

**A morphological analysis of weevils from sub-Antarctic Prince
Edward Islands: an assessment of ecological influences**

by

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A morphological analysis of weevils from sub-Antarctic Prince Edward Islands: an assessment of ecological influences

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Abstract The ecologically sensitive, but relatively simple sub-Antarctic mouse-colonised Marion and mouse-free Prince Edward Islands represent ideal ecosystems for addressing questions relating to the partitioning of potential influences of anthropogenic changes, such as climate change and alien species on ecosystem functioning. Consequently, weevil species were used in the present investigation to address questions of morphological change over time with reference to climate change and mouse predation.

As a prelude to the assessment of morphological changes over time, the six currently recognised weevil species, namely, *Bothrometopus randi*, *B. parvulus*, *B. elongatus*, *Ectemnorhinus similis*, *E. marioni* and *Palirhoeus eatoni* from both Marion and Prince Edward Islands were confirmed by morphometric analyses. However, the taxonomic status of *Ectemnorhinus* weevil species on both islands is much more complex than previously considered. A multi-faceted approach based on both morphometric and molecular (COI gene) data suggest the presence of a single species, comprising diverse, genetically discrete populations on Marion Island and two genetically distinct species on Prince Edward Island.

The assessment of morphological changes over time included the four remaining weevil species (*B. elongatus*, *B. randi*, *B. parvulus* and *P. eatoni*) occurring on both Marion and Prince Edward Islands, collected non-consecutively over five decades. These analyses suggest morphometric size differences between samples from both Marion and Prince Edward Islands collected in the mid-1960s and 1970s and those collected recently. Similarly, samples from both islands collected in the early- to mid-1980s also showed morphometric shape differences with those collected recently for both Prince Edward and Marion Islands, respectively. Generalized Linear Models (GLZ) suggested year of sampling to contribute more, to both,

morphometric size and shape in all species sampled on both islands, while temperature contributed more to shape for species collected on Marion Island. Given the consistent pattern of morphological change over time for both the mouse-infested Marion Island and the mouse-free Prince Edward Island, it is possible that climate change rather than mouse predation may primarily influence weevil morphological changes on the two islands.

Subsequent analyses extended the question of weevil morphological changes over time with reference to climate change and mouse-predation, and included sub-fossil weevil elytra and head capsule remains collected on Marion Island mire habitats. As a prelude to these analyses, an attempt was made to first identify the sub-fossil samples (using head capsules) with reference to recent samples of the currently recognised weevil species on both islands. While species-level identifications were not possible, morphometric analyses suggest that the sub-fossil remains belong to the *Ectemnorhinus* group of weevils. Sub-fossil weevil remains recovered in mire sediments from 2 m and 2.5 m depths, considered to represent different dimensions in space and time, were dated at 789 BC and 2331 BC, respectively. Subsequent analyses showed no significant morphometric changes in sub-fossil material between the various depths, predating the effects of climate change on both islands and the introduction of the house mouse (*Mus musculus*) on Marion Island in the early 1800s. However, a comparison between the sub-fossil remains and recently collected material considered to represent a period characterised by climate change and mouse-predation showed significant morphometric differences over time. However, the questions investigated in this study need to be investigated further because the potential ecological influences driving ecosystem functioning on the islands may be much more complex than currently understood.

Keywords: *Ectemnorhinus* weevils, sub-fossils, systematics, morphometrics, COI gene, morphological change over time, ecosystem functioning, anthropogenic influences, climate change, mouse-predation, sub-Antarctic Marion and Prince Edward Islands

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...

“Challenge is a dragon with a gift in its mouth. Tame the dragon and the gift is yours.”

Noela Evans

Disclaimer

The present study forms part of a larger study entitled: Threats to biodiversity and ecosystem functioning at the Prince Edward Islands: Developing a conservation strategy for endemic and keystone insect species. All genetic work and analyses presented in the study were conducted by Mr. Gert Grobler, Department of Zoology and Entomology, University of Pretoria. This thesis consists of a series of chapters that have been prepared as “stand alone” manuscripts for subsequent submission for publication purposes. Consequently, unavoidable overlaps may occur between chapters.

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