Dispersal, population genetics and taxonomy of selected aquatic macroinvertebrates in ephemeral river systems

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Thesis Abstract

Ephemeral rivers make up a large portion of the world's river systems and yet in the past they receive little attention compared to perennial rivers. In addition to this, interest into the dispersal of aquatic macroinvertebrates until recently has also received little attention. Recent work has uncovered that aquatic macroinvertebrate dispersal may be more limited than previously thought. I investigated the dispersal and population structure of aquatic macroinvertebrates across two ephemeral catchments in South Australia using both genetic techniques as well as direct measures of dispersal.

Previous studies on *Paratya australiensis* have shown that it is not a single species, but rather a species complex made up of multiple linages, some of which have been shown to be reproductively isolated. We analysed the CO1 region of the mitochondrial DNA and compared that to sequence from previous studies (chapter 2). Both lineages 4 and 8 were found which are also found in the head waters of the Murray River and we suggest they used this as a dispersal pathway from eastern Australia.

In order to assess population structure within and between the study catchments we developed microsatellite primer pairs for the shrimp (Chapter 3). The primer pairs developed in chapter 3 were used to look at the population structure of the shrimp across the Broughton and Wakefield Catchments of South Australia (chapter 4). The results showed distinct variation between catchments and additional structuring within the Broughton Catchment. We suggested that even though there were no definitive barriers along the water course that it was

impossible for the shrimp to pass, that repeated times in isolation have led to population differentiation.

One of the challenges to the study macroinvertebrates has always been identification. We looked at two morphologically very similar damselflies, *Ischnura heterosticta* and *Austroagrion watsoni* to investigate the benefit of genetic techniques in species identification (chapter 5). The mitochondrial sequence showed the rate of incorrect morphological identification at approximately 50%. This highlights both the need for accurate identification as well as the power of genetic techniques for identifying morphologically similar species.

One of the most successful methods for direct dispersal measurement is the light trap. We designed and trialled a new type of light trap for catching emerging caddisflies (chapter 6). The light traps were used in a short study to assess their ability to detect dispersal direction of Caddisfly from a permanent water pool within an ephemeral river using a concentric ring design (chapter 7). The results showed that the majority of individuals dispersed along the river channel and that there was a trend to disperse downstream.

The Ecology of the ephemeral rivers is often different to perennial river theory. This difference is the subject of an increasing research effort and this thesis contributes significant new information to the discussion. Through the development of new methods and the use of genetic techniques this thesis has documented previously unknown patterns and suggests areas for future work.

Declaration

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma at any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text

Douglas Green

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Overview of thesis content

Chapters two through seven of this thesis present original research in the format of scientific papers. For this reason each chapter has a separate reference list. Tables and figures are presented after the references of each chapter. Chapters three and six are already published while chapters three, four, five and seven are yet to be submitted for publication.

All chapters have been written by me. My supervisors, Duncan Mackay and Molly Whalen, are co-authors due to their significant input, advice and guidance. Laurence Clarke is also co-author of chapter three owing to his significant input and advice with the project. Michael Gardner is also a co-author on chapter five due to his input and advice through the development of analysis of the project.

Chapter three:

Green, D.J., Clarke, L.J., Mackay, D.A., and Whalen, M.A. (2011) Microsatellite markers for the freshwater shrimp *Paratya australiensis* (Atyidae). *Conservation Genetics Resources* 3, 295-296

Chapter six:

Green, D.J., Mackay, D.A., and Whalen, M.A. (2012) Next generation light traps: The use of LED light technology, *Australian Entomology*, 39, 189-194