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DNA Barcoding the Birds of New Zealand

A thesis presented in fulfillment of the requirements for the degree of Doctor of Philosophy in Molecular BioSciences at Massey University, Auckland, New Zealand

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2011
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.
# Table of Contents

Abstract i

Acknowledgements iii

Thesis Structure, Financial Support and Regulatory Compliance vii

Table of Contents ix

List of Figures xiii

List of Tables xvii

## Chapter 1  General Introduction to DNA barcoding 1
1.1 A brief history of modern taxonomy 1
1.2 The size of the taxonomic task 3
1.3 Potential solutions to the taxonomic impediment 4
1.4 DNA barcoding 5
1.5 A review of the efficacy of DNA barcoding in published studies 8
  1.5.1 Efficacy at identifying species 16
  1.5.2 Problematic taxa 18
1.6 Discussion 19
1.7 Conclusion and outlook 24
1.8 The scope of this thesis 24
1.9 References 26

## Chapter 2  Methods 37
2.1 Overview of sample collection 37
2.2 Samples obtained for this study 38
2.3 Tissue collection and recording 39
2.4 DNA extraction, amplification and sequencing of fresh samples 42
2.5 DNA extraction, amplification and sequencing of historical samples 43
2.6 Analysis of sequence data 45
2.7 References 48
Appendix A  Papers published from this study  199


Appendix B  BOLD submission sheets  233

Appendix C  BOLD published primer list  239

Appendix D  GenBank accession numbers  247

Appendix E  Barcoding New Zealand Birds project list  251
# List of Figures

## Chapter 1

1.1 The mitochondrial genome of a Eukaryote  
   6

1.2 A diagrammatic representation of cytochrome c oxidase subunit I (COI)  
   7

## Chapter 2

2.1 An example of a data form from the database of birds sampled.  
   40

2.2 Part of the Barcoding New Zealand Birds project on the BOLD website  
   41

2.3 Amplification product of the DNA barcode region of the COI gene  
   43

2.4 A data.xls sheet for uploading ab1 or .scf and .phd files to the BOLD website  
   46

2.5 Summary page for the Barcoding NZ Birds project on the BOLD website  
   47

## Chapter 3

3.1 Part of the mass alignment used to locate suitable primer binding sites  
   51

3.2 A diagrammatic representation of the COI barcoding region  
   55

## Chapter 4

4.1 An asymptotic divergence with time in the evolution of DNA  
   69

4.2 The Jukes-Cantor correction to distance model  
   70

4.3 Flow chart of the series of steps of the MCMC algorithm  
   73

4.4 A sequence record for a Puffinus griseus specimen on the BOLD website  
   75

4.5 A specimen data record for a Puffinus griseus specimen on the BOLD website  
   76

4.6 New Zealand Anseriformes K2P neighbour joining tree  
   83

4.7 New Zealand Anseriformes Bayesian tree  
   84

4.8 New Zealand Apterygiformes K2P neighbour joining tree  
   86

4.9 New Zealand Apterygiformes Bayesian tree  
   87

4.10 New Zealand Charadriiformes K2P neighbour joining tree  
   89

4.11 New Zealand Charadriiformes Bayesian tree  
   90

4.12 New Zealand Ciconiiformes K2P neighbour joining tree  
   91

4.13 New Zealand Ciconiiformes Bayesian tree  
   91

4.14 New Zealand Falconiformes K2P neighbour joining tree  
   92

4.15 New Zealand Falconiformes Bayesian tree  
   92

4.16 New Zealand Gruiformes K2P neighbour joining tree  
   93

4.17 New Zealand Gruiformes Bayesian tree  
   94

4.18 New Zealand Passeriformes K2P neighbour joining tree  
   97
Chapter 6

6.1 Boeing 737 passenger jet striking a flock of more than 200 starlings
6.2 Sample collection kit
6.3 Total annually reported birdstrikes from airports in New Zealand 2003-2009
6.4 The species most highly represented in reported birdstrikes in New Zealand
6.5 Unidentified birds involved in birdstrike in New Zealand 2003 - 2009
6.6 US Airways flight 1549 after making a forced landing in the Hudson River

Chapter 7

7.1 Stages of development of a major biological project such as the HGP
## List of Tables

**Chapter 1**
1.1 Design details and major results from selected DNA barcode studies 9

**Chapter 2**
2.1 Sample data by category entered in a database for each sample sequenced 40

**Chapter 3**
3.1 Table used during testing of the primers for the Barcoding NZ Birds project 52
3.2 PCR primers and 5’ tags used for the amplification of the 648 bp COI region 57
3.3 Results of PCR success of modern and historical samples 58
3.4 PCR primer success on 17 different avian orders 59

**Chapter 4**
4.1 An example of Nexus file format 74
4.2 Native and endemic bird species with number of samples obtained for each 77
4.3 Intraspecific divergence within Columbiformes, Coraciiformes and Strigiformes 82

**Chapter 5**
5.1 The six subspecies that have been recognised in *Eudyptula minor* 123
5.2 K2P distance measures for 57 specimens of *Eudyptula minor* 126

**Chapter 6**
6.1 Birdstrike samples identified using DNA barcoding 165

**Chapter 7**
7.1 Published examples of current usage of DNA barcoding 178
7.2 A summary of campaigns overseen by the Consortium for the Barcode of Life 185