IMPACT OF WILLOWS ON AQUATIC INVERTEBRATE COMMUNITIES

WAHIZATUL AFZAN AZMI

THE UNIVERSITY OF ADELAIDE
2011

Impact of willows on aquatic invertebrate communities

Wahizatul A. Azmi

A dissertation submitted to The University of Adelaide
in fulfilment of the requirements for the degree of
Doctor of Philosophy

School of Earth and Environmental Sciences

THE UNIVERSITY OF ADELAIDE
AUSTRALIA

SUB CRUCE LUMEN

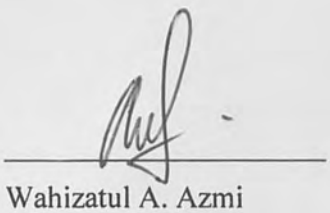
June 2011

DECLARATION

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 to **Wahizatul A. Azmi** and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due references has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being 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, the Australasian Digital Theses Program (ADTP) and also through web search engines.



Wahizatul A. Azmi

Dated: June 2011

I dedicate this thesis to my beloved husband, Md. Yuzeiry Md. Yasin and my sons, Erfan Kheiry and Ezlan Kheiry.

ABSTRACT

Exotic willows (*Salix* spp.) have invaded the riparian zones of many Australian streams, but the impact of willows and their removal on aquatic invertebrate communities are poorly understood. In the Mount Lofty Ranges, South Australia, willows have aggressively invaded riparian zones of many freshwater streams, often affect stream morphology and erosion, leading to water quality problems and suppress growth of native vegetation. We hypothesized that aquatic invertebrate diversity and abundance would be reduced in streams with willows present and after they have been removed. We also investigated whether willow leaves could provide a useful food source by comparing feeding preference, growth rates and survivorship of five dominant aquatic invertebrates. Also, we investigated the potential habitat value created by willow roots for aquatic invertebrates and whether shade (willow canopies) can influence the invertebrate assemblages.

Our findings suggest that the presence of willows was clearly associated with a reduction in taxon diversity. However, the abundance of invertebrates was significantly higher in sites with willows due to the high abundance of the introduced hydrobiid snail (*Potamopyrgus antipodarum*). The establishment of this snail under willows should be considered a serious threat as it may be in resource competition with native invertebrates. Lower invertebrate diversity and taxa numbers were observed where willows were removed and the site not revegetated. This reduction in diversity and change in composition of aquatic invertebrate communities may be due to loss of habitat, changes in water quality, or may depend on the prior history of willow invasion. Taxa responsible for the significant differences among sites when riparian vegetation is changed from the original vegetation to willows, or when willows are removed, were also identified. We found that changes in the pattern of invertebrate assemblages seemed to be influenced by differences in season, habitat quality, food availability and water quality.

Feeding preference experiments where eucalypt and willow leaves were compared revealed that willow leaves are a source of food for some native invertebrates [e.g., *Dinotoperla evansi* (Plecoptera: Gripopterygidae), *Tasmanocoenis tillyardi* (Ephemeroptera: Caenidae) and *Lingora aurata* (Trichoptera: Conoesucidae)], and may influence their growth rates and survivorships. In habitat preference experiments, we found willow roots supported significantly higher and more diverse aquatic invertebrate assemblages than an artificial substrate of aluminium wire mesh of different sizes. These findings revealed that willow roots provide a better habitat and a variety of microhabitats

for invertebrate colonisation. However, the introduced hydrobiid snails were strongly associated with willow root habitats compared with other invertebrates. In experiments of the effect of shade, we found that increased light as a result of willow removal and revegetation resulted in lower invertebrate abundance, although there were higher taxa numbers and diversity. This increase in sites lacking a riparian canopy (i.e., open canopy), may be due to an increase in the availability of quality food through reduced shading, which in turn increases the long term invertebrate community diversity, productivity and abundance.

Careful management of restoration programs to remove willows and to revegetate the sites is highly recommended, particularly in small streams such as those in this study. Many aspects need to be considered before willows are removed and revegetation programs carried out. These include: the impact of willows including their canopies and root masses, and that of the revegetation to replace willows. Aquatic invertebrates are potential bioindicators in the ecological success of willow control and revegetation programs, and should be considered as an important component during monitoring of such programs.