MACQUARIE PERCH UNDER PRESSURE: PREDATION RISK TO AN ENDANGERED FISH POPULATION

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A thesis submitted for the degree of Ph.D. in Applied Science
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December 2010

CERTIFICATE OF AUTHORSHIP OF THESIS

Except where clearly acknowledged in footnotes, quotations and the bibliography, I certify that I am the sole author of the thesis submitted today entitled:

Macquarie perch under pressure: predation risk to an endangered fish population.

I further certify that to the best of my knowledge the thesis contains no material previously published or written by another person except where due reference is made in the text of the thesis.

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Signature of Candidate

C.R.M. Morris

Signature of chair of the supervisory panel

Date: 4 August 2011

STATEMENT OF CONTRIBUTION

Chapters 3, 4 and 5 of this thesis have been prepared for publication in peer-reviewed journals, and therefore several other people have contributed to the work and they deserve special acknowledgement. These include:

Dr Brendan Ebner (Australian Rivers Institute, Griffith University), who provided guidance and supervision for all aspects of the PhD Study and assisted in the preparation of manuscripts.

Associate Professor Mark Lintermans (Institute for Applied Ecology, University of Canberra), who provided guidance and supervision for all aspects of the PhD Study and assisted in the preparation of manuscripts.

Professor Richard Norris (Institute for Applied Ecology, University of Canberra), who provided guidance and supervision for all aspects of the PhD Study and assisted in the preparation of manuscripts.

These people will be included as authors on publications resulting from this thesis. However regardless of their contribution, the work within is my own and I have received no assistance other than which is stated above.

As primary supervisor I agree with the above statement.

Professor Richard H. Norris — 4 August 2011

Professor Richard H. Norris — Date

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ACKNOWLEDGEMENTS

As a kid what I wanted to do when I grew up was follow around an endangered species and figure out how to save it. This thesis is a testament that childhood dreams can come true. I thank my parents Michael and Fay Ryan for raising me to have such dreams and encouraging me to follow them.

This research was kindly funded by ACTEW, eWater CRC and the University of Canberra.

Brendan Ebner, Mark Lintermans and Richard Norris have been wonderful supervisors throughout this PhD and I am incredibly grateful to each of them for all of their contributions to this thesis and my career development. In particular I would like to thank Mark for his help in the field, inspiring me with his passion for freshwater fish conservation, and being the practical and chilled out supervisor; Brendan for his help in the field, inspiring me with his passion for fish spatial ecology, conversations about the big picture stuff (sometimes), and being the excitable supervisor; and Richard for his help improving my writing style, inspiring me with his passion for freshwater ecology, letting me go to lots of conferences, and for offering me this opportunity in the first place.

Thank you to my colleagues at the Institute for Applied Ecology, University of Canberra. I am incredibly grateful to the fish boys, Ben Broadhurst, Rhian Clear, Jason Thiem, Danswell Starrs and Danny Wright for providing lots of help with my research, making me feel part of the team and being lots of fun to work with. Jeremy Groves, Evan Harrison, Hayley White and Elizabeth Deschaseaux were also lots of fun to work with and were magnificent field volunteers. Fiona Dyers moral support over the past 6 months has been fantastic and very much appreciated. Thank you to all members of the Freshwater Ecology Writing Group for providing valuable feedback on Chapter 5. I would also like to thank the IAE office staff, particularly Kerrie Aust who is capable of solving everything, and Vicki Smyth for helping with field equipment. I have had a blast at the IAE and I wish all of my colleagues past and present the very best with their futures.

This project could not have happened without so many brilliant volunteers including Stewart Pittard, Mathew Young, Eleena Wykes, Lea Knight, Andrew Palmer-Allen, Berlinda Bowler, Rohan Rehwinkle, Ciera and Lyndall. I am very grateful to everyone ventured into the field with me.

Thank you to my lovely friends who have supported and encouraged me throughout the past 3.5 years. In particular, Penny Wijnberg for reading and editing this thesis, and Nicole Walker, Amy Pepper, Brooke Bowyer, Tom Camilleri, Samantha Lloyd and Brendan Linton-Smith for your help in the field. I am lucky to have such wonderful friends.

My family has been extremely supportive throughout this PhD and I would like to thank all of them – Ryan's, Whalan's, Byfield's, Calvert's and Witteveen's. Their love and encouragement has been really appreciated. The arrival of Kaelie, Noah and Zachary into my family during the course of this PhD has brought me so much happiness and I am grateful to them and their amazing parents, Shawn and Chell, and Miriam and Ben. I hope that one day I can help to inspire them to follow their dreams.

I could not have taken on such a huge endeavour as this PhD without the support of my partner, Paul Calvert. I am extremely grateful to him for being my number one field assistant, for always telling me I could do it, for giving me the motto "saving the world one species at a time", for putting up with me working late, for taking me and this thesis to Revelstoke, and for standing beside me throughout everything. I can't imagine it's always easy to love a PhD candidate, but he has done it and for that I will always be thankful.

ABSTRACT

The extinction of freshwater fish species poses a threat to the health of freshwater ecosystems and must be prevented. Habitat loss is largely responsible for the decline of many of Australia's freshwater fish species, resulting in small and often isolated populations that are vulnerable to stochastic processes. Macquarie perch, *Macquaria australasica* (Percichthyidae), is one such species, and is now listed nationally as endangered. Cotter Reservoir in the Australian Capital Territory (ACT) is home to one of the last self-sustaining populations of Macquarie perch. The success of the Macquarie perch population at Cotter Reservoir has been largely attributed to the abundance of structural habitat around the perimeter of the reservoir, which established primarily in response to long-term stable water levels. This habitat is thought to mitigate predation by cormorants which are known to prey on adult Macquarie perch, a vulnerable component of the population. However, habitat availability in the reservoir will soon change when it is enlarged from 4 to 78 GL and regularly drawn down for water supply. It was the aim of this thesis to guide effective conservation measures to protect Macquarie perch from cormorant predation in the enlarged Cotter Reservoir by:

1. Determining spatial and temporal trends in cormorant predation risk to Macquarie perch in Cotter Reservoir.
2. Investigate trends in the spatial ecology and habitat use of Macquarie perch over the course of a year to develop an understanding of refuge and spatial requirements.

Predator abundance, predator-prey overlap, prey behaviour and habitat characteristics, were considered key parameters for achieving the objectives of this thesis. Adult Macquarie perch were radio-tracked at Cotter Reservoir every two weeks from April 2008 to June 2009. During this period a 2 m drawdown occurred for one month in each season to mimic structural habitat availability in the enlarged reservoir. Cormorants were counted from February 2008 to June 2009 and their activity and location within the reservoir were recorded. Habitat was mapped using aerial photographs taken during a 5 m drawdown. Macquarie perch, cormorant and habitat data was analysed in ArcGIS to investigate spatial and temporal relationships.

Predation risk to Macquarie perch was greatest in the shallow upstream section of Cotter Reservoir during spring and summer, when predator-prey overlap and predator abundance were highest. This corresponded with a shift by the Macquarie perch population into the upstream section of the reservoir during its spawning period. A decline in predator-prey overlap at the fish microhabitat scale suggests that the use of structural habitat by adult Macquarie perch in the current reservoir mitigates predation. A 2 m drawdown resulted in the loss of all emergent macrophytes and 55% of structural woody habitat. During drawdown fish did not aggregate in remaining structures or increase their use of depth as refuge, resulting in increased vulnerability to predation. The addition of constructed habitats in the upstream section of the enlarged reservoir is essential to ensure that Macquarie perch are able to make a spawning run into the river and access upstream foraging habitat without increased risk of cormorant predation.

Adult Macquarie perch established larger home-ranges than previously reported for percichthyids in rivers and demonstrated a spatial awareness of Cotter Reservoir. The population distribution shifted temporally, with upstream shifts in spring and summer and downstream shifts in response to drawdown. Smaller fish inhabited deeper habitats (>15 m) while larger fish inhabited shallower habitats (<15 m), potentially in response to a trade-off between avian predation risk and food availability. This information contributes significantly to understanding the resource requirements of Macquarie perch and provides valuable baseline data for investigating the effects of reservoir enlargement.

The present thesis provides a valuable approach for developing an understanding of predator-prey interactions, particularly when dealing with small populations in the field. Investigation of predator-prey overlap allowed the identification of when and where predation risk is greatest, which cannot be obtained from conventional consumption estimates. Information about spatial and temporal trends in predation risk is critical for

implementing effective conservation measures to protect small prey populations threatened by predation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES