The flowers of *Leucopogon fasciculatus* (Ericaceae)

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Introduction

Long ago the great Kew botanist George Bentham reported "partial dioecism" in some Australian members of what was then called the Epacridaceae (see Smith-White 1959, p.23). It took another century to get confirmation from the New Zealand flora, but in fact, both of our common and widespread 'mingimingi' epacrids, *Leptecophylla juniperina* and *Leucopogon fasciculatus*, share the same kind of sexual dimorphism: they are functionally dioecious.

Godley (1957) first made the critical observations for these two species. He found that female plants had small, pollen-less anthers, and that, although the gynoecium in what he termed the "apparent hermaphrodites" was not very much smaller than in the females, this other form did not make fruit and so acted as male. Certainly, a look at populations of these species at the right time of year (Fig. 1) will show that some bushes have set a great deal of fruit while others are fruitless or, at least in *L. juniperina* (Gardner 2011), have very few fruit indeed.

Since fruitless plants might simply result from a lack of effective pollination I undertook a closer examination of the flowers of *L. fasciculatus* (see Footnote for a summary of the dimorphism in *Leptecophylla*). *S*ex-ratio counts were also made. These studies were carried out during the months of flowering (late August to mid-September) in 201l & 2012.

Floral morphology of *Leucopogon fasciculatus*

The dainty, pendent inflorescences seem to be produced in similar abundance in each sex. Nor do they differ much in size; however, male trees tend to catch the eye more (a problem in sampling for sex-ratio) because their flowers have a slightly larger corolla (Figs. 2 & 3). Both sexes produce a small amount of nectar, presumably from the greenish fleshy pads around the base of the ovary, and both emit a pleasant floral-honey fragrance that seems stronger at midday than at dusk.

In male flowers (Godley's "apparent hermaphrodites") the anthers are 0.75 mm long and are filled with cream-coloured, loosely coherent pollen; they dehisce shortly before the corolla opens. The gynoecium tends to be 2-locular, but the 3-locular condition is not infrequent. Each locule contains a single ellipsoid ovule. The truncate, papillose stigma is like that of the female but slightly smaller (as is the style). In female flowers the anthers are only c. 0.5 mm long, and although they

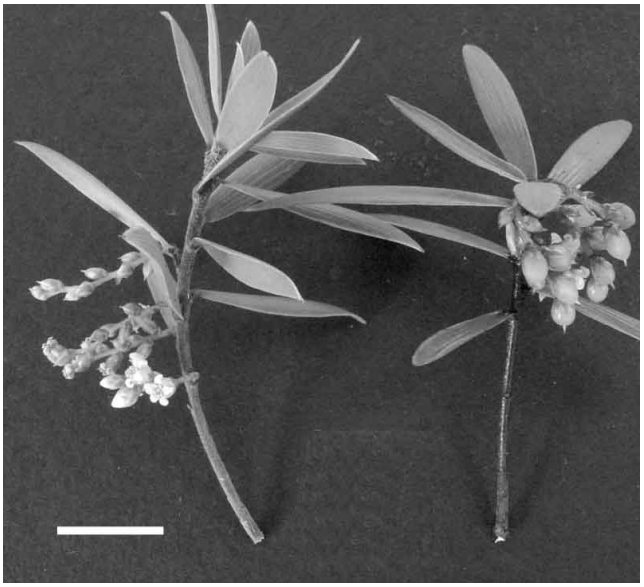

Fig. 1. *Leucopogon fasciculatus*, ageing inflorescences. Left: male. Right: female, most flowers swelling into fruit. Scale: 1 cm. Photo: R. Gardner, Green Bay, 12 Oct.

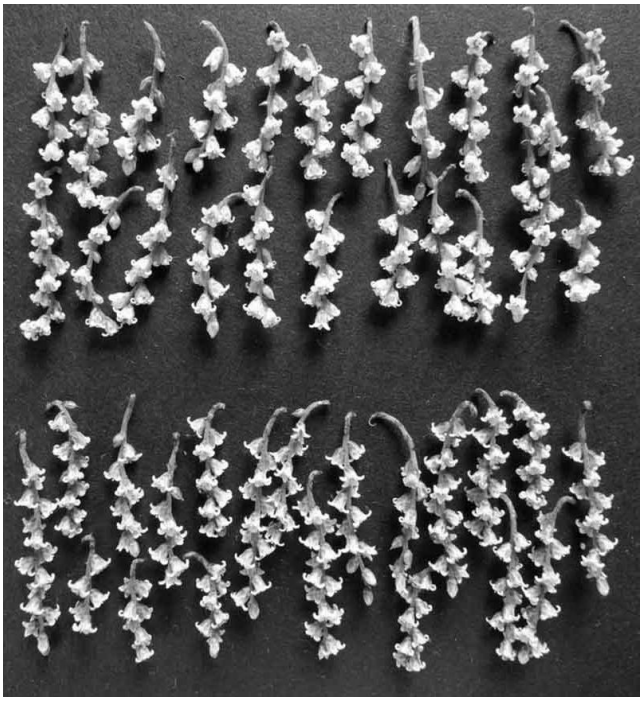

Fig. 2. *Leucopogon fasciculatus*, inflorescences from several individuals. Above: males. Below: females. Inflorescences are c. 3 cm long. Photo: R. Gardner, Craigavon Park, 26 Sept 2012.

Footnote:

Weiller (1999), in establishing the genus *Leptecophylla* (12 spp.; Micronesia, New Guinea, Australia, New Zealand, Rapa I., eastern Polynesia and Hawaii), has described it as having flowers that are "effectively unisexual (the plants dioecious)". Female flowers are said to have anthers reduced in size and empty of pollen, while male flowers have a reduced gynoecium, and fruit set on such plants is said to be "rare and usually small and malformed" (Weiller 1999: 199). The sex-ratio is said generally to be 1:1. My counts for several Auckland populations (Gardner 2011) are in agreement.

dehisce as the flowers open they have no pollen at all. The gynoecium tends to be 3-locular, and the ovules are c. 0.37 mm long, somewhat larger than those of the males. As in the male flowers the female's corolla lobes are densely clothed over their densely clothed over their recurved surface with stout crisped hairs.

In both sexes, just before anthesis and for a day or more afterwards, the stigma is covered by a drop of clear viscid fluid (Fig. 4). Casual observation of male flowers suggests that pollen grains on the surface of this drop do not germinate.

The floral dimorphism is summarized in the diagram of Fig. 5. Moore & Irwin (1978) illustrate various aspects of the female flower.

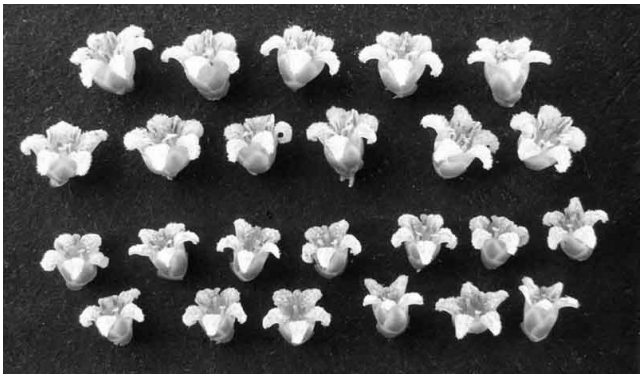

Fig. 3. *L. fasciculatus*, flowers. Upper two rows: males. Lower two rows: females. Male flowers as seen from above, including corolla lobes, are almost 4 mm in diameter. Photo: R. Gardner, Green Bay, 25 Sept 2012.

Fig. 4. *L. fasciculatus*. Showing drop of viscid fluid c. 0.2 mm diam. on stigma of newly-opened male flower. Photo: R. Gardner, Green Bay, 26 Sept 2012.

Table 1: Details of populations investigated.

***Leucopogon fasciculatus* populations, sex-ratio**	
Avondale South Domain, woodland of pines and wattles over native scrub	
Sampled 9 September 2011:	32 male, 23 female
Sampled 27 August 2012:	18 male, 16 female
Hillsborough Cemetery, scrub of tall *Leptospermum scoparium*	
Sampled 27 August 2012:	27 male, 12 female
Craigavon Park, woodland of pines over native scrub	
Sampled 27 & 30 August 2012:	66 male, 42 female
Kendall Bay, tall *Kunzea ericoides* scrub	
Sampled 31 August 2012:	44 male, 17 female
Waikumete Cemetery, woodland of eucalypts and native scrub	
Sampled 7 September 2012:	22 male, 13 female

Fruit-set

In order to tell something about the comparative ability of the two sexes to produce fruit it is necessary to work with marked individuals, because fruiting inflorescences do not persist on the plant into the next flowering season. I have made such observations on only four plants, at 178 Cliff View Drive, Green Bay. In January 2013 two 'males' lacked fruit entirely, while two females had a fruit (and seed) set of moderate degree (most inflorescences having set at least 20% of their flowers).

Sex-ratio

All populations investigated (see Table 1) consisted mainly of healthy small trees that seem likely to be of middling age for the species (most having trunks c. 2 m tall and 5 cm basal diameter) — at least, they do not contain many newly-matured individuals. This is important because it has sometimes been found (and more often, claimed) that in general, male trees tend to become sexually mature some years earlier than females, thus biasing the sex-ratio, especially in young, even-aged populations.

The sex-ratio counts for these *L. fasciculatus* populations show a significant departure from the 1:1 ratio to be expected from dioecious trees. Males were consistently more frequent than females. The pooled totals for these counts is 209 males, 123 females.

Discussion

The morphology of the sexual dimorphism in *Leucopogon fasciculatus* closely parallels that of *Leptecophylla juniperina* (Gardner 2011). For both species one would now like to know whether or not the male flowers require to be outcrossed in order to set fruit, that is, whether their low degree of set (as seen at least in the latter species) is due to sporadic

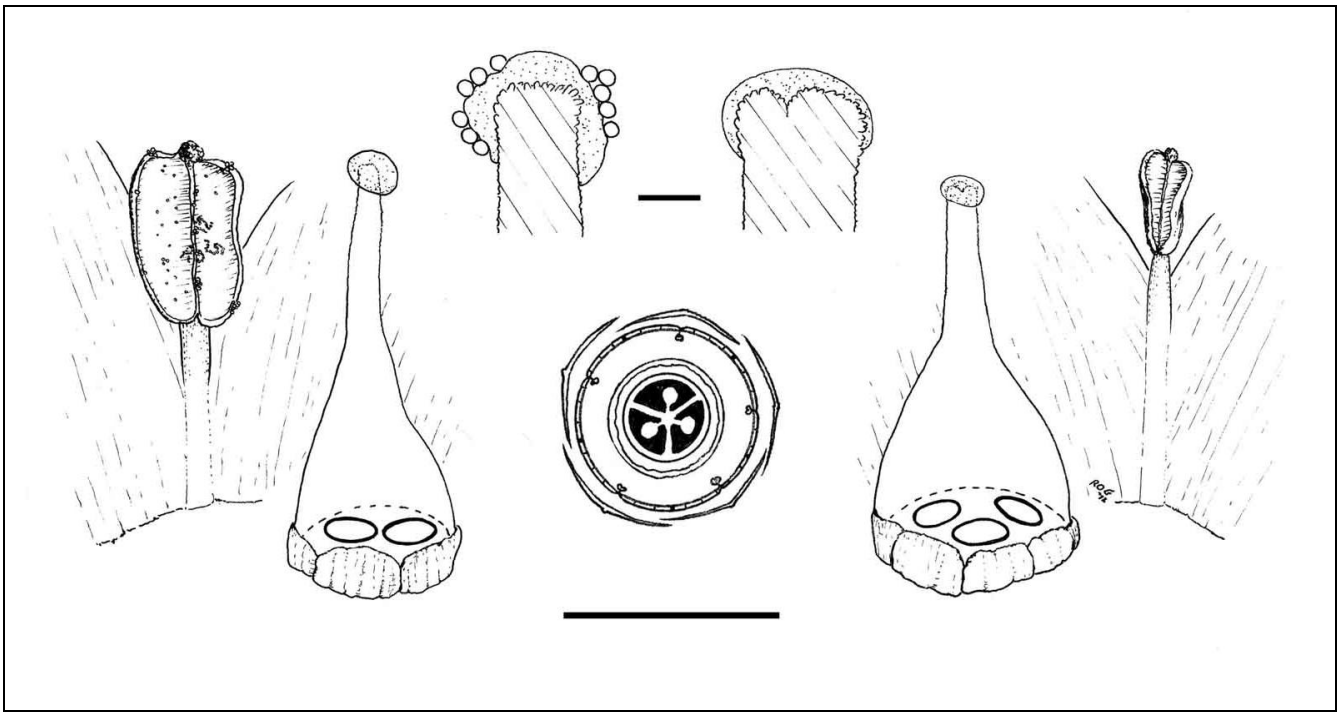

Fig. 5. *Leucopogon fasciculatus*, floral morphology and floral diagram (centre). Left: male, showing anther, ovary, and stigma. Right: female, as for male. Larger scale bar 1 mm; shorter scale bar for stigmas only, 0.1 mm. Vouchers: male (*ROG 11179*), female (*ROG 11180*), both from Avondale South Domain, 31 Aug 2012.

failure of a self-incompatibility system. As usual, too, one would want to do bagging experiments on the females, to rule out apomixis, although the abundance of 'male' plants argues against this being a significant complication.

Populations of *Leptecophylla juniperina* from west Auckland exhibit the 1:1 ratio often found in dioecious trees (Gardner 2011). The departure from this ratio in *Leucopogon fasciculatus*, from the same region and with a very similar floral morphology, is then rather odd. It could be suggested that in this latter species female trees have a higher mortality than 'males', but then, why not in the former species too, especially since its females have relatively large flowers and fruit?

References

Gardner, R. 2011: Sex ratios of some trees native to New Zealand. *Auckland Botanical Society Journal* 66: 151-155.
Godley, E. J. 1957: Unisexual flowers in the Ericales. *Nature* 180: 284-285.
Moore, L.B.; Irwin, J.B. 1978: *The Oxford book of New Zealand plants*. O.U.P., Wellington.
Smith-White, S. 1959: Pollen development patterns in the Epacridaceae. *Proceedings of the Linnaean Society of New South Wales* 84: 8-35.
Weiller, C. M. 1999: *Leptecophylla*, a new genus for species previously included in *Cyathodes* (Epacridaceae). *Muelleria* 12: 195-214.