Titoki (*Alectryon excelsus*, Sapindaceae) revisited

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Several years ago I examined the flowering of the titoki trees planted near Auckland's Eden Park (Gardner 2008). Somewhat more than half were found to bear just male flowers, while most of the others (that is, disregarding a few trees of mixed gender) bore flowers of "apparently bisexual" appearance (Fig. 1). It was suggested then that the species might be androdioecious. In fact, this condition is rare in the flowering-plants at large, much rarer than either dioecy or gynodioecy, and I should have been on guard.

The older literature is imprecise on the matter of titoki's sexuality. In using the term "apparently bisexual" for some of the flowers I followed the lead of Moore & Irwin (1978) — see for example their illustration of a "flower, bisexual in form" showing its plump anthers. I myself had gone slightly further, and had squashed out the pollen grains of such anthers, to find nothing aberrant about their shape or staining capabilities (with acetocarmine, or iodine).

But to my dismay, a look at the same population in December 2012 disclosed a vital oversight: the stamens of these "apparently bisexual" flowers hardly elongate and their anthers, despite being filled with pollen, never open. This, and the confirmatory illustrations of Moore & Irwin (1978), Eagle (2006), and Dawson & Lucas (2011), then indicate that the species should be described as exhibiting "functional dioecy". The Sapindaceae is well-known for having a great variety of sexual arrangements, so it seems unlikely that this late prevention of bisexuality is unique in the family. It does suggest though that the advantage of having distinct male and female sexes is strong enough to outweigh the waste in producing pollen that is never shed.

Fig. 1. ***Alectryon excelsus.*** **Above: pieces of male inflorescence, some flowers with anthers dehiscing. Below: "apparently bisexual" [female] inflorescence. Scalebar: 1 cm. From trees cultivated in King Edward Ave, Sandringham. Not vouchered. Photo: R. Gardner, 16 Jan 2013.**

The Eden Park population was revisited because I had intended to check its sex-ratio. This was not completed (see Appendix) but several of my earlier observations were confirmed or enlarged on, as follows:

1. Several male trees also bore a few last-season infructescences. Rarely, one branch of an otherwise male inflorescence of the current season consisted entirely of female flowers.

2. Female inflorescences tend to be more compact than male ones. A few male flowers may be produced here and there within predominantly female inflorescences.

3. The cushion-shaped disc around the base of the staminal filaments is a conspicuous feature of both sexes, but the quantity of nectar produced is slight — even in males, at the time the anthers first open, on the hotter days of the season. If indeed a supply of pollen is the main attractant for insect pollinators we can see why the female flowers might have "decided" to retain their conspicuous red stamens — that is, to deceive. I cannot guess what the native pollinators might be. Even honey-bees and bumblebees are only infrequent visitors to my street trees (and there is no such thing as "titoki honey"!).

4. Despite the apparent lack of insect pollinators the female trees have a very high level of fruit-set. Perhaps pollination by wind is sufficiently effective.

References

Dawson, J.; Lucas, R. 2011: *New Zealand Native Trees*. Craig Potton Publishing, Nelson.
Eagle, A. 2006: *Eagle's Complete Trees and Shrubs of New Zealand*. Te Papa Press, Wellington.
Gardner, R. 2008: Sex in the city: flowers and fruit of titoki (*Alectryon excelsus*, Sapindacae). *Auckland Botanical Society Journal* 63: 32–33.
Moore, L.B.; Irwin, J.B. 1978: *The Oxford book of New Zealand plants*. O.U.P., Wellington.

Appendix: Counting of the sexes was done less extensively in Jan 2013 because I decided instead to measure the relative size of male and female trees, to test the claim that females tend to be disadvantaged in their vegetative growth (as a consequence of their supposedly spending more on reproduction than males).

Two sub-populations, one of Walters Road, the other of Altham Avenue, were studied. Except for a handful of obviously much younger "replacements", which were not counted, these trees are likely to be at least 40 years old.

Flowering in early January was generally copious, with all trees having at least a few inflorescences; that is, there were no "resting" ones of unknown sex.

The size of the tree was assessed (diameter to the nearest 5 cm) at c. 20 cm above ground level, just above the contorted basal growth.

Since the observations (basal diameter, in cm) are not especially numerous they are listed in full:

Walters Rd
16 male trees: 25, 30, 35, 35, 35, 35, 40, 40, 40, 40, 50, 50, 50, 50, 55, 55
13 female trees: 30, 30, 35, 35, 35, 35, 40, 40, 45, 45, 50, 50, 50

Altham Ave
14 male trees: 15, 15, 25, 25, 30, 35, 35. 35, 35, 35, 35, 40, 40, 40
20 female trees: 10, 15, 15, 15, 20, 20, 20, 20, 25, 25, 30, 30, 35, 35, 35, 40, 40, 40, 45, 50

Nothing here suggests that male and female titoki have dissimilar growth rates. It is also simplest to suppose that these (presumably seed-derived) populations had an approximately 1: 1 sex ratio when planted, which has not been altered by differential survival of the sexes over c. 40 years or more.