DNA Barcoding the Birds of New Zealand

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I dedicate this thesis to my parents Molly and Charles Waugh

both of whom died before it was complete.

I know that my achieving this degree would have

given them great pleasure.

No matter how much I imagined I would miss their

love, guidance and friendship,

nothing prepared me for the reality of the loss that I feel.

I also dedicate this thesis to my wife Fiona

who gave me the opportunity to undertake it and

the love and support needed to complete it.

Abstract

A comprehensive inventory of the life forms on earth is at the heart of any scientific study of evolution and biodiversity. The international "Barcode of Life" project is an attempt to identify the earth's biodiversity, at the species level, using short signature DNA sequences. The hypothesis underlying DNA barcoding is being comprehensively tested in different taxa. A database was constructed of DNA sequences from part of the mitochondrial gene cytochrome *c* oxidase subunit 1 for the avian fauna of New Zealand. To date, 833 sequences from 215 species have been added to this database, of which 628 sequences from 126 species are from native or endemic birds. This represents an average of 5 samples per species (minimum 1, maximum 18) for the latter group, which is the central focus of this thesis. Samples of species, from different geographical locations throughout New Zealand, have been collected to highlight any intraspecific nucleotide variation that may occur. Some samples analysed here were from historical specimens housed in museum collections and required specialised DNA extraction and amplification. These techniques were developed as part of the project and provide a means of collecting DNA barcodes where no modern material is available. In general, DNA barcoding proved effective at identifying avian species in New Zealand. However, some species were highlighted that contained distinct DNA barcode clusters, indicative of possible subspecies or cryptic species while in other cases two or more species that appear to be different share very similar DNA barcodes. Remains from aircraft birdstrikes were identified using this technique in order to inform wildlife management at airports around New Zealand. A review of and outlook for the uses of this technique are given.

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Thesis Structure, Financial Support and Regulatory Compliance

This thesis begins with a general introduction (Chapter 1), which is a review of DNA barcoding and provides the background and intellectual framework that underpins the thesis. It is an update of a review paper published in BioEssays. Chapter 2 is a general methods section outlining the collection and processing protocols associated with the project. Chapters 3 and 6 have been written as stand-alone scientific papers. Therefore some information provided in the introduction will be briefly outlined again in these chapter introductions. Chapter 4 is an analysis of the data. Chapter 5 outlines and discusses interesting anomalies within the data and Chapter 7 discusses the variety of uses that DNA barcoding has and may be put to and the conclusions and applications of the research findings and potential future research.

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Ethics Approval

This research had ethics approval from the New Zealand Department of Conservation (DOC) Animal Ethics Committee for sampling.

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