

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

ASPECTS OF THE BIOLOGY OF THE AUSTRALASIAN HARRIER

(*CIRCUS AERUGINOSUS APPROXIMANS* PEALE 1848)

A thesis presented for the degree of
Master of Science by thesis only
in Zoology at
Massey University

David John Baker-Gabb

May 1978

NOTE

This thesis has been supplied for the purpose of private study. All information in it is restricted and may not be reproduced in any way without the prior written consent of the author.

D.J. Baker-Gabb,
Botany and Zoology Department,
Massey University,
Palmerston North, New Zealand.

27 May 1978

ABSTRACT

The study is based on 18 months intensive field-work during which 212 Australasian harriers were trapped, retrapped, measured, sexed, aged, individually marked and observed. Fortnightly observations of the individually marked population were made over a further seven months. The Australasian harrier and European marsh harrier are considered to be conspecific. Evidence is presented showing that there is no valid reason for considering *Circus aeruginosus* of the Pacific Islands to be a different subspecies from *C. aeruginosus* of Australia and New Zealand. During the breeding season ten territories in the 12 km² study area averaged 31 ha, nest sites averaged 910 m apart, pairs' overlapping home ranges averaged 9 km² and favourite hunting areas 3 km². A high population density of one bird per 50 ha was calculated. A low fledging success rate of 1.8 young per successful pair and 1.1 young per nest site, and two cases of polygyny were recorded during two breeding seasons. Territorial and courtship behaviour, nest parameters and the parental division of labour is described. Seasonal movements and the dispersion of all age and sex classes from the study area at the end of the breeding season are described. Most (66.7%) individually marked adults returned after the autumn dispersal phase and established winter home ranges averaging 9 km². The home range of an adult female in open farmland was calculated to be 14 km² using radio-telemetry techniques. A non-breeding season population density of one bird per 80 ha was calculated. Communal roosting, which occurred throughout the year, is discussed. Four hundred and seventy food items were identified in the diet from pellets, prey remains, stomach contents and field observations. In descending order of numerical importance in the diet were mammals (46.4%), introduced passerines (29.0%), insects (7.6%), game birds (6.7%), birds' eggs (4.8%) and aquatic prey (4.6%). Australasian harriers ate significantly greater numbers of live prey than carrion annually. Adults took significantly greater numbers of agile food items than juveniles. Females ate significantly more large (>200 g) and fewer agile food items than did males. Seven search techniques and five attack techniques, including some buteonine techniques, are identified and described in the Australasian harriers' wide range of hunting techniques. Ninety five attacks on prey are recorded and 15.8% of these were successful. Adults were significantly more successful hunters than juveniles. Co-operative

hunting, hunting in the daily cycle, feeding behaviour at carrion, interspecific competition for carrion, interspecific disruption of hunting and prey escape tactics are described. From a computer analysis of hunting behaviour data it is concluded that adult males are more manoeuvrable and less conspicuous than adult females and juveniles because they flew significantly lower and faster. Adult males also hunted, to a significantly greater degree, those habitats where there were greater numbers of agile prey. The hunting inexperience of juveniles was quantified. The Australasian harrier is moderately sexually dimorphic. Current hypotheses proposed to explain the degree of sexual dimorphism in raptors and why the females of most raptor species are larger than males are critically reviewed.

ACKNOWLEDGEMENTS

I would like to thank first my two supervisors Mr Lou Gurr and Dr Phil Moors for the interest they maintained and the encouragement they provided throughout the study.

Andy Garrick and Tom Caithness of the Wildlife Service always provided a warm welcome when I arrived at Pukepuke Lagoon. Andy Garrick and Bill Pengelli also kept a record of sightings of individually marked Australasian harriers.

I was billeted in the Wildlife Service's newly erected house at Pukepuke Lagoon for four months. Prior to this I used a shooter's hut owned by the Department of Lands and Survey for accommodation. The manager of the Department of Lands and Survey's Tangimoana farm, Mr H. Ellison, kindly allowed me to set traps on the farm and to travel to and from the traps at will. Neil Bowick of the Manawatu Pest Destruction Council provided a steady supply of rabbits which were used as bait in the traps.

Besides allowing me to use equipment at Pukepuke Lagoon, the Wildlife Service of the Department of Internal Affairs provided \$300 towards travelling expenses. The Botany and Zoology Department, Massey University, paid for the materials for the 11 traps I built. I travelled between Palmerston North and Pukepuke Lagoon and around the study area on a Honda C.T.90 motorbike my parents generously lent to me.

I have benefited from correspondence with ornithologists Dr R. Fitzner, Dr Nick Fox, Dr F. Hamerstrom, Lex Hedley and Mervyn Jukes. Dr Nick Fox and Lex Hedley also provided designs for the traps I used and they both read and commented on a draft of a chapter of the thesis. Dr I. Andrew and Dr J. Skipworth read and commented on a chapter. Andy Garrick, Dr Phil Moors and Hugh Robertson all reviewed four chapters. I would like to thank all these people and particularly Dr Phil Moors who constructively criticised my first chapters. Several members of the Ornithological Society of New Zealand sent records of sightings of individually marked Australasian harriers to me. These were gratefully received.

Dr R. "Dusty" Clark was my statistical mentor. His expertise and willing help was called upon in the statistical analysis of the hunting behaviour data. Bill Thomas helped build the six cage traps, Ross Hunt helped with the illustrations and Mrs F. Barton made a very neat and professional job of the typing. Finally I would like to express my gratitude to June Blenkhorn who devoted many hours to proof-reading and who saw me through the darkest hours.

CONTENTS

	Page
INTRODUCTION	1
1. NOMENCLATURE	2
1.1 Species	2
1.2 Subspecies	3
1.3 Common name	6
2. THE STUDY AREA AND METHODOLOGY	7
2.1 Introduction	7
2.2 Part one: the study area	7
2.3 Part two: methodology	12
2.4 Methodology: results	16
2.5 Methodology: discussion	23
3. THE BREEDING BIOLOGY OF THE AUSTRALASIAN HARRIER	27
3.1 Territories and home ranges	27
3.2 Voice	32
3.3 Pair formation and maintenance	33
3.4 Nests	37
3.5 Hatching to dispersal	39
3.6 Calendar of events	44
4. THE NON-BREEDING BIOLOGY OF THE AUSTRALASIAN HARRIER	46
4.1 Introduction	46
4.2 The dispersal phase and seasonal movements	46
4.3 Home range size and population density	52
4.4 Communal roosting	53
5. THE DIET OF THE AUSTRALASIAN HARRIER AT PUKEPUKE LAGOON	60
5.1 Introduction	60
5.2 Methods	61
5.3 Results	66
5.4 Discussion	79

	Page
6. AUSTRALASIAN HARRIER HUNTING TECHNIQUES	88
6.1 Introduction	88
6.2 Methods	88
6.3 Results	89
6.4 Search techniques	90
6.5 Attack techniques	96
6.6 Discussion	108
7. THE AUSTRALASIAN HARRIERS' HUNTING BEHAVIOUR: AN INTRASPECIFIC COMPARISON	116
7.1 Introduction	116
7.2 Hypothesis	116
7.3 Methods	117
7.4 Results	123
7.5 When average height is the dependent variable	123
7.6 When average flaps is the dependent variable	130
7.7 When average height changes is the dependent variable	136
7.8 Proportion of time allocated to each habitat	140
7.9 Differential habitat use	142
7.10 Discussion	145
8. SEXUAL DIMORPHISM AND THE AUSTRALASIAN HARRIER	152
8.1 Introduction	152
8.2 The degree of sexual dimorphism exhibited by the Australasian harrier	152
8.3 Sexual dimorphism hypotheses	153
SUMMARIES OF CHAPTERS	162
APPENDIX - Australasian harrier diet tables	167
Hunting techniques tables	180
Hunting behaviour data analysis	185
LITERATURE CITED	215

LIST OF TABLES

TABLE	Page
1.1 Male harrier measurements	5
1.2 Female harrier measurements	5
2.1 Number of Australasian harriers banded, individually marked, retrapped and resighted	17
2.2 Male Australasian harrier morphological data	18
2.3 Female Australasian harrier morphological data	19
2.4 Seasonal weight changes	20
2.5 Comparison of seasonal differences in weight	20
2.6 Moulting data from trapped Australasian harriers	22
2.7 Seasonal changes in colour of the cere, eye-ring and feet of Australasian harriers	22
4.1 Australasian harriers ringed per season and subsequent movements	47
4.2 Ringing returns	49
4.3 Distant sightings of wing-tagged Australasian harriers	51
4.4 Average number of Australasian harriers counted per trip per season	53
4.5 Communal roost data	51
5.1 Successful attacks by Australasian harriers at Pukepuke Lagoon	67
5.2 Carrion use by Australasian harriers at Pukepuke Lagoon	69
5.3 Seasonal diet of the Australasian harrier at Pukepuke Lagoon determined from nest site pellets and prey remains and communal roost pellets	71
5.4 Seasonal diet of the Australasian harrier at Pukepuke Lagoon	74
5.5 Average number of birds counted seasonally per trip along 2.5 km transect	75
5.6 Numbers of road-killed animals and the number eaten by Australasian harriers	75
5.7 Live prey and carrion in the diet of the Australasian harrier	77
5.8 Seasonal comparison of the proportion of mammals, birds, eggs, aquatic prey and insects in the diet of the Australasian harrier	77
5.9 Diet of the Australasian harrier ages and sexes	78
5.10 Number of food items per pellet	78

TABLE	Page
6.1 Search techniques used prior to observed attacks by Australasian harriers	99
6.2 Observed Australasian harrier attack techniques	100
6.3 Observed attacks on Australasian harriers by other species	105
7.1 When average height is the dependent variable	
7.1.a-c	125
7.1 t-tests	126
7.1.d, e	128
7.1.f, h	129
7.2 When average flaps is the dependent variable	
7.2.a-c	131
7.2 t-tests	132
7.2.d, e	134
7.2.f, g	135
7.3 When average height changes is the dependent variable	
7.3.a-c	137
7.3 t-tests	138
7.3.d, e	139
7.4 Time recorded for Australasian harrier flying speeds and wind direction relative to flying direction	141
7.5 Number and percentage of Australasian harriers observed hunting over five habitats	143
7.6 Chi-square test of relative distribution of Australasian harrier age and sex classes over five habitats	143
7.7 Time spent hunting over habitats into a head wind at slow and normal speeds	144
8.1 Australasian harrier dimorphism index	152
 APPENDICES	
A.1 - A.5 Diet analysis of nesting pairs	167
A.6 Diet analysis; communal roost pellets	172
A.7 - A.12 Diet analysis of age and sex classes	173
A.13-A.15 Hunting techniques of age and sex classes	180
A.16-A.43 Hunting behaviour data analysis	185

LIST OF FIGURES

FIGURE	Following page
2.1 Map of Manawatu-Rangitikei sand country and study area	7
2.2 Map of study area	8
3.1 Territories and nest sites in study area	27
6.1 Slow quartering	90
6.2 Slow quartering vertical edges	90
6.3 Dive attack and hover attack	96
7.1 Hunting behaviour data sheet	117
7.2.a-c Graphs of means v standard deviations	121
7.3.a-i Graphs of individual group regressions	124

LIST OF PLATES

PLATE	Following page
2.1 Study area	9
2.2 Study area	9
2.3 Cage trap	13
2.4 Automatic bownet	13
2.5 Adult male with wing tags and juvenile female	15
2.6 Female aged three months	22
2.7 Female aged eighteen months	22
2.8 Adult female	22
2.9 Adult female	22
2.10 Male aged three months	22
2.11 Male aged twelve months	22
2.12 Male aged eighteen months	22
2.13 Adult male	22
7.1 Open farmland	118
7.2 Farm drain	118
7.3 Dunes	118
7.4 Raupo swamp	118
7.5 Cabbage trees and flax	118
7.6 Pine plantations	118

INTRODUCTION

This thesis was initially proposed as part of a more general study of the influence of predators on the fauna at Pukepuke Lagoon Wildlife Management Reserve. The broad aim of the thesis is to describe the Australasian harriers' hunting behaviour and to discuss the factors influencing that behaviour. A further aim is to elucidate differences in morphology, diet, hunting techniques and habitat use between the Australasian harrier age and sex classes, and to relate these differences to current theories on sexual dimorphism in raptors.

Hunting behaviour is an integral part of the birds' breeding and non-breeding biology. In the course of the study numerous original observations and data were collected pertinent to the Australasian harriers' biology, and although breeding and non-breeding biology are discussed individually, frequent reference is made to their effect on diet and hunting behaviour.

Within the text of the thesis I have endeavoured to describe at all times the data collected and what I observed, rather than what I felt. However I believe that some of the understanding gained during the study is expressed in a short verse written in my field-notes as I observed an adult female hunting at the end of the 1976-77 breeding season.

Already she feels the winter, and it is sad.
Still she flies to feed her young, but the excitement,
expectation and wonder of the sexual spring is gone.
The race is almost run, and she can see the finish line.
She's a little tired, but it was a great race,
full of tactics and new doors opened.
And there's all those wonderful memories of finding out
what few have seen and fewer still noted.
There's still time, and more,
a need for that new feather dress to greet next spring.
Will she choose again the same C-1,
or will she mate a-new?
Yes winter's coming, but then so is spring.
She wonders what it will bring?
Life, I hope, for you A-2.
The free life to hunt the long grasses,
and soar on the wind, and on ... and on ... and on ...