

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.

The Social System and Reproduction in a New Zealand

Magpie Population, and a Test of the

Cooperative Breeding Hypothesis.

A Thesis Presented in Partial Fulfilment
of the Requirements for the Degree of
Doctor of Philosophy in Zoology
at Massey University.

Clare Johanna Veltman

1984

Abstract

Magpie social behaviour was studied at Linton in the Manawatu, from June 1978 to November 1982. Social behaviour patterns and reproduction were investigated, and the hypothesis that magpies were cooperative breeders was tested.

There were two population phases. Nomadic flocks formed in spring and foraged on open, treeless pasture. The flock sex ratio was determined from morphometric measurements, and was between 33:66 and 50:50 males to females. Flock density stabilised at 1 magpie per hectare, and the estimated daily survival rate was 0.9. Territorial magpies defended all-purpose areas averaging 5 hectares in size, and there was no correlation between territory size and the number of occupants. The mean adult survival rate was 0.85, and annual productivity was 0.96 juveniles per breeding female.

Flock magpies associated randomly, and flock membership changed frequently. The primary activity of flock birds was foraging, which intensified during the afternoons, and in the month of March. The proportion of flock magpies foraging was positively correlated with the number of birds present.

Territories were defended by pairs and groups. Non-kin groups may have formed in the flock, and kin groups formed when juvenile dispersal was delayed. Non-breeders did not help at

the nest, and male parents made as many visits to nestlings as females did. Time of day strongly influenced the distribution of activities, so that foraging occupied more time in the afternoons. Group-territory magpies spent less time perching and more time defending the territory than pair-territory birds.

The average national clutch size was 3.5 eggs. There was no difference in the breeding output of pair-territory and group-territory hens, but per capita production was lower in the groups. Average individual fitness estimates were prepared for each of four magpie lifestyles, and were highest for pair-territory birds.

Supplementary food did not inhibit juvenile dispersal, and lead to polygyny in the formerly pair-defended territories. Hens receiving extra food fledged more juveniles than they had in the previous spring.

It was argued that magpies were not cooperative breeders, but selfish opportunists which exploited various social lifestyles in order to obtain reproductive status.

ACKNOWLEDGEMENTS

The advice and help received from many people during the study is gratefully acknowledged.

Messers Harrington, Greatorex, Manning, Crowley, Underwood, McGovern and Irvine, and the managers of the Kilsby Estate all granted permission for their properties to be freely entered.

Jane Hughes (Griffith University, Brisbane) and Wim Vestjens (late of C.S.I.R.O., Canberra) discussed magpie trap designs and problems, and Neil Murray (La Trobe University, Melbourne) described his method for scoring magpie plumages.

Bob Kreyborg helped with the construction of traps and cages, and made the pole-mounted mirror used to examine nests.

David Crockett made available the nest record cards collected by members of the Ornithological Society of New Zealand Inc. for analysis, on behalf of the Society.

Christine Reed cut and delivered about half of the meat consumed during the food-addition experiment, while employed as a temporary technician in the Botany and Zoology Department.

Walt Abell and Robert Lambourne of the Massey Computer Centre

taught the author to compile SPSS and Genstat programmes, and Robert Lambourne and Greg Arnold (Department of Mathematics and Statistics) helped to unravel problems with analyses of variance.

John Craig (University of Auckland) critically appraised drafts of Chapters Two to Six inclusive, and offered helpful advice on presentation.

Neil Pinder drew Figures 3.a, 3.b, 4.j, 4.k, and 4.l, arranged the photocopying, and assisted in many other ways with the production of the thesis.

This project was supervised by Prof. Brian Springett who helped with some of the field work, and read and commented on each of the chapter drafts.

Robert Carrick and Lou Gurr provided solid encouragement, stimulating conversation and generous hospitality throughout the study. Their ideas challenged the author and helped to shape the thesis.

To them, and all those listed above, sincere thanks.

CONTENTS LIST

	Page
ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
CONTENTS	vii
LIST OF TABLES	xiii
LIST OF FIGURES	xv
LIST OF PLATES	xvii

CONTENTS LIST

	Page
CHAPTER ONE	1
Introduction	
1.0.0 The Evolutionary Paradigm	1
1.0.1 Aim of the Study	2
1.1.0 Taxonomy of the Gymnorhinae	3
1.2.0 Habitat, diet, predators and pathogens of magpies	4
1.3.0 Introduction to New Zealand	4
1.4.0 Magpie longevity	5
1.5.0 Contents	6
1.5.1 Contents of Chapter Two	6
1.5.2 Contents of Chapter Three	6
1.5.3 Contents of Chapter Four	6
1.5.4 Contents of Chapter Five	7
1.5.5 Contents of Chapter Six	7
1.5.6 Contents of Chapter Seven	8
CHAPTER TWO	9
Dispersion and Spacing Mechanisms in the Linton Population	
2.0.0 Introduction	9
2.1.0 Methods	11

	Page
2.1.1 Study area	11
2.1.2 Live trapping	12
2.1.3 Morphometric measurements	12
2.1.4 Banding	14
2.1.5 Sex and Age classes	14
2.1.6 Colour classes	15
2.1.7 Exploratory observations	15
2.1.8 Sampling density	20
2.1.9 Statistical Analyses of morphometric measurements	22
2.1.10 Calculation of dispersion measure	23
2.2.0 Results	24
2.2.1 Two population phases	24
2.2.2 The nomadic flock	25
2.2.3 Magpie territories	33
2.2.4 Magpie dispersion in the study area	40
2.2.5 Stereotyped display behaviour	42
2.2.6 Singing behaviour	44
2.3.0 Discussion	45
CHAPTER THREE	51
Flock Cohesion and Behaviour	
3.0.0 Introduction	51
3.1.0 Methods	53

	Page
3.1.1 Trapping and Banding	53
3.1.2 Sampling behaviour	53
3.1.3 Behaviour Patterns	54
3.2.0 Results	56
3.2.1 Associations between magpies	56
3.2.2 Time-activity Distributions	56
3.3.0 Discussion	64
CHAPTER FOUR	70
Territory histories and time-activity distributions	
4.0.0 Introduction	70
4.1.0 Methods	76
4.1.1 Trapping and Banding	76
4.1.2 Sampling behaviour	76
4.1.3 Behaviour classes	78
4.1.4 Statistical Analyses of Time-Activity scores	80
4.2.0 Results	81
4.2.1 Number and distribution of territories	81
4.2.2 Annual cycle of activity	81
4.2.3 Inter-territory behavioural interactions	82
4.2.4 Defense by pairs and groups	87

	Page
4.2.5 Composition of groups	87
4.2.6 Intra-territory relationships	88
4.2.7 Sexual behaviour	91
4.2.8 Cooperative breeding	93
4.2.9 Juvenile and sub-adult dispersal	94
4.2.10 Time-activity distributions	95
4.3.0 Discussion	116
CHAPTER FIVE	130
Reproduction in the Linton population	
5.0.0 Introduction	130
5.1.0 Methods	133
5.1.1 Searching for nests	133
5.1.2 Examination of nest contents	134
5.1.3 Monitoring breeding progress	134
5.1.4 Annual census	134
5.2.0 Results	134
5.2.1 Clutch sizes	134
5.2.2 Nestling and fledgling survival	136
5.2.3 Reproduction in pair- and group-defended territories	137
5.3.0 Discussion	141

	Page
CHAPTER SIX	151
Food Addition Experiment	
6.0.0 Introduction	151
6.1.0 Methods	152
6.1.1 Test and Control territories	152
6.1.2 Description of food stations	153
6.1.3 Description of supplementary food	153
6.1.4 Experimental regime	153
6.1.5 Sex of dispersing juveniles	155
6.2.0 Results	155
6.2.1 Juvenile dispersal	156
6.2.2 Polygyny in test territories	156
6.2.3 Productivity in test and control territories	159
6.3.0 Discussion	161
CHAPTER SEVEN	167
Discussion and Summary	
7.0.0 Discussion	167
7.1.0 Parameters of a magpie population in New Zealand	167
7.1.1 Population size and density	168

	Page
7.1.2 Clutch size and productivity	168
7.1.3 Survival	170
7.1.4 Operational sex ratios	170
7.2.0 Four lifestyles in a New Zealand magpie population	170
7.2.1 Nomadism versus territoriality	171
7.2.2 Monogamy versus group-territoriality	173
7.3.0 The cooperative breeding hypothesis	173
7.3.1 Strong inference	174
7.3.2 Cooperative breeding	175
7.3.3 Delayed juvenile dispersal	175
7.4.0 Summary	178
APPENDIX	180
REFERENCES	182

LIST OF TABLES

Table		Page
2.a	Magpie age classes.	16
2.b	Morphometric measurements of flock magpies.	27
2.c	Results of discriminant function analysis on tarsus, toe and beak length measurements of 18 sexed magpies and 33 unsexed magpies.	29
2.d	Population parameters estimated from flock recaptures, using Fisher-Ford method.	31
2.e	Morphometric measurements of territorial males and females.	36
2.f	Morphometric measurements of Age Class 3 magpies.	37
2.g	Summer census counts of territorial magpies.	39
2.h	Summer census counts of 12 closely-watched territories.	39
3.a	Distribution of possible-pair sightings.	57
3.b	Flock time budget sampling effort.	58
3.c	Analysis of variance on number of flock birds per scan, by month and time, excluding September.	60
3.d	Analysis of variance on transformed proportions of flock magpies foraging, by month and time, excluding September.	62
3.e	Regression analysis of flock size and foraging activity.	63
4.a	Group composition at January 1980 census.	89
4.b	Summary of sampling effort for territory time budgets in real-time minutes.	97
4.c	Hypotheses.	101
4.d	Analysis of variance on time spent foraging by month and time, for territory magpies.	103
4.e	Analysis of variance on time spent perching by month and time, for territorial magpies.	105
4.f	Analysis of variance on time spent defending the territory, by month and time.	108

Table		Page
4.g	Time budget and territory size changes predicted by Schoener's (1983) model of energy-maximising territory holders with processing constraints.	125
5.a	Nestling number counted from clutches of known size.	138
5.b	Production of juveniles by breeding female magpies.	139
5.c	Fledgling success estimated from clutch sizes of 3.5.	140
5.d	Female productivity in pair- and group-defended territories.	142
5.e	Production <i>per capita</i> by adults in pair- and group-defended territories.	143
5.f	Number of juvenile magpies fledged in groups of various sizes.	144
5.g	Estimated average individual fitness.	149
6.a	Length of stay by juvenile magpies (estimated) during food-addition experiment.	157
6.b	Number of yearling magpies remaining and nests built in test and control territories at completion of food-addition experiment.	158
6.c	Number of juveniles fledged by female magpies in test and control territories.	160
6.d	Number of juveniles fledged per breeding female in 1981 and 1982, for test and control territories.	162

APPENDIX

1	Number of visits and sights in 12 closely-watched magpie territories, and number of sightings needed for 90% census efficiency (when visit efficiency of 60% is set).	180
---	---	-----

LIST OF FIGURES

Figure		Page
2.a	Back plumage patterns ranging from white-backed (A) to black-backed (E) magpies.	18
2.b	Distribution of flock magpies in the Linton study area, and location of a short-term territory established by flock birds.	26
2.c	Approximate boundaries of thirty numbered magpie territories in the Linton study area, with dates of first observations.	34
2.d	Stereotyped display behaviour of magpies.	43
3.a	Variation in flock sizes measured during six day-time periods for twelve months.	61
3.b	The percentage of flock magpies performing each activity during six day-time periods for twelve months.	65
4.a	The distribution of territory defence activity in each day-time period for four seasons.	84
4.b	Movements of four magpies banded in territory [09], August 1978.	86
4.c	Pre-mating display by female magpies.	92
4.d	Percent time expended in three predominant activities from November to July by territorial magpies.	98
4.e	Male and female magpie time budgets in the breeding season.	99
4.f	Seasonal patterns of foraging activity by territorial magpies, over six day-time periods.	104
4.g	Seasonal patterns of perching activity by territorial magpies, over six day-time periods.	107
4.h	(1) Individual foraging scores.	109
4.h	(2) Individual foraging scores continued.	110
4.h	(3) Individual foraging scores continued.	111

Figure		Page
4.i	(1) Individual perching scores.	112
4.i	(2) Individual perching scores continued.	113
4.i	(3) Individual perching scores continued.	114
4.j	Distribution of anti-predator behaviour by pair- and group-territory magpies.	117
4.k	Distribution of social interactions of pair- and group-territory magpies.	118
4.l	Distribution of play behaviour by pair- and group-territory magpies.	119

APPENDIX

1	Sightings of individually banded flock magpies from October 1978 to April 1979.	181
---	---	-----

LIST OF PLATES

Plate		Page
2.a	Territory trap, containing decoy bird. Two magpies sing in response to the decoy stimulus, and two other magpies exhibit the bill-down display.	13
2.b	Flock trap.	13
2.c	Fledgling magpie.	17
2.d	Adult male magpie.	17
3.a	Flock magpies perching, preening and foraging.	67
4.a	Male magpie provisions three nestlings.	120
5.a	Pole-mounted mirror used to view magpie nest contents.	135
6.a	Feeding station.	154
6.b	Male magpie consumes ox-heart at feeding station.	154