and the pair of bristles covering most of the mouth of the terminal pore. Scale bar = 0.1 mm. **5.** Anther-head from above, before stimulation of bristles. Scale bar = 0.5 mm. **6.** Anther-head from above, after stimulation of bristles, showing yellow pollen emerging from apical pore and covering bristles. Scale bar = 0.5 mm.

Flowering

My material was potted, put in a sunny place in my Auckland garden, and watered occasionally. Flowering was continuous between early November and early January, ceased for several hot, dry weeks, then restarted in plenty. As in the original colony, the size of the corolla varied somewhat, but the flowers were uniform in the morphology of their sexual parts and in the progressive changes these showed. (A confession: I should have teased out the rhizomes and grown them singly in case the colony was made up of clones with different floral morphologies, etc.).

The flowers each lasted about a week. They gave off a honey-like odour and produced a little nectar from the top of the ovary. I never saw them being visited by insects.

Morphology

The flower of *Lobelia pedunculata* contrasts with that of *L. angulata* in its nearly symmetrical rather than zygomorphic form and sub-horizontal rather than angled presentation. The largest of the corolla's five lobes is the lowest (ventral) one, and the next largest are the two lateral lobes. As often the case in the genus, the two shortest corolla lobes, each side of the dorsally positioned staminal column, are separated by a split that runs the entire length of the corolla tube.

The corolla lobes are pale blue to nearly white, with a darker midvein of indigo-violet. On the throat of the corolla tube ventrally there is a transverse band of green, which extends further into the tube on the two well-developed ridges here. Alternating with these ridges are three pale-coloured channels about half a millimetre or so wide, down which an insect would be able to extend its proboscis (Fig. 3).

In this group of plants (variously as *Hypsela*, *Isotoma*, *Laurentia*, *Lobelia*, and *Pratia*) the degree of fusion between the five stamen-filaments and the corolla has been regarded as taxonomically important. The biological interest though is at the other end of the staminal column, in what can be called the 'anther-head'. Here, around the upper part of the style, the five anthers (one dorsal, two lateral and two ventral) are fused into a short, curved, dark-coloured tube. Before the flower opens the anthers' inner walls disintegrate and the pollen, produced in some fair quantity, is shed into the tube. The upper part of the style is enclosed in this tube. It now grows forward and the stigma

(as yet unreceptive and unexpanded), together with its corona of 'pollen-pushing hairs', begin to put the pollen under pressure. Eventually, the pollen mass reaches the pore at the tip of the anther-head, where it can be contacted by a visiting insect.

In *L. pedunculata* and *L. angulata*, and also in *L. purpurascens* and related taxa, there is a remarkable refinement of this 'piston method' of pollen discharge. In these plants, the tip of the lower (ventral) pair of anthers carries, as a continuation of the anther-connectives, a number of pale, robust hairs: a conspicuous outwardly curved pair of long-triangular bristles, and several shorter, terete, vertically-standing ones (Fig. 4). The bases of these hairs form a barrier across the anther-head's terminal pore.

The two long bristles (sometimes termed 'setae') are trigger-hairs. The anther-head itself is not touch-sensitive, but lightly depressing one or both bristles causes a sudden extrusion of pollen in a cylindrical mass, and this continues for a second or so (Figs. 5, 6). Subsequent responses soon diminish to zero. A little experimenting indicates that pressure can be regained in just a few hours.

My observations find confirmation in an article by versatile Kew botanist Ronald Melville (1960). His work was itself a rediscovery, the mechanism having first been noticed nearly a hundred years previously, in a plant named there as *Isotoma axillaris* (for reference see Knuth 1909: 3).

In my cultivated *L. pedunculata*, if there had been no human or insect visitors to set off the discharge mechanism, the stigma would have eventually reached the pore but no pollen would have been shed. The flower would then have begun to wilt. In other species of *Lobelia* though, including *L. angulata*, the style grows out beyond the pore and the stigma's upper and lower lips expand and recurve to expose their receptive papillae—the flower here is now in its female phase (Fig. 7).

In my *L. pedunculata*, and in the only colony of *L. purpurascens* I have seen, the ovaries lack ovules, so these plants are male. Nor is there any mention of fruit on the herbarium labels (AK, CHR, WELT) of New Zealand-grown plants of *L. pedunculata*. However, a specimen collected from coastal forest near Raglan (AK 209224, annotated "female" by its collector) appears to bear at least one (immature) fruit.



Figs. 7 & 8: **7.** *Lobelia angulata*. Side-views of anther-head and stigma. Left: male phase, the long-triangular pair of bristles conspicuous, stigma enclosed. Right: female phase, the stigma emergent, receptive. Scale bar = 1 mm. **8.** *Lobelia anceps*. Ventral view of anther-head. Material from Hillsborough coast, not vouchered. Scale bar = 1 mm.

As an aside, I note that our very common (indeed, rather taken for granted) coastal herb *Lobelia anceps* has vestigial trigger-hairs and a stigma that seems never to extend beyond the anther-head pore. So, because it fruits abundantly, I think it is probably a self-pollinator. This might be a piece of 'natural wisdom', the appearance of its

anther-head being, to human eyes at least, just as likely to scare off as to attract (Fig. 8).

Acknowledgements

Ewen Cameron and Marley Ford took a helpful interest in the topic.

References

- Knuth, P. 1909: *Handbook of flower pollination*. Vol. 3. Oxford University Press.
 Melville, R. 1960: Contributions to the flora of Australia, VI. The pollination mechanism of *Isotoma axillaris* Lindl. and the generic status of *Isotoma*. *Kew Bulletin* 14: 277–79.
 Moore, L.B.; Irwin, J.B. 1978: *The Oxford book of New Zealand plants*. OUP.

Appendix: List of *Lobelia* specimens examined. All held in Auckland Museum Herbarium (AK).

Lobelia angulata

AK 384237 coll. *ROG 11468*, 17 Nov 2021, Auckland, Western Springs, Stadium Rd, common in the several roadside native-plant beds, flowering in abundance and much fruit developing.

Lobelia pedunculata

AK 277082 coll. *E.K. Cameron*, 15 Feb 1988, Auckland, Balmoral, 12 Thames St, originally planted and now [extensive] in lawn.

AK 209224 coll. *P.J. de Lange*, 13 May 1992, cult. Percy Reserve, Petone, from plant wild on trackside in coastal forest at Maungaakohe nr Taharoa (Kawhia District), "plants all female".

AK 210580 coll. *E.D. Hatch*, 15 Nov 1992, Laingholm, opposite 115 Victory Rd, occ. on grass verge.

AK 360558 coll. *C. Kilgour*, 16 Dec 2011, South Auckland, Mauku, Gearon Rd, occ. in lawn and along driveway.

AK 384238 coll. *ROG 11453*, 20 Oct 2021, Auckland, Wesley, upper Oakley Creek in Mt Roskill War Memorial Park, a small colony in damp muddy grass at edge of concreted waterway, not seen elsewhere in park and not present at rear of neighbouring properties.

Lobelia purpurascens

AK 231041 coll. *K. Massey*, 28 Jan 1997, North Auckland, Kerikeri, nr the Stone Store, common in gardens here, originally planted?

AK 384239 coll. *ROG 11460*, 14 Nov 2021, Auckland Domain, nr foot of Lover's Lane, spreading up shaded roadside bank at forest edge; no fruit seen.