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A Revision of Malagasy Species of *Anochetus* Mayr and *Odontomachus* Latreille (Hymenoptera: Formicidae)

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Abstract

Species inventories are essential for documenting global diversity and generating necessary material for taxonomic study and conservation planning. However, for inventories to be immediately relevant, the taxonomic process must reduce the time to describe and identify specimens. To address these concerns for the inventory of arthropods across the Malagasy region, we present here a collaborative approach to taxonomy where collectors, morphologists and DNA barcoders using cytochrome c oxidase 1 (CO1) participate collectively in a team-driven taxonomic process. We evaluate the role of DNA barcoding as a tool to accelerate species identification and description.

This revision is primarily based on arthropod surveys throughout the Malagasy region from 1992 to 2006. The revision is based on morphological and CO1 DNA barcode analysis of 500 individuals. In the region, five species of *Anochetus* (*A. boltoni* **sp. nov.**, *A. goodmani* **sp. nov.**, *A. grandidieri*, and *A. madagascarensis* from Madagascar, and *A. pattersoni* **sp. nov.** from Seychelles) and three species of *Odontomachus* (*O. coquereli, O. troglodytes* and *O. simillimus*) are recognized. DNA barcoding (using cytochrome *c* oxidase 1 (CO1)) facilitated caste association and type designation, and highlighted population structure associated with reproductive strategy, biogeographic and evolutionary patterns for future exploration.

This study provides an example of collaborative taxonomy, where morphology is combined with DNA barcoding. We demonstrate that CO1 DNA barcoding is a practical tool that allows formalized alpha-taxonomy at a speed, detail, precision, and scale unattainable by employing morphology alone.

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Introduction

Anochetus and *Odontomachus* were treated globally by Brown [1,2]. This paper revises the genera for the Island of Madagascar and also includes new records from the Seychelles and Comoro Islands. The revision is based on morphological and CO1 sequence analysis of 500 individuals. We evaluate the role of DNA barcoding as a tool to accelerate species identification and description.

Anochetus and *Odontomachus* are closely related genera [1,3,4] characterized by long and straight mandibles inserted just on either side of the cephalic midline and with two or three large teeth near tip arranged in a vertical series (Figure 1a,b). The single tooth or spine at the apex of the petiole separates *Odontomachus* from the closely related genus *Anochetus* (which has two teeth or rounded margin). *Odontomachus* and *Anochetus* can also be easily distinguished by the characters on the back of the head. With head viewed from back near neck of pronotum, *Odontomachus* has dark, inverted V-shaped apophyseal lines that converge to form a distinct, sometimes shallow groove or ridge on upper back of head. In *Anochetus*, the V-shaped apophyseal lines are absent. In the same region of the back of head, however, nuchal carinae in *Anochetus* form an uninterrupted, inverted U-shaped ridge. In the field, small members of *Anochetus* might also be mistaken for *Strumigenys*, from which they may be distinguished by their one-segmented waist (vs. two segments in *Strumigenys*).

The utility of a standardized single gene for species recognition (but not phylogenetics) has been tested in an increasing swath of life. Here we tested how well a cytochrome *c* oxidase 1 (CO1) DNA barcode resolved species within Malagasy *Anochetus* and *Odontomachus*. In Madagascar, these ponerine genera are known to include species with independent colony formation by ergatoid (wingless) queens – and therefore are expected be a challenge for DNA barcoding using a single mitochondrial marker – but also include cases where prior taxonomy has not linked males with females and workers, nor has resolved obvious worker dimorphism as either caste variation or provisional species.

Species level taxonomy in these genera can be quite difficult. Brown [2] noted that males provide a useful source for species level delimitation. Males, however, are rarely associated with the worker castes. Brown [2:553] states: "Unfortunately, males found associated in the nest with the female castes are known only for a minority of the species. Additional kinds of males are known from collections at light or by Malaise trap, but it has not yet been possible to link any of these securely to worker-based species."