Short note

Gender dimorphism in *Toronia toru* (Proteaceae)

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Abstract

Toronia toru (Proteaceae), endemic to New Zealand, shows gender dimorphism. Some trees are male (flowers pollen-bearing, ovule(s) well-formed but always infertile). Others are female (flowers with stamens reduced in size and lacking pollen). Also, in the principal population studied, two trees with pollen-bearing flowers set (in some years) a substantial amount of fruit. The situation is tentatively classified as one of "leaky dioecy".

Keywords: gender - floral morphology - *Toronia* - *Persoonia* - Proteaceae.

Introduction

The New Zealand flowering-plant flora is known to have a high incidence of dioecism and related conditions (Webb *et al.* 1999). A recent addition in this respect (Braggins *et al.* 1999; Gardner 2007) was *Dysoxylum spectabile* (Meliaceae). Here I discuss another familiar New Zealand native tree whose gender dimorphism has been overlooked, *Toronia toru* (A.Cunn.) L.A.S Johnson & B.G. Briggs.

Toronia toru, here called by its Maori name toru, is a small bushy tree of northern New Zealand's low-altitude forests. It is most often seen on impoverished, dryish soils, in scrub dominated by kanuka (*Kunzea ericoides*), this often successional after destruction of kauri (*Agathis australis*) forest. Its fruit is a small, red-purple, usually 1-seeded drupe. In ecological character toru appears not so very different from the numerous species of the Australian genus *Persoonia*, from which *Toronia* was segregated (Johnson & Briggs 1975; Moore & Irwin 1978).

Materials and Methods

Since 1999 I have repeatedly examined toru trees in the Auckland region, and especially those in kanuka scrub above Kendall Bay on Auckland's North Shore (Waitemata Harbour); the observations reported here are based solely on this population. These trees are numerous and accessible, and many are well into

adulthood, reaching c. 8 m tall and 15 cm dbh. Voucher specimens are held at AK (Auckland War Memorial Museum herbarium). They are: *ROG 9265*, *10206*, *10389*, *10398*, *10432*, *10587*, *10588*, *10591*, *10871*, *10872*.

Observations

Toru begins to flower at Kendall Bay in early spring, in the first or second week of September, and flowering is largely over by mid-late October. The flowers are arranged in racemes, which are aggregated one per axil among the upper leaves of the most recent flush of growth. Each flush is terminated by a vegetative bud that is dormant at the time of flowering. The lower racemes on a flush begin and finish flowering earlier than the upper ones, but there is a fair degree of overlap. The raceme, c. 3 - 5 cm long, bears a dozen or so well-spaced flowers, and again, the direction of flower-opening is acropetal, i.e. the lower flowers open first. The flowers are mostly erectly to subpatently orientated, with few facing down towards the ground. I have not observed actual flower-opening but suspect it occurs early in the morning. Flowers remain open for several days before dropping their tepals.

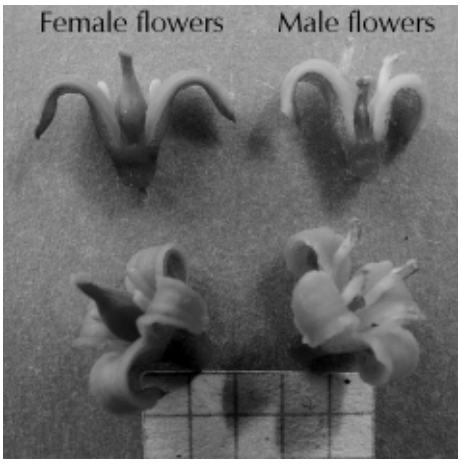
Most authors, for example Moore & Irwin (1978), say that toru's flowers are yellowish. In fact, on their first day of opening, the flowers (that is, the four reflexed tepals) show as creamy pink with streaks of crimson. They become yellowish-orange only on their second day (when the crimson of the abaxial side of the staminal filaments is lost too). The flowers have nectar and a pleasant "honey" scent, but I have never seen insects, lizards or birds visiting them.

In the Kendall Bay population there are three kinds of flower: female, male, and hermaphrodite; the first two are shown in Figure 1. No instance of flowers of a single tree being other than uniform in morphology has been seen, nor any of a tree changing between male and female. The flowers of each gender are approximately the same size, and inflorescence characters that correlate with gender seem to be lacking too.

The female flowers are distinctive in their large capitate stigma and large ovary with usually 2 - 3 ovules. They have short staminodes, whose hardly-differentiated anthers lack pollen and never dehisce. When a female flower drops its tepals the ovary persists for at least a week or so, whereas the ovaries of male flowers drop with the tepals. Moore & Irwin (1978) have illustrated the female inflorescence and its flowers and fruit.

The male flowers have a relatively small stigma whose margin hardly overhangs the top of the style. It seems that this stigma is unreceptive - even in newly opened (pink-cream) flowers it

Figure 1. *Toronia toru*. Flowers. Squares on scale are 1 cm wide. Material from Kendall Bay population (not vouchered). Left. Female flowers (upper one dissected). Note short staminodes and robust ovary. Right. Male flowers (upper one dissected). Note exserted anthers and short slender ovary.



has already darkened and dried somewhat. Male flowers have one or two well-formed ovules - I have never observed an empty ovary. The anthers are slightly exserted and relatively large, and dehisce introrsely to expose their only moderately sticky white pollen. As in *Persoonia*, a secondary pollen-presentation mechanism, otherwise common in the family, is lacking.

Hermaprodite flowers, which I have seen only on two trees, appear identical to those of males, except that their stigma does not darken soon after anthesis.

The ratio of the three genders in the Kendall Bay population has not been rigorously determined, partly because of the difficulty of distinguishing males and hermaphrodites - this requires observation at just the right time to see both the stamens/staminodes of the remaining flowers and whether or not some ovaries are persisting. Also, each year there are some trees "doing nothing": are they resting (from a previously heavy fruit crop, perhaps), or are they too shaded to flower every year? In September 2004, a very good flowering season, I recorded 30 pollen-bearing trees and 18 females. In September 2006, a notably poorer year, another sampling gave a ratio of 13:13. In October 2007, another rather poor year, sampling gave a ratio of 21: 11.

The amount of fruit set by females is low, perhaps of the order of one seed per fifty to a hundred ovules. Trees with male flowers never set any fruit. The two hermaphrodite trees have, however, in some years set a considerable amount of fruit and viable-looking seed (voucher for one of these trees: *ROG 10432*). In other years their fruits have been very few or completely lacking, so presumably the trees are then functioning just as males.

Discussion

Because the majority of trees with pollen-bearing flowers never make fruit, and because the two hermaphrodite trees sometimes function largely or entirely as males, I judge the situation is best described as "leaky dioecy" rather than gynodioecy or trioecy.

Floral dimorphism does not seem to be known in *Persoonia* (98 species, all endemic to Australia; Weston 1995) nor in its nearest relatives *Garnieria* of New Caledonia and *Acidonia* of south-western Australia (Weston 1995, 2007). So this condition in toru can be presumed to have evolved in New Zealand, in response to factors as yet undetermined (Webb *et al.* 1999).

Acknowledgements

John Braggins mentioned to me that while studying kohekohe he had also observed sexual variation in toru. I am grateful to him for sharing that find. In reviewing the manuscript, Phil Garnock-Jones advised on terminology.

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