

The role of allochthonous dissolved organic carbon in supporting food webs in Australian lowland rivers



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Certificate of original authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text. I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This research is supported by an Australian Government Research Training Program.

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Dedicated to my mum and dad.

Preface

This thesis consists of six chapters. Chapters 2 to 5 have been written as separate articles that are in preparation for submission to peer reviewed scientific journals. These chapters are included in their pre-submission form, and as such use the terms we/our when discussing results and hypotheses. To prevent unnecessary duplication of references, a single reference list has been provided at the end of this thesis.

This thesis is a compilation of my own work, carried out with guidance from my supervisors and others. I conceptualized this research, conducted all data collection and analysis and wrote the manuscript. Contributions by supervisors and others are as follows:

Chapter 2: Variable flow sizes and their effects on carbon, nutrients, phytoplankton and zooplankton in a highly regulated lowland river

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Table of Contents

Certificate of original authorship	2
Acknowledgements	3
Preface	4
Table of Contents	6
Table of Figures	8
List of Tables	11
Abstract	12
Chapter 1.0 General introduction	13
1.1 Research Scope and significance	13
1.2 River flows and importance of freshes and floods	14
1.3 River ecology	15
1.4 Basal food resources	16
1.5 Primary and secondary production under autochthonous and allochthonous carbon conditions	17
1.6 River regulation	19
1.7 Environmental flows	19
1.8 Namoi River and significance	20
1.9 Research gaps	21
Aims and Hypotheses	22
Chapter 2.0 Variable flow sizes and their effects on carbon, nutrients, phytoplankton and zooplankton in a highly regulated lowland river	25
2.1 Abstract	25
2.2 Introduction	25
2.3 Methods	28
2.4 Results	31
2.5 Discussion	40
Chapter 3.0 Hydrology controls of primary energy sources supporting zooplankton growth in a lowland river	46
3.1 Abstract	46
3.2 Introduction	47
3.3 Methods	49
3.4 Results	53
3.5 Discussion	63
Chapter 4.0 Allochthonous dissolved organic matter support large increases in riverine mixotrophs and zooplankton in a mesocosm experiment	68
4.1 Abstract	68

4.2 Introduction	68
4.3 Methods.....	71
4.4 Results.....	75
4.5 Discussion.....	84
Chapter 5.0 Bioavailable DOC additions increase mixotroph and ciliate production in riverine microcosms.	91
5.1 Abstract.....	91
5.2 Introduction	91
5.3 Methods.....	93
5.4 Results.....	96
5.5 Discussion.....	104
Chapter 6.0 General discussion	109
6.1.1 Monitoring changes in resources and food webs.....	109
6.1.2 The relationships between discharge and carbon.....	110
6.1.3 The relationship between discharge and planktonic food webs.....	112
6.1.4 Experimental studies reveal food web patters.....	113
6.1.5 Food web responses to pulses of dissolved organic matter.....	114
6.1.6 Importance of mixotrophy.....	115
6.2 Management recommendations	116
6.3 Recommendations for further studies.....	117
6.4 Conclusion.....	119
References	120

Table of Figures

Figure 1.1 Examples of connections between the river and surrounding landscape; longitudinal, lateral, vertical and temporal (Ward, 1989).....	15
Figure 1.2 Simplified conceptual map of trophic pathways of autochthonous (blue) and allochthonous (red) energy. Green lines represent energy via both pathways (mixotrophy)..	18
Figure 2.1 Map of the mid-lower reaches of the Namoi River displaying where the 2 sampling sites were located. The river flows right to left making Site 1 the most upstream and Site 2 the most downstream.....	28
Figure 2.2 Hydrographs showing daily average discharge (ML d-1) for the 2 sampling sites on the Namoi River across the sampling period June 2016 to February 2018. Site 1 is in black, Site 2 grey.....	31
Figure 2.3 Monitoring data from the Namoi River for the sampling period June 2016 to February 2018. Discharge is shown in grey. Site 1 data is shown in the left column, Site 2 on the right. Mean concentrations of DOC (mg L-1, A-B), TN and NO _x (C-D, mg L-1), TP and FRP (E-F mg L-1) and Chl-a (G-H, µg L-1) are all shown with standard error of the mean..	34
Figure 2.4 nMDS plots of environmental variables (DOC, TN, TP and Chl-a), rotifer community assemblage and mesozooplankton assemblage and at high (green triangles), medium (dark blue circles) and low (light blue squares) flow periods. The numbers above each point represent sites 1 and 2.....	37
Figure 2.5 Monitoring data for zooplankton concentrations on the Namoi River from June 2016 to February 2018. A-B shows mean rotifer (individuals L-1) and Nauplii (individuals m-3) concentrations with standard error of the mean. Rotifers are in black while nauplii are on a secondary axis in white. C-D shows mean mesozooplankton concentrations (individuals m-3) with standard error of the mean. Copepods are in black while cladocerans are in white. Zooplankton concentration peaks were not included to allow visibility of low concentration periods.....	38
Figure 2.6 Redundancy analysis for all major zooplankton groups at Site 1 (A) and 2 (B)...	39
Figure 2.7 SIMPER analysis of rotifer communities at high, medium and low flow periods. Brach: Brachionus, Kera: Keratella, Trich: Trichocerca, Fili: Filinia, Ceph: Cephalodella, Poly: Polyarthra; Synch: Synchaeta; Asco: Ascomorpha, and Leca: Lecane.....	39
Figure 3.1 Site locations of Milloo (upstream) and Bugilbone (downstream) on the Namoi River in North central NSW. The Namoi River flows from right to left.....	50
Figure 3.2 Zooplankton (A-B, Log ₁₀ transformed), total phytoplankton biovolume (C-D) and relative phytoplankton community composition (E-F) over the sampling period, the hydrograph for both sites is shaded grey.....	56
Figure 3.3 ¹³ C signatures for particulate organic matter (A-B) and zooplankton (C-D) and, ¹⁵ N for zooplankton (E-F). Discharge (ML d-1) for each site is shown in shaded grey: Milloo (left column) and Bugilbone (right column).....	61

Figure 3.4 POM $\delta^{13}\text{C}$ vs zooplankton taxa $\delta^{13}\text{C}$ linear regressions with R ² and p-value at Milloo (left column) and Bugilbone (right Column).....	62
Figure 4.1 Dissolved oxygen (%), Soluble reactive phosphorus (SRP, $\mu\text{g L}^{-1}$), Dissolved organic carbon (DOC, mg L^{-1}), Chlorophyll-a ($\mu\text{g L}^{-1}$) and nitrogen oxides ($\mu\text{g L}^{-1}$), in all treatments across the sampling period. Treatments are identified by black circle (high), white circles (medium), black triangles (low) and white triangles (control).....	75
Figure 4.2 Total biovolume ($\mu\text{m}^3/\text{mL}$) of algal groups in each treatment. Black circle are high, white circles are medium, black triangles are low and white triangles are control. Standard error bars removed for clarity.	77
Figure 4.3 Mean concentration (cells mL^{-1}) of mixotrophic algae, amoeba and ciliates in each treatment over time with standard error of the mean. Treatments are indicated by black circles (high), white circles (medium), black triangle (low) and white triangles (control).....	79
Figure 4.4 Mean zooplankton concentrations for each zooplankton group and treatment.	81
Figure 4.5 $\delta^{13}\text{C}$ signatures of cyclopoids, Daphnia, Ceriodaphnia and particulate organic matter (POM). All zooplankton samples were pooled between replicates. Standard error of the mean was used for POM.	83
Figure 4.6 Linear regression analysis of mixotrophic:autotrophic biomass ratio vs POM (A) and POM vs zooplankton ^{13}C signature (B), separated into treatments with sampling days. .	84
Figure 5.1 Dissolved oxygen (%) and chlorophyll-a ($\mu\text{g L}$) concentration in all treatments. black circles= control, white circles =nutrients, black triangles= high carbon, white triangles =high carbon and nutrients, black squares =low carbon and white squares= low carbon + nutrients. Error bars are standard error of the mean.....	97
Figure 5.2 Total bacterial cell concentrations and the ratio of HNA to LNA emitting cells across all treatments. black circles= control, white circles =nutrients, black triangles= high carbon, white triangles =high carbon and nutrients, black squares =low carbon and white squares= low carbon + nutrients. Error bars are standard error of the mean.....	98
Figure 5.3 biovolume ($\text{mm}^3 \text{L}^{-1}$) of chlorophytes (A), diatoms (B), mixotrophic algae (C) and ciliates (D) in all treatments over time. black circles= control, white circles =nutrients, black triangles= high carbon, white triangles =high carbon and nutrients, black squares =low carbon and white squares= low carbon + nutrients. Error bars are standard error of the mean.....	99
Figure 5.4 Phytoplankton and protozoa community composition by percent of total biovolume on days 1 (including day 0), 2 and 3. For clarity phytoplankton groups have been grouped into mixotrophs (bottom, black), diatoms (second from bottom, grey), chlorophytes (second from top, dark grey) and ciliates (top, light grey).....	101
Figure 5.5 Total biovolume ($\text{mm}^3 \text{L}^{-1}$) of all measured phytoplankton and ciliate groups (chlorophytes, diatoms, mixotrophs and ciliates) in each treatment over time. black circles= control, white circles =nutrients, black triangles= high carbon, white triangles =high carbon and nutrients, black squares =low carbon and white squares= low carbon + nutrients. Error bars are standard error of the mean.....	101

Figure 5.6. Non-parametric multidimensional scaling (nMDS) plot of phytoplankton community composition and biovolume. Data is separated by sampling day (Green triangle: day 0, blue triangle: day 1, blue square day 3 and red diamond day 5) and treatment (C,N,L,H,LN,HN). All data was log(+1) transformed before analysis.....102

List of Tables

Table 2.1 Quadratic regression results of flow vs DOC, TN and TP. Downstream (Site 2) nutrient concentrations were also compared to upstream (Site 1) discharge levels to account for irrigation extraction	33
Table 2.2 PERMANOVA with pairwise comparisons for Environmental (Chl-a, DOC, TN, TP) concentrations, rotifer assemblage and abundance and mesozooplankton assemblage and abundance. Main test results use pseudo-f statistic whereas t- tests between flow groups use t- statistic.	33
Table 3.1 Water quality parameters (mean \pm standard error) for DOC, NO _x , SRP, dissolved oxygen (DO) and turbidity at flow and cease-to-flow (CTF) conditions at the Milloo and Bugilbone sites. n=36 for each parameter at each site.....	534
Table 3.2 PERMANOVA main test results for zooplankton and phytoplankton community analysis between sites and flow periods.	55
Table 3.3 Permutational analysis of variance of POM 13C signatures between terrestrial detritus and POM (TDPOM) at flow and cease to flow conditions at Milloo (MF: flowing, MCTF: cease to flow) and Bugilbone (BF: Flowing, BCTF: Cease to flow).....	578
Table 3.4 PERMANOVA analysis of zooplankton carbon stable isotopes between flow groups and sites.....	589
Table 3.5 PERMANOVA with pairwise comparisons for δ 15N value of zooplankton across sites, flow conditions and zooplankton taxa	6059
Table 4.1 PERMANOVA main test results for differences between treatments.....	81
Table 5.1 Ammonia ($\mu\text{g L}^{-1}$), soluble reactive phosphorus ($\mu\text{g L}^{-1}$), nitrogen oxides ($\mu\text{g L}^{-1}$) and DOC (mg L^{-1}) concentrations on day 0 (initial) and day 5 (all treatments). Standard error in brackets.	96
Table 5.2 PERMANOVA main test comparing phytoplankton community across all treatments, days and the interaction between days and treatments. N=9.....	102
Table 5.3 PERMANOVA with pairwise comparisons analysis for changes in phytoplankton community comparing all treatments across days 1, 3 and 5.	103
Table 5.4 PERMANOVA with pairwise comparisons comparing significant differences between individual phytoplankton groups compared to treatments.	1033

Abstract

The flow regime of a river plays a critical role in maintaining the health and processes within a river ecosystem. However, due to high water requirements for human needs such as agriculture, many rivers are regulated with dams and weirs. Regulation greatly reduces large flow events and in-channel flows resulting in a severe impact on the natural flow regime of a river, reducing allochthonous carbon loads otherwise mobilised during flows. Environmental flows are a key tool in mitigating the effects of regulation by reinstating a portion of the natural flow regime. However, there is still a knowledge gap between the role of these flows in mobilising allochthonous dissolved organic carbon (DOC) and the subsequent response of the lower food web.

Field monitoring on the Namoi River over 2.5 years revealed discharge was positively correlated with increases in nutrient and DOC concentrations with overbank flows mobilising very high levels of all measured nutrients. Phytoplankton and zooplankton also increased during and/or after flow events indicating flows increased food web production potentially via both heterotrophic and autotrophic production. Carbon stable isotope (^{13}C) analysis revealed allochthonous energy was supporting zooplankton communities even during small flow events which changed to autochthonous sources when the river ceased to flow.

Two manipulative studies were run using mesocosm and microcosm techniques. These studies showed pulses of DOC and dissolved organic matter (DOM) can greatly boost food web production with mixotrophic algae and zooplankton increasing significantly following terrestrial floodplain leachate additions in the mesocosm experiment. This was further seen in the phytoplankton communities of the microcosm experiment as mixotrophs and ciliates clearly increased following DOC (as glucose) +nutrient additions, making up for any autotrophic biovolume lost due to competition with bacteria.

This thesis contributes to the growing body of evidence suggesting allochthonous carbon may be an important energy source for riverine food webs. In particular, it suggests allochthonous organic matter may be considerably bioavailable and increase production via both heterotrophic and autotrophic production and greatly increase resources for higher consumers. Protecting flows that mobilise allochthonous DOM through environmental flows will be highly beneficial for riverine communities, particularly in highly regulated lowland rivers.