Community Structure and Algal Feeding Preferences of Zooplankton in Myponga and South Para Reservoirs

Azma Hanim Ismail

A Thesis Submitted for the Degree of
Doctor of Philosophy

Discipline of Ecology and Evolutionary Biology
School of Earth and Environmental Sciences
The University of Adelaide
June 2012

TABLE OF CONTENTS

ABSTRACT

Zooplankton community structure was studied monthly in Myponga and South Para Reservoirs in South Australia from January 2008 to June 2009. Myponga Reservoir is a highly managed reservoir with prolong artificial mixing while South Para Reservoir is non-managed and has less human perturbation. The total number of taxa in Myponga and South Para Reservoirs were 16 and 20 respectively. Cladocera was the dominant taxonomic group in relation to the total number of taxa but in terms of total density, Copepoda were the numerically dominant group in both reservoirs. The most frequently occurring Cladocera were *Ceriodaphnia* cf. *quadrangula*, *Ceriodaphnia cornuta* and *Bosmina meridionalis* while *Asplanchna priodonta* was the predominant Rotifera throughout the study. Copepoda were dominated by *Calamoecia ampulla* and *Microcyclops* sp., making up the largest portion of total zooplankton density. Differences with regard to species richness were due to the sole occurrence of *Polyarthra dolichoptera, Keratella slacki, Anuraeopsis fissa* and *Pompholyx complanata* in South Para Reservoir.

Observations showed relatively consistent species diversity and density throughout the study in Myponga Reservoir except for low densities during summer for Cladocera and Copepoda groups while seasonal variations in zooplankton composition and abundance are features of South Para Reservoir. Shallow locations have greater zooplankton densities compared to deep locations in both reservoirs. Nevertheless, vertical migration in shallow locations was inexplicit as compared to deep locations in Myponga Reservoir.

Physico-chemical factors particularly water temperature and biological factors including the occurrence of green algae and cyanobacteria may influence zooplankton abundance and the

dynamics of the community. Thermal stratification and circulation resulted in brief population dispersion and consequently had a fluctuation of seasonal distribution pattern of zooplankton. Both horizontal gradients and stratification are strong factors enhancing zooplankton richness at South Para Reservoir.

The functional responses of *Daphnia carinata*, *D. lumholtzi* and *Ceriodaphnia* cf. *quadrangula* to six algal species at three concentrations are described. The ingestion and filtration rates were measured by Low Revolutions per Minute Tumbler (LRPMT) for 2 hours at 20^{o}C. Ingestion and filtration rates varied with algal species and concentrations. *Daphnia carinata* removed algal cells at a higher rate than other two species when feeding on uni- and multi-algal species suspensions. Quantitative differences in the rate of food intake were found in suspensions of *Ankistrodesmus falcatus, Scenedesmus obliquus, Chlorella vulgaris, Chlamydomonas reinhardtii, Anabaena circinalis* and *Microcystis flos-aquae*. Small cells of green algae were more readily ingested by grazers. Ingestion rate increased linearly with cell concentration up to a maximal rate. Comparison of the ingestion rate on a green and blue-green algal mixture demonstrated the importance of edible algae in zooplankton selective feeding. Filamentous *Anabaena circinalis* and colonial *Microcystis flos-aquae* were less favourable as food particularly in a multi-algal suspension. In contrast, both these blue-green algal species can also be utilized by the grazers when presented as a unialgal suspension although these species were previously reported to have lethal toxic effects on cladocerans. Therefore, a management strategy using cladocerans for controlling undesirable cyanobacteria is contemplated to be necessary in the future. As the grazing rates would be correlated with zooplankton taxonomy composition, monitoring data is important in order to know the dominant zooplankton taxa in the reservoirs.

DECLARATION

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Azma Hanim Ismail

June, 2012

ACKNOWLEDGEMENTS

I owe a great many thanks to a great many people who helped and supported me during the writing of this thesis.

First and foremost, my utmost gratitude to my supervisors, Assoc. Prof. Friedrich Recknagel, Dr. Russell Shiel and Dr. Scott Mills whose sincerity and encouragement I will never forget. This thesis would not have been possible without their help and guidance. Assoc. Prof. Friedrich Recknagel, my principal supervisor, has guided me during all phases of this research. Taxonomic expertise was provided by my co-supervisor, Dr. Russell Shiel, who also provided field work facilities throughout the sampling. I am indebted to my co-supervisor, Dr. Scott Mills for valuable guidance and constant advice. He has been my inspiration as I hurdle all the obstacles in the completion of this research work particularly during laboratory works and grazing vessel (LRPMT) invention. His willingness to motivate me contributed tremendously to this project.

Thanks and appreciation to the helpful people at SA Water Corporation for their support. Particular thanks are due to Thorsten Mosisch, who provided access to Myponga and South Para reservoirs as well as valuable phytoplankton and water quality data. I gratefully acknowledge boat operators, Rod Boothey and Jason, for technical assistance during sampling. I thank Peter Baker, Peter Hobson, Steve Amos and Hossain Siddiqui for generously provided cultures of the algae and for advice on maintaining laboratory cultures. I am heartily thankful to Nurul Izzati Othman for superb technical assistance during field sampling. The contributions of these people are gratefully acknowledged who also assisted in field work; Cecile Perillon, Helen Brown, Siti Suriani, Mardhiah, Nur Alia, Nurizzati and Farah.

I would also thank my faculty members without whom this project would have been a distant reality. Grace Chan has shared valuable insights in the relevance of the study, Azman, Yusoff, Pranay, Deborah, Pik Vipasiri, Young Kil, and Rebecca for their constructive comments and improvement to the research. Special thanks are also to Jeffrey Newman, Samuel Martin and Byron for their valuable assistance, guidance, support and information on SALMO-OO model. It is a pleasure to thank Julianne Francis, John Stanley, David Ladd, Kate Fitzpatrick, Robert Reid and Kane Aldridge for providing laboratory facilities and encouragement throughout the study.

An honourable mention goes to my beloved parents and family for their care, support and strength along the way. I would like to express a sense of gratitude to my hubby for his unending love, support, understanding and patience throughout my study. Last but not least, my deepest thanks and regards to my beloved late father who supported me in any respect and built a strong foundation on me. Indeed, he has a place of honour, deep within my heart.

Most of all, the omnipresent God, for answering my prayers for giving me the strength to plod on, despite my constitution wanting to give up and throw in the towel, your grace is boundless and I thank you so much Dear Allah.

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES