Nuytsia The journal of the Western Australian Herbarium

32: 59–61 Published online 24 June 2021

Review of the infrageneric classification of *Adenanthos* (Proteaceae)—the subsections of *Adenanthos* are polyphyletic

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SHORT COMMUNICATION

Adenanthos Labill. (Proteaceae) is an endemic Australian genus comprising 31 species (Nge *et al.* 2021). Most species are restricted to southwest Western Australia, with two in South Australia. The genus was divided into two sections, sect. *Eurylaema* Benth. and sect. *Adenanthos* Benth., by Bentham (1870) based on anther and style morphology (Figure 1).

Nelson (1978), in the most recent full revision of the genus, erected a subsection (subsect. *Anaclastos* E.C.Nelson) within sect. *Adenanthos* (thus also establishing the autonymic subsect. *Adenanthos*) based on the single character of perianth length (Figure 1).

***Adenanthos* sect. *Eurylaema* Benth.**

One anther sterile; style-end flattened, much broader than style

(3 species: *A. detmoldii* F.Muell., *A. barbiger* Lindl., *A. obovatus* Labill.)

Adenanthos* sect. *Adenanthos

All anthers fertile; style-end conical, not broader than style

(All remaining species)

subsect. *Anaclastos* E.C.Nelson

Perianth 10–15 mm long

(3 species: *A. apiculatus* R.Br., *A. dobagii* E.C.Nelson, *A. drummondii* Meisn.)

subsect. *Adenanthos*

Perianth > 15 mm long

(All remaining species)

Figure 1. Nelson's (1978) infrageneric classification of *Adenanthos*, with diagnostic characters and species numbers.

https://florabase.dpaw.wa.gov.au/nuytsia/
ISSN 2200-2790 (Online)
ISSN 0085-4417 (Print)

Nge *et al.* (2021) have shown that the two sections are reciprocally monophyletic, but the two subsections of sect. *Adenanthos* are polyphyletic, with strong support, in Bayesian and Maximum Likelihood phylogenetic analyses using nuclear and chloroplast gene sequences. The three species of *A.* subsect. *Anaclastos* are nested within other clades comprising taxa belonging to *A.* subsect. *Adenanthos* (Figure 2).

Polyphyly of the subsections in the chloroplast topology could be attributed to introgression and chloroplast capture, which was shown to be very common within *Adenanthos* (Nge *et al.* 2021). However, polyphyly is also strongly supported in analyses based on 35 nuclear gene regions, and these are expected to provide a more accurate estimation of the species phylogeny. The nuclear topologies of Nge *et al.* (2021), from both coalescent and concatenated analyses, are largely congruent with morphological delimitations of species in *Adenanthos.*

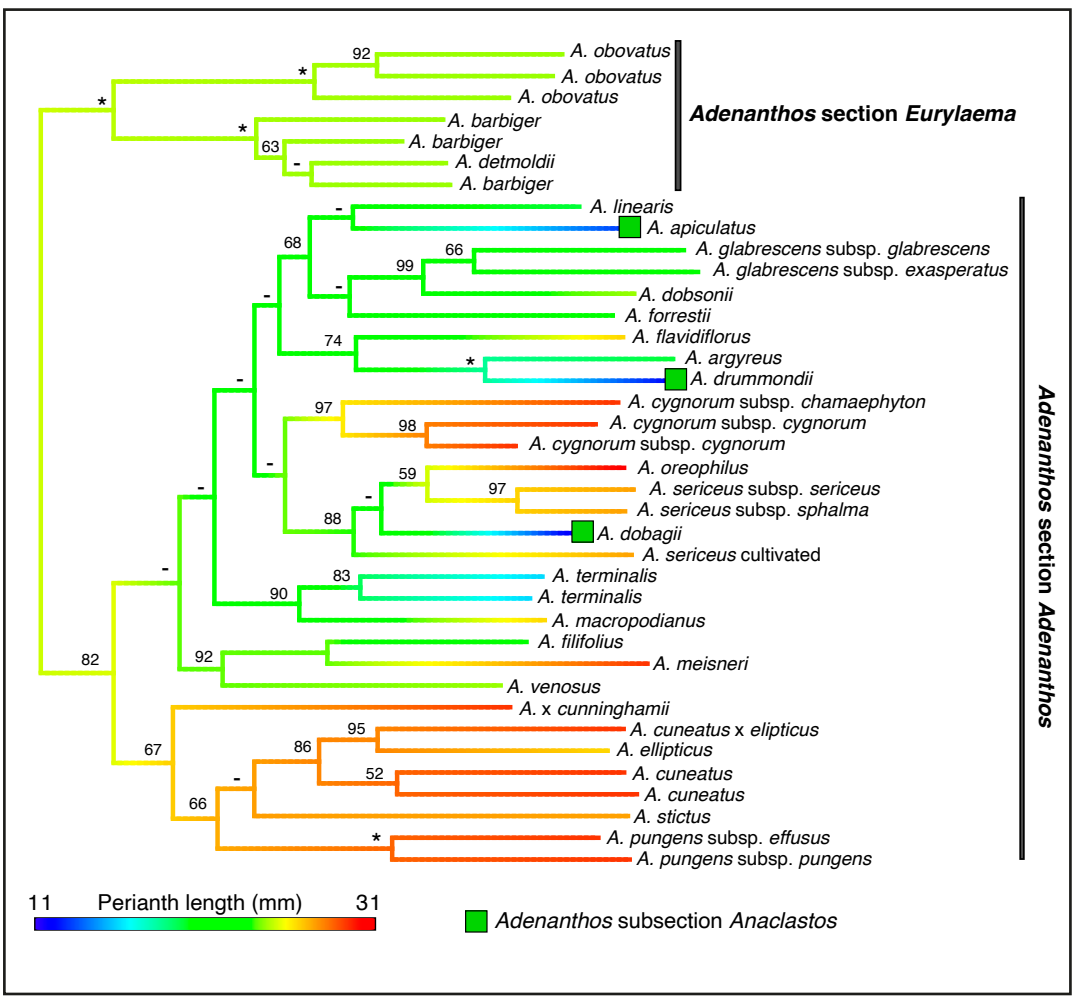

Figure 2. The floral character used to delimit *Adenanthos* subsect. *Anaclastos* (perianth length) mapped onto a Maximum Likelihood RAxML phylogram of *Adenanthos,* based on 35 nuclear genes, using the 'anc.ML' function in the phytools package in R (R Core Team 2016). Perianth length (mm) is coloured from blue–red (short–long). The three species in *A.* subsect. *Anaclastos* are highlighted with green squares. Bootstrap support values are indicated at each node (very strongly supported branches [100 bootstrap] are represented by '*', weakly supported branches [< 50 bootstrap] are represented by '-'). The tree was sourced and adapted from Nge *et al.* (2021).

Short and long perianths have both evolved multiple times independently in the genus (Figure 2), presumably as adaptations to different pollinators. The placement of species in the two subsections based on whether the perianth is 10–15 mm long (subsect. *Anaclastos*) or > 15 mm long (subsect. *Adenanthos*) is not supported phylogenetically. Accordingly, the sections, but not the subsections, are accepted here as infrageneric taxa in *Adenanthos* and subsect. *Anaclastos* is reduced to a synonym of sect. *Eurylaema*.

Revised classification

Adenanthos Labill., *Pl. Nov. Holl*. i. 28. t. 36 (1804). *Lecto*: *Adenanthos cuneatus* Labill., *fide* E.C. Nelson, *Brunonia* 1: 316 (1978) [as *A. cuneata*].

Adenanthos sect. **Eurylaema** Benth., *Fl. Austral.* 5: 350 (1870). *Lecto*: *Adenanthos obovatus* Labill., *fide* E.C. Nelson, *Brunonia* 1: 322 (1978) [as *A. obovata*].

Adenanthos Labill. sect. **Adenanthos**

Adenanthos subsect. *Anaclastos* E.C.Nelson, *Brunonia* 1(3): 332 (1978), *syn. nov. Type*: *Adenanthos apiculatus* R.Br.

Acknowledgements

We thank Laurence Haegi and Barbara Rye for their comments, which improved the manuscript.

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