LakesWater Quality Society

(incorporation pending)

formerly known as The Lakeweed Control Society

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LakeScience Rotorua

A newsletter about research on the Rotorua Lakes

Produced from time to time by the LakesWater Quality Society, in association with the Royal Society of NZ (Rotorua Branch)

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Welcome to the first issue of what we hope will be a useful medium of information exchange for those involved in or interested in scientific or management work on the Rotorua Lakes. It is up to **you** to make this informal newsletter a success by providing it with copy – our Society is merely providing the vehicle. We intend to email it free of charge to all those who attended the Rotorua Lakes 2001 Symposium and are on email, and also to anyone else who requests it. We will snail mail it on request. The newsletters will also be posted on the Royal Society (Rotorua Branch) website at www.rsnz.govt.nz/clan/rotorua. If you are interested in, or working on lakes, but not the Rotorua Lakes, we are still very happy to receive material from you and to send you newsletters.

The *raison d'etre* for this newsletter? At the recent Symposium it became clear that people working on relevant research were often unaware of what other workers in other fields of research were up to. At the symposium we had limnologists, geochemists, piscatologists, algologists, botanists, microbiologists, chemists, geneticists, land and water managers, economists, politicians and the general public all talking to one another. We would like that to continue, hence this newsletter. If you have something to say or ask, drop us a line, a paragraph, a proposal, a report….

The more copy we receive, the more frequently we will be able to send this newsletter out. Electronic copy is preferred but not essential. Only minimal editing will be carried out. The editors have supplied some copy for this first issue – don't regard that as a precedent! If we receive sufficient copy, expect another issue in early December, if not – March is a more likely date.

All material and correspondence relating to *LakeScience Rotorua* to Nick Miller, millern@wave.co.nz, 91 Te Akau Road, R D 4, ROTORUA.

DEVELOPMENTS FROM THE SYMPOSIUM.

The Proceedings are in the final stages of production and are expected to be mailed shortly. If you have not ordered a copy but wish to do so, they can be ordered on the special Order Form in this newsletter. Just print it out and post with a cheque. Complimentary copies will be sent to various libraries and institutions.

Lake issues do seem to have had a higher profile, generally, in the last few months. Environment BOP have formally resolved to endow a Chair of Lake Studies at Waikato University, for a minimum period of 5 years. Special research areas will include lakes watershed management and lake rehabilitation. We hope this will encourage a renaissance of research on lakes in this country.

There are hopes for some grants for student research on the lakes for next year. Because of the good attendance, the Rotorua Lakes 2001 Symposium produced a surplus, and we plan to put that, together with funds we hope to obtain from other sources, towards student research. Student Grant Application forms are available from the LakesWater Quality Society secretary (address above) or by email to Nick Miller.

There has been an application to the Royal Society of New Zealand for a Teacher Fellowship to carry out a one-year research project on lake sediments. We understand that some student research grants with other organisations are also planned.

Dr Julie Hall and Professor Warwick Silvester were recently commissioned by Environment BOP to conduct a scientific review of the 'Mylechreest Hypothesis". This review is to be presented to EBOP very shortly. Hopefully more details in our next issue.

GLEANINGS – a few interesting papers seen recently (other contributions to this section are welcome.)

Miller, M.J and Fallowfield, H.J. (2001). Degradation of cyanobacterial toxins in batch experiments. *Wat. Sci & Technol.* **43** (12) 229-232.

Various south Australian soils were tested for their ability to sustain microbial degradation of the hepatotoxins Nodularin and Microcystin-LR. Soils with the highest organic carbon content (2.9%) and clay content (16.1%) were able to sustain complete toxin removal within 10 – 16 days. Sandy soil (98.5% sand) was incapable of degrading either toxin. Degradation was considered likely to be the rate-limiting step in toxin removal, rather than adsorption or desorption.

Lahti, K., Raoala, J., Kivimaki, A-L., Kukkonen, J., Niemala, M. and Sivonen, K. (2001). Occurrence of microcystins in raw water sources and treated drinking water of Finnish waterworks. *Wat. Sci & Technol.* **43** (12) 225-228.

Microcystins were detected sporadically (by immunoassay, HPLC and phosphatase inhibition) in raw water sources of most of the waterworks examined. In two raw water supplies toxins were detected for several months. In treated water microcystins were detected occasionally but the concentrations were always below the guideline value proposed by WHO.

Sharpley, A.N., Kleinman, P. and McDowell, R. (2001). Innovative management of agricultural phosphorus to protect soil and water resources. *Commun. Soil Sci. Plant Anal.* **32** (7&8) 1071-1100.

A variety of stratagems for immobilising phosphorus (P) in the environment and controlling its sources and transport are examined. The cost effectiveness of various measures is considered. Various best management practices are proposed. A useful bibliography is attached.

Miyasaka, S.C. and Habte, M. (2001). Plant mechanisms and mycorrhizal symbioses to increase phosphorus uptake efficiency. *Commun. Soil Sci. Plant Anal.* **32** (7&8) 1101-1147.

This is basically a review of the literature on phosphorus uptake processes in plants and the mechanisms by which P uptake efficiencies could be enhanced, with particular emphasis on arbuscular mycorrhizal fungi. The ultimate aim is to reduce P inputs and thus minimise adverse environmental effects on waterways. A substantial bibliography is attached.

Lee, T.J., Nakano, K. and Matsumara, M. (2001). Ultrasonic irradiation for blue-green algae bloom control. *Environmental Technology* **22** 383-390

The use of ultrasonic irradiation for the control of clue-green algal (cyanobacterial) blooms was investigated under laboratory conditions. Suspended cells in cultures of *Microcystis* spp. were shown to settle rapidly after a brief exposure to ultrasound at a frequency of 28 kHz. This settling was shown to be due to the disruption of gas vacuoles in the cells. Settled cells were shown to have reduced viability. Significant reductions in photosynthetic activity of sonicated cells were also demonstrated, with ultrasound at 28 kHz being more effective than frequencies of 45 and 100 kHz. Some microcystin release was observed following sonication of cells that were already releasing microcystins, with the degree of additional release being controlled by the duration of sonication.

ANYBODY FOR DREDGING?

Should restoration efforts in any of the water bodies in the Rotorua District come to a stage where dredging is considered, work going on in the Orakei Basin at Auckland may be of interest.

Brian Perry Civil (a subsidiary of Fletcher Construction) use a barge-mounted digger to scoop material from the bottom of the basin (depth approximately 2 metres) and dump it into Breezecraft 4.9 m polyethylene dories, which are then towed, 6 in line-astern, to an access point. Each dory is hoisted up and its contents (2 tonnes of mud, rocks and debris) are dumped into a truck after which it returns for another load. These boats appear to last indefinitely under this treatment. Some have been in use for over 2 years!

About 5000 m^3 of material are removed each year, in an ongoing contract, as funding permits. Most of the dredged material is used for landfill capping, and the approximate cost of dredging and disposing of it (mostly to the GreenMount landfill) is $137 per m^3 , with some seasonal variation (Grant Ocklestone, Auckland City Council, *pers. comm.*) No doubt delays in transporting the material through the Auckland traffic add somewhat to this price! A similar process, using the same type of craft, is used at the Mangere Sewage works project, and was also used in the Viaduct Basin remodelling.

Symposium Proceedings

If you have not ordered a copy but would like to do so, please use the following form (print out, fill in and send with a cheque).

To: The Treasurer LakesWater Quality Society P O Box 2008 ROTORUA $25.00 enclosed	Please supply a copy of the Rotorua Lakes 2001 Proceedings Name: Postal Address:

Our first contribution is from Jules Witt, a stormwater engineer at Rotorua District Council. It consists of extracts from a paper he recently presented at the Ingenium 2001 Conference.

What's in a Storm from the Rotorua CBD?

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Abstract
Stormwater runoff from urban areas can be a major source of contaminants to receiving waters and is becoming an important environmental issue. To address this potential problem the Rotorua District Council set up a monitoring programme over a period of 6 months to assess the effects of the Central Business District (CBD) stormwater on Lake Rotorua. Stormwater pond treatment systems are used to lower the flow velocity so suspended solids and associated contaminants have time to settle out of the flow stream. The monitoring results showed that the environmental impact of the CBD stormwater discharge on Lake Rotorua is negligible when the toxicants and nutrients contained in the stormwater were considered. No conclusions regarding the specific pond removal performance could be made due to unusual inflow results. However, a qualitative comparison with an earlier stormwater monitoring exercise before the ponds were installed indicates a reduction in suspended solids by approximately 70% after the installation of the stormwater ponds and treatment device. This is consistent with a previous New Zealand study of stormwater pond removal efficiency that found removal levels of around 75% for a range of contaminants for this type of stormwater detention pond.

Some data from this paper is shown below.

For further information, Jules Witt may be contacted by phone at RDC (07 348 4199) or by email at Julian.Witt@rdc.govt.nz

Table 1: Summary of Environmental Monitoring of the Rotorua CBD Stormwater Drain

Analyte	Mass of Analyte Entering Lake Rotorua (kg/year)				Mean conc. of lake inflow
	1-May	17-Jul	28-Nov	Weighted Mean	(g/m^3)
As	0.5	0.49	0.73	**0.52**	0.002
B	4.4	27.5	13.4	**10.1**	0.042
Cd	0.1	0.05	2.4	**0.35**	0.001
CL	390	1997	1169	**809**	3.3
COD	3653		6576	**4105**	16.9
Cr	0.3	0.39	0.54	**0.37**	0.002
Cu	1.8	2.0	2.3	**1.9**	0.008
DRP	8.3	10	4.6	**8.2**	0.034
Fe	146	127	122	**139**	0.57
Hg	0.2	0.02	0.18	**0.14**	0.001
Mn	7.9	8.4	7.4	**7.9**	0.033
NH_4-N	15.3		7.3	**14.10**	0.058
Ni	0.2	0.27	0.27	**0.25**	0.001
Pb	1.9	2.0	2.7	**2.0**	0.008
SS	5115	4384	10716	**5660**	23.24
TPH	< 48.7		< 49	**< 49**	< 0.20
TKN	91.1	73.6	89	**87**	0.36
TOXN	10.2	10.5	9.0	**10**	0.042
TP	26.5	28.3	22.7	**26.4**	0.11
Zn	20.0	43.4	25.3	**25.3**	0.100

Also by courtesy of the Rotorua District Council and NIWA is the following document relating to Okawa Bay, Lake Rotoiti.

3 August 2001

Paul Sampson
Rotorua District Council
Private Bag RO 3029
Rotorua

Dear Paul

Potential for improvements to Okawa Bay water quality

A meeting was held on 23 July between Paul Sampson and Adrian Vosloo of Rotorua District Council, John McIntosh of Environment Bay of Plenty, and David Ray and Max Gibbs of NIWA, to discuss the potential benefits to Okawa Bay of implementing a sewerage scheme for Mourea and Okawa Bay. At the meeting, Paul Sampson asked NIWA to provide a brief summary of the issues at Okawa Bay, addressing in particular:

- The existing water quality in the Bay and the incidence of toxic algae blooms

- Will implementing a sewerage scheme (and thus removing septic tank leachate from the Okawa Bay catchment) improve Okawa Bay water quality and reduce the incidence of algal blooms and/or weed growth significantly? If so, how long would these improvements take?
- Would other options assist with improving water quality?

RDC notes there is a public perception that algal bloom problems at Okawa Bay are caused by septic tanks. RDC made it clear that the sewerage scheme may be implemented for reasons other than improvement to Okawa Bay (e.g., to reduce public health risks), but Council (and thus residents and ratepayers) needs to know whether a sewerage scheme would result in any noticeable improvement to the Bay.

This report has been prepared drawing on the knowledge of some key NIWA personnel (Max Gibbs, Kit Rutherford, John Clayton and Bob Spigel), who have had involvement with water quality issues in Lakes Rotorua and Rotoiti over a number of years. We have also drawn on the knowledge of John McIntosh and other staff at EBOP.

The status of Okawa Bay – past, present and future

Okawa Bay has an area of about 45 ha, and is almost completely encircled by land, with a narrow (approximately 100 m) wide channel to the main body of Lake Rotoiti. There are no surface water inflows to the Bay, and the catchment area is only about 115 ha (including the Bay itself). Therefore there is little freshwater 'flushing' of the Bay. The Bay is also relatively shallow, with a mean depth of approximately 4 m and maximum depth less than 10 m.

By virtue of the steep catchment around the southern half of the Bay, Okawa Bay is sheltered from the prevailing winds, and thus does not experience the same degree of wind-induced mixing as the open waters of Lake Rotoiti or Lake Rotorua. Consequently, the Bay is thought to thermally stratify on occasion in summer, when the upper and lower waters do not mix. This can cause oxygen depletion in the bottom waters, leading to increased release of nutrients from the sediments.
Dissolved oxygen profiles measured in the Bay in early 2001 by EBOP show that the lake is usually well mixed. However, stratification does occur in calm conditions with a temperature difference of about 1°C being measured between top and bottom waters. In these conditions the very bottom waters can become deoxygenated and nutrient release can occur from the sediments in these conditions, similar to the situation at Lake Rotoehu.

Okawa Bay was originally dominated by native charophytes. These form underwater 'meadows', and are generally regarded as a desirable plant species, since they stabilise the lake bed and reduce turbidity. They also do not reach the surface except in the shallows, and thus do not cause significant problems for recreational activities. Like many New Zealand lakes, the Bay was progressively invaded by exotic macrophytes (commonly referred to as aquatic weeds), especially hornwort. These species are able to grow to the surface from considerable depths (several metres), and can cause problems for recreation activities. Then in the mid 1980s much of the macrophyte beds 'collapsed' and were replaced by algae. The reasons for this are uncertain, but an increase in nutrient concentrations in the water column was probably an important factor. Since then the Bay has remained algal-dominated (i.e., algae dominate over macrophytes), although the macrophytes have recovered to some extent. In many respects Okawa Bay is similar to Hamilton Lake, which has experienced similar changes to its plant life and water quality over the past 20 years.

There have been algal blooms in the Bay every summer in recent years. In the absence of wind-induced mixing, these blooms can comprise a significant proportion of blue-green algae, which can cause toxic effects to bathers. These blooms have necessitated warning signs for the public.

There is little data on the Bay's water quality. EBOP monitor bathing suitability by measuring indicator bacteria (*E. coli*) levels at the yacht club jetty at regular intervals. EBOP have also started measuring surface water quality in the middle of the Bay to assess the 'trophic status' of the Bay. Total phosphorus, total kjeldahl nitrogen, secchi depth (a measure of water clarity) and chlorophyll levels (a measure of algae abundance) are measured, and the combination of these measurements can be used to give a 'trophic level index' for the Bay. This is a measure of how enriched the Bay is with nutrients, and how susceptible it is to algal blooms and weed growth. At present the Bay has a trophic level index of 4.6, and is classified as eutrophic. However, this classification is based on only one set of results to date, and must be regarded as very preliminary (the main intention of the index is to build up a picture of a lake's status over time).

It is difficult to predict the future status of the Bay. However, if there are no changes to the present nutrient inputs, it is possible that the water quality of the Bay will continue to decline, with increased frequency and duration of blue-green algal blooms, until it becomes highly eutrophic, similar to Lake Okaro.

How significant are nitrogen inputs from septic tanks?

There are a number of private dwellings on the western and southern shores of the Bay. In addition, there is a resort lodge at the south-western corner of the Bay (the Okawa Bay Lake Resort), and a marae located to the west of the entrance to the Bay. The residences and marae are serviced by septic tanks. The Okawa Bay Lake Resort has a wastewater treatment system that discharges to groundwater, which then flows into the Bay (the treatment system probably removes little nitrogen from the sewage). We estimate that the septic tanks and Resort Lodge could contribute about two-thirds of the nitrogen inflow to the Bay (up to 1.6 tonnes per annum). The other main sources of nitrogen are rainfall, urban stormwater and rural runoff. Therefore the septic tanks and Resort Lodge are potentially a very significant source of nitrogen for the Bay.

It is possible that there are also significant inputs of nitrogen into Okawa Bay from geothermal springs. About 25 % of the nitrogen inputs to Lake Rotoiti are sourced from such springs. Given the close proximity of the Tikitere thermal area, it is possible that there are also springs discharging geothermal waters into Okawa Bay. Results from recent bore drilling in Mourea and Okawa Bay also point to a possible geothermal influence beneath the Bay. In view of the high concentrations of ammonia that can occur in these waters, even relatively small inflows of geothermal fluids could result in these springs being a significant nitrogen source for the Bay, in comparison to other sources. Such springs might make the contribution of nitrogen from septic tanks less significant. However, the existence of any such springs discharging into the Bay is presently unknown.

Management options being considered by RDC

RDC are considering a number of options to improve the water quality of Okawa Bay:

1. Implementing a sewerage scheme, which would remove the sewage from septic tanks and discharge the effluent outside the Bay's catchment.
2. Constructing a pipeline from the Lake Rotorua end of the Ohau Channel to the southern end of Okawa Bay, with a gravity flow of about 1 $m^3 s^{-1}$. The intention is to create a flushing action in the Bay from the southern end of the Bay to the outlet.
3. Install aerators in the Bay to increase oxygen levels in the water and reduce the released of nutrients from bed sediments.

The key questions to address are whether any or all of these options will in fact cause a measurable improvement in the water quality in the Bay and reduce algal and weed growth, and if so, how quickly these improvement will happen. With our present limited knowledge of the Bay, we can not give a clear answer to these questions. However, we can make some 'educated guesses', and suggest some investigations to improve our understanding of the likely outcomes.

The role of nitrogen in bed sediments

Apart from the septic tank nitrogen inputs and the possible geothermal inputs, there is also likely to be a very large reservoir of nitrogen in the bed sediments of the Bay. This will have built up over many years from detritus sinking to the bottom of the Bay (mainly decayed weeds and algae). When the bottom waters are well oxygenated, this nitrogen reservoir is relatively stable, although there will usually be some release of nutrients to the water column from the sediments. However, if the Bay intermittently stratifies in summer (as discussed above), the bottom waters may become depleted of oxygen and the sediments may release quantities of inorganic nitrogen. When wind induces complete mixing of the waters, this nitrogen will become available to algae, and an algal bloom can occur. This nitrogen is later returned to the bed when the algae die and sink.

Therefore even if septic tank effluent is removed from the catchment, it may be many years (even decades) before the sediment nitrogen source is depleted. Increased flushing (e.g., by the proposed pipeline from the Ohau Channel) would probably speed up this process.

Aerators might help to prevent deoxygenation, but there would be significant difficulties in directing this oxygen to the bottom waters. Most aerators that we are aware of are designed to oxygenate the upper few metres of wastewater treatment ponds. In any event, large aeration or mixing units would be required, implying substantial capital and operating costs. Aerators would also have other negative impacts (e.g., noise and aesthetics).

Would a flushing inflow be worthwhile?

Because there are no obvious surface water inflows to Okawa Bay, flushing is minimal and probably driven by direct rainfall, lake circulation, and the water inflow from septic tanks. Consequently the introduction of a flow of water into the Bay from the Ohau Channel is likely to increase the flushing rate, but by how much is unknown without detailed investigations. A 'back-of-the-envelope' calculation suggests that the mean theoretical residence time of a 1 $m^3\ s^{-1}$ inflow to the Bay would be about 21 days. As algae typically double in numbers in 2-3 days, the flushing is unlikely to prevent the development of high algal biomass directly.

It is possible that the flushing inflow may influence whether or not the Bay stratifies and de-oxygenates in summer. This could result from the mild stirring induced by the inflow, but is more likely to reflect the buoyancy of the flushing water. When the inflow is colder than the Bay water, which is likely to occur frequently in the summer, it will sink to the bottom of the Bay, carrying oxygen with it, and thus potentially reducing the rate of sediment nutrient release. The flushing water may also influence which algal species become dominant in summer. In Lake Rotoaira, increased flushing reduced the residence time from about 280 days to 27 days and the algal dominance shifted from toxic blue-green algae to non-toxic diatoms. The blue-green algae are still present, but they no longer dominate and cause nuisance blooms.

Another potential benefit of a flushing flow is that algae will be physically flushed out of the Bay, and when they die their nutrients will not return to the sediments in the Bay. Hence this flushing may gradually reduce the nitrogen reservoir in the sediments.

While there could be positive effects from introducing flushing water to Okawa Bay, there are also potential adverse effects. If the flushing water is drawn from the Ohau Channel during periods of strong south-westerly winds, or during an algal bloom event in Lake Rotorua, the quality of the flushing water could be poor and thus detrimental to the Bay. At other times the quality of the flushing water is likely to be better than that of the Bay, and hence be beneficial. Therefore it might be advantageous to be able to close off the pipeline flow at certain times.

In conclusion, a flushing flow could be beneficial, but whether the inflow would cause a marked improvement to the Bay is uncertain without detailed investigations (field measurements and modelling).

Summary

In conclusion, it is unlikely that the removal of septic tank effluent from the catchment of Okawa Bay will cause an immediate, marked improvement in water quality or reduction of the incidence of algal blooms, because of the nitrogen reservoir available in the bed sediments. Any changes are likely to occur over a number of years, possibly decades. However, removal of the septic tanks may arrest a continued decline in water quality, and prevent an increase in the duration of blue-green algal blooms.

It is possible that introducing a flushing flow via a pipeline from the Ohau Channel would enhance improvement, particularly if the septic tanks are removed, but this option needs detailed investigation to assess its true potential.

As agreed with RDC, we will carry out a CTD (conductivity, temperature, depth) profile of the Bay within the next two weeks to try to determine whether any geothermal springs discharge into the Bay. This work will also provide a detailed bathymetry of the Bay, which will be useful when carrying out any future modelling of the Bay. We will advise the costs of this work shortly.

Yours faithfully

David Ray

cc: John McIntosh
Environment Bay of Plenty, PO Box 364, Whakatane

Here is a contribution from Susie Woods, who presented two posters at the Symposium.

The Fifth International Conference on Toxic Cyanobacteria - July 2001

Susie Wood (Ph.D. student – Massey University, Wellington & Victoria University)

The Fifth International Conference on Toxic Cyanobacteria was held in July in the beautiful sub tropical Queensland town of Noosa. Approximately 175 delegates from over 50 countries attended. The conference spanned five days and provided an excellent opportunity for me to learn about the large array of overseas research and to meet many of the worlds experts in this field. Other New Zealand attendees were; Anna Crowe - Cawthron Institute, Dr. Ian Garthwaite – Agresearch, Dr. Penny Truman – ESR and Dr. Alexander Kouzminov – Ministry of Health.

Cyanobacteria (also commonly called blue-green algae) are aquatic and photosynthetic bacteria that are found in many of New Zealand's aquatic ecosystems. Some cyanobacteria species produce toxic substances known as cyanotoxins, such as hepatotoxins, which are primarily toxic to the liver (e.g. microcystins and nodularin). There is now a large amount of work that demonstrates that these cyanotoxins pose a risk to both human and animal health.

Toxic cyanobacteria have been identified in New Zealand. The species known to produce cyanotoxins in New Zealand are *Microcystsis* sp., *Anabaena* sp., *Oscillatoria* sp., *Phormidium* sp. and *Cylindrospermum* sp. However in New Zealand our knowledge of which species are producing cyanotoxins, and which cyanotoxins, are being produced is limited.

A wide variety of topics were covered during the conference ranging from toxin production, toxin detection, toxin persistence and degradation, ecological and population studies, genetics, bioaccumulation, management and many others.

While the problems associated with toxic cyanobacteria are relatively new to us in New Zealand it is a dilemma that a number of countries have being tackling for many years. The conference opened with an interesting plenary session chaired by the World Health Organisation expert Dr Ingrid Chorus, on the theme of “Toxic Cyanobacteria - Towards a Global Perspective”. The theme of the session was to gain a feel for the global extend of occurrence of cyanobacteria and cyanotoxins and what countries are doing in terms of monitoring and toxin detection. Attendees of the conference were asked to give their "expert judgment" of the situation in their country via an email survey prior to the conference.

Responses came from experts in over 20 countries. In most countries the proliferation of both cyanobacteria and cyanotoxins was rated as frequent. Some countries, for example, Australia are clearly leading the way in terms of surveillance programmes with a number of national and routine monitoring programmes in place for both cyanobacteria and cyanotoxins. In some areas of Australia there is data on cyanobacteria abundance for the last 30 years. What the session clearly illustrated is that in New Zealand, we are lagging behind a number of the world leaders in cyanobacteria research. We have only one regular monitoring program that attempts to occasionally monitor cyanotoxins and this is in the Rotorua District.

The problem of cyanotoxin bioaccumulation and the effect of cyanotoxins on biota were covered by a number of papers. Bas Ibelings from the Netherlands presented an interesting study in which they had looked at microcystin content in zooplankton, zebra mussels, fish livers and water birds. They found that despite relatively high levels of microcystin in the study lakes it seemed unlikely that this was the primary cause of large fish kills. Although oral uptake of microcystin led to high concentrations in the liver this appeared to have a low toxicity.

World-renowned toxic cyanobacteria expert Dr Ian Falconer gave an interesting talk on cancer risks from cyanobacterial toxin exposure. He summarised the results from many years of research. These results show that *Microcystis aeruginosa* toxicity indicated the possibility of a tumor promoting action. Further studies involving a wider variety of species are underway.

Dr Phillip Orr (CSIRO, Australia) presented a further study looking at the potential human health impacts on cyanotoxins. His study team investigated the effect of ingestion of environmentally realistic concentrations of toxic *Microcystsis aeruginosa* by dairy cows on toxin levels in their milk. The results from their study were encouraging as they concluded that milk obtained from that cattle exposed to sub chronic levels of *Microcystsis aeruginosa* presents little or no risk to human health.

There were several sessions' discussing toxin persistence and degradations, in particular in drinking water treatment plants. Studies using a variety of cyanotoxin removal methods where presented. For example a team lead by Dr Linda Lawton (UK) have being investigating the use of TiO_2 to remove cyanotoxin in drinking water treatment plants. Dr Ingrid Chorus showed us some of the amazing research facilities in Germany. In this study a number of man-made lakes were being used in an experiment to assess the retention of microcystins through soil and sand filtration. Varying success at removing microcystins was achieved depending of type of sediment and filtration time.

Another large area of research reported at the conference was on the genetics of cyanobacteria. Again many different aspects were covered. Several studies used genetic techniques to show that a revision of the taxonomy of some genera may be needed.

There was a lot of work presented on the use of gene probes to detect toxic strains of cyanobacteria. Gene probes are unique pieces of synthetic DNA that will attach to matching genetic material in a particular toxic cyanobacteria. While this is an exciting area of research there is still a lot more work required before such techniques could be used in routine monitoring programmes.

The results of a number of regional and national studies were presented. Dr Gregory Boyer presented his study of cyanobacterial toxins in New York State waters. He analysed 220 water samples using a variety of techniques. 24% of samples were found to contain microcystin toxins and 4% anatoxins. However in some lakes more than 50% of samples tested were positive for microcystins. He summarised by saying "that New York had now joined many other parts of the world in admitting that they now have a problem with toxic cyanobacteria in their waterways."

This is just a small insight into some of the many topics covered at the Fifth International Conference on Toxic Cyanobacteria. For more information, visit the conference web site at: www.clw.csiro.au/ICTC-V/. All abstracts from talks and posters will be available on this website shortly.

Thanks to The Victoria University Science Facility Small Grants Committee for providing funding for me to attend this conference.

Toxic Cyanobacteria in New Zealand – I am currently involved in a Ph.D. study that is attempting to assess the occurrence, frequency, toxicity, toxin content and species composition of cyanobacteria blooms/mats in New Zealand waterbodies. If you have any information on cyanobacteria blooms or mats in your area please contact me as I would be interested in obtaining samples and carrying out analysis of any toxins present.

Susie Wood (Ph.D. student – Massey University, Wellington & Victoria University) Email: S.Wood@massey.ac.nz or Ph: (04) 801 2794 extn. 6918.

Finally for this issue, Kim Young of Doc writes about her work on koaro.

Koaro - our native trout of the Rotorua lakes

For the last 2 years I have been studying the role of tributary streams in the maintanance of koaro populations in the Tarawera Lakes and am currently writing up my study, due to be completed in November 2001.

Lake Tarawera and its associated tributaries including Lake Okareka, support populations of these elusive and rare native fish. In the past, koaro were a commonly encountered fish in these lakes with anecdotal evidence suggesting that pre-European harvest of koaro was common practice.

Since the arrival of Europeans however, and the introduction of rainbow trout and smelt to these lakes, the abundance and size class of koaro has substantially declined.

It is hoped that determining the role that tributary streams play in the maintenance of lakelocked koaro populations will assist in the conservation management of this native fish species in the Rotorua Lakes. Koaro are classified as a category c species in the Department's priority ranking system, and since much of the Lake Tarawera and Lake Okareka catchments and their beds are managed as crown reserves, there is an opportunity to enhance spawning and rearing success of lake-locked populations if the role of tributary streams in their lifecycle were better understood.

The aims of the study were to:
(a) investigate the movement of koaro between lake and stream habitats,
(b) describe lake dwelling koaro populations, and
(c) describe lake dwelling koaro spawning patterns.

The first part of the study was simply to determine the best methods for catching lake dwelling koaro using a combination of fyke nets, box traps, and gee minnow traps. These methods were then used for monthly sampling of these populations in Lakes Tarawera and Okareka. Each fish caught was PIT tagged, weighed, measured, and assessed for reproductive status.

Populations of koaro in two streams entering Lakes Tarawera and Okareka were also studied. Reduction electric fishing has taken place each season and caught fish were also tagged, weighed and measured. Drift samples for larvae have been collected and searches for spawning sites have been undertaken.

All sampling has been completed and now the hard part, writing up the results is currently in progress. A preliminary look at the results has revealed that tributary streams may play a minimal role in the maintenance of lake populations with lake resident fish most likely spawning and remaining in the lake. It also appears that the lake and stream populations may be quite seperate, or at least have little interaction at the breeding level. Lake fish were found to have a peak spawning period in summer in contrast to stream fish which appear to spawn in autumn or early winter.

I look forward to providing conclusions in the next *LakeScience Rotorua* newsletter.

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