Reproductive success and demography of the Orange-bellied Parrot *Neophema chrysogaster*

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Statement of originality

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Orange-bellied Parrots at Melaleuca (original watercolour by Mel Hills)

Abstract

The Orange-bellied Parrot is one of only two obligate migratory parrots in the world. The species is listed nationally as endangered and has been the subject of intensive study and conservation activities over the past 25 years. Reproductive and demographic data collected over this period from the wild population form the basis of this thesis.

Remote breeding sites in southwestern Tasmania at Melaleuca and Birchs Inlet were used to study this species in the wild. Through deployment of up to 52 artificial nest boxes and observations of natural nests at Melaleuca it was possible to collect information on a range of reproductive success parameters over a long period, including 12 consecutive breeding seasons. In addition, the provision of up to 33 nest boxes over seven consecutive years at Birchs Inlet provided a comparison with the use of nest boxes by several competitors at Melaleuca. The use of colour-bands to identify 760 individuals from 16 different cohorts provided the means to assess a range of behavioural and demographic parameters of the species.

This study confirmed the Orange-bellied Parrot has a regular migratory pattern with birds beginning to return to the breeding area on the 2nd October (± 5.1 days s.d) in each year. The first birds to return are those in their second year of life or older, while first-year adult birds begin to arrive 13 days later. The median arrival date for birds in their second year or older was the 23rd October compared with 9th November for first-year adult birds. There was no difference between the sexes in arrival date. The mean date of last departure from Melaleuca was 5th April (± 11.1 days s.d).

A total of 190 nests with known contents were studied in the wild and, of these 185 nests contained eggs and five nests contained no eggs. This study found the earliest laying date was on the 29th November and the latest was the 19th January with eggs (95%) laid during December (n = 101 eggs). Clutch size ranged from 2—6 eggs with

over half of the clutches having 5 eggs and 95.3% of all clutches 4—6 eggs in size. The mean clutch size was 4.7 eggs per active nest across all years and there was no evidence the species can produce second clutches in the wild. The mean incubation period for Orange-bellied Parrot eggs was 21.4 ± 0.8 days (*n* = 49 observed incubations). The mean dimensions of unhatched eggs was 22.9 ± 0.98 mm by 18.5 ± 0.67 mm (*n* = 99 eggs).

The 185 nests with eggs studied by this work contained a total of 874 eggs. Of these 695 eggs hatched and 179 eggs failed to hatch. Of the 179 failures, 107 eggs (69.7%) were infertile, 48 eggs (26.8%) were fertile and 24 eggs (13.4%) were of unknown fertility. Of the 48 unhatched fertile eggs, 23 eggs (47.9%) were early-term failures, 15 eggs (31.2%) were mid-term failures and 10 eggs (20.8%) were late-term failures. The mean egg fertility rate for the species was calculated to be 85.6% (± 2.91 s.e).

Hatching success from all eggs laid was 79.5% (*i.e.* 695 nestlings hatched from 874 eggs laid) with the mean hatching success across all years being 80.2%. A total of 89 nestlings died prior to fledging. Early stage deaths represented 44.9% (*n* = 40) of all mortalities and late stage deaths 55.1% (*n* = 49). The annual egg failure and nestling mortality varied across years. Of a total of 268 egg and nestling failures across all years, 66.8% (*n* = 179 eggs) were attributable to hatch failure and 33.2% (*n* = 89 nestlings) to mortality. Unhatched infertile eggs represented most (39.9%, *n* = 107) of all failures. Of the 190 nesting attempts, only 27 failed to produce any young. The most common cause of total nest failure was attributed to failure to hatch (44.4%, *n* = 12) followed by nestling deaths (37%, *n* = 10) and no eggs laid (18.5%, *n* = 5).

Average brood size was 4.0 nestlings ± 0.09 s.e (range = 1—6) from 173 nests with 65.9% of nests producing four (33.5%) or five (32.4%) nestlings. The majority of nests produced four fledglings with a mean fledgling brood size of 3.7 ± 0.09 s.e (range =

1—6) from the 163 successful nests. Only 4.3% of successful nests produced the maximum of six fledglings.

Of the 190 Orange-bellied Parrot nests studied, 85.8% (n = 163) produced fledglings. The distribution of nest productivity is presented and discussed in detail. The number of fledglings produced per breeding attempt varied between zero and six. A total of 69% of all nests produced 3—5 fledglings whereas 33% of all nests produced four fledglings. The fledging success for 12 consecutive breeding seasons was 87.2% (606 fledglings from 695 nestlings) and the mean fledging success across all years was 86.9% (± 2.47 s.e). The overall breeding success for the Orange-bellied Parrot was 69.3% (606 fledglings from 874 eggs laid). The overall reproductive output of the species was 3.3 fledglings per nest (606 fledglings from 185 nests) from an investment of 4.7 eggs laid.

Egg fertility, nestling survival and fledgling survival of Orange-bellied Parrots in the wild is noticeably higher than for the captive population, and is equal to or exceeds many other Psittacidae. The reproductive success results reported here are comparable with the more common Turquoise Parrot *Neophema pulchella* of mainland Australia. Although the Orange-bellied Parrot has a healthy mean fecundity rate of 1.62 females/egg laying female, there was some variability between years, with a low of 0.87 females/egg laying female in 1998/99.

The mean lifespan of the Orange-bellied Parrot was calculated to be 2.22 years (± 0.074 s.e, range = 0.37–11.70, N = 693) with no significant difference between male and females. Males lived on average for 2.75 years (± 0.127 s.e, range = 0.43–11.70, n = 240) and females lived on average for 2.67 years (± 0.141 s.e, range = 0.18–10.41, n = 189). The oldest male recorded was 11.70 years of age and the oldest female recorded was 10.41 years of age. This study was not able to compare the reproductive lifespan of wild Orange-bellied Parrots with captive-bred birds due to database problems or with

other Psittacidae due to lack of comparable studies. The capacity to compare the wild population with captive-bred birds and other Psittacidae will greatly enhance our knowledge of the species.

This work suggests the Orange-bellied Parrot does not have a strong fidelity to mates, nest site or nesting zone. This finding is contrary to previous assumptions made about the species. This study did not measure hollow availability; however, a comparison of the use of nest boxes between Birchs Inlet and Melaleuca indicates competition from introduced species may be limiting the breeding range and reproductive success.

Survivorship rates of juveniles to first breeding (*c.* one year old), adults and both sexes were determined. Mean survivorship of juveniles over the study was 55% (± 3.2 s.e) and is within expected limits when compared to other Psittacidae. Mean survivorship of adults was 63.6% (± 2.0 s.e). There was a decreasing trend in survival rates across all cohorts from 1999 onward with average annual survival declining markedly thereafter. The reason for this decline is unclear. There was no difference in survival rate of each sex over the study.

This study has significantly increased our understanding of the reproductive success and demography of the Orange-bellied Parrot. This information will reduce the level of uncertainty in the Population Viability Analysis model for the species and, in turn, increase the power of such models to assess the species status and test the effectiveness of conservation measures. Some of the results of this study have important implications for future research and conservation of the species. These are discussed, and include management of nest boxes, refinement of mark-recapture studies, population viability analysis and influence of introduced nest competitors.

Acknowledgments

When I joined the Tasmanian Parks and Wildlife Service in 1979, one of the first projects in which I was involved, was the first concerted effort to study the Orange-bellied Parrot (OBP) led by Peter Brown. This study involved a large team of professional and volunteer observers, spending time in what is now Tasmania's great Southwest Wilderness World Heritage Area. Peter's enthusiasm for the OBP was infectious and we became strong allies. Through this connection and the opportunities that followed, my career became inextricably linked to the goals of conserving Tasmania's natural diversity and in particular playing a key role in the recovery program for the Orange-bellied Parrot. My experience and connection with this enigmatic species has provided me with the opportunity to consolidate my knowledge within this thesis. While this document is by no means a comprehensive description of the species it represents a significant part of the species' life history and the efforts of many individuals who care for our natural world.

My friends and colleagues in the Nature Conservation Branch (formerly the much-loved Wildlife Branch) have encouraged me to undertake this research. In particular, Peter Brown, Sally Bryant, Robbie Gaffney, Stephen Harris, Nick Mooney and Alistair Scott have provided support and encouragement over the years. Likewise, I sincerely thank my supervisor, Dr. Alastair Richardson, for his patient support and guidance throughout the study. His good nature, breadth of knowledge and encouragement has been invaluable to me throughout the study.

This work would have been more difficult to achieve without the logistical support of several organisations. The Parks and Wildlife Service (PWS) provided accommodation in the Melaleuca staff quarters for field teams. Albert Thompson and Chris Arthur were important collaborators in allowing the use of these facilities and departmental vessels. Par Avion Pty. Ltd. transported personnel and equipment to and from Melaleuca. Don and Greg Wells and their team of pilots provided us with a

safe, reliable and cost effective service throughout. The transport of personnel and equipment to more isolated areas was conducted by Helicopter Resources and Mario Sorantino (Strahan Marine Charters) provided transport for operations at Birchs Inlet.

Numerous expeditions in search of breeding activity, locating nest sites, banding nestlings and lugging nest boxes across waterlogged buttongrass plains, were undertaken throughout the southwest region. These expeditions could not have been conducted without my team of enthusiastic and skilled volunteers. Foremost among these are Tom Burke, Mike Brakey, Peter and Claire Marmion and Freya Schiefelbein, who share my love for the wilderness and without whom these expeditions would have been far less enjoyable. Others who have assisted me include Mick Dudgeon, Dave James, Adam, Analie and Ian Marmion, Jacob Holdsworth, Robbie Gaffney, Kylie 'Qug' McKendrick-King and Matt Webb among others.

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My dad, Hedley Holdsworth, turned his carpentry skills to designing and building 'bomb proof' nest boxes and assisted with the maintenance of captive breeding aviaries. The inspection of nest sites and maintenance of nest boxes requires significant strength and agility. I could not have done this on my own and I'm indebted to Dave James, Matt Webb, Justine 'Juzz' Shaw and Pip Morse who assisted me in scaling trees, often in trying conditions. Peter and Helen Brown, Janine Long and Paul Wilson, Sue McNeil, Tom Ralph and Jenny Tulip have at various times over the years managed the captive breeding facility at Taroona. Drs. Barry Wells, Brett Gartrell and James Harris provided veterinary support and advice throughout the project. Jocelyn Hockley (Healesville Sanctuary) provided useful data relating to the captive population. Glen Atkinson worked tirelessly to control European Starlings at the study sites.

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I've enjoyed involving my children in my interest in the Orange-bellied Parrot over the years. Robert (deceased), Jacob and Chelsea were always great company for me when they had the opportunity to spend time in Tassie's wilderness country. It is gratifying to know these experiences will make Jacob and Chelsea strong advocates for conservation of our natural world. I pay special tribute to the late Charles Denison 'Deny' King. Deny's home and garden at Melaleuca was the focus of most of my studies over the past two decades, as it has been a central feature of the Orange-bellied Parrot's breeding range. Deny, and then later, his daughters Janet and Mary and their families, Geoff, Tony and Sally Fenton and Qug, have always made me feel welcome at Melaleuca. Together we have shared many great moments exploring a backyard like no other. I hope this work will go some way toward saving Deny's beloved 'grass parrots'. Likewise, Barbara and Peter Willson provided me with great

company during my field trips. We were always welcome in their home and spent many hours discussing the Orange-bellied Parrot and all manner of subjects pertaining to the world we live in—often over a 'Rallinga' homebrew or bottle of red.

Most of all I'm grateful to my friend, partner and colleague, Sally Bryant. Sally provided invaluable field assistance throughout the study and, as Manager of the Threatened Species Section, has been critical in securing funds for the Recovery Program. Sally has very patiently encouraged me through my, at times laborious progress toward completion of this work. I thank her for her clear thinking, professional guidance and gentle encouragement throughout the years. Thank you SBGP.

Finally, I dedicate this thesis to my son Robert. If he were here today I'm sure he'd be proud of his dad.

Contents

Organisation of thesis

The thesis is organised as follows:

Chapter 1 General introduction

Provides a general introduction to threatened species conservation, the Orange-bellied Parrot and background to this study.

Chapter 2 Reproductive success

Describes the breeding biology and reproductive success parameters of the Orange-bellied Parrot obtained through this study. Results are discussed in comparison to other species of psittacids.

Chapter 3 Population demographics

Describes the demography of the wild Orange-bellied Parrot population obtained through this study. Data relating to survivorship, lifespan, sex ratios, mate and site fidelity, fecundity and migration are presented and discussed.

Chapter 4 Implications for conservation

Summarises the findings of this study and discusses the information presented in the preceding chapters. Recommendations for future research directions under the recovery program are presented.