

LERNZ

Lake Ecosystem Restoration
New Zealand



University of Waikato

Issue 20 July-September 2011

Modelling future water quality of Lake Rotorua

The LERNZ group has been modelling Lake Rotorua to assist with managing water quality to a satisfactory level in the future (target Trophic Level Index of 4.2). We collaborated with Bay of Plenty Regional Council, its lake strategy partners (Te Arawa Lakes Trust, Rotorua District Council), and NIWA and GNS for understanding of land use effects on nutrient export. Current challenges to managing water quality are increasing intensification of pastoral land use, particularly expansion of dairy and increasing nitrogen-based fertiliser applications, which is progressively increasing nitrogen loads to the lake. Modelling has allowed quantitative assessments of the lake water quality effects from different land uses, climates and in-lake management (e.g. sediment capping).

The suite of models applied included

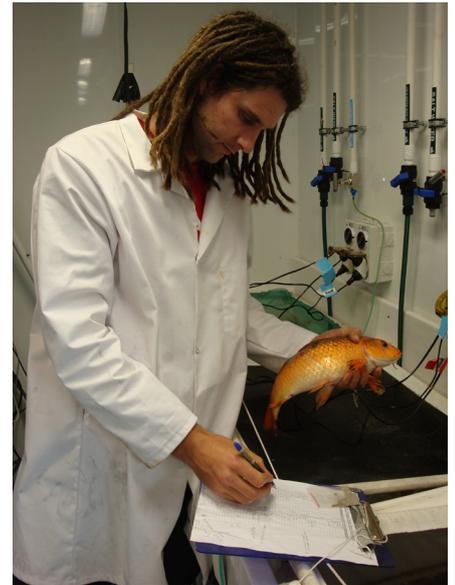
- SimCLIM: a model to generate past and future air temperature and rainfall within the Rotorua catchment, used as input data for ROTAN and DYRESM-CAEDYM.
- ROTAN: the Rotorua TAupo Nitrogen model developed by NIWA to determine past and future streamflows and nitrate concentrations for sub-catchments of Lake Rotorua, which provided input data to DYRESM-CAEDYM.
- CLUES: the Catchment Land Use for Environmental Sustainability (CLUES) model provided phosphorus loads for DYRESM-CAEDYM.
- DYRESM-CAEDYM, a coupled hydrodynamic-ecological model that produced a range of physical, chemical and biological outputs, the most relevant of which is the Trophic Level Index (TLI).

Results indicate that at least 350 tonnes of the present annual nitrogen load (and a large relative fraction of the phosphorus load) needs to be removed to arrest the present trend of declining water quality and to begin to meet a target TLI value of 4.2 (current TLI c. 4.8). This would be likely to entail substantial land use change. Climate change would make the lake water quality targets more difficult to attain because of increases in stratification leading to extended periods of anoxia of bottom waters and increasing internal nutrients (i.e. those released from the bottom sediments). The modelling also considered using chemical flocculants to reduce internal loading of nutrients. Use of flocculants hastened the beneficial effects of land use change, offset the negative effects of climate change, but must still be considered as a risky option if catchment nutrient loads are not attenuated effectively first.

The LERNZ group is now on Facebook if you would like to join. Type LERNZ into the search box.

Audio lure to attract koi carp

Developing an audio lure to attract koi carp (*Cyprinus carpio*) through use of food rewards is the aim of research being conducted by **Brennan Mahoney**. Use of an audio lure as a possible attractant was proposed as a means to maximise catch rates. The research aims to identify the sound frequencies that best attract koi carp, determine which of these sounds performs best in natural water bodies and compare the visitation and catch rates at bait stations with and without an audio lure. The first stage of research has



been completed. Results from tank trials on captive koi show that subjects can learn to associate a sound with a food reward in less than ten days. Sounds broadcast at 120 (dB re 1 μ Pa) were optimal, frequencies from 400Hz to 1000Hz were tested; 400Hz tended to produce the best results. Results from sound attenuation and degradation experiments are currently being analysed, and field trials are awaiting approval from the University's Animal Ethics Committee.

Visitors

Andy Bruere (BoPRC) brought the Ngati Rangiwewehi hapu from Rotorua to hear about research at LERNZ and at NIWA and to be shown around our lab. Both visitors and the LERNZ group enjoyed the afternoon and felt there was much to be gained from this sort of interaction.

Liangcong Luo who formerly with us as a post-doctoral researcher and now works at Jinan University, China, spent a month with us. He and his PhD student, Wang Yao, worked with David Hamilton and Jonathan Abell using SWAT, ELCOM-CAEDYM and DYRESM-CAEDYM modelling software for simulations of Dashahe Reservoir, Lake Taihu and Lake Rotorua.

Hiroshi Yajima, an Associate Professor at the Department Civil Engineering, Tottori University, Japan, has been working with us for two months. He has been helping Mat Allan, Kohji Muraoka and Konrad Górski with their modelling work.

Røskva Høimark is a Masters student from Aalborg University, Denmark. She is here for five months to work on modelling the influence of wetlands on shallow lakes, using PCLake.

For more information go to www.lernz.co.nz Centre for Biodiversity and Ecology Research, Department of Biological Sciences, Science and Engineering, The University of Waikato, Private Bag 3105, Hamilton 3240, New Zealand.

NZ Lakes Database



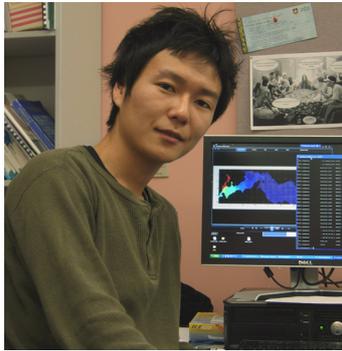
Max Wauthy has been working hard to sort, check and enter data into a New Zealand lakes database being developed by LERNZ. Currently the data in the database comes from the Bay of Plenty lakes but it is envisaged that it will include data from all New Zealand lakes in the future. The aim is to make

the data available and accessible to students and researchers in a centralised website. The data includes lake and catchment descriptions, physical and chemical variables and zooplankton and phytoplankton measurements. The website can be accessed at

<http://symphony.waikato.ac.nz/LSD>

Congratulations

Kohji Muraoka recently completed his BSc (Hons) dissertation. We are fortunate that Kohji has chosen to stay with us and pursue further research as a Ph D student into hydrodynamics and ecology using 3D modelling. Kohji won the University of Waikato International Doctoral Scholarship. He has become expert in visualisation and has been producing movies of model outputs and helping viewers to gain a true understanding of the results.



Conferences

Adam Daniel, Brendan Hicks and Jennifer Blair attended the *Australian Society for Fish Biology Annual Conference* in Townsville. Brendan presented research on satellite imagery as a tool for remote sensing of water quality and spawning habitat in unmonitored lakes; Adam's paper was entitled "The use of baited vs. unbaited double-wing fyke nets to capture common carp in a shallow New Zealand lake" and Jennifer presented her findings on lake morphology and trophic state controlling growth of rainbow trout in New Zealand lakes.

Kevin Collier, Konrad Górski and Michael Pingram attended the *2nd biennial symposium of the International Society for River Science* in Berlin. Michael presented a paper "Trophic patterns and carbon pathways in a lowland river - a comparison of food webs in the main channel and tributary confluences". Kevin presented a paper on "Developing macroinvertebrate metrics to detect human pressure responses on large rivers in New Zealand and Konrad delivered his research into flow as the driver of nutrient and plankton dynamics in a large temperate system (Waikato River, New Zealand).

David Hamilton and Wendy Paul attended the *16th Workshop of the International Association of Phytoplankton Taxonomy and Ecology* at San Michele all'Adige, Italy. David gave a plenary entitled "Ecological model applications for prediction of phytoplankton biomass succession: can you believe them?" and Wendy presented a paper on the environmental variables that influence species composition in lakes of differing trophic status.

Kevin Collier, Deniz Özkundakci, Rebecca Eivers and Marie Dennis attended the *Annual Conference of the New Zealand Ecological Society*. Kevin gave a plenary called "Reconnecting theory with management: lessons from large rivers. Ecology in the Heartland". Deniz gave a paper on Liebig's law of the minimum and ecosystem modelling, Marie presented a paper about bacterial, viral and algal interactions in freshwater lakes and Rebecca presented a paper entitled "Lake restoration and the dual benefits of constructed wetlands - habitat provision and pollutant attenuation".

Recent Publications

Abell, J.M. and Hamilton, D.P. 2011. Spot sampling of nutrient concentrations in the Puarenga catchment, Rotorua. CBER Contract Report No. 122. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Abell, J.M., Hamilton, D.P. and Paterson, J. 2011. Reducing the external environmental costs of pastoral farming in New Zealand: experiences from the Te Arawa lakes, Rotorua. *Australasian Journal of Environmental Management* 18: 139-154.

Ashraf, S., Brabyn, L. and Hicks, B.J. 2011. Image data fusion for the remote sensing of freshwater environments. *Applied Geography* 32: 619-628.

Ashraf, S., Brabyn, L. and Hicks, B.J. 2011. Alternative solutions for determining the spectral band weights for the subtractive resolution merge technique. *International Journal of Image and Data Fusion* 2: 1-21.

Collier, K. 2011. The rapid rise of streams and rivers in conservation assessment. *Aquatic Conservation: Marine and Freshwater Ecosystems* 21: 397-400.

Collier, K.J., Demetras, N.J., Duggan, I.C. and Johnston, T.M. 2011. Wild record of an apple snail in the Waikato River, Hamilton, New Zealand, and their incidence in freshwater aquaria. *New Zealand Natural Sciences* 36:1-9.

Collier, K.J. and Clements, B.L. 2011. Influences of catchment and corridor imperviousness on urban stream macroinvertebrate communities at multiple spatial scales. *Hydrobiologia* 664: 35-50.

Daniel, A.J. and Morgan, D.K.J. 2011. Lake Ohinewai pest fish removal. CBER Contract Report No. 120. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Hamilton, D.P. and Parparov, A. 2010. Comparative assessment of water quality with the trophic level index and the Delphi method in lakes Rotoiti and Rotorua, New Zealand. *Water Quality Research Journal of Canada* 45:479-489.

Hicks, B.J., Baker, C., Tana, R., Powrie, W. and Bell, D. 2010. Boat electrofishing of the Waikato River upstream and downstream of the Huntly Power Station: spring 2010. CBER Contract Report No. 115. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Hicks, B.J., Ling, N. and Daniel, A.J. 2011. *Cyprinus carpio* L. (Common carp). In: Francis, Robert. A (ed.) *A Handbook of Global Freshwater Invasive Species*, pp. 247-260.

Landman, M.J., Bleackley, N.A., Ling, N. and van den Heuvel, M.R. 2010. Physiological health of common bully (*Gobiomorphus cotidianus*) in the Tarawera and Rangitaiki Rivers of New Zealand: evidence of diminished ecological effects of pulp and paper effluents in wild fish populations. *Water Quality Research Journal of Canada* 45: 223-233.

Hicks, B.J. and Tempero, G.W. 2011. Comparative boat electrofishing surveys of Lake Waahi in 2007 and 2011. CBER Contract Report No. 117. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Paul, W., McBride, C., Hamilton, D.P., Hopkins, A., and Özkundakci, D. 2011. Restoration of Lake Hakanoa: Results of model simulations. CBER Contract Report No. 118. Centre for Biodiversity and Ecology Research, The University of Waikato, Hamilton.

Read, J.S., Hamilton, D.P., Jones, I.D., Muraoka, K., Winslow, L.A., Kroiss, R., Wu C. H., and Gaiser E. 2011. Derivation of lake mixing and stratification indices from high-resolution lake buoy data. *Environmental Modelling and Software* 26: 1325-1336.

Read, J.S. and Muraoka, K. 2011. LakeAnalyzer User Manual (Version 3), Global Lake Ecological Observatory Network.