LERNZ

Lake Ecosystem Restoration New Zealand

Newsletter 4 | May 2007

In this newsletter we introduce you to some of our researchers and their projects.

Sediment study completed on Rotorua lakes

Dennis Trolle has now finished analysing sediment cores collected from 11 lakes in the Rotorua district, as well as from Lake Ellesmere (Canterbury) and Lake Taihu in China. In each lake, a minimum of three sediment cores was collected and sectioned into 2 cm intervals (right figure). Some of the highlights from Dennis' results combined with data from Lisa Pearson's and Olivia Motion's M.Sc. studies (in the Department of Chemistry at the University of Waikato) indicate that the phosphorus pool in the surface sediment of Lake Rotorua has decreased by roughly 40% during the last decade, whereas the phosphorus pool in the surface sediment of Lake Rotoiti has increased by more than 55% during the same period.

As well as being a foundation for testing and developing a coupled sediment and water column model, the data from Dennis' field study will form the basis for his first paper, which will be submitted to a scientific journal as partial fulfilment of his Ph.D. degree.

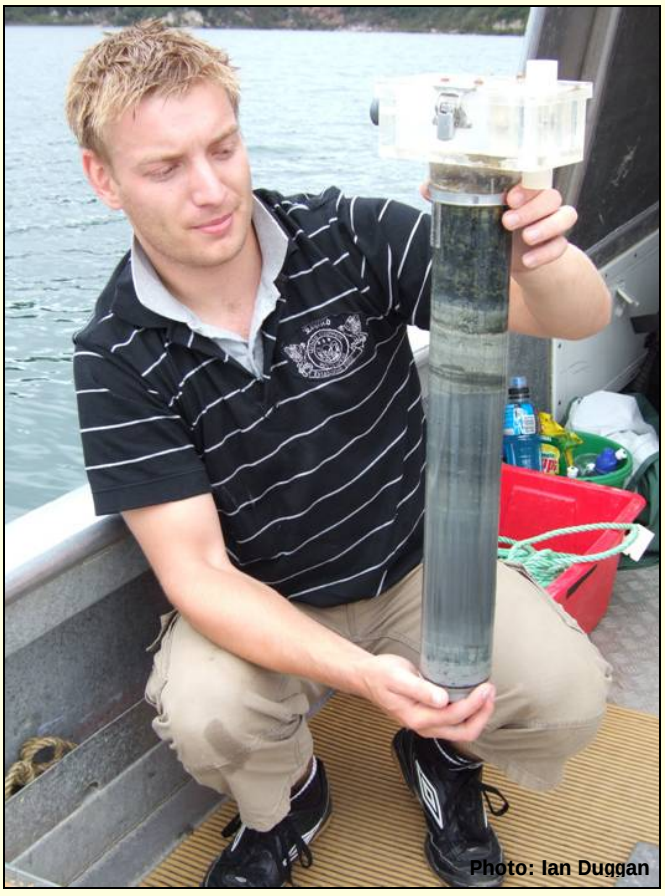


Photo: Ian Duggan

Dennis Trolle with sediment core of Lake Rotomahana (above)

2 cm interval sectioned sediment core (right)

Introducing Lisa Pearson

Lisa Pearson has recently submitted her M.Sc. thesis. Her study focused on the chemistry of Lake Rotorua sediment to determine the nature, composition and distribution of elements, through a 1.5 year coring programme. The results show that the phosphorus concentration in Lake Rotorua sediments decreases with sediment depth. In the centre of the lake phosphorus concentrations in the top 2 cm can exceed 2500 g/tonne and decline to 800 g/tonne at 20 cm depth. A geophysical survey together with sub-bottom profiling provided stratigraphic information relating to the bathymetry of the lake. The basin sediments of Lake Rotorua are significantly pockmarked, with deep, circular flat-bottomed depressions of 20-60 m diameter and 0.5-6 m depth. The pockmarks are located on the lake floor in areas where the sediment is saturated with methane gas.

Currently, Lisa is designing and building a working model of the Waikato River which will be displayed at the Field Days in June. The booth will exhibit the theme of environmental traceability and the model will be used to portray the transport of nutrients down the river system.

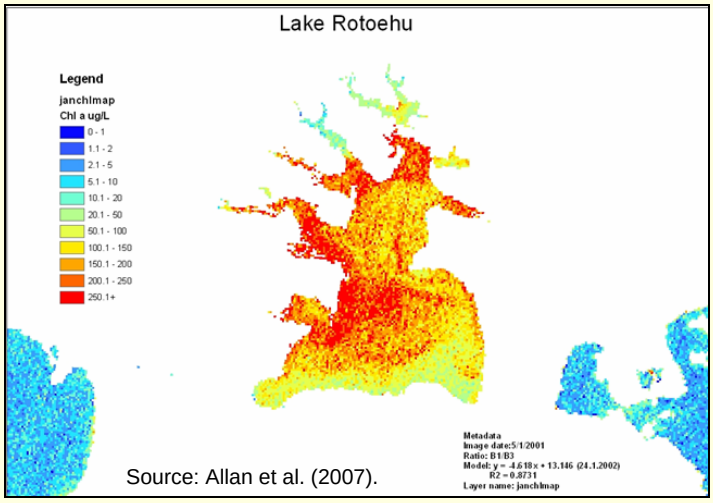
Photo: Dougal Laird

Lisa Pearson building the model of the Waikato River

Lisa will begin her Ph.D. on the significance of sediments in modifying the availability of nutrients in Taupo Volcanic Zone lakes, in B Semester. Her Ph.D. research will be focused on resolving whether denitrification at the sediment/water interface may be a determining factor in modifying the availability of nitrogen species in the water column. In this way, denitrification may provide, an effective lake buffer against eutrophication of the large volcanic lakes.

Remote sensing determines lake water quality

Remote sensing of water quality offers a unique bridge between research into harmful algal blooms and invasive fish. In a first for New Zealand, Mat Allan's M.Sc. studies have shown that satellite images can be used to determine lake water quality from space. Mat compared colour bands from Landsat images of the Rotorua lakes with summer and winter measurements of chlorophyll *a* (chl-*a*), Secchi depth, and Trophic Lake Index (TLI) made by EBOP. He established powerful regression relationships between band intensity and physical measurements (r^2 = 0.86) and was able to map fine-scale distribution of chl-*a* concentrations. Mat's relationships can be used to extend monitoring to lakes with no sampling record, and to assess the results of invasive fish introductions and removal. This work is supervised by Brendan Hicks (Biological Sciences) and Lars Brabyn (Geography).



Chl-*a* concentrations in Lake Rotoehu on 5 Jan 2001 predicted at 30 m by 30 m pixel resolution from regressions.

Recent Publications:

Allan, M.G, B.J. Hicks, L. Brabyn (2007). Remote sensing of the Rotorua lakes for water quality. *CBER Contract Report No. 51*. Client report prepared for Environment Bay of Plenty.

Hicks, B. J., D. Hamilton, N. Ling, and S. Wood (2007). Top down or bottom up? Feasibility of water clarity restoration in the lower Karori Reservoir by fish removal. *CBER Contract Report No. 54.* Report prepared for the Karori Wildlife Sanctuary Trust.

Özkundakci, D. and D. Hamilton (2007). Recent studies of sediment capping and flocculation for nutrient stabilisation. *CBER Contract Report No. 53.* Report prepared as part of the Lake Ecosystem Restoration New Zealand (LERNZ).

Robson, B. J., I. T. Webster, T. Chan, D. P. Hamilton (2007). Ten steps applied to development and evaluation of process-based biogeochemical models of estuaries. Environmental Modelling and Software Society, (in press).

White, P.A., T. Y-S. Hong, G. Zemansky, J. McIntosh, D. Gordon, P. Dell, (2007). Groundwater and surface water hydrology in the Lake Rotorua catchment, New Zealand, and community involvement with lake water quality restoration. *South Korean Water Resources Conference*, South Korea, 17-19 May.

Introducing Nigel Goodhue

Nigel Goodhue submitted his MSc thesis in March 2007. The thesis was completed under the supervision of Karin Bryan (Earth Science) and David Hamilton (Biological Sciences) and involved setting up a hydrodynamic-biological numerical model (ELCOM-CAEDYM) of the lower Kaituna River and Maketu Estuary located in the Bay of Plenty.

The Maketu is a shallow intertidal estuary (2.3 km^2), with the Kaituna River contributing the largest freshwater flow into the estuary through control gates. Water quality within the river (and estuary) is affected by elevated nutrients, faecal coliforms, biochemical oxygen demand and algae concentrations.

Water quality and hydrodynamic measurements for the study were collected in the field and from Environment Bay of Plenty's data archives. The data was used to generate the boundary conditions and validate the model. Once validated, ELCOM-CAEDYM was used to predict the salinity, residence time and phytoplankton growth within the river and estuary. A number of scenarios were also carried out to predict the effects of changes in flow regimes and nutrient loads in the river and estuary, as well as considering the potential impacts of flow diversion of the Ohau Channel from Lake Rotoiti directly towards the Kaituna River.

Nigel is currently working at NIWA Hamilton analysing the long-term sea level records from tidal stations around New Zealand.

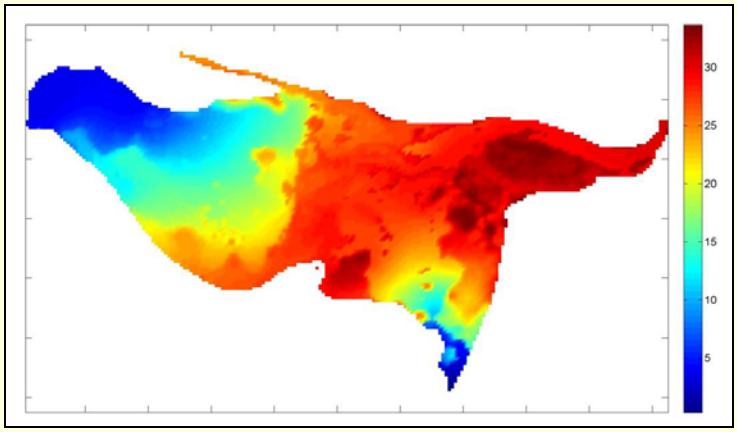


Figure of salinity in Maketu Estuary as predicted with ELCOM-CAEDYM showing freshwater inputs from the Kaituna River and the local catchment

Recent Event:

David Hamilton was recently appointed to the Queensland Water Commission Expert Panel to advise on the re-use of wastewater for the city of Brisbane. Due to severe drought and projected long-term water shortages as 1,500 people settle in Brisbane each week, the Premier of Queensland has made a decision that Queensland will begin recycling its treated wastewater. The Expert Panel has been appointed to advise on the level of treatment required, the potential risks and whereabouts in the water system that the water can be recycled.

Photo: Deniz Özkundakci - Lake Rotorua

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