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**Towards an *in situ* technique for
investigating the role nutrients play in
epilithon growth in an Australian
upland stream**

by

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July 2001

A thesis submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy in Applied Science

Cooperative Research Centre for Freshwater Ecology
University of Canberra

Acknowledgments

Firstly, I would like to acknowledge the support and encouragement provided by my family. I am exceptionally fortunate to be surrounded by family members whose company, advice and friendship I value. Thanks Kath, Mum, Dad, Rik, Kel, James, Khan, Zak and Lokki.

Secondly, and not least important, a special thanks is extended to my supervisors, **Bill Maher** and **Richard (Chuck) Norris**, without whose time, direction and assistance this thesis would not have been possible. As mentors, they have contributed greatly towards my professional development through their inspiration, knowledge and advice, and for this I am eternally grateful. In particular, Bill showed great faith in me by encouraging me to pursue postgraduate studies, while Chuck showed similar confidence by offering me the scholarship to conduct research in the Thredbo River.

I would also like to thank a number of individuals who contributed much of their time and assistance, far and above what normally would reasonably be expected.

- **Dr Ken Thomas** provided a friendly ear to which I regularly sounded out my ideas and frustrations. He also constructively criticised several drafts; offered statistical advice; and provided direction. His contributions are greatly appreciated.
- **Jamie Mathieu** provided a summer of field and laboratory assistance, and then some. His friendship and efforts have not gone unrecognised.
- **Kelli Brown** and **James McBroom** spent many an hour, between their own studies, helping me to conduct field experiments and perform laborious laboratory analyses. They were always there, providing assistance at a moments notice. When other avenues were unavailable, I always knew that I could call on Kel and James. James also provided valuable statistical advice.
- **Graham Brown** used two weeks of his hard earned recreational leave to come and labour in the field with me. This assistance was a defining moment in my research as it provided much needed impetus to my waning enthusiasm. Dad also provided several very practical and useful ideas that worked their way into the final design of the experimental channels and the macroinvertebrate grazing inhibition technique. Mum's contributions, during my parents' frequent forays into the field with me, were also gratefully received.
- **Kathy Brown** was always there to provide additional support and encouragement, as well as keeping me company during long days in the field, laboratory, and in front of the computer. She even agreed to be my wife mid-way through this study, and then produced two beautiful sons who have made the completion of this thesis all the more worthwhile. To Kath, Zak and Lokki, I dedicate this thesis.
- **Paul Woolmer** provided great assistance in the laboratory, where his analytical skills, knowledge, ideas and motivation were of enormous value. Paul also conducted several nutrient analyses of water, agar, and clay samples.
- **Glen Fisher** prepared thin section slides for me; provided valuable assistance during field experiments; and advised, arranged and assisted in the preparation of clay samples for a variety of analyses.
- **Shari Griinke** spent considerable time scanning on to disk, editing and printing plates and diagrams.

Aside from those whose names appear above, the following people also assisted with field experiments and laboratory analyses, at one time or another: Mat Allanson, Wayne Robinson, Steve Dudgeon, Adam Scott, David Hilhorst, Robyn Bevitt, Caleb Rose, Ben Collyer, Dan Mawer, Corey Fisher, Jody Moore, Sean Grimes, Kerry Beggs, Sue Nicholls, Lisa Evans, Karen Redwin, Tim Goodisson, Mike Palmer-Allen, Frank Krikowa, Shelley Baldwin, Michelle Deaker, Caroline Greig, Janet McNamara, Mark Carson, Karina Palmer.

Thanks are also extended to:

- Hans Schmidt for constructing a variety of contraptions on request, as well as allowing me to 'play' in his workshop;
- Jeremy Willis for modifying the energizer to deliver the desired electrical pulse rate;
- Dr Ken McQueen (University of Canberra, Applied Science Department) for providing expert opinion on the pore size and mineralogical structure of clay samples;
- Dr Phil Ford (CSIRO Centre for Environmental Mechanics) for providing initial advice on diffusion experiments;
- Dr John Rayner (University of Canberra, Information Science and Engineering Department) for discussing the theoretical feasibility and application of electricity to inhibit macroinvertebrate grazing;
- The Australian Geological Survey Organisation for permitting me to use their facilities to crush clay saucers and paving bricks for analysis; and
- The Research School of Earth Sciences at the Australian National University for performing X-Ray Diffraction mineralogical analysis of clay samples.

Financial support initially came from a scholarship from Kosciusko Thredbo Pty Ltd, and then from an Australian Postgraduate Research Award from the Commonwealth Government. Kosciusko Thredbo Pty Ltd and the CRC for Freshwater Ecology met field, laboratory, equipment, and travel expenses.

Abstract

There is limited knowledge and understanding of the role of nutrients and effect of herbivore grazing on epilithon production in Australian upland rivers. Before investigating these processes, a method was required that will allow the study of factors (physical, chemical and biological) that affect epilithon abundance and distribution in lotic systems. The Thredbo River, Kosciusko National Park, New South Wales, provided an opportunity to conduct this investigation because it: is relatively undisturbed; has been intensely studied; is easily accessed; and is of appropriate width and depth to conduct in-stream experiments.

The specific goals of this research were the: (1) validation of the nutrient-diffusing substrate method for investigating epilithon responses to nutrients; (2) development of experimental channels in which to investigate nutrient/epilithon dynamics in an upland stream; (3) development of a method to inhibit macroinvertebrate grazing from *in situ* experimental channels, so that epilithon responses to nutrients with and without grazing pressure can be studied; and (4) assessment of the ecological implications of nutrient/epilithon/macroinvertebrate interactions assessed from in-stream experiments.

Major achievements of my research, that advance the study of stream ecology, are as follows:

- The investigation of the features of nutrient release from terracotta nutrient-diffusing substrates showed that phosphorus does not readily diffuse through terracotta clay, probably because terracotta contains known binding agents for phosphorus, such as iron, and because pores are easily blocked. I concluded that this type of substrate is inappropriate for studying nutrient dynamics and epilithon responses to the nutrient(s) limiting growth. The outcomes of this research has implications for future research using nutrient-diffusing substrates, and of how nutrient limitation information is interpreted from past research using terracotta nutrient-diffusing substrates.
- I designed and tested in-stream experimental channels that were functional and provided near natural conditions for studying the interactions between nutrients/epilithon/macroinvertebrates, without affecting physical variables not tested for.

The *in situ* method developed was successful in simulating 'real world' complexities. Clay paving bricks were used as standardized common surface for community development because their colour, size and surface texture are similar to those of natural stones.

- I developed a technique for successfully inhibiting macroinvertebrate grazing from designated areas, using electricity, without affecting flow and light. This technique will enable in-stream herbivory studies to assess the effects of macroinvertebrate grazing pressure on epilithon under natural conditions, including variability in flow, temperature, light and nutrients. It will allow the vexed question of whether epilithon biomass is controlled by bottom-up or top-down processes to be objectively addressed.

The construction of *in situ* experimental channels that simulate natural conditions, combined with the non-intrusive methods of macroinvertebrate exclusion and nutrient addition, resulted in a study design that will facilitate the investigation of biotic responses to nutrients in Australian upland streams. Using the method developed, I showed that variable flows in the upper Thredbo River appear high enough to slough epilithon, but not high enough to dislodge macroinvertebrates. This may mean that in systems such as the Thredbo River that experience frequent low level disturbance, the epilithon is unable to reach equilibrium. There is strong top-down control of epilithon in this stream, with nutrients, temperature and light playing a secondary role. I concluded that natural variability may be more important than previously considered and perhaps this, rather than constancy, should be studied.

This thesis adds support to the continuance of multiple factor investigations, and advocates that such studies be conducted under natural conditions so that the results are more relevant to natural systems than from studies conducted in controlled laboratory and outdoor artificial streams. Clearly, the in-stream channels, developed as part of the current research, will allow research that contributes to our understanding of community responses to the physical, chemical and biological processes operating in lotic environments.

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