

AVIAN MOLECULAR EVOLUTION AND SYSTEMATICS

Edited by

DAVID P. MINDELL

*Museum of Zoology & Department of Biology
University of Michigan
Ann Arbor, Michigan*



ACADEMIC PRESS

SAN DIEGO

LONDON

BOSTON

NEW YORK

SYDNEY

TOKYO

TORONTO

Contents

Contributors	xiii
Preface	xvii

PART I

Molecular Sequences and Evolutionary History in Birds

1 *Molecular Evolution of the Mitochondrial Genome*

Thomas W. Quinn

I. Introduction	4
II. Mitochondria: An Ancient Legacy	4
III. The Vertebrate Mitochondrial Genome	5
IV. Avian Mitochondrial Genomes	6
A. An Altered Gene Order throughout Aves	6
B. Other Features of the Avian Mitochondrial Genome	10
V. Major Genomic Features as Characters for Phylogenetic Analysis	11
A. Two Approaches to Phylogenetic Analysis Using DNA Sequence Information	11
B. The Sister Taxon to Birds: Evidence from Comparisons of DNA Sequence and "Genomic Landmarks"	13
C. Other Potentially Informative Characters	16

er of Mitochondrial Sequences	17
of Mitochondrial DNA: Not Unusual	17
	18
e for Studies of Avian Phylogenetics	19
led by Numts	22
	23
	23

as Genetic Markers at Several Scales

Wayne K. Potts

	30
	30
lected Plasmid Genomic Library	32
Techniques	33
y for Microsatellite-Bearing Clones	33
	33
ons	34
	34
	34
	36
	36
	38
Higher Taxa	38
ient DNA)	39
alysis	39
	41
artners in Male Long-Tailed Manakins	41
	42
n Sheep	42
usions	43
	43
	49

l Region Sequences as Tools olution

n Marshall

	51
on and Evolution	53
ence Data and Structural Features	53
	61

III. Population Stru
A. Global Phyloge
B. Bottlenecking
C. Colonization R
D. Intraspecific Va
E. Phylogeograph
F. Recent Mixing
IV. Higher Level Sy
References

4 *The Window of T Based on Mitocha*

William S. Moore and

I. Introduction
A. Avian Phyloge
B. Objectives of
C. Properties of I
Phylogenies
II. Materials and M
A. Producing Sec
III. Results
A. Sequences
B. Phylogenetic
C. Base Composi
D. Pairwise Com
E. The Relations
F. The Relations
Transversions
G. The Relations
Substitutions
H. Short Interno
Resolution
1. Rate Variation
J. How Much S
IV. Discussion
A. The Window
B. Molecular Cl
C. Conclusions a
References
Appendix I
Appendix II

III. Population Structure and Intraspecific Taxonomy	64
A. Global Phylogeography of the Dunlin	66
B. Bottlenecking and Recent Population Expansion in Knots	69
C. Colonization Routes of Chaffinches in the Atlantic Islands	70
D. Intraspecific Variation in Canada Geese	73
E. Phylogeography of Gray-Crowned Babblers	74
F. Recent Mixing of Lineages in Adélie Penguins and in Snow Geese	75
IV. Higher Level Systematics	77
References	79

4 *The Window of Taxonomic Resolution for Phylogenies Based on Mitochondrial Cytochrome b*

William S. Moore and Victor R. DeFilippis

I. Introduction	84
A. Avian Phylogenies Inferred from Mitochondrial DNA	84
B. Objectives of This Study	85
C. Properties of DNA Sequences That Are Ideal for Recovering Phylogenies	86
II. Materials and Methods	87
A. Producing Sequence Data	87
III. Results	88
A. Sequences	88
B. Phylogenetic Analysis	88
C. Base Composition	92
D. Pairwise Comparisons among Divergent Sequences	94
E. The Relationship between Transitions and Transversions	98
F. The Relationship between Taxonomic Divergence and Saturation of Transversions	100
G. The Relationship between Taxonomic Divergence and Amino Acid Substitutions	102
H. Short Internodes, Long Terminal Branches, and Phylogenetic Resolution	102
I. Rate Variation within Lineages	104
J. How Much Sequence in a Pilot Study	105
IV. Discussion	105
A. The Window of Taxonomic Resolution for Avian Phylogenies	105
B. Molecular Clock	107
C. Conclusions and Advice	107
References	109
Appendix I	114
Appendix II	115

5 *Phylogeny and Evolution of 12S rDNA in Gruiformes (Aves)*

Peter Houde, Alan Cooper, Elizabeth Leslie, Allan E. Strand, and Gabriel A. Montaña

I. Introduction	121
A. The Birds	122
B. The Gene	125
II. Methods	127
A. DNA Sequence Data	127
B. Phylogeny Reconstruction	133
III. Phylogenetic Inferences	134
A. Results	134
B. Discussion	139
IV. Molecular Evolution	142
A. Sequence Divergence	142
B. Evolutionary Dynamics of 12S rDNA	144
C. Character Evolution of 12S rDNA	148
V. Implications of 12S Evolution for Phylogenetic Inference	152
VI. Summary	153
References	154

6 *Phylogeny of the Pelacaniiformes: Molecular Systematics of a Privative Group*

Douglas Siegel-Causey

I. Introduction	159
A. The Problem of the Putatively Privative Pelecaniformes	160
B. The Enigma of <i>Balaeniceps</i>	163
II. Methods	164
A. Data Sets and Analysis	164
III. Results	166
A. Molecular Evidence	166
B. Morphological and Behavioral Evidence	167
IV. Discussion	167
References	170

7 *The Phylogeny of Ratite Birds: Resolving Conflicts between Molecular and Morphological Data Sets*

Krista Lee, Julie Feinstein, and Joel Cracraft

I. Introduction	173
II. Materials and Methods	176
A. Taxa	176
B. DNA Extraction and Sequencing	177
C. Phylogenetic Analysis	180
III. Results	181
A. Morphological Analysis	181
B. Sequence Analysis	184
C. Total Evidence Solution	185
IV. Discussion	186
A. Ratite Interrelationships: Morphological Data	186
B. Why Do Molecular and Morphological Data Conflict?	187
V. Conclusions	190
References	192
Appendix I	196
Appendix II	209

8 *Phylogenetic Relationships among and within Select Avian Orders Based on Mitochondrial DNA*

David P. Mindell, Michael D. Sorenson, Christopher J. Huddleston, Hector C. Miranda, Jr., Alec Knight, Steven J. Sawchuk, and Tamaki Yuri

I. Introduction	214
II. Issues in Phylogenetic Analyses	215
A. Constraints on Molecular Evolution	215
B. Sampling of Characters and Taxa	218
III. Methods	219
A. Study Characters and Taxa	219
B. Phylogenetic Analyses	222
IV. Results and Discussion	225
A. Phylogenetic Placement of Anseriformes and Galliformes	225
B. Relationships among Neognath Orders	228
C. Placement of Buttonquail, Hoatzin, and Flamingoes	230
D. Relationships among Passeriformes	233
E. Relationships among Anseriformes and Galliformes	233
F. Relationships among Falconiformes and Strigiformes	235

V. Conclusions	241
References	243

PART II

Applying Phylogeny and Population Genetics to Broader Issues

9 *Relevance of Microevolutionary Processes to Higher Level Molecular Systematics*

Scott V. Edwards

I. Introduction	251
II. Molecular Variability	253
A. The Specter of Polymorphism	253
B. Pattern of Nucleotide Substitution	258
III. Population Processes	262
A. Gene and Species Trees	266
B. Permanent Effects of Incomplete Lineage Sorting and Hybridization	266
C. Dating Biogeographic Events: Coalescence in Subdivided Populations	267
D. Selection	271
IV. Conclusion	273
References	274

10 *Phylogeny in Studies of Bird Ecology, Behavior, and Morphology*

Frederick H. Sheldon and Linda A. Whittingham

I. Introduction	279
II. Accurate Phylogenetic Estimates and Historical Ecology	281
A. An Example of the Phylogenetic Framework Approach	283
III. Application of the Comparative Approach to Classic Problems of Evolution	285
A. Adaptation	285
B. Phylogenetic Constraints	291

IV. Summary	294
References	296

11 *Phylogeographic Studies of North American Birds*

Robert M. Zink

I. Introduction	301
II. Allozymic Studies of Avian Geographic Variation	302
III. The DNA Revolution in Intraspecific Studies	303
IV. Phylogeographic Studies in Birds	305
A. Nature of Variation	305
B. Haplotype Phylogenies and Directionality	310
C. Estimates of Gene Flow	310
D. Description and Significance of Genetic Variation among Populations	311
V. Comparative Phylogeography	314
A. Method	314
B. Some Avian Results	315
C. Mismatch Distributions and Population Histories	318
D. Comparative Phylogeography and the History of Communities	320
VI. Prospectus	320
References	321

12 *The Speciation of South American and African Birds in Montane Regions*

**Michael S. Roy, José Maria Cardoso da Silva, Peter Arctander,
Jaime García-Moreno, and Jon Fjeldså**

I. Introduction	325
II. The Model Hypothesis	326
A. Basic Assumptions	326
B. Method	327
III. Old and New Species in South America	328
IV. Old and New Species in Africa	330
V. Implications for the Model	332
VI. Case Studies of Biogeographic Patterns in Tropical Mountains	333
A. The Andes	333
B. East African Mountains	334
VII. Discussion and Summary	339
References	341

13 *Studies of Avian Ancient DNA: From Jurassic Park to Modern Island Extinctions*

Alan Cooper

I. Introduction	345
II. Review of Ancient DNA Research	346
A. Techniques	347
III. Systematics and Paleoecological Applications	349
A. Ratite Systematics	349
B. Paleoecological Studies	362
IV. Summary	368
V. Future Research	368
References	369

Index	375
-------	-----