How can we observe the evolution of the species: an example of the New Zealand damselfly genus Xanthocnemis?

This article is part of a large research that investigates the taxonomy of the endemic to New Zealand damselfly genus *Xanthocnemis*. Prior to the beginning of this study, four species have been reported for the genus: *X. zealandica*, a common species throughout New Zealand except the Chatham and subantarctic islands; *X. tuanii* occurring on the Chatham Islands only; *X. sobrina*, restricted to cool, shaded streams in kauri forests and other forested areas on the North Island, and *X. sinclairi* only reported from the mountain wetlands on the South Island.

Specimens of all so far reported species have been compared as morphological and molecular variation was assessed. Morphological examination included assigning landmarks for all body parts corresponding to the external morphological features. Molecular analysis targeted fragments of the different genes.

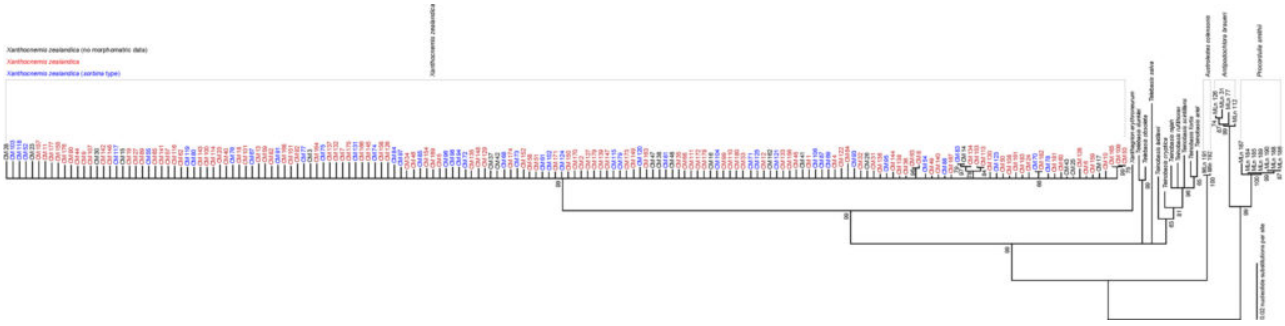

Fig. 1. Maximum likelihood phylogenetic tree of concatenated 28S and 16S rRNA genes of Xanthocnemis specimens collected in the North Island, and sequences available on GenBank. Legend: CM (Xanthocnemis only) and MLn (other species) numbers—North Island specimens collected during the present study; all others — sequences on GeneBank.

Our results already proved that *X. sinclairi* is actually still very similar on general morphology and at molecular to the widely distributed *X. zealandica* and has not evolved enough to be considered a distinct species. In contrary the isolation of the Chatham Islands has assisted the speciation of the local *X. tuanii* which is now clearly a separate species. The status of *X. sobrina* was most problematic and investigated in a very detailed separate study the results of which are reported below.

Geometric morphometrics revealed statistically significant differentiation between specimens identified as *X. zealandica* and *X. sobrina* for four traits. However, a careful investigation showed that these variations appeared to be the result of size, rather than shape, differences. Molecular analysis grouped all specimens into a single cluster showing almost no variation at the molecular

level among the sampled populations (Fig. 1). Therefore, *X. sobrina* is proposed as a synonym of *X. zealandica*. It is believed that the genus *Xanthocnemis* consists of two species only: *zealandica* occurring all over the North, South and Stewart Islands, and *tuanuii*, endemic to Chatham and Pitt islands.

Considering several statistical tests involving body measurements and ecological variables recorded during the field study, as well as various discussion points from similar studies of other species, two alternative hypotheses are proposed for future testing.

> The first hypothesis synonymises *sobrina* with *X. zealandica*. Perhaps the ancestral species was originally associated with standing waters. The formation of a long mountain ridge oriented in a NE– SW direction split the *Xanthocnemis* populations which now are probably in little or no contact at all on both side of this ridge. Individuals in the east inhabit mostly standing waters. Those of the western populations have secondarily invaded streams and have acquired certain morphological traits that differentiate them slightly from other conspecifics. They induced the development of morphotypes with body sizes larger than is typical of the more widely distributed type. Body enlargements occurred in both sexes and have probably resulted in modifications of the male appendages to respond to the increased load of the larger females. While those traits were evolving in stream individuals they were not completely isolated from adjacent standing wetlands. Thanks to close proximity they were able to exchange genes occasionally. The offspring were a type of intraspecies hybrid which has acquired traits from the inhabitants of the two different habitats. As a result, the contemporary populations on the North Island show a remarkable diversity of shapes, structures and sizes of those traits and displaying a large array of forms in between those of the two types that have previously been described as separate species. The second hypothesis suggests that as typical *X. sobrina* were not sampled during this study this could represent a species that is now extinct, unless future studies prove it otherwise.

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Publication

Geometric morphometrics and molecular systematics of Xanthocnemis sobrina (McLachlan, 1873) (Odonata: Coenagrionidae) and comparison to its congeners.
Marinov M, Amaya-Perilla C, Holwell GI, Varsani A, Bysterveldt KV, Kraberger S, Stainton D, Dayaram A, Curtis N, Cruickshank RH, Paterson A
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