Black-fronted terns and banded dotterels: causes of mortality and comparisons of survival

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Abstract

1. The braided rivers of the South Island, New Zealand, provide feeding and breeding habitat for a range of endemic bird species. Many of these species are entirely reliant on braided river habitat for breeding, but because of a reduction in habitat quantity and quality due to weed infestation, hydroelectric power development and water abstraction, and high predation rates by introduced mammals, the survival of many of these bird species is under threat.

2. Predation is the primary cause of mortality for most braided river bird species, but most studies have only measured the effects of predation at the egg stage. In this study, I monitored breeding success of banded dotterels (*Charadrius bicinctus*) and black-fronted terns (*Sterna albostriata*) on the Ohau River, South Island, from 1998-2000, and examined the effects of predation on both species. The black-fronted tern is an endangered species about which very little is known, so I also investigated aspects of its breeding biology.

3. I used time-lapse video cameras at 39 nests of banded dotterels and determined that nest monitoring did not affect nest survival rates, nor do predators use human scent trails to locate nests. I attached radio transmitters to 49 banded dotterel chicks to assess rates and causes of mortality, but although a minimum of 18% of chicks were killed by predators, the transmitters did not provide information on the relative importance of the different predator species. Hatching success at 338 banded dotterel nests was 68%, and 48% of hatched nests fledged at least one chick.

4. Hatching success for 1022 black-fronted tern nests was 50.2%, and a minimum of 27.6% of 897 chicks survived through to fledging. Cause of mortality was assessed for 148 chick, juvenile and adult terns, and I found that predators were responsible for 47% of deaths. Feral cats (*Felis catus*) and Norway rats (*Rattus norvegicus*) were probably responsible for 19% and 51% of predator related deaths, respectively. Mortality rates remained high immediately after fledging because of predation. Annual adult mortality was estimated at 88-92% but the associated confidence intervals were wide (57-99%). I document aspects of black-fronted tern ecology such as incubation period, fledging period, egg and chick weights, and develop a preliminary method for sexing adult black-fronted terns based on body measurements. I measured black-fronted tern chick growth and survival and found that hatching asynchrony results in lower growth and survival in second hatched chicks. I collated all existing data on black-fronted tern

populations and from these data estimate that the population size is less than 10 000 but conclude that better data on population size and trends are required.

5. Using population viability analysis models, I compare the survival of banded dotterels and black-fronted terns on the braided rivers. Higher productivity and shorter generation times, rather than any behavioural differences, are probably the key factors that result in stronger population growth for banded dotterels, despite both species being subject to similar levels of predation. Simulations indicate that predator control could be the most effective way to increase black-fronted tern survival.

6. This study provides the first comprehensive record of black-fronted tern breeding biology. I provide evidence that the black-fronted tern population is almost certainly in decline and the species urgently needs further research. In addition, the interrelationships between rabbit (*Oryctolagus cunniculus*) abundance, predator abundance and nest predation rates are poorly understood and urgently need attention in order to better manage braided river communities and ensure the survival of black-fronted terns and other vulnerable bird species.

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Many people and organisations helped make this project possible. Each chapter has its own acknowledgements section, but here I'd like to thank people whose assistance was not specific to any one part.

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produced top quality results. A particularly big thanks to Tim for putting up with getting shat on repeatedly and for his sense of humour that made things highly entertaining for the two years that he was helping me.

I thank Ian Anderson from the Equine Blood Testing Unit at Massey University for generously providing free DNA analysis of my feather samples, and to Maurice Alley and Caroline Twentyman for doing the post-mortem analyses. Emily Sancha also helped teach me the intricacies of egg and chick necropsies. Peter Ritchie helped me draw a map of my study areas, and Barbara Feeney proofread some chapters. Grant Norbury, Elaine Murphy, John Dowding, Ian Nisbet, Colin O'Donnell, Doug Armstrong and Richard Maloney all provided useful advice and/or discussions at various stages of the project. Duncan Hedderley and Ray Webster provided endless assistance with statistics.

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My acknowledgements would not be complete without mentioning my favourite canine friend. Without Cass, I doubt I would have discovered the effects of Norway rats and other predators on black-fronted terns, nor would my data on chick survival have been as complete without the use of his nose. He also provided a lot of entertainment and kept me sane: some days I realized the only living beings I had talked to included a dog and some birds, instead of just birds alone. Made me feel a little less mad anyway!

Finally, thanks to the terns and dotties themselves, without which this study would not exist.

Preface

Each chapter in this thesis was written as a separate paper for publication in a journal. Consequently, there is a degree of repetition and overlap between some chapters. The purpose of this preface is to detail the full references for those chapters that have been published and list the journals to which chapters have been or will be submitted. Although I have co-authors for some chapters, in all chapters my input was the greatest. I planned the research, organized the funding, carried out the fieldwork, analysed the data and wrote the manuscripts. Below I describe the roles of each of my co-authors.

Chapter 1 has been accepted for publication in *The Condor*:

> Keedwell, R. J., and M. D. Sanders. 2002. Nest monitoring and predator visitation at nests of banded dotterels. Condor.

Mark Sanders was one of my supervisors. His co-operation allowed me to carry out the research in Chapter 1 in collaboration with his on-going video monitoring of braided river bird nests.

Chapter 2 is published in *Waterbirds*:

> Keedwell, R. 2001. Evaluation of radio transmitters for measuring chick mortality in the banded dotterel. Waterbirds 24:217-223.

Chapters 3, 6 and 9 will be submitted to *Notornis*. **Chapter 4** will be submitted to *Emu*.

Chapter 5 was submitted to *Pacific Conservation Biology* in April 2002. The paper was submitted as:

> Keedwell, R. J., M. D. Sanders, M. Alley, and C. Twentyman. (submitted). Causes of mortality of black-fronted terns (*Sterna albostriata*) in the Ohau River, South Island, New Zealand.

Collaboration with Mark Sanders provided valuable video footage; and Maurice Alley and Caroline Twentyman carried out the post-mortem analyses.

Chapter 7 will be submitted to *Ibis*. **Chapter 8** was submitted to the *Journal of Field Ornithology* in May 2002. The paper was submitted as:

> Keedwell, R. J. (submitted). Does fledging equal success? Post-fledging mortality in black-fronted terns.

Chapter 10: my co-authors on this paper, Ed Minot and Murray Potter, were both my supervisors. Ed provided extensive help with the computer modelling, and both Ed and Murray provided input into the construction and write-up of this paper.

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