LAKES

Highlights 2001-2002

- The invasion of aquatic weeds in Northland Lakes is a significant problem and is likely to become worst over time.
- Five nationally endangered aquatic plants were found in Northland Lakes.
- Pest fish are a threat to aquatic vegetation and water quality.
- Catchment management efforts have resulted in improved water quality in some selected lakes.

Annual Plan Performance Targets

To continue to develop and implement a prioritised State of the Environment programme based on the Regional Policy Statement and Regional Plans; by:

- Operating a region-wide water quality network for the measurement, recording and reporting of river, lake and groundwater quality trends.
- Weed and algae monitoring of Lake Omapere and associated community liaison and advice.

The Aquatic Vegetation of 33 Northland Lakes

Thirty three Northland lakes, from Lake Ngakaketa at the top of Ninety Mile Beach to Lake Kahuparere at the bottom of the Poutu Peninsula were surveyed for aquatic vegetation by NIWA between February and May 2001. Twenty six of these lakes had been previously surveyed in the 1980s by Tanner et al. (1986, 1988), thus allowing a comparison of lake condition.

Emergent vegetation at a typical Northland dune lake

Changes in the Aquatic Plant Populations

Fifty-four aquatic plant species, of which 40 were native plants, were found in the 1980s surveys. The current survey found a total of 65 aquatic species, with 47 of these being indigenous. Comparison between the 1985 and 2001 surveys also showed 8 of the 26 lakes included in both surveys still supported the same submerged vegetation, 3 of these being dominated by introduced submerged weeds. Six lakes surveyed in 2001 were essentially devegetated (none reported in the 1980s), 8 lakes were infested with alien submerged weeds (5 reported in the 1980s, one of which is now devegetated), and the remaining 8 lakes supported different indigenous vegetation to that in the 1980s.

Endangered Plants Found

Five nationally endangered plants were found during the 2001 survey. The largest national populations of three of these species *Utricularia protrusa*, *Thelypteris confluens* and *Hydatella inconspicua* occur in Northland. The population of *Myriophyllum robustum* found at West Coast Road Lake is the largest known North Island site. The remaining species *Isolepis fluitans* was re-discovered in Northland some 89 years since its last collection is the only known lowland northern North Island site known.

Invasion of Weed Species

Alien submerged aquatic weeds continued to expand their ranges within Northland. The oxygen weeds and hornwort all are capable of displacing the majority of indigenous submerged vegetation in any of the Northland lakes with the possible exception of the three deepest Kai-iwi lakes. Twelve of the 33 lakes have been impacted by these plants, with one or more of these species now dominating the vegetation of 6 lakes. Spread of these weeds is solely by human activities, with eel fishing nets, boats or the planting of waterlilies contaminated with these plants, probable mechanisms for spread.

Other aquatic weeds that could potentially disrupt the ecology of these lakes included the sprawling emergent alligator weed found at two lakes and Manchurian wild rice, which dominated much of the margin of Phoebes Lake. Both are already well known problems in Northland.

The introduced aquatic oxygen weed *Egeria densa*

Pest Fish

The alien fish rudd was noted in Lake Waiparera, with records of this and other coarse fish reported from several of the other lakes surveyed. These fish may have had a major role in the collapse of vegetation in this lake and also Lake Parawanui.

Water Clarity

The maximum depth to which submerged vegetation grows is an indication of water clarity. A comparison of bottom depth limit between the 1984/5 survey and 2001 allow a long-term evaluation of changes in those lakes. Seven lakes showed significantly improved water clarity, some of these relating to increased riparian vegetation and prevention of stock access. Five lakes have significantly decreased bottom depth limits, relating to loss of submerged vegetation cover with loss of protection from sediment resuspension by wave action, thus increasing turbidity. Cattle access and loss of marginal vegetation also cause increased turbidity.

Catchment Management

Riparian retirement is an effective management tool to protect these lakes as it prevents cattle access to lake edges allowing contamination of waters with urine and faeces and also removal of marginal vegetation by grazing and trampling. Fencing allows dense vegetation to develop on the edge and shallow margins of the lake. This is an important way to intercept nutrients entering the lake through overland flow and groundwater.

The catchments of the three largest Kai-iwi lakes and several of the Aupouri Peninsula lakes support mature pine trees and harvesting may occur in the near future. Physical disturbance of sites and increased sediment contamination of these lakes is likely to occur, which would have a major impact on the Kai-iwi lakes by decreasing water clarity and increasing the susceptibility of these lakes to alien submerged weed invasion. A sufficient buffer zone between harvested trees and the lake margin needs to be enforced to militate against this.

Restoration project at Lake Ngatu

Management of Invasive Weeds

Removal of invasive alien weeds from a lake situation once these are established is difficult and requires radical techniques like removal of all vegetation using grass carp. This can be justified if a new highly invasive aquatic weed is discovered in Northland at one or few locations, or where the lake was of high value prior to weed invasion. Education of groups likely to spread these weeds (fishers and boat users) can reduce the likelihood of spread, but spread is still actively occurring despite the prevalence of signs outlining the dangers of weed spread present on several routes to these lakes. Monitoring is therefore required to intercept new weed incursions. A weed surveillance programme for the remaining high value indigenous lakes is recommended. Techniques like bottom-lining with weed mat or suction dredging can be employed, but due to cost and logistics they are only effective on small areas of weed and are thus dependent on early detection of new weed incursions.

Prioritisation of Northland Lakes for Management

The ten highest ranked lakes in order of importance are **Kai-iwi, Waikere, Wahakari, Kanono, Humuhumu, Rotokawau (Aupouri), Carrot, Ngakapua, Rototuna and Taharoa**. These lakes are representative of Northland lakes varying in geographic location, size and depth, vegetation types (all indigenous) and contain populations of three endangered plant species.

Despite the deterioration of some of the lakes outlined in this survey, Northland still contains at least 19 lakes with totally indigenous submerged vegetation. This is certainly the largest concentration of such lakes in the North Island, and possibly in New Zealand. This unique national resource will only remain this way if preventative measures are implemented, at least to the highest ranked lakes.

Future Monitoring

- **Regular surveillance of lakes for invasive aquatic weeds and management action to control weeds as soon as they are found.**

- **Support the Department of Conservation in their efforts to control pest fish**

- **Set up a 'Lake Monitoring Network' similar to the Regional Water Quality Network to establish the health of our lakes.**

Lake Omapere Monitoring and Management

Highlights 2001-2002

- An additional 20 000 grass carp have been released.
- The weed *Egeria densa* has declined.
- An algal bloom is present in the lake water.
- New Lake Omapere Trustees have been appointed
- Work has began on an integrated long term management plan.

Weed Management – Introduction of Grass Carp

Twenty thousand adult grass carp (*Ctenopharyngodon idella*) have been released into Lake Omapere in an attempt to control the problem weed *Egeria densa*. The grass carp were, on average, longer than 20cm with some individuals being greater than 60cm in length.

The use of herbicide spray was also considered, but in the end, this was not needed, as the weed had not grown as much as anticipated over the summer. It is likely that this slow growth is a result of moderate summer conditions and an algal bloom that has shaded the weed. The weed control project has been funded jointly by central government though Te Puni Kokiri and by local government, Northland Regional Council and The Far North District Council.

Grass carp being released into Lake Omapere

Weed Monitoring - Biomass

The biomass of the weed *E.densa* has been monitored over the past year. To monitor the biomass of weed in Lake Omapere, divers have sampled weed using randomly placed 1-meter quadrats. The harvested weed is dried and the results are extrapolated to estimate the dry weight weed biomass over the entire lake. Figure 4.1 shows the changes in weed biomass since 1996.

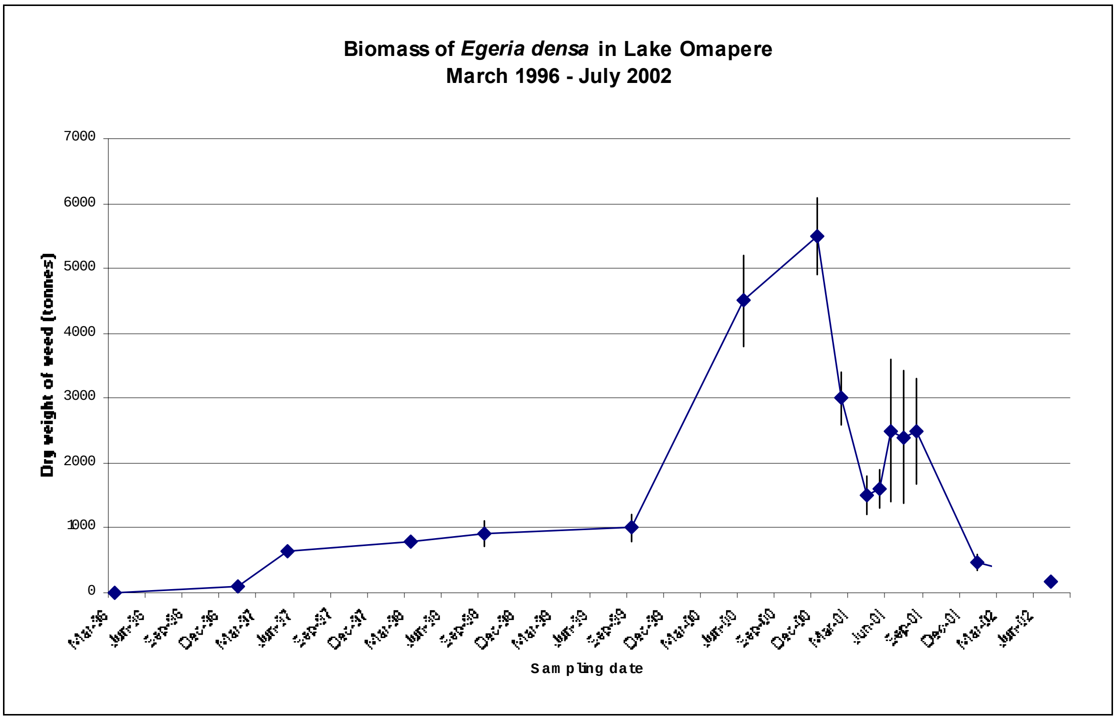


Figure 4.1: Biomass of *Egeria densa* in Lake Omapere 1996-2002

Weed monitoring – Spatial Extent

Weed biomass monitoring gives a very accurate estimate of the amount of weed at a particular point, but does not give a good picture of the distribution of weed in the lake, which may vary.

In November 2001, the Council contracted hydrographic surveyors to map the distribution of the weed throughout the lake using ecosounders and positioning systems. The lake was divided in transects spaced 100 meters apart and measurements of weed height were made. The results of this survey gave a very detailed picture of the distribution of weed and showed patches of low and high density.

In July 2002 we trialed a much smaller survey using a standard boat echo sounder. The following traces (figure 4.2) show the variation in weed density across the lake. The location of the transect lines are presented in figures 4.2 and 4.3.

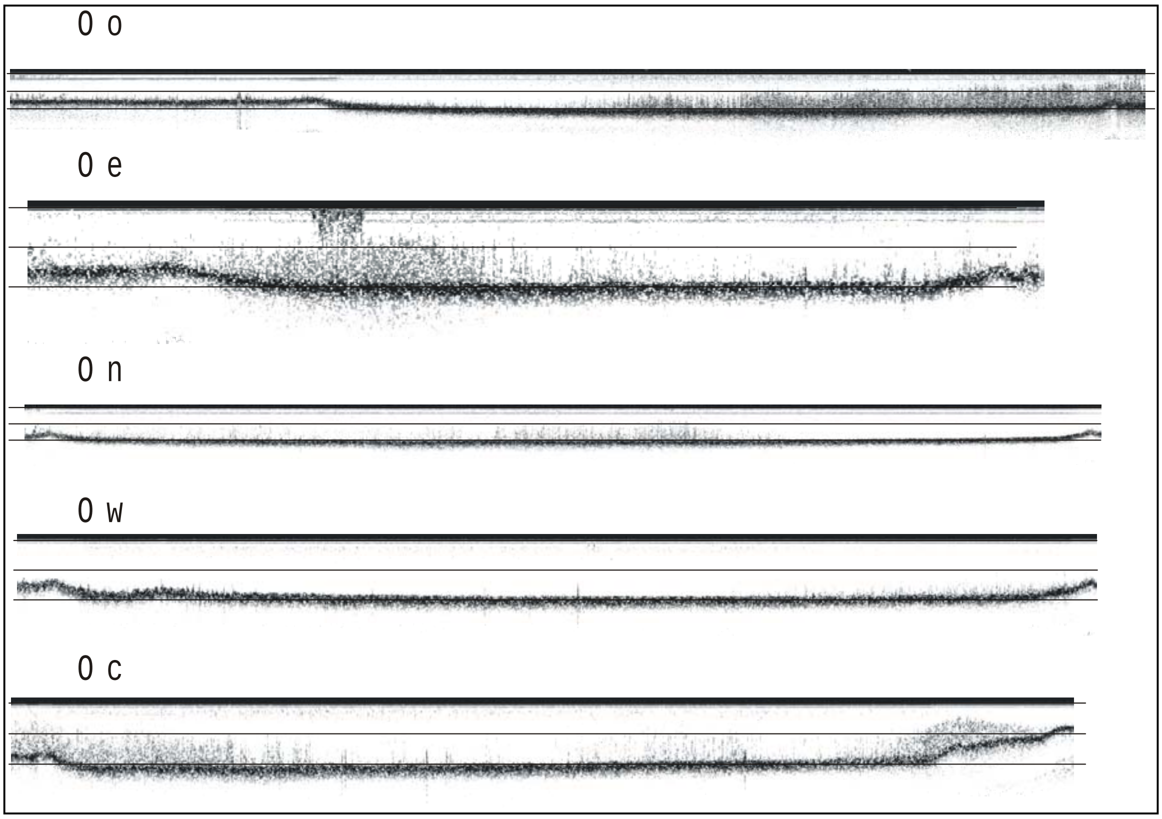


Figure 4.2: Acoustic traces of transect lines in Lake Omapere. For location of transects see Figure 4. Length of each transect were as follows: Oo – 3.68 km (West to East), On – 1.19 km (South to North), Ow – 3.61 km (East to West), Oc – 2.89 km (North to South) and Oe – 2.58 km (South to North). Macrophytes appear as lines above the lake bottom where their density exceeded 5%. Horizontal lines in each transect represent 1 m depth intervals.

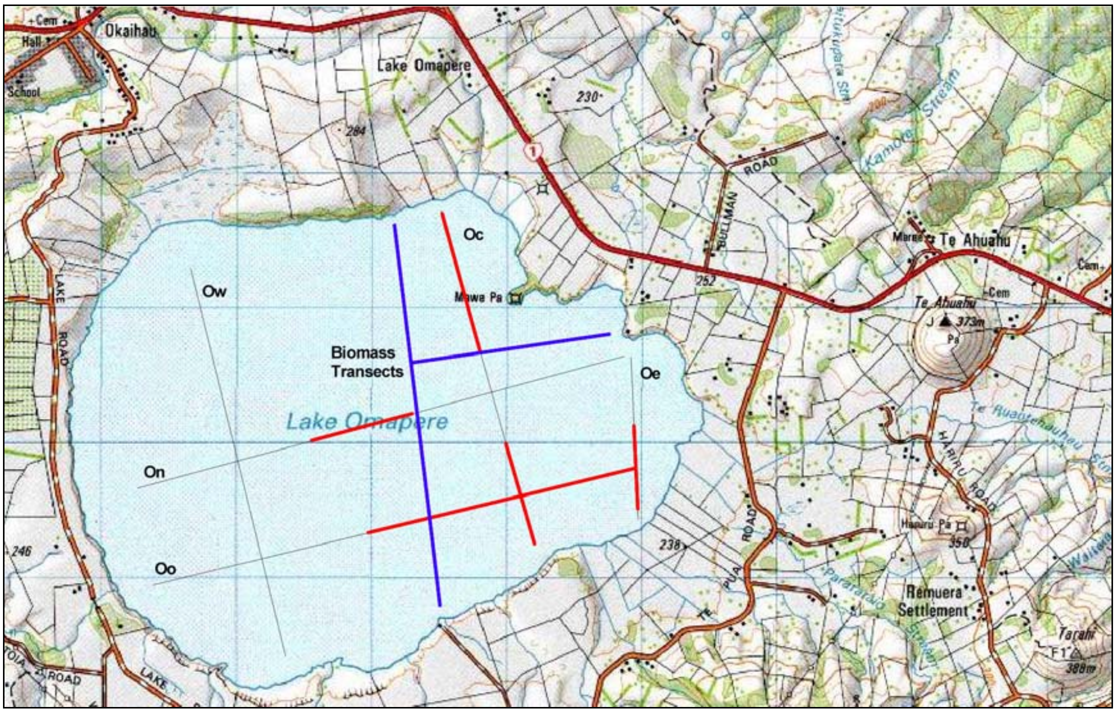


Figure 4.3: Lake Omapere weed biomass transects

Algae

Lake Omapere has supported a dense cyanobacterial algal bloom throughout the summer of 2001/2002, with dominant species changing from *Anabaena circinalis* (up to January 2002) to *Microcystis aeruginea.* These algae can sometimes be toxic, give the water a bright green colour and reduce its visual clarity.

By measuring the amount of the green pigment (chlorophyll a) in water samples, we get an indication of the amount of algae in the water. The graph below shows an increase in spring 2001 that cleared and then increased again over the summer months, but dropped back over winter.

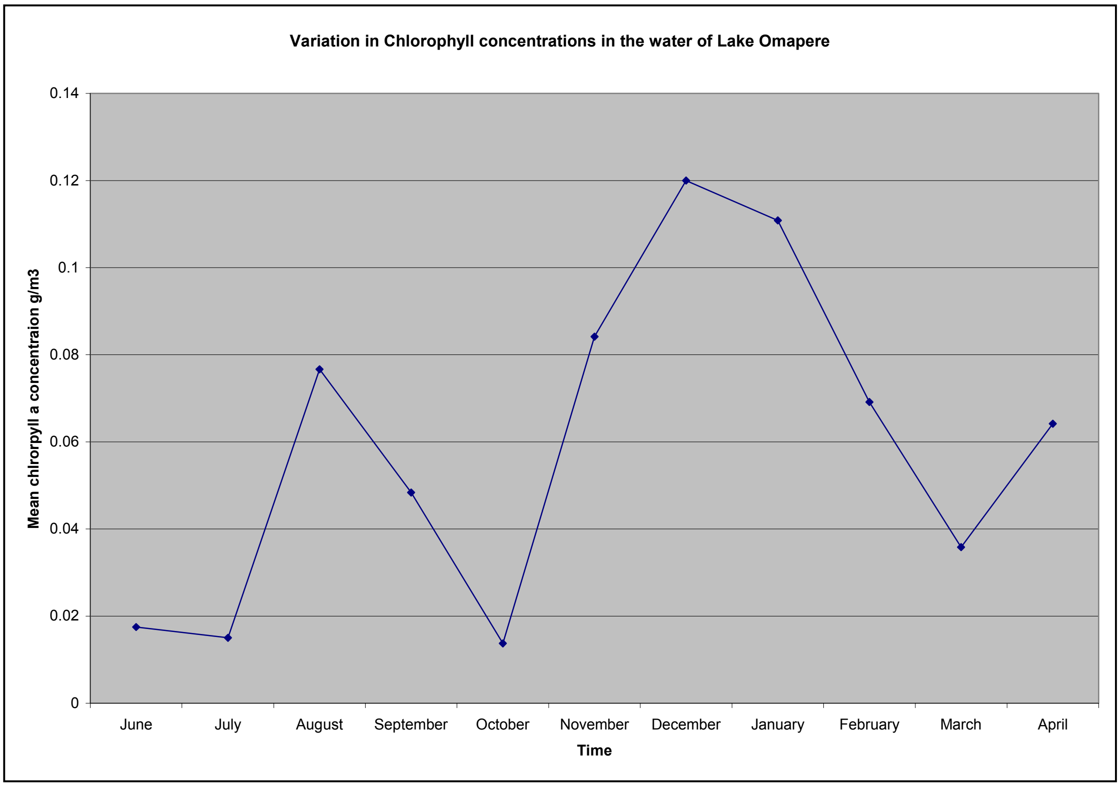
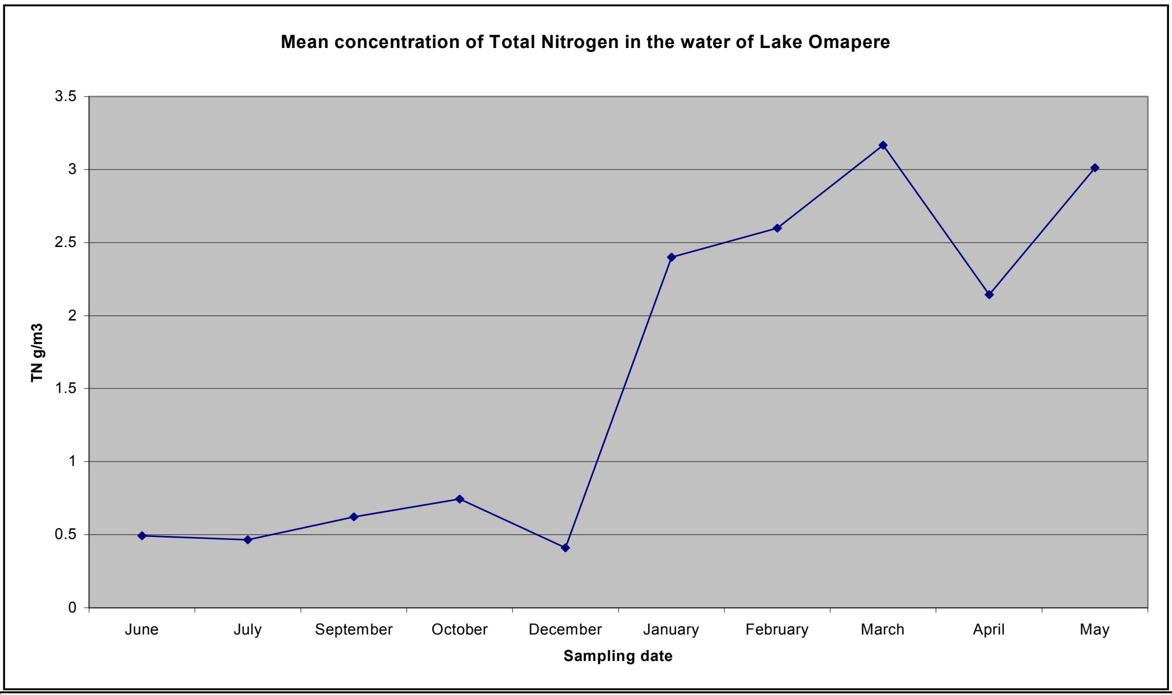


Figure 4.4: Variation in Chlorophyll concentrations in the water of Lake Omapere

Nutrients

Weed and algal growth is encouraged by high concentrations of nutrients, particularly nitrogen and phosphorus. This year concentrations of these nutrients in lake water were monitored. The results show a general increase in both of these nutrients over the last year.



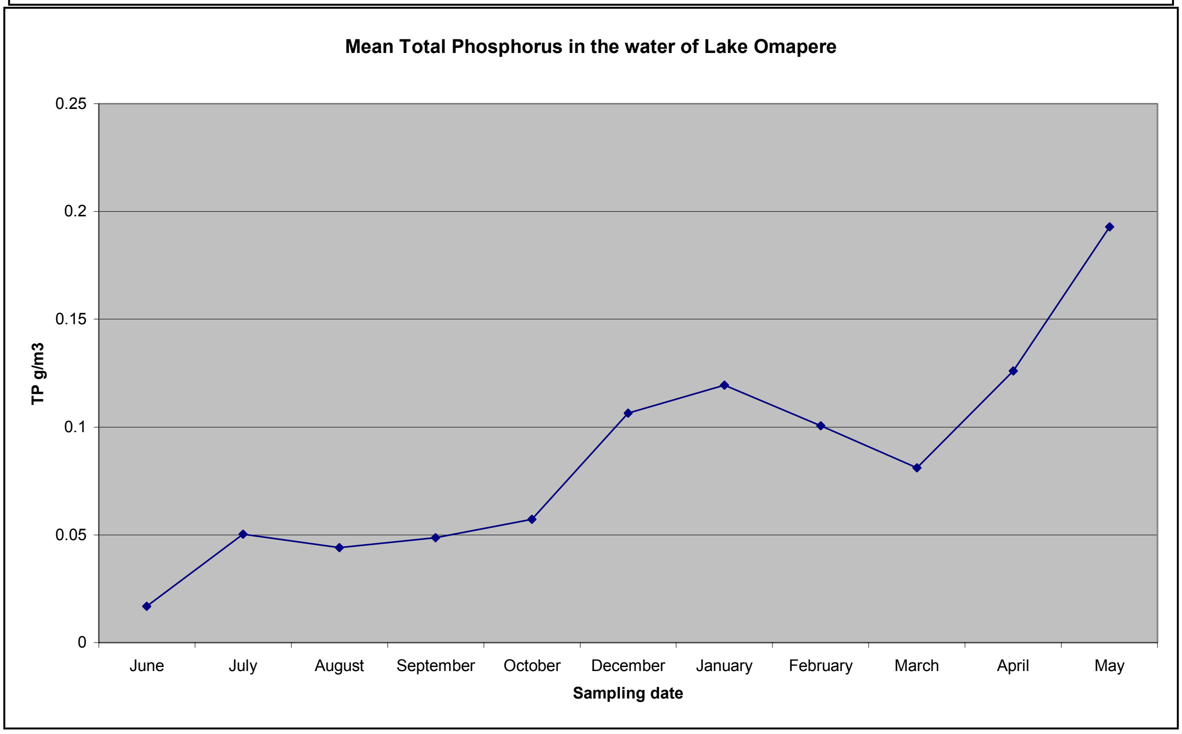


Figure 4.5: Nutrient concentrations in Lake Omapere

Dissolved Oxygen

Organisms living in the lake need sufficient oxygen to breathe. Over the summer of 2000/2001 oxygen concentration at the bottom of the lake became very low (almost zero at times) and as a result many freshwater mussels died. Extra monitoring of dissolved oxygen levels was therefore carried out over the summer of 2001/2002. A datalogger was used to take continuous measurements of dissolved oxygen and temperature. The results show a couple of days where DO dropped below 50% and lower DO at night. It is likely that these low levels were responsible for the small number of shellfish deaths observed at this time.

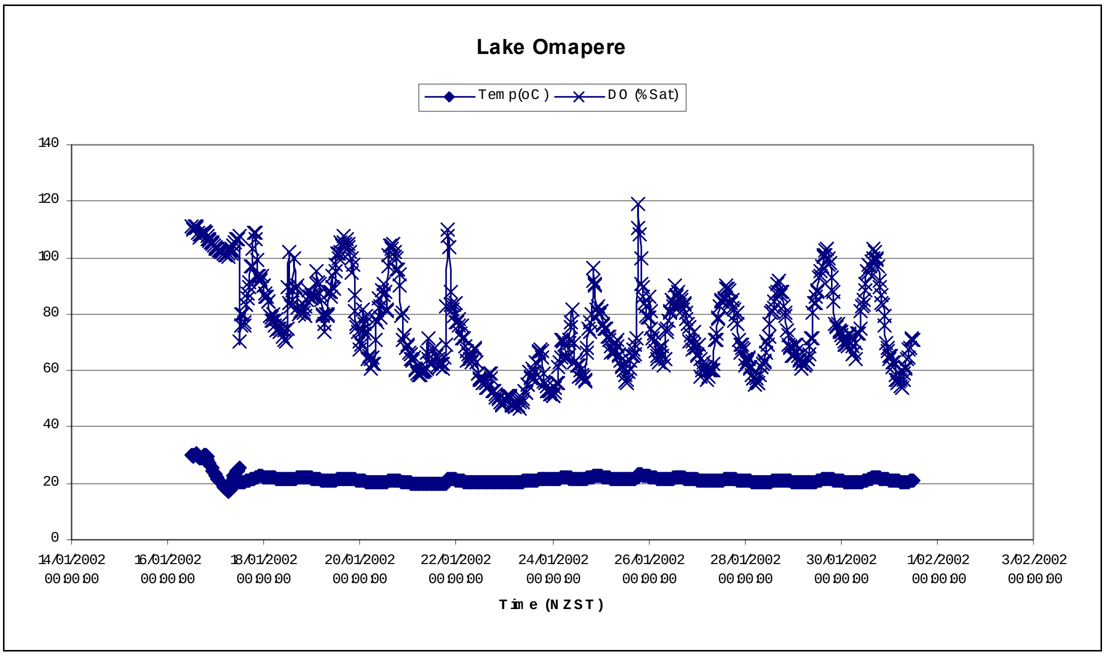


Figure 4.6: Temperature and dissolved oxygen variation in Lake Omapere

Freshwater Mussels

Freshwater mussels are the lakes filters. They remove algae from the water, which helps to keep it clear. Unfortunately, many of Lake Omapere's mussel's died over the summer of 2000/2001 when the dissolved oxygen in the lake became very low.

A survey of freshwater mussel numbers in July 2002 estimated numbers of around 11 mussels m^{-2}. This estimate compares with an April 2001 estimate of 4 mussels m^{-2} and a May 2001 assessment of 13 mussels m^{-2} (Champion & Burns 2001). Variation reflects the clustered distribution of living mussels, with 19 mussels recovered from one cluster of five 0.1 m^{-2} quadrats (and 27 in a similar area sampled in May 2001). It appears that no further mussel mortality events have occurred since February 2001.

Dead freshwater mussels as the result of the 2000/01 low oxygen event

Management Plan

With management of excessive weed growth well underway, the Northland Regional Council is now working with the Lake Omapere trustees to develop a plan for the long term management and utilisation of the lake. This will involve working with the all sectors of the Lake Omapere community other stake holders to define long-term visions and develop plans of actions to achieve the vision.

The next steps:

- **Continue to work with and support the Lake Omapere Trustees in the development of a long term management plan for the lake.**

- **Seek funding and support from other agencies for lake management work**

- **Continue monitoring macrophytes and water quality**

- **Maintain the current grass carp browsing pressure to attempt eradication of egeria**

- **Look at methods of reducing the longevity of the current algal bloom and mitigating against future algal dominated events by:**

    - **carrying out identification and quantification of major nutrient sources influencing lake productivity (including the catchment sources; streams (especially during flood periods), groundwater and overland flow, and also in-lake sources (i.e. bottom sediments, plants and the water column)**
    - **establish a water budget (the volume of water entering the lake from streams, groundwater and rainfall, the volume of water leaving the lake from the outflow and evaporation and the residence time of water within the lake)**
    - **determine the seed bank of turf species from various parts of the lake by sampling sediment cores and carrying out germination experiments under ideal conditions**