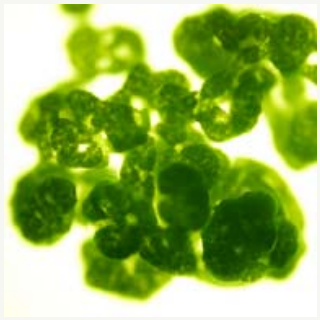
Lake Ecosystem Restoration New Zealand

AUGUST /2008 **ISSUE 9**

Ever wondered why cyanobacteria (blue-green algae) produce toxins?

Professor Craig Cary

A Waikato University research group led by Prof. Craig Cary is combining cutting-edge molecular techniques with powerful high-throughput chemical detection methods to investigate conditions that regulate toxin production. This knowledge may shed light on the ecological role of cyanotoxins and ultimately assist in predicting when they will occur in lakes.

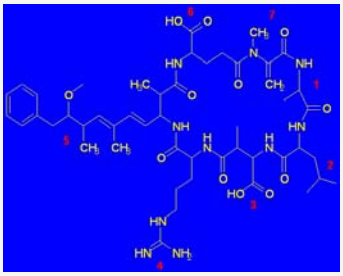


Toxin producing *Microcystis* sp. colony

The production of toxins is an energetically demanding process. The genes involved with toxin production can account for an amazing 3% of a cyanobacteria's genome and up to 2% of the organism's dry weight can be toxin. Researchers have suggested many functions for toxins including; alleopathic interactions (when a chemical produced by one organism inhibits growth of another species) and as a defense against grazers. However, results are conflicting, and their true function is uncertain.

Dr. Andreas Rueckert

Post-doctoral researcher Dr Andreas Rueckert, has recently developed an unique molecular-based assay that can quantitatively measure changes in the expression of genes involved in toxin production. Experiments are underway using toxin producing cultures to elucidate how environmental parameters (e.g., light, nutrients) regulate these genes and influence actual toxin production.



The chemical structure of the toxin Microcystin

Accurate and sensitive measurement of toxins is critical. PhD student Jonathan Puddick is developing a method known as MALDI-TOF mass spectrometry for cyanotoxin detection. This method detects toxins based on their specific mass and is proving to be rapid, inexpensive and sensitive. Jonathan and Dr Susie Wood are using this technique to investigate how factors such as nitrogen concentrations alter the ratios of toxin variants within species Each variant differs in its toxicity; knowledge of what regulates these changes may assist in determining times of greatest health risk during bloom formation in lakes.. Susie has a joint postdoctoral appointment to Waikato University and Cawthron Institute.

Dr. Susie Wood

Research has commonly focused on predicting the arrival of blooms and less attention has been given to the often rapid senescence of blooms. The critical role of lake microbes (i.e., bacteria/viruses) is often neglected because of difficulties in measuring their abundance and composition. Masters student Richard O'Rorke has just completed an intensive study of Lake B (Waikato). Using molecular tools developed by Prof. Cary's group and epifluorescence microscopy, Richard aims to gain an in-depth understanding of microbial/cyanobacterial interactions. Delineating the role of microbes may enable predictions of cyanobacterial bloom "crashes" and potentially lead to the novel use of these microorganisms for bio-control.

PhD student Jonathan Puddick

For more information visit

www.LERNZ.co.nz

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Meet New People - Denise Bruesewitz

A rock colonised with zebra mussels from Gull Lake

I came to the LERNZ group from the University of Notre Dame in Indiana, USA, where I received my Ph.D. in Dr. Jennifer Tank's lab. My dissertation work focused on aquatic nitrogen cycling in ecosystems ranging from the Mississippi River to inland lakes of the mid-west. Specifically, I quantified nitrification and denitrification rates under various scenarios of zebra mussel invasion.

I started a post-doc at the University of Waikato in mid-June in Prof. David Hamilton's group. I am generally interested in ecosystem ecology, biogeochemistry of freshwater ecosystems, and the tools they give us to understand anthropogenic pressures on aquatic ecosystems. During my time here, I hope to characterise denitrification in the Rotorua lakes. Denitrification is an important link in the nitrogen cycle, because it is a 'permanent sink' for nitrogen, converting nitrate to nitrogen gas. High denitrification rates can alleviate nitrogen pollution in aquatic ecosystems, or could influence the ratio of nitrogen to phosphorus in a lake, which could increase the occurrence of harmful algal blooms. The Rotorua lakes provide a very interesting system to study denitrification in because of the variation in nutrient loads between these lakes in a relatively small area. Gaining a clear understanding of seasonal patterns of denitrification in the lakes will help us understand how the nitrogen and phosphorus cycles are interacting in the lakes, and ultimately how these nutrient cycles may affect the occurrence of harmful algal blooms.

I will also work with others in the LERNZ group to collate the long-term data we have on the Rotorua lakes into a geodatabase. Many different groups and projects have gathered data on the lakes, so developing an easily accessible database is important for examination of long-term trends in the lakes. This database will be linked to various spatial datasets in ArcGIS, such as watershed land-use to provide insight into how changes in the landscape have affected water quality in the Rotorua lakes over time.

Andrea (left) and Ryan (right)

Andrea Cardenas is a Mechanical Engineering student at the University of California San Diego visiting through the PRIME programme. With the help of Professor David Hamilton and Chris McBride, she is working to link the lake research data from the University of Waikato to the greater limnology network. In addition, she is also making recommendations as to how this information should be used in a database context.

Ryan Kroiss, a Computer Science student at the University of Wisconsin–Madison (USA), is currently working for Professor David Hamilton at the University of Waikato in association with GLEON (Global Lake Ecological Observatory Network). He is developing software that can be used to calculate various indices that help analysed the temperature profiles of lakes. In addition, he is aiding in the deployment of monitoring buoys in the Waikato region.

Symposium 2008

Nutrient Sensitive Zones – Lakes and Waterways

Presentations from LERNZ group:
The current state of Rotorua and Taupo lakes by Prof. David Hamilton

Symposium posters from LERNZ group:
"A flow cytometric method for haemocyte counts in the koura, *Paranephrops planifrons*" by Dr. Nick Ling

"Heavy metal bioaccumulation in Te Arawa Lakes koura: seasonal changes in total mercury" by Dr. Nick Ling

"Monitoring water quality in the Rotorua lakes using wireless sensor buoys" by Chris McBride

"Dissolved oxygen dynamics and simulations based on DYRESM-CAEDYM in Lake Rotorua, New Zealand" by Dr. Liancong Luo

"Restoration of Lake Okaro" by Deniz Özkundakci

"Restoring water quality in New Zealand lakes – the influence of internal loading and future climate change" by Dennis Trolle

"The significance of sediments in modifying the availability of nutrients in Taupo Volcanic Zone lakes" by Lisa Pearson

"Water balance for the Okataina caldera lakes" by Nicolas Gillon

For more information about the symposium visit:
www.lakeswaterquality.co.nz

Recent publications:

Trolle, D., Jorgensen, T.B. and Jeppesen, E., 2008. Predicting the effects of reduced external nitrogen loading on the nitrogen dynamics and ecological state of deep Lake Ravn, Denmark, using the DYRESM-CAEDYM model. *Limnologica*, in Press

Paul, W. J., Hamilton, D. P., Gibbs, M. M. 2008. Low-dose alum application trialled as a management tool for internal nutrient loads in Lake Okaro, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 42: 207–217.

Blair, J. 2008. An investigation of koi carp (*Cyprinus carpio*) movement in the Waikato region using laser ablation otolith microchemistry. MSc thesis, University of Waikato, New Zealand .

Mulling, B.T.M., 2008. A tool for investigation of cyanobacterial metabolism and behaviour. MSc thesis, University of Waikato, New Zealand and University of Amsterdam, Holland.

Butterworth, J., 2008. Lake Rotokakahi: The kakahi (*Hyridella menziesi*) in a general framework of lake health. MSc thesis, University of Waikato, New Zealand.

Prentice, M.J., 2008. Temporal and spatial variations of cyanobacteria in Karori Reservoir, Wellington. MSc thesis, University of Waikato, New Zealand.

Posch, T., 2008. Characterisation of colloidal-bound nutrients in pore water of sediments in the Rotorua lakes region, New Zealand. BSc(Hons) Thesis. Department of Chemistry, University Duisburg – Essen, Germany.

Allan, M.G. 2008. Remote sensing of water quality in Rotorua and Waikato lakes. MSc thesis, University of Waikato, Hamilton. 84 p.

Riceman, M.S. 2008. The use of otolith microchemistry to investigate natal origins and movement of lacustrine wild rainbow trout (*Oncorhynchus mykiss*) and common smelt (*Retropinna retropinna*). MSc thesis, University of Waikato, Hamilton. 99 p.

Cornes T., Wehi P., Clarkson B.D., 2008. Waiwhakareke Restoration Plantings: Remeasurement of Monitoring Plots 2007/08. CBER Contract Report No. 85. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Cornes T., Wehi P., Clarkson B.D., 2008. Waiwhakareke Restoration Plantings: Establishment of Experimental Monitoring Plots 2008. CBER Contract Report No. 86. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Ashraf, S., L. Brabyn, B.J. Hicks., 2008. Evaluating remote sensing data classification techniques for mapping freshwater habitats in the Tongariro River delta, Lake Taupo. CBER Contract Report No. 87. A report prepared for Environment Waikato. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

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