

Rotorua Lakes Water Quality Research: A Bibliography

by

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Information from this thesis may be quoted or copied, provided that proper acknowledgement of its source is given.

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ABSTRACT

The Rotorua Lakes have been described as the Jewels in the Crown of the Rotorua District. They play a large role in the economy, environment, culture, recreation and tourism potential of the area. However, since human settlement in the region, the water quality and ecology of the lakes has deteriorated. Introductions of exotic flora and fauna, combined with the impact of a large population in the lake catchments, have increased the problem.

Over the last half century, concern over the water quality of the lakes has grown, and many studies on the subject have been undertaken. This selective annotated bibliography seeks to identify and locate the reports and publications produced from this research, providing a solution to the lack of bibliographic information on the topic. The primary aim of this bibliography is to provide information for researchers on what studies have already been carried out, and to present a chronological view of the perceived problems in the lakes. The bibliography contains four hundred entries, arranged chronologically by author, and indexed by subject, author and organisation. The primary format of the bibliography is digital, as this provides advanced retrieval features and the ability to easily update the study, but it is also supported by a paper-based format for easy reference for those who prefer it.

Keywords:

Eutrophication; Lakeweed; Nutrients; Rotorua Lakes; Water quality.

INTRODUCTION

The lakes in the Rotorua District play an important part in the district's economy, ecology and recreation. They provide household water supplies, a world-famous trout fishery, recreation and a scenic tourist attraction, and are a major part of the infrastructure of the district. As deterioration has been recorded for some of the lakes, it is vital to monitor the condition of the lakes, to know how that condition will impact on the surrounding environment, to prevent the decline of the least affected lakes, and, if possible, to improve the condition of those that have deteriorated.

The Rotorua lakes were formed either from explosion craters or as the result of subsidence associated with volcanic activity. They are comparatively recent, compared to many lakes around the world, which formed as the results of other geological processes. However, for several of these lakes, ageing appears to have accelerated markedly, due, to a large extent, to human interference. Humans have lived near the Rotorua lakes for several hundred years, but it is only over the last century or so that there has been a major population increase near them, causing widespread changes in the lakes and on the surrounding land. Until the beginning of the 20th century most of the lake catchments were forested, but since then large-scale exotic forests have been planted in place of the native bush, large-scale land development has converted much of the catchment into farmland, and there has been increasing urban development in many of the lake catchments.¹

¹ G.E. Mulligan, "Farming Settlement & Development" in *Rotorua 1880-1980* (Rotorua: H.A. Holmes, 1980), 85.

The first troublesome exotic water weeds were introduced to Lake Rotorua in the mid 1950s, and quickly spread to the other lakes. Of the four species, *Lagarosiphon* and *Egeria* rapidly assumed epidemic proportions, creating public nuisances and a public health threat, and at some times preventing boating and swimming in Lakes Rotorua and Rotoiti. Responsibility for the management of the lakeweed was disputed, but once the Department of Lands and Survey had been identified as the organisation responsible for controlling the menace, it developed a weed-spraying system, which is still in operation, although undertaken by a different organisation.² One of the arguments against total eradication, even if possible, was the possibility of an algal bloom in the lakes if the weed was removed.

Since human settlement in the area, sewage pollution has been entering the lakes, and with the development of Rotorua as a city, the amount of sewage increased significantly, along with other sources of nutrients into the lakes, caused in particular by land clearance. By the 1960s several algal blooms had occurred due to the nutrient enrichment, and the ecology and water quality of some of the lakes in the Rotorua district had demonstrably deteriorated or altered. This caused concern among residents.

Studies on the conditions or changes in the lakes had been undertaken sporadically since the 1920s, but increased exponentially after the lakeweed problems in the 1950s and 1960s. Further studies were undertaken upon realisation of the ongoing eutrophication of some of the lakes, the occurrence of algal blooms, and the effects which these could have upon some of the most important assets of the district.

² V.J. Chapman, *A history of the lake-weed infestation of the Rotorua Lakes and the lakes of the Waikato hydro-electric system*. DSIR Information Series 78 (Wellington: Government Printer, 1970), 18.

PURPOSE

This bibliography is intended to locate and identify information and research studies relating to the water quality issues of the Rotorua lakes, facilitating access to earlier research. Although many reports and studies of the Rotorua lakes have been undertaken, there is no comprehensive list of what has been carried out, as several organisations or institutions were involved at different times in various aspects of the management and study of the lakes. Each organisation has produced its own reports, but may not be aware of all the publications produced by other organisations, particularly of organisations that no longer exist. The loss of staff who have been involved with the lakes, either through organisational dissolution or through retirement, means that the institutional memory of what has already been studied and reported on is also lost. This may lead to work being duplicated, either at the time or later. This is particularly likely with unpublished reports, of which there are often not many copies produced. They may be held only in one location, or may even have been destroyed or misplaced once the organisation which produced them was dissolved.

Under these circumstances, an updated bibliography is desirable for the continued study of the Rotorua lakes, and to supply information on what has gone before. As this bibliography is arranged in chronological order, it presents a timeline of the water quality of the lakes, how problems were perceived at different stages, and the research or management carried out at particular times by the various organisations that have been involved. Annotations on each work will aid researchers to identify what is necessary for them to access and what may not be relevant to their area of study.

AUDIENCE

The bibliography is primarily intended to aid researchers and those who manage the lakes, but it is also intended to be available to any interested members of the public or organisations which are not directly involved in the management of the lakes. It is hoped that the bibliography will prove to be of historical as well as scientific value, as it provides a timeline of the progressing condition of the lakes and how they were perceived over the better part of the last century, as well as what was carried out or discussed in order to improve their condition.

SCOPE

The study covers information on water quality and related studies on eleven large lakes (Lakes Okareka, Okataina, Rerewhakaaitu, Rotoehu, Rotoiti, Rotokakahi, Rotoma, Rotomahana, Rotorua, Tarawera and Tikitapu) and five small lakes (Lakes Ngahewa, Ngapouri, Okaro, Rotokawau and Rotowhero) in the area managed by Rotorua District Council. Other lakes of much the same size as the smaller lakes are present in the Rotorua District but are not specifically included in the bibliography as there has apparently been no research carried out upon them. The material covered dates from 1922 to the present day, from early studies on the suitability of the Rotorua Lakes for the introduction of trout to the latest studies on the trophic status targets of the lakes, providing an insight into the differing concerns of the scientific community over time.

The works listed are primarily scientific reports and articles. The large numbers of these restricted the practicable scope of the present study. Apart from these, unpublished or internal organisational reports, as well as theses and conference proceedings, are included but material such as memoranda, letters or public statements are not. Newspaper or magazine articles are not included, as these generally convey personal opinions rather than information, and can sometimes include incorrect or misinterpreted facts. In addition, the number of newspaper articles would be expected to be large, and their inclusion would have considerably extended and altered the focus of the study. Similar reasoning has excluded evidence presented to the Planning Tribunal, the Waitangi Tribunal, the administrators of the Resource Management Act, or any other such body. Minutes or internal publications of voluntary organisations are also excluded, as are works published only on the Internet, as to date only one has been discovered.

As there are many interrelated influences which impact on or react to the water quality of a lake, it has been necessary to restrict the subjects covered in this bibliography, although some which are excluded might be considered to be relevant. Therefore, this bibliography does not include works which concentrate solely upon water levels, geomorphology, rainfall, geothermal activity and its influences, or wildlife ecology, although these subjects may be commented upon if they are included in a report which focuses on the lakes or their impact upon the water quality of the lakes.

Availability is not an intentional limitation on the study, but some publications, particularly the earlier reports, have become unavailable due to time and departmental transitions. In this case they are listed but marked as “Not sighted”, with no other annotations.

This does not necessarily mean that they are totally lost, but only that they were not located during the present study. Further attempts in retrieving them may be successful.

SOURCES CONSULTED

Research on this topic began with the reports held in the library of Environment B.O.P. These reports provided bibliographic references to works held elsewhere, which in turn held further references. Two bibliographies, both dating from the early 1980s, extended the scope of the search. The New Zealand Science database was also searched for relevant material.

Materials held in the following locations were also examined: Analytical & Environmental Consultants (Rotorua); Department of Conservation (Bay of Plenty Conservancy Office); Fish & Game New Zealand, Eastern Region (Ngongotaha Hatchery); National Forestry Library, Forest Research (Rotorua); LakesWater Quality Society Inc. (Rotorua); National Institute of Water and Atmospheric Research Hamilton Library; Rotorua District Council; Rotorua Public Library; University of Auckland Library; and University of Waikato Library. The Victoria University of Wellington Library also provided a large amount of material, including interloans from other libraries.

FORMAT

CITATION STYLE

The citation style chosen for the bibliography is Harvard, as it is a style very often used in the environmental sciences and in the publications cited in the bibliography. The style is derived from *The Chicago Manual of Style*.³ Each entry also includes an annotation and the location of the work viewed.

ARRANGEMENT

The publications are listed chronologically, and alphabetically by author within each year. This arrangement appeared to be the most convenient, rather than arrangement by subject or format, as the topic of water quality includes many disparate subjects, and many of the publications cover more than one of these subjects. The publications are also all of one general type, i.e. scientific reports, whether they are internal organisational reports or journal articles. There is no great difference in their styles, as there would be between newspaper articles and monographs, making an arrangement by format unnecessary.

³ *The Chicago Manual of Style* (Chicago, University of Chicago Press, 1993, 14th edition).

INDICES

The entries are indexed alphabetically by subject, author and originating organisation. The indices refer to item number rather than pagination.

The subject keywords have been drawn and adapted from two sources – the thesaurus used by the Environment B.O.P. library, and that used in the bibliography of the Future Options for the Rotorua Lakes District (FORLD) project, which was produced in 1981, and is referenced in the bibliography. Both of these thesauri were created to deal with material in the same field as this bibliography.

PHYSICAL FORMAT

The primary physical format of the bibliography is digital. Paper copies will also be produced for general reference and distribution, but the digital format permits a wider search capability than any paper index, and is more easily updated as new reports are produced. The bibliography was created using Microsoft Excel and Microsoft Word, as these computer software programmes are familiar to and commonly used by the great majority of probable users. It is intended that both physical and digital formats will be used, according to the preference or needs of the users.

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- Wetzel, R.G. *Limnology*. 2nd ed. Philadelphia: Saunders College Publishing, 1983.

GLOSSARY

The glossary contains a selection of terms used in the bibliography, in order to assist users in the evaluation and selection of material. Terms are arranged alphabetically, and are only included if deemed relevant to the bibliography. Definitions are derived and selected from the glossary of V.H. Jolly & J.M.A. Brown (eds.), *New Zealand Lakes*. Auckland: Auckland University Press, 1975. This work was chosen as it focusses on the topic in discussion, is quoted in the bibliography, and has a national rather than international reference.

Adventive: not native, naturalised.

Aerobic: refers to life or a biological process occurring only in the presence of free oxygen.

Algae: simple plants distinguished from fungi by the presence of the green pigment chlorophyll.

Algae may be single or many-celled, filamentous or diverse in structure, do not develop roots, usually occur in water or wet conditions, and may live in salt or freshwater.

Anaerobic: without free oxygen.

Aufwuchs: an assemblage of organisms attached to underwater surfaces, but above the bottom.

Benthic: the bottom of a body of water; also refers to the organisms living on or in the bottom mud.

Biomass: the total weight of living organisms of one species (species biomass), or a community biomass, per unit area of space.

BOD: biochemical oxygen demand.

Dystrophic: rich in humic material, usually brownish. The term was initially used in referring to lakes which had deteriorated and were low in production.

Epilimnion: the upper stratum of a stratified lake.

Eutrophication: the enrichment of bodies of water by mineral nutrients and organic matter; frequently accompanied by deoxygenation.

Heterotrophic: organisms which cannot synthesize their food like plants and therefore must eat complex foods to obtain energy, e.g. animals.

Hydrosere: a collective term which includes all the stages in a succession beginning in water.

Hypolimnion: the lowest stratum of a stratified lake.

Macrophyte: a large plant, i.e. a multicellular structure.

Mesotrophic: partially enriched, but oxygen never fully depleted; falling between eutrophic and oligotrophic.

Nekton: actively swimming organisms, as opposed to the passive drifting organisms of the plankton.

Oligotrophic: refers to lakes poor in nutrients and with adequate oxygen at all levels.

Overturn: this refers to the mixing of the water in a lake which has been stratified. In New Zealand lakes it occurs in the late autumn or early winter, when the lake temperature is isothermous.

Phytoplankton: planktonic plant life, mainly microscopic algae, which drift passively in the water at any depth though individuals may be capable of movement.

Secchi disc: a white disc (sometimes quartered black and white) 20cm in diameter, used for measuring light penetration in water by lowering to the disappearance level.

Seiche: a periodic oscillation in the level of a lake which tends to develop after high winds or changes in barometric pressure.

Stratification: may refer to thermal or chemical stratification. In thermal stratification temperature differences divide the water into discrete layers. Chemical stratification may also occur in association with thermal stratification, when chemically different strata are isolated by differences in the density of the water.

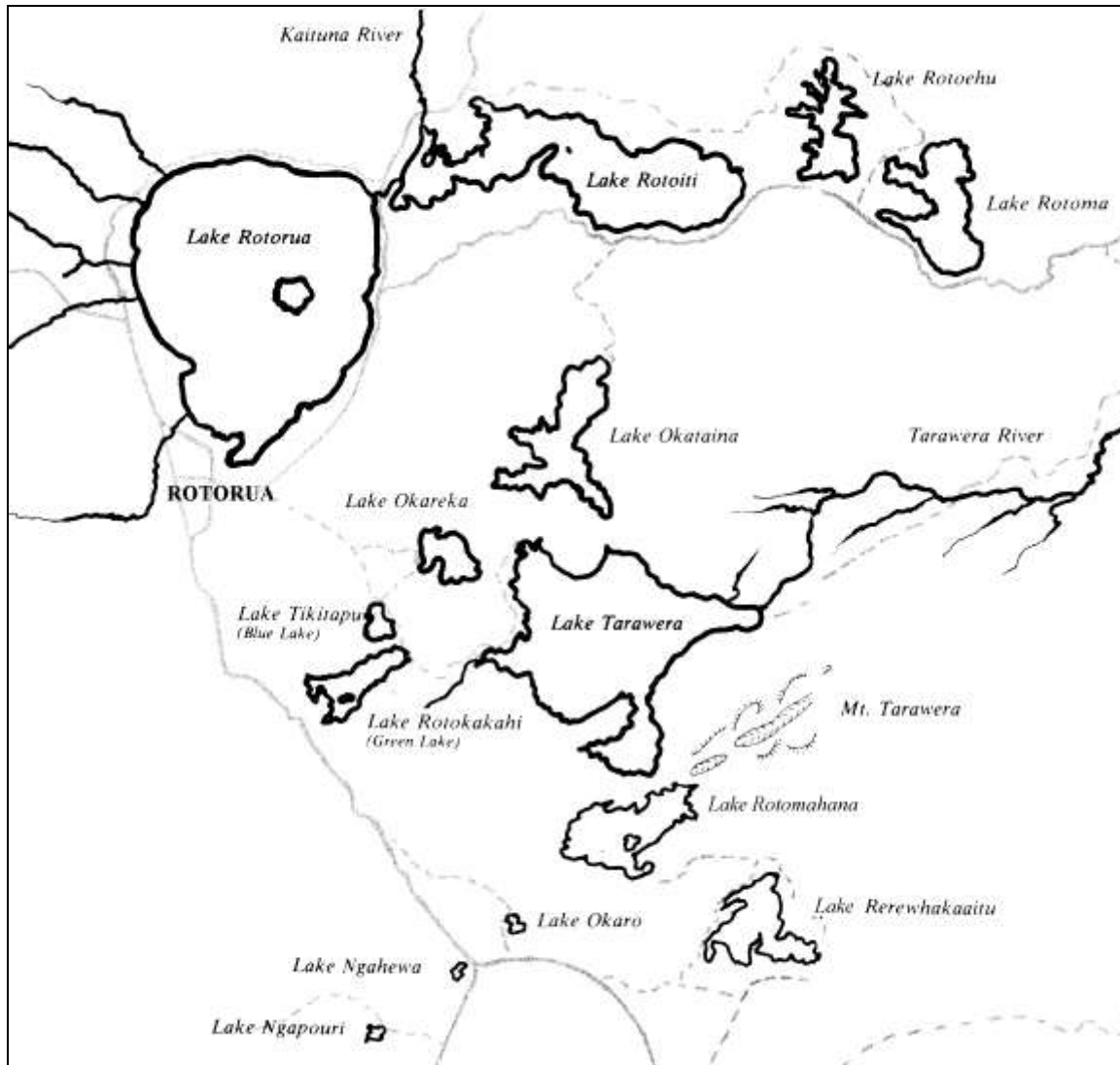
Thermocline: the stratum of water between the epilimnion and the hypolimnion in a stratified body of water. In this stratum the temperature decreases rapidly usually at a rate greater than 1°C per metre of depth.

Trophic: refers to nutrition – (a) productive capacity of a lake, e.g. eutrophic (rich), oligotrophic (poor); (b) the level of organisms from which food is obtained in a community: primary producers – algae; primary consumers – planktonic cladocerans and copepods; secondary consumers – carnivores, e.g. carnivorous fishes.

Zooplankton: the animals in the plankton, which are passively moved by the water, although many are capable of individual movement.

ABBREVIATIONS

AEC – Analytic and Environmental Consultants
AU – University of Auckland General Library
AUEN – University of Auckland Engineering Library
CU – University of Canterbury Central Library
DH – David Hamilton
DOC – Department of Conservation
DSIR – Department of Scientific and Industrial Research
DU – University of Otago Central Library
DUS – University of Otago Science Library
ERFG – Fish & Game New Zealand, Eastern Region
HU – University of Waikato Central Library
HWA – NIWA Hamilton Library
LIPL – Landcare Research New Zealand Ltd. Library
LIU – Lincoln University Library
LWQS – LakesWater Quality Society Inc.
MAF – Ministry of Agriculture and Fisheries
MWD – Ministry of Works and Development
NIWA – National Institute of Water and Atmospheric Research
NWSCO – National Water and Soil Conservation Organisation
PU – Massey University Library
RDC – Rotorua District Council
ROFO – New Zealand Forest Research Institute Ltd. National Forestry Library
WCO – Department of Conservation Information Resource Centre
WKRG – Environment B.O.P. Library
WN – National Library of New Zealand - Wellington
WSU – Land Information New Zealand Knowledge Centre
WU – Victoria University of Wellington, Main Library



Map of the Rotorua Lakes, courtesy of the Rotorua Anglers' Association.

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Not sighted.

2.

NWSCO. (n.d.): Lake Rotorua publications and reports : bibliography: compiled from D.S.I.R.'s computerised Freshwater bibliography. National Water and Soil Conservation Organisation. 14 pp.
Not sighted.

1922

3.

Phillips, W.J.; Grigg, F.J. 1922: The geochemistry of the thermal lakes, North Island, New Zealand, in relation to problems bearing on the acclimatised Salmonidae. *New Zealand Journal of Science & Technology* 5: 156-165.
Correlation of the geochemistry of the thermal lakes of the North Island with the nature and abundance of the trout food-supply is attempted. Samples were taken from various locations in the Rotorua district, and the ecology of the sites was studied.
Location: WU.

1924

4.

Phillips, W.J. 1924: Food supply and deterioration of trout in the Thermal Lakes District, North Island, New Zealand. *Transactions and proceedings of the New Zealand Institute* 55: 381-391.
The stomach contents of trout were examined to determine their preferred food species, which were then correlated to the location from which the trout had come, and to the size of the trout.
Location: WU.

1938

5.

Nash, A. 1938: The Cyanophyceae of the thermal regions of Yellowstone National Park, U.S.A., and of Rotorua and Whakarewarewa, New Zealand; with some ecological data. Ph.D. thesis, University of Minnesota, U.S.A.

The cyanobacteria in the thermal areas of Rotorua and Whakarewarewa are examined and compared with the species in Yellowstone National Park, U.S.A. The ecology of the regions studied is also described.

Location: AU.

1957

6.

Jolly, V.H. 1957: Thermal stratification in some New Zealand lakes. *New Zealand Ecological Society Proceedings* 4: 43-44.

The effects of thermal stratification in lakes are discussed, and the physical characteristics and thermocline data for six lakes, including Lakes Tarawera, Rotorua and Tikitapu, is presented.

Location: WU.

1958

7.

Jolly, V.H. 1958: A preliminary study of some New Zealand lakes. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 13: 436-438.

Seasonal water temperatures and morphometric features are summarised for nine New Zealand lakes, including Lakes Rotoehu, Rotorua, Rotomahana, Tarawera, and Tikitapu.

Location: WU.

1959

8.

Jolly, V.H. 1959: A limnological study of some New Zealand lakes. Ph.D. thesis, University of New Zealand, Dunedin.

A comparative study is made of the physical and chemical conditions and the phytoplankton of several lakes in New Zealand, including several in the Rotorua district. It is based on monitoring on a monthly cycle over a year. The aim of the study, which was not achieved, was to develop a means of assessing biological productivity. However,

the information gathered may provide a basis for further study.

Location: DU.

1960

9.

Hellaby, J.A.B. 1960: Lake Rotorua weed. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial Research.

Not sighted.

10.

Thomasson, K. 1960: Some planktic *Staurastrum* from New Zealand. *Botaniska Notiser* 113: 225-245.

The species of the phytoplankton genus *Staurastrum* inhabiting Lakes Rotorua, Rotoiti, Tarawera and Rotomahana, as well as Taupo and Waikaremoana, are commented upon.

Location: WU.

1961

11.

Annett, H.E. 1961: Control of water weed in Lakes Rotorua, Rotoiti. Unpublished report, Wildlife Service, Department of Internal Affairs.

Not sighted.

1963

12.

Fish, G.R. 1963: Limnological conditions and growth of trout in three lakes near Rotorua. *New Zealand Ecological Society Proceedings* 10: 3-7.

The results and their interpretation of an analysis of the limnology and associated trout growth rates are presented for three lakes (Okataina, Okaro and Ngapouri) in the Rotorua area. The study was carried out in the summer of 1962 and data of temperature, oxygen content, numbers of fish, size of fish and production rates is presented. It was concluded that Lakes Okaro and Ngapouri have higher primary production and lower dissolved oxygen contents than Lake Okataina. The trout density is the same or lower in the former two, however, the Lake Okataina growth rates and ultimate sizes are much larger than for the other two lakes. The observations are correlated to show that eutrophication, resulting from development of farmland in the catchment, has produced an inferior environment for trout in Lakes Okaro and Ngapouri.

Location: WU.

13.

Fish, G.R. 1963: Observations on excessive weed growth in two lakes in New Zealand. *New Zealand Journal of Botany* 1: 410-418.

An experiment was carried out on one-acre plots of *Lagarosiphon* in lakes Rotorua and Rotoiti in the winter of 1961 to test the efficiency of arsenic as a herbicide. The limnological and biological conditions observed before the experiment are described, as well as the results. The arsenic had no significant effect upon the weed or upon the fauna in the weed beds, perhaps because it was administered in winter, or perhaps because of the plants' developed tolerance to arsenic due to relatively high natural arsenic levels. The arsenic in the bottom deposits may become soluble again if the lake further eutrophies to a state where there is a significant loss of oxygen in the bottom waters of the lakes.

Location: ROFO.

14.

Fish, G.R. 1963: Some effects of external conditions upon the water content of rainbow trout in New Zealand lakes. *Ichthyologica* 11: 76-84.

The limnological conditions of five lakes near Rotorua have been studied during 1961-1963 and the state of the resident trout over this period has been determined by estimating the water present in their muscle tissues and comparing it to both their growth rates and the trophic state of the lake.

Location: WU.

1964

15.

Anderson, G. 1964: Weed survey: Lake Rotoiti. Department of Lands and Survey File 22/260/10. 6 pp.

An assessment was carried out of lakeweed populations in Lake Rotoiti, detailing where weed beds were found and to what extent.

Location: WSU.

16.

Anderson, G. 1964: Weed survey, Lake Rotorua. Department of Lands and Survey File 22/260/10. 3 pp.

An assessment was made of lakeweed populations in Lake Rotorua, detailing where weed beds were found and to what extent.

Location: WSU.

17.

Fish, G.R. 1964: Some aspects of the ecology of Rotorua Lakes. Department of Lands and Survey File 22/260/10. 6 pp.

A description is given of the lake ecosystem, concentrating on the lake's fertility and productiveness, and how humans impact upon the lakes. It uses some of the Rotorua lakes as examples of human interference.

Location: WSU.

18.

University of Auckland, Department of University Extension. 1964: Seminar on problems associated with the lakes in the Rotorua District: Wednesday and Thursday 14th and 15th October, 1964, Conference Room, Soundshell, Rotorua. University of Auckland. Auckland.

Not sighted.

1965

19.

Anderson, G. 1965: Pollution within the Rotorua basin and eutrophication of Lake Rotorua. Unpublished report, Wildlife Service, Department of Internal Affairs.

Not sighted.

20.

Bulfin, M.J.A.; Moss, J. 1965: Macrophyte studies in Lake Rotoiti, 1960-64. Unpublished report, Botany Division, Department of Scientific and Industrial Research.

Not sighted.

21.

Cameron, D.D. 1965: Oxygen weed, Rotorua Lakes. Unpublished report, Department of Scientific and Industrial Research. 2 pp.

Not sighted.

22.

Davis, K.R. 1950: Report to Lakeweed Control Society. Unpublished report, Department of Scientific and Industrial Research. Wellington.

Not sighted.

23.

Lands and Survey Department. 1965: Weed in Rotorua Lakes. Unpublished report, Lands and Survey Department. 3 pp.

These notes contain a description of the existing weed situation in the Rotorua lakes, from owners of properties on the lake shores affected, to the trials conducted and the results. Recommendations were to make a reduction in the sewage and fertilizer inputs, continue testing of chemical poisons, and to undertake further research. It was considered that to rid the lakes of weed entirely might cause algal blooms, and create problems for fish and waterbirds.

Location: WSU.

1966

24.

Carr, J.L. 1966: Freshwater phytoplankton and phytonekton from Lake Rotoiti. *Tane* 12: 13-26.

The species and abundance of phytoplankton found in Lake Rotoiti are described, and methods of collection and identification are given.

Location: ROFO.

25.

Chapman, V.J.; Brown, J.M.A. 1966: The lake weed problem in the North Island of New Zealand. *Phykos* 5: 72-82.

A background description is given of the presence of adventive aquatic macrophytes in the lakes of the Rotorua and Waikato areas, and the possible methods of control discussed. The growth habits and responses of *Lagarosiphon* to changes in environment were also outlined.

Location: LIPL.

26.

Dick, I.D. 1966: Lake weed at Rotorua. Unpublished report, Department of Scientific and Industrial Research. 3 pp.

Not sighted.

27.

Fish, G.R. 1966: Some effects of the destruction of aquatic weeds in Lake Rotoiti, New Zealand. *Weed Research* 6: 350-358.

The experimental spraying programme for lakeweed control in Lake Rotoiti and the resulting effects and changes in the physical and chemical conditions of the lake area sprayed compared to a control region are considered. The experiment resulted in the death of the *Lagarosiphon* without a major drop in the dissolved oxygen content of the water although algae did become more wide spread and abundant for a short period of time after spraying. The *Lagarosiphon* was replaced by *Nitella*, although it is thought likely that *Lagarosiphon* will again become the dominant weed in the area.

Location: WKRG.

28.

Prowse, G.A. 1966: Report on the lake weed problem. Unpublished report. 3 pp.
Not sighted.

1967

29.

Cassie, U.V. 1967: Effects of spraying on phytoplankton in Lake Rotorua, 1966. In: Chapman, V.J.; Bell, C.A. (eds.): Rotorua and Waikato water weeds: problems and the search for a solution. Proceedings of the Rotorua Seminar on Water Weeds. University of Auckland. Auckland. pp. 31-40.

A description is given of the effects on phytoplankton of an experiment on *Lagarosiphon* control by diquat spraying in Lake Rotorua, May 1966. It resulted in a decreased population of phytoplankton, and clearer water. The result on each species of phytoplankton found is also described.

Location: WU.

30.

Chapman, V.J. 1967: General report. In: Chapman, V.J.; Bell, C.A. (eds.): Rotorua and Waikato water weeds: problems and the search for a solution. Proceedings of the Rotorua Seminar on Water Weeds. University of Auckland. Auckland. pp. 1-14.

The background to the research being carried out on the weed in the Rotorua and Waikato lakes is outlined, and the results of various experiments in weed control are described. The presentation also touches on the possible methods of weed control.

Location: WU.

31.

Hellaby, J.A.B. 1967: *Lagarosiphon major* infestation, Lake Rotorua. Unpublished report. 7 pp.

Not sighted.

32.

Mackenzie, T.D. 1967: Background to and policy of Interdepartmental Committee for Control of Lake-weed. In: Chapman, V.J.; Bell, C.A. (eds.): Rotorua and Waikato water weeds: problems and the search for a solution. Proceedings of the Rotorua Seminar on Water Weeds. University of Auckland. Auckland. pp. 47-53.

In this presentation Mackenzie describes the occurrences and public complaints which led to the government setting up the Interdepartmental Committee for the Control of

Lakeweed in Wellington, which was comprised of the Department of Agriculture, the Department of Lands and Survey, the Department of Internal Affairs, the Department of Scientific and Industrial Research, the Marine Department, the Department of Health, and the Electricity Department. An Interdepartmental Committee had been set up in Rotorua shortly beforehand, consisting of the Departments of Health, Internal Affairs, Marine and Lands and Survey. Mackenzie also describes the activities and policies of the Committee.

Location: WU.

33.

Matthews, L.J. 1967: Further results of spraying lake weeds. In: Chapman, V.J.; Bell, C.A. (eds.): Rotorua and Waikato water weeds: problems and the search for a solution. Proceedings of the Rotorua Seminar on Water Weeds. University of Auckland. Auckland. pp. 40-47.

This presentation examines the probable consequences of further applications of diquat to the lake weeds in the Rotorua Lakes. It contains tables of water sample analyses from Lake Rotorua and considerations of the desirability of the various species of lakeweed.

Location: WU.

1968

34.

Baumgart, I.L. 1968: Sewage discharge in Lake Rotorua. Unpublished report, Department of Scientific and Industrial Research. 3 pp.

Not sighted.

35.

Brown, J.M.A. 1968: Submerged vegetation of the Rotorua lakes. Unpublished report, Department of Scientific and Industrial Research.

Not sighted.

36.

Fish, G.R. 1968: An examination of the trout population of five lakes near Rotorua, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 2: 333-362.

From 1960 to 1965, Lakes Okaro, Ngahewa, Ngapouri, Rotoehu and Okataina were examined to determine the effect of regular stocking on the size and number of fish present. Fish production has been correlated to the trophic state of the lake, with trout production decreasing with the environment becoming more eutrophic. Similarly, a close inverse relationship between numbers supported and average weight achieved was found. It is concluded that the angling potential of local lakes can be maintained despite the eutrophication resulting from intensive agricultural development of the catchments and the trout will become large if the trout population is kept relatively small.

Location: WU.

37.

Freshwater Fisheries Advisory Council. 1968: Synoptic surveys of Lakes Rotorua and Rotoiti. Unpublished report, Freshwater Fisheries Advisory Council. 3 pp.

Not sighted.

38.

Green, J.D.; Norrie, P.H.; Chapman, M.A. 1968: An internal seiche in Lake Rotoiti. *Tane* 14: 3-11.

This article describes a study of the water temperatures at a fixed point in Lake Rotoiti. The results showed that there was an internal seiche on the thermocline. Tables and equations are included to explain how this might be related to variations in the limnology of the lake as a whole. An explanation of the seiche phenomenon is included.

Location: ROFO.

39.

Irwin, J. 1968: Observations of temperatures in some Rotorua district lakes. *New Zealand Journal of Marine and Freshwater Research* 2: 591-605.

Temperatures and bathymetric surveys were carried out on cross-sections of the lakes of the Rotorua district. The data gathered divides the lakes into two major types, which either have no thermal structure, or are thermally stratified during part of the year. The lakes varied greatly, both in depth and in temperature variations.

Location: WU.

40.

Jolly, V.H. 1968: The comparative limnology of some New Zealand lakes: 1. Physical and chemical. *New Zealand Journal of Marine and Freshwater Research* 2: 214-259.

Twenty-four New Zealand lakes are discussed with respect to morphometry, environmental conditions and some physical and chemical properties. All but nine of the lakes are within the Rotorua region. The lakes as a whole are divided into two groups with Rotoehu and Rotorua lakes being temperative consistent throughout while the remainder were thermally stratified. On a chemical basis, those lakes with a thermal water input show an excessively high ion concentration compared with those with a glacial origin.

Location: WU.

1969

41.

Arthur, H.J. 1969: Aquatic vegetation control on Rotorua, Rotoiti and Waikato hydro lakes. Department of Internal Affairs File 6-5-1.

Not sighted.

42.

Brown, J.M.A. 1969: The arsenic content of some water weeds from the Rotorua and Waikato lakes. *New Zealand Limnological Society Newsletter* 4: 22-23.

A brief summary is given of tests of the arsenic content of dried water weeds from the Rotorua and Waikato lakes.

Location: AU.

43.

Cassie, U.V. 1969: Algal diversity in the North Island Lakes Rotoiti and Rotorua. *New Zealand Limnological Society Newsletter* 4: 14.

The phytoplankton species of Lakes Rotoiti and Rotorua were examined, and 118 species identified.

Location: AU.

44.

Cassie, U.V. 1969: Seasonal variation in phytoplankton from Lake Rotorua and other inland waters, New Zealand, 1966-67. *New Zealand Journal of Marine and Freshwater Research* 3: 98-123.

The results of phytoplankton sampling from varied environments within Lake Rotorua undertaken between 1966-1967 are presented. Species and cell counts have been compared with data from other locations in New Zealand, including Lake Rotoiti. The seasonal variation was more pronounced in the autumn than the spring. Comment is made on the effect of lakeweed control spraying with diquat on the phytoplankton populations.

Location: WU.

45.

Chapman, M.A. 1969: Rotorua and Rotoiti zooplankton. Freshwater Fisheries Advisory Council, Appendix F, 3. Fisheries Research Division, MAF. 3 pp.

Not sighted.

46.

Chapman, V.J. 1969: Report on summer research work, Lake Rotoiti. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial

Research.

Not sighted.

47.

Department of Internal Affairs. 1969: Lake Rotoehu weed area survey. Department of Internal Affairs File 9/1/6.

Not sighted.

48.

Fish, G.R. 1969: Eutrophication in Lake Rotorua. *New Zealand Limnological Society Newsletter* 4: 13.

This abstract discusses causes of eutrophication, including the high concentrations of dissolved plant nutrients supplied by excessive erosion and rapid run-off from surrounding catchment areas, establishes that Lake Rotorua has become eutrophic, and examines phosphate and nitrogen budgets in the lake. It determines that the Hamurana Springs are the largest supply of phosphate, that the town sewage does not supply much nutrient salts, and that drainage from developed land is the most important factor.

Location: WU.

49.

Fish, G.R. 1969: Lakes: the value of recent research to measure eutrophication and to indicate possible causes (in Lake Rotorua, 1967-68). *New Zealand Journal of Hydrology* 8: 77-85.

Research on the water and nutrient budget of Lake Rotorua for the year June 1967-8 showed that although sewage is an important source of eutrophication, run-off from agricultural land use is probably a more important source of nitrate, phosphate and other salts, other than ammonium salts which were mainly supplied by some thermal effluents. The agricultural run-off is greatly increased during flash flooding. The author further states that the conclusion that agricultural development is the most important cause of eutrophication of local lakes is supported by results published by other workers in other parts of New Zealand.

Location: ROFO.

50.

Fish, G.R. 1969: The oxygen content of some New Zealand lakes. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 17: 392-403.

The oxygen content, over a year, of eight lakes in the Rotorua district, as well as four lakes in other parts of New Zealand, is discussed, together with the possibility of using the biological oxygen demand as an indicator to the trophic state of the lakes.

Location: CU.

51.

Fish, G.R.; Chapman, M.A. 1969: Synoptic surveys of Lakes Rotorua and Rotoiti. *New Zealand Journal of Marine and Freshwater Research* 3: 571-584.

Data from the surface and bottom waters of Lake Rotorua and Lake Rotoiti was used to relate physical properties to the limnologies of the lakes as a provisional study for a later long-term study. The results showed that small horizontal differences existed between the northern and southern parts of Lake Rotorua as a result of wind movement and higher inflow of plant nutrients from the south. Lake Rotoiti however, though being vertically stratified, shows no horizontal variations probably due to deep seiches.

Location: WU.

52.

Hopkins, C.L.; Solly, S.R.B.; Ritchie, A.R. 1969: D.D.T. in trout and its possible effect on reproductive potential. *New Zealand Journal of Marine and Freshwater Research* 3: 220-229.

Rainbow trout eggs from Lakes Okataina, Waikaremoana, Rotorua, Taupo and Rerewhakaaitu were reared to determine whether they showed significant differences in survival which could be linked with DDT levels in the tissue. The highest DDT levels were found in fish from Lake Rerewhakaaitu, and the eggs from these fish showed the least viability, while mortality was relatively low among eggs from fish out of the other lakes.

Location: WU.

53.

Solly, S.R.B.; Shanks, V. 1969: Organochlorine insecticides in rainbow trout from three North Island lakes. *New Zealand Journal of Marine and Freshwater Research* 3: 585-590.

Samples were taken from trout from Lakes Rerewhakaaitu, Ngapouri and Okataina. The samples were examined for traces of organochlorine insecticides. The fish from Lake Rerewhakaaitu, with an extensively top-dressed catchment, had the highest level of DDT although trout from Lake Okataina also contained traces of DDT.

Location: WU.

1970

54.

Brown, J.M.A. 1970: Submerged vegetation of the Rotorua lakes. Unpublished report, Botany Department, University of Auckland. 10 pp.

Not sighted.

55.

Burstall, P.J. 1970: Factors affecting the recreational use of Lake Rotorua. *Public Health*

85: 14-16.

Not sighted.

56.

Chapman, V.J. 1970: A history of the lake-weed infestation of the Rotorua lakes and the lakes of the Waikato hydro-electric system. *DSIR Information Series 78*. Department of Scientific and Industrial Research. Wellington. 52 pp.

Information is given about the botanical habit of the four problem lakeweeds, and their history in New Zealand. The problems which the weed creates are also outlined, as well as attitudes and measures taken against the lakeweeds in the Rotorua district and the Waikato hydro-lakes since the 1950s. It is decided that complete eradication of the weeds is not possible, and may not be desirable, but that control might be achieved using Chinese grass carp or mechanical harvesting.

Location: ROFO.

57.

Chapman, V.J. 1970: Lake eutrophication and biological problems. *Explorer 12*: 18-22.

Not sighted.

58.

Coffey, B.T. 1970: A contribution to the autecology and control of *Lagarosiphon major*. MSc. (Hons) thesis, University of Auckland.

This thesis studied the ecology and growth of *Lagarosiphon* in order to have information about the effects and effectiveness of diquat spraying on lakeweed. It examines the different types of communities *Lagarosiphon* grows in, regeneration and productivity, growth habits, nutrient uptake, control by fish, and the limnology of Lake Rotoiti. The study was carried out in Lake Rotoiti as the lake contains elements of native flora, *Elodea canadensis* and *Lagarosiphon*, making it easy to study their interactions.

Location: AU.

59.

Coffey, B.T. 1970: The submerged vegetation of the Rotorua Lakes. *New Zealand Limnological Society Newsletter 6*: 12-15.

An abstract is given of a conference paper, which described methods of classifying submerged phytocommunities and applied these to the communities in the Rotorua lakes. An interesting feature of these communities is the interaction between the native flora, the established *Elodea*, and the more recent *Lagarosiphon*, which is presented as a hydrosere.

Location: AU.

60.

Dromgoole, F.I. 1970: Weed growth and diurnal pH fluctuations in Lake Rotoiti. *New Zealand Limnological Society Newsletter* 6: 15.

This communication comments upon diurnal pH fluctuations in *Lagarosiphon* weedbeds in Lake Rotoiti.

Location: WU.

61.

Fish, G.R. 1970: A limnological study of four lakes near Rotorua. *New Zealand Journal of Marine and Freshwater Research* 4: 165-194.

This article comments upon physical features, chemistry, and seasonal change in water temperature and differences between Lakes Okataina, Rotoehu, Ngapouri and Okaro, correlated with altitude and size. The data collected is compared with that from lakes in other parts of the world. A possible explanation is put forward for the comparatively high heat budget of Lake Okataina.

Location: WU.

62.

Fish, G.R. 1970: Eutrophication. In: New Zealand Water Conference Proceedings: Part 2. New Zealand Water Conference Organising Committee. Lincoln. pp. 34.1-34.4.

The fast rate of eutrophication and algae growth in various waters in New Zealand, including Lake Okaro and Lake Rotorua, is described.

Location: LIU.

63.

Flint, E.A. 1970: Phytoplankton in some New Zealand surface waters. In: New Zealand Water Conference Proceedings: Part 1, background papers. New Zealand Water Conference Organising Committee. Lincoln. pp. 7.1-7.16.

Background information is given on phytoplankton and blue-green algae in New Zealand lakes, with reference to some lakes in the Rotorua district.

Location: LIU.

64.

Freestone, H.J. 1970: Lake Rotorua - abstract. Unpublished report, Ministry of Works and Development.

Not sighted.

65.

Harding, A.F. 1970: Report on lake weed spraying, 1969-70. Unpublished report, Electricity Division, Ministry of Energy, File 34/4/1.

Not sighted.

66.

Mason, R. 1970: Littoral aquatics in Rotorua Lakes. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial Research.

Not sighted.

67.

Mason, R. 1970: Notes on New Zealand aquatic macrophytes and their relation to habitat. Unpublished report, Officials Committee on Eutrophication.

Not sighted.

68.

Spiller, D. 1970: Lake weed control, Lakes Rotoiti and Rotorua. Unpublished report, Department of Lands and Survey. 2 pp.

This report to the Director-General of Lands describes the results of an inspection trip of the Rotorua Lakes in order to determine lakeweed control and proposed management of the lakes in the future.

Location: WSU.

1971

69.

Chapman, V.J.; Brown, J.M.A.; Dromgoole, F.I.; Coffey, B.T. 1971: Submerged vegetation of the Rotorua and Waikato lakes: 1. Lake Rotoiti. *New Zealand Journal of Marine and Freshwater Research* 5: 259-279.

The aquatic vegetation of Lake Rotoiti is described as well as the sequence of dominant plant communities, according to the physical variables of depth, substrate type, exposure to erosion and water temperature. Little is known of the native vegetation which may have occupied the lake before the advent of the introduced weeds or of the effects of diquat weedkiller on the plant communities.

Location: WU.

70.

Chapman, V.J.; Coffey, B.T.; Brown, J.M.A. 1971: Submerged vegetation of the Rotorua and Waikato lakes: 2. 'Cyclic change' in Lake Rotoiti. *New Zealand Journal of Marine and Freshwater Research* 5: 461-482.

The 'cyclic change' among the mounds of low mixed aquatic vegetation in Lake Rotoiti between 1968-1970 is described. Transects and quadrats were set up in the lake to sample the aquatic community to determine community composition, distribution, growth and dependence upon depth.

Location: WU.

71.

Coffey, B.T. 1971: Report on monitoring programme Lake Rotoiti - effect of diquat on macrophytes. Unpublished report, Department of Lands and Survey, File 22/260/10.

Not sighted.

72.

Department of Internal Affairs. 1971: Lake Rotoiti water quality. Department of Internal Affairs File 9/0/4.

Not sighted.

73.

Department of Internal Affairs. 1971: Lake Rotoma water quality. Department of Internal Affairs File 9/0/4.

Not sighted.

74.

Department of Internal Affairs. 1971: Lake Rotomahana water quality. Department of Internal Affairs File 9/1/18.

Not sighted.

75.

Department of Internal Affairs. 1971: Water quality in Lake Rotoehu. Department of Internal Affairs File 9/0/4.

Not sighted.

76.

Fish, G.R. 1971: Nutrient incomes and water quality of Lake Rotorua. *Waters of the Waikato: Seminar Proceedings: 195-201.*

The nutrient income of Lake Rotorua,, including particularly phosphate, is considered in a study from 1967-1970 that sought to find some of the likely causes of the lake's eutrophication, which is also commented upon.

Location: WU.

77.

Fish, G.R.; Andrew, R.D. 1971: A nutrient budget for Lake Rotorua. *Proceedings of the Symposium on natural water quality and waste treatment technology: Massey University Fourth Biotechnology Conference: 15-25.*

The water balance and nutrient income of Lake Rotorua is estimated using data collected from 1967-1970.

Location: WU.

78.

Graham, W. 1971: Diquat spraying, Lake Rotoiti. Some aspects of the monitoring programme. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial Research.

Not sighted.

79.

Ministry of Energy. 1971: Eutrophication in Lake Rotorua. Unpublished report, Electricity Division, Ministry of Energy, File 34/4/1.

Not sighted.

80.

Rotorua Conservation Society. 1971: Proceedings of the seminar 'Top Dressing - Bottom Dredging' held at Rotorua August 14th & 15th, 1971. Rotorua Conservation Society. Rotorua. 34 pp.

The effects of top-dressing farms in lake catchments are considered from several angles, with reference to lakes in the Rotorua district.

Location: DOC.

81.

Spiller, D. 1971: Diquat spray monitoring, Lake Rotoiti. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial Research.

Not sighted.

1972

82.

Atkinson, I.A.E. 1972: Ecological consequences of the rising lake level at Lake Okataina. Unpublished report held by Division of Marine and Freshwater Science, Department of Scientific and Industrial Research.

Not sighted.

83.

Bay of Plenty Catchment Commission. 1972: Lakes Rotorua and Rotoiti: Environmental impact study. Unpublished report, Bay of Plenty Catchment Commission. Whakatane.

The trophic condition of Lakes Rotorua and Rotoiti is examined.

Location: WKRK.

84.

Burstall, P.J. 1972: Trophic status and research being done on Lake Rotorua by the Wildlife Service of the Department of Internal Affairs. Unpublished report, Officials Committee on Eutrophication. 3 pp.

Not sighted.

85.

Department of Internal Affairs. 1972: Lake Rotoiti. Department of Internal Affairs Files 9/0/0, 9/0/4, 9/1/2 (1971-1972).

Not sighted.

86.

Evison, F.F.; Calhaem, I.M. 1972: Report on heat flow investigation in Lake Rotoiti, February-June 1972. Department of Physics, Victoria University of Wellington. 18 pp.

Not sighted.

87.

Fish, G.R. 1972: Lake Rotorua and Rotoiti survey. Unpublished report, Ministry of Agriculture and Fisheries. Wellington.

Not sighted.

88.

Fish, G.R. 1972: Limnological aspects of heat increment from sediments in Lake Rotoiti. Fisheries Research Division draft report. Rotorua.

Not sighted.

89.

Fish, G.R. 1972: Research from the Fisheries Research Laboratory, Rotorua. In: Press forum on eutrophication: held at White Heron Caravelle, Rotorua, 27th September 1972. New Zealand Fertilizer Manufacturer's Association. Napier. pp. 29-33.

This seminar was presented to the Fertilizer Manufacturer's Association, and focused on the effects of fertilizers on the state of the lakes. This presentation summarises Fish's earlier report 'Lake Rotorua and Rotoiti survey' (No.85) and looks at lakeweed, catchment developments, and sources of nutrient inflows into the lakes.

Location: WU.

90.

Gibbs, E.J. 1972: Weed survey - Lake Rotorua. Unpublished report, Ministry of Agriculture and Fisheries. 3 pp.

Not sighted.

91.

McColl, R.H.S. 1972: Chemistry and trophic status of seven New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 6: 399-447.

In 1970-1971 a study was carried out on the chemistry of the epilimnion and hypolimnion of Lakes Okataina, Rotoma, Tikitapu, Okareka, Rotokakahi, Ngapouri and Okaro in order to examine the biology of the lakes. Variables measured and discussed included dissolved oxygen, phosphorus, nitrogen, silica, algal pigments, trace elements and major ions. The results were used to classify the lakes' trophic conditions.

Location: WU.

92.

Officials Committee on Eutrophication. 1972: Eutrophication of Lake Rotorua. Unpublished report, Officials Committee on Eutrophication. 3 pp.

Not sighted.

93.

Thomasson, K. 1972: Some planktic *Staurastrum* from New Zealand. 2. *Svensk Botanisk Tidskrift* 66: 257-274.

The various species of the plankton *Staurastrum* in the Rotorua lakes are examined and commented upon.

Location: WU.

1973

94.

Burnet, A.M.R.; Wallace, D.A. 1973: The relation between primary productivity, nutrients, and the trout environment in some New Zealand lakes. *Fisheries Research Bulletin* 10. Ministry of Agriculture and Fisheries. 28 pp.

This project investigated trace elements in the water of several lakes in New Zealand, including Lakes Rotorua and Rotoiti, in order to discover the effect of eutrophication and low dissolved oxygen levels on trout populations.

Location: WKRK.

95.

Burstall, P.J. 1973: Secchi disc readings, Lake Rotorua. Unpublished report, Department of Internal Affairs. 3 pp.

Not sighted.

96.

Calhaem, I.M. 1973: Heat flow measurements under some lakes in North Island, New

Zealand. Ph.D. thesis, Victoria University of Wellington.

This thesis examines the natural heat flows in several lakes in the North Island, including Lakes Rotoiti, Rotoma and Okataina. The sources of the heat flows were investigated, and theories on the origin of the Taupo Volcanic Zone discussed.

Location: WU.

97.

Carter, D.A. 1973: A preliminary investigation of the location and general ecology of mat plants in the Rotorua Lake District. *Tane* 19: 233-242.

Six lakes (Rotoma, Rotoehu, Tikitapu, Okareka, Tarawera and Rerewhakaaitu) in the Rotorua district were surveyed to determine the extent and location of mounds of mat plants on the lakebed, and to note their species and general ecology. It was found that the mat plants were located on sheltered, gently sloping shores growing on sandy substrate, and grew to a maximum depth of 2m. Maps are included showing the location of the beds of mat plants.

Location: ROFO.

98.

Chapman, J.T. 1973: Lake Rerewhakaaitu. *Auckland Botanical Society Newsletter*: 8.

This article presents base line data of the vegetation present in Lake Rerewhakaaitu for future work and experimentation being undertaken to see if the process of eutrophication can be controlled or even reversed.

Location: LWQS.

99.

Chapman, M.A. 1973: *Calamoecia lucasi* (Copepoda, Calanoida) and other zooplankters in two Rotorua, New Zealand lakes. *Internationale Revue der gesamten Hydrobiologie und Hydrographie* 58: 79-104.

The seasonal cycles of the zooplankton in Lakes Rotorua and Rotoiti are described, with particular emphasis upon the copepod species *Calamoecia lucasi* and its productivity.

Location: WU.

100.

Chapman, M.A.; Green, J.D. 1973: Copepod production in some northern lakes. *New Zealand Limnological Society Newsletter* 9: 23-24.

The annual production by *Calamoecia lucasi* in Lakes Rotorua and Rotoiti was summarised.

Location: AU.

101.

Fish, G.R.; Bryers, G.G. 1973: Water quality report on Ohau Channel and Okawa Bay,

1972 - 1973. Ministry of Works and Development Internal Report 73/1. 9 pp.

A water quality study was undertaken over the course of a year to see whether the proposed diversion of the Ohau Channel into Okawa Bay would have a detrimental effect on the water in Okawa Bay. The study included analyses of temperature, dissolved oxygen, B.O.D., chlorophyll *a*, coliform bacteria, dissolved solids and nutrients in both the Ohau Channel and Okawa Bay, and the results showed that the Ohau Channel was not significantly polluted and would not harm the water quality of Okawa Bay, and might possibly benefit it.

Location: HWA.

102.

Forsyth, D.J. 1973: Distribution of the benthic fauna in some lakes of the Rotorua Region. *New Zealand Limnological Society Newsletter* 9: 14-15.

This short communication describes the results of a benthic faunal sampling programme in Lakes Rotokakahi, Tikitapu, Okareka, Okaro and Ngapouri. It comments on the seasonal distribution and species dominance, as well as indications of the lakes' trophic status based on the species distribution.

Location: WU.

103.

Gibbs, E.J. 1973: Weed survey - Lake Rotorua. Unpublished report, Ministry of Agriculture and Fisheries. 3 pp.

Not sighted.

104.

McColl, R.H.S.; Forsyth, D.J. 1973: The limnology of a thermal lake: Lake Rotowhero, New Zealand: I. General description and water chemistry. *Hydrobiologia* 43: 313-332.

The physical characteristics and water chemistry of Lake Rotowhero are studied and related to the lake's biology. Variables studied include water temperature, clarity, pH, chlorophyll levels, dissolved oxygen and elements present in the water and sediments.

Location: HU.

105.

Officials Committee on Eutrophication. 1973: Eutrophication of Lake Rotorua. Unpublished report, Officials Committee on Eutrophication. 4 pp.

The condition of Lake Rotorua is summarised and recommendations for the further management of the lake and its sewage inputs are given.

Location: ERFG.

106.

Officials Committee on Eutrophication. 1973: Report of the Technical Working Party

(1973) of the Officials Committee on Eutrophication. Unpublished report, Officials Committee on Eutrophication. 12 pp.

The land use of the Lake Rotorua catchment and the sources of nutrient inputs into the lake are outlined, and recommendations for the management of these nutrient sources are put forward.

Location: ERFG.

107.

Stephens, P.R. 1973: Land use capability survey: Lake Rerewhakaaitu catchment. Unpublished report, Water and Soil Division, Ministry of Works and Development. 36 pp.

Not sighted.

108.

Thomasson, K. 1973: *Actinotaenium*, *Cosmarium*, and *Staurodesmus* in the plankton of Rotorua lakes. *Svensk Botanisk Tidskrift* 67: 127-141.

The species of the plankton genera *Actinotaenium*, *Cosmarium* and *Staurodesmus* in the Rotorua lakes are examined.

Location: WU.

109.

Weissberg, B.G.; Zobel, M.G.R. 1973: Geothermal mercury pollution in New Zealand. *Bulletin of Environmental Contamination & Toxicology* 9: 148-155.

The levels of mercury concentrations in the trout and sediment from several of the Rotorua lakes and the Waikato hydro lakes were measured and related to the amounts of geothermal inputs into the lakes, as well as trout size.

Location: PU.

1974

110.

Cassie, U.V. 1974: Algal flora of some North Island, New Zealand, lakes, including Rotorua and Rotoiti. *Pacific Science* 28: 467-504.

The composition of the phytoplankton and other algal communities of Lakes Rotorua and Rotoiti in particular, as well as from some of the Waikato hydro lakes, are described.

Location: WU.

111.

Cassie, U.V. 1974: Phytoplankton in Lakes Rotoiti, Rotoehu, Rotoma, June 1973, May 1974. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial Research.

Not sighted.

112.

Cassie, U.V. 1974: Progress report on phytoplankton in Lakes Rotoiti and Rotoehu. Unpublished report, Division of Marine and Freshwater Science, Department of Scientific and Industrial Research. 5 pp.

Not sighted.

113.

Forsyth, D.J.; McColl, R.H.S. 1974: The limnology of a thermal lake: Lake Rotowhero, New Zealand: II. General biology with emphasis on the benthic fauna of Chironomids. *Hydrobiologia* 44: 91-104.

The biology of Lake Rotowhero, particularly the benthic fauna, is described. The lake has a high water temperature and acidity level. There are no aquatic macrophytes, little microfauna and the macrofauna is composed entirely of insects.

Location: AU.

114.

McColl, R.H.S. 1974: Rotorua Lakes. *Nature Heritage* 3: 1200-1208.

A background description is given of the trophic status and physical characteristics of the lakes in the Rotorua district, and possible management plans for them.

Location: WU.

115.

McColl, R.H.S. 1974: Rotorua Lakes: estimates of trophic condition and resistance to trophic change. Unpublished report, Officials Committee on Eutrophication. 21 pp.

The trophic condition and sensitivity to further nutrient enrichment of the lakes in the Rotorua district other than Lake Rotorua is summarised.

Location: ERFG.

116.

Ministry of Works and Development. 1974: Report made on Rotorua sewage disposal. *Soil and Water* 10 no.3: 7-9.

A summary is made of a report on the feasibility and costs of removing sewage from the Lake Rotorua catchment. The report considered three options: spraying irrigation of sewage onto pasture, nutrient stripping by chemical and mechanical methods, and removal by piping into the Kaituna River and thus to the Bay of Plenty. It was considered that the third option was more effective and economical than the other options.

Location: WU.

117.

Starling, M.B.; Chapman, V.J.; Brown, J.M.A. 1974: A contribution to the biology of *Nitella hookeri* A.Br. in the Rotorua lakes: I. Inorganic nutritional requirements. *Hydrobiologia* 45: 91-113.

The inorganic nutrient requirements of *Nitella hookeri* were investigated in laboratory conditions, and then considered in relation to the known levels of nutrients present in the lakes in the Rotorua district, in order to determine their distribution patterns.

Location: AU.

118.

Starling, M.B.; Chapman, V.J.; Brown, J.M.A. 1974: A contribution to the biology of *Nitella hookeri* A.Br. in the Rotorua lakes: II. Organic nutrients and physical factors. *Hydrobiologia* 45: 157-168.

Laboratory experiments to determine the organic nutrients and physical conditions affecting the growth of *Nitella hookeri* were undertaken, and the results compared with data taken from weed *in situ* in the Rotorua lakes.

Location: AU.

119.

Thomasson, K. 1974: Rotorua phytoplankton reconsidered (North Island of New Zealand). *Internationale Revue der gesamten Hydrobiologie und Hydrographie* 59: 703-727.

The composition and distribution of phytoplankton species in Lakes Okareka, Okataina, Rotoiti, Rotokawau, Rotoma, Rotomahana, Rotorua, Tarawera, Tikitapu and Taupo is described.

Location: WU.

120.

Thomasson, K. 1974: Some planktic *Staurastrum* from New Zealand. 3. *Svensk Botanisk Tidskrift* 68: 33-50.

The various species of the plankton *Staurastrum* in the Rotorua lakes are examined and commented upon.

Location: WU.

121.

White, E. 1974: Lake Rotorua and its problems. Unpublished report, Officials Committee on Eutrophication. 20 pp.

Not sighted.

1975

122.

Bay of Plenty Catchment Commission. 1975: Upper Kaituna Catchment control scheme. Bay of Plenty Catchment Commission. Rotorua.

Details are given of a project intended to manage Lakes Rotorua and Rotoiti and the catchments surrounding them. This scheme was intended to improve the water quality of the lakes, prevent soil and nutrient inputs into the lakes, control the lake levels, and investigate the possibility of diverting Rotorua's sewage effluent into the Kaituna River. The report examines proposals on how to implement these tasks, and comments on their likely effects.

Location: WKRK.

123.

Brown, J.M.A. 1975: Ecology of macrophytes. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 244-262.

The species of aquatic macrophytes growing in the New Zealand lakes, particularly the Rotorua lakes, are examined. The article examines the habitats used by various species, their growth habits, and the communities they associate in. It also looks at the options for controlling aquatic weeds. The chapter summarises information rather than providing detailed data.

Location: WU.

124.

Burnet, A.M.R.; Wallace, D.A. 1975: Eutrophication and the trout environment. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 158-163.

This chapter discusses the effects of lake eutrophication on trout productivity and growth, using Lake Rotorua, among other lakes, as an example. This is intended as a general summary, not as in-depth research.

Location: WU.

125.

Cassie, U.V. 1975: Phytoplankton of Lakes Rotorua and Rotoiti (North Island). In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 193-205.

The phytoplankton species in Lakes Rotorua and Rotoiti are discussed, including their dominance, range of species and distribution.

Location: WU.

126.

Chapman, V.J.; Clayton, J.S. 1975: Submerged vegetation of the Rotorua and Waikato lakes 3: Lake Rerewhakaaitu. *Hydrobiologia* 47: 399-413.

The various species of aquatic macrophytes in Lake Rerewhakaaitu are surveyed by means of transects and described. Rerewhakaaitu is spelt Rerewhakaitu throughout.

Location: AU.

127.

DSIR. 1975: Lake Rotorua, notes on recent research. Unpublished report, Eutrophication Committee, Department of Scientific and Industrial Research.

Not sighted.

128.

Fish, G.R. 1975: A nutrient budget for Lake Rotorua. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 150-157.

A discussion of the sources, concentrations and cycle of the nutrients in Lake Rotorua. Individual types of sources, such as streams, rainfall, urban effluents and springs are considered. This is a broad summary of the information rather than an in-depth examination.

Location: WU.

129.

Fish, G.R. 1975: Lake Rotorua - notes on recent research: the monitoring of limnological changes. Unpublished report, Ministry of Agriculture and Fisheries. 6 pp.

Soluble nitrogen and phosphorus salts, dissolved oxygen and water temperatures were measured in surface and bottom water samples from a limnological station in Lake Rotorua. It is concluded that there is an increasing concentration of nitrogen and phosphorus compounds in the water.

Location: ERFG.

130.

Fish, G.R. 1975: Lake Rotorua - surface water analyses. Unpublished report, Ministry of Agriculture and Fisheries.

Not sighted.

131.

Fish, G.R. 1975: Lakes Rotorua and Rotoiti, North Island, New Zealand: their trophic status and studies for a nutrient budget. *Fisheries Research Bulletin* 8. Fisheries Research Division, Ministry of Agriculture and Fisheries. Wellington. 72 pp.

The results of a survey which monitored the existing conditions of Lakes Rotorua and Rotoiti and the major inflows for Lake Rotorua from 1967-1970 are given. The report

comments upon the lake temperatures and stratification, dissolved oxygen, pH and silicon, phytoplankton, and phosphorus and nitrogen measurements in the lakes. A comparison was also made with the nitrogen and phosphate salts in Lake Okaro. The inflows to Lake Rotorua are also examined with regard to the same determinands. The study shows that the condition of Lake Rotorua is changing, but that Lake Rotoiti is much more stable.

Location: ROFO.

132.

Flint, E.A. 1975: Phytoplankton in some New Zealand lakes. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 163-192.

This chapter discusses the occurrence and growth of phytoplankton species in various New Zealand lakes of differing trophic status, including some of those in the Rotorua district. A list is given of species present in each lake.

Location: WU.

133.

Forsyth, D.J. 1975: The benthic fauna. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 281-291.

The benthic fauna of many New Zealand lakes, including those in the Rotorua district, is evaluated. Information is given about their life cycles, and species distribution in lakes of differing trophic and thermal status.

Location: WU.

134.

Forsyth, D.J.; McColl, R.H.S. 1975: Limnology of Lake Ngahewa, North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 9: 311-332.

The water chemistry, physical characteristics and biology of Lake Ngahewa are described as an example of a dystrophic lake.

Location: WU.

135.

Gibbs, E.J. 1975: Hornwort - Lake Rotorua. Unpublished report, Ministry of Agriculture and Fisheries. 2 pp.

Not sighted.

136.

Green, J.D. 1975: Light penetration. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 84-90.

This article briefly discusses the causes and effects of water transparency in lakes, and gives a list of the water clarity as measured by Secchi disc in the 1950s - 1970s of some

lakes in New Zealand, including most of the lakes in the Rotorua district.

Location: WU.

137.

Hatton, C.; Larcombe, M.F.; Donovan, W.F.; Thomson, M.R. 1975: Ecology of Ohau Channel. Unpublished report, Biosearches Ltd. Auckland. 7 pp.

The physical and biological conditions in the Ohau Channel, between Lakes Rotorua and Rotoiti, are summarised. The report comments on the uses made of the Channel, and what species of flora and fauna can be found there. Both short-term and long-term changes are described. As an appendix it contains "A brief report on conditions existing in parts of Lake Rotorua, the Ohau Channel, and Lake Rotoiti - January 1975". This was undertaken in response to press reports of an extensive algal bloom in Lake Rotorua, and observations were made with regard to water colour, zooplankton, and algae colonies at various locations in Lakes Rotorua and Rotoiti, and in the Ohau Channel.

Location: WKRG.

138.

Jolly, V.H.; Flint, E.A. 1975: Limnological variations between two regions of a New Zealand lake. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 19: 1450-1451.

This abstract summarises the findings of a limnological study of Lake Rerewhakaaitu.

Location: CU.

139.

Jolly, V.H.; Irwin, J. 1975: Thermal conditions. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 90-105.

The causes of lake stratification are outlined, and various lakes in New Zealand, including the Rotorua lakes, are discussed, examining which are stratified or homothermous. Data on water temperature ranges are included.

Location: WU.

140.

Karlgren, L.; Hanson, A. 1975: Report on Lake Rotorua problems. Unpublished report, Ministry of the Environment. 30 pp.

An examination of the eutrophic state of Lake Rotorua discussed the deterioration in trophic status caused by an accelerated nutrient input into the lake from different sources in the surrounding Rotorua basin. Remedial measures already taken are outlined and commented on, and further measures, comments and suggestions are given.

Location: WKRG.

141.

McColl, R.H.S. 1975: Chemical and biological conditions in lakes of the Volcanic Plateau. In: Jolly, V.H.; Brown, J.M.A. (eds.): New Zealand Lakes. Auckland University Press. Auckland. pp. 123-139.

The geological and biological aspects of the chemistry of the Rotorua lakes and other lakes on the Volcanic Plateau are described in general terms. The article looks at neutral chloride, acid-sulphate and acid-sulphate-chloride water types, identifying where each may be found in the district. It also describes the ion chemistry of the lakes, and the types of biota which live in them. A discussion of the presence and concentrations of the minor elements in the lakes is also included.

Location: WU.

142.

MAF. 1975: Research proposal concerning the limnology of Lakes Rotorua and Rotoiti. Unpublished proposal, Ministry of Agriculture and Fisheries.

Not sighted.

143.

Morris, K. 1975: Rotorua's salvation lies in lake weed. Unpublished report. 2 pp.

Not sighted.

144.

Nagels, J.W.; Fish, G.R.; Pyle, B.H.; Keyworth, D. 1975: Water movements in Lake Rotorua. Ministry of Works and Development Internal Report 75/10. 15 pp.

This survey of Lake Rotorua was originally intended to estimate the fluctuations in dissolved oxygen concentrations to show photosynthesis and respiration rates. However, the water movements in the lake obscured any such measurements, instead providing data on the importance of water movements in the lake as an agent controlling water quality in particular locations.

Location: HWA.

145.

Nairn, I.A. 1975: Land use capability assessment of the Kaituna River catchment. *National Water and Soil Conservation Organisation: Land Use Capability Bulletin 2*. Water and Soil Division, Ministry of Works and Development. Wellington. 32 pp.

This assessment of the Kaituna River catchment was completed as part of investigations towards a catchment land use scheme. It concentrates primarily on the soil types and origins of the catchment, but also examines the vegetation and types of land use in the district. The area is also classified as to its land use capability, and maps are included, showing the areas classified.

Location: WN.

146.

Officials Committee on Eutrophication. 1975: An appraisal by the Officials Committee on Eutrophication of the report on Lake Rotorua problems by L. Karlgren and A. Hanson. Unpublished report, Officials Committee on Eutrophication. Wellington. 10 pp.

This appraisal on the report by Karlgren and Hanson (No.140) recommends that the necessary engineering work to divert the treated sewage effluent to the Kaituna River be undertaken as soon as possible. It also emphasises that any other steps taken towards the restoration without first halting all nutrient input from sewage would have little effect. The committee does not agree with the method of implementing the removal of sewage nutrients, and takes issue with the indictment of pastoral and agriculture as the major source of pollution. This appraisal elaborates those areas where differences exist between the consultants and the Eutrophication Committee.

Location: WKRG.

147.

Richmond, C.J. 1975: Trophic status of Rotorua Lakes. Unpublished report, Officials Committee on Eutrophication.

Not sighted.

148.

Richmond, C.J. 1975: Water quality data summaries. Unpublished report. 14 pp.

Not sighted.

149.

White, E. 1975: Bioassay of potential limiting nutrients in Lake Rotorua. Unpublished report. 2 pp.

Not sighted.

150.

White, E. 1975: Toxigenicity of bloom-forming blue-green algae. Unpublished report, Department of Scientific and Industrial Research. 2 pp.

Not sighted.

1976

151.

Baars-Kloos, J.A. 1976: Phytoplankton in Lake Rotorua and Lake Okareka, and its interaction with aquatic macrophytes. MPhil. thesis, University of Waikato.

This thesis details the results of sampling which was carried out regularly over February 1972-December 1973 to attempt to analyse the differences in phytoplankton composition

and abundance, and in water chemistry. Samples were taken from open water sites and from among emergent and submerged aquatic macrophytes. Productivity experiments were also carried out in the lab. Lake Rotorua was found to be more eutrophic than Lake Okareka, and to contain a greater number of phytoplankton. Results show that rooted macrophytes enhance phytoplankton growth by making available nutrients from the bottom sediments which otherwise would have remained bound under aerobic conditions.

Location: HU.

152.

Bowie, I.S.; Gillespie, P.A. 1976: Microbial parameters and trophic status of ten New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 10: 343-354.

Eight lakes in the Rotorua district were assessed for microbial biomass and activity in order to determine the relationship between microbial population and trophic status, using three different techniques.

Location: WU.

153.

Brooks, R.R.; Lewis, J.R.; Reeves, R.D. 1976: Mercury and other heavy metals in trout of the central North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 10: 233-244.

Trout from lakes and rivers in the Rotorua, Waikato and Taupo districts were analysed for the trace elements mercury, cadmium, copper, iron, manganese, and zinc. The results showed that only mercury was likely to be a public health hazard. Recommended "acceptable daily intake" weights from the areas studied are presented.

Location: WU.

154.

Burnet, A.M.R. 1976: Lake Rotorua - measurements of P-max and bioassay of nutrient additions. Unpublished report, Fisheries Research Division, Ministry of Agriculture and Fisheries. Wellington.

Not sighted.

155.

Gillespie, P.A. 1976: Heterotrophic potentials and trophic status of ten New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 10: 91-107.

The possibility of using heterotrophic microbial flora as an indication of the trophic condition of lakes was examined, using data from eight lakes in the Rotorua District and two other lakes. It is concluded from the data collected - glucose, glutamine and bacteria levels - that Lakes Rotowhero, Rotorua and Okaro are eutrophic, Lakes Rotokakahi, Tikitapu and Okareka are mesotrophic and Lakes Rotoma and Okataina are oligotrophic.

Location: WU.

156.

Hall, A.R.; Hayward, M.T. 1976: Lake Okareka catchment control scheme. Unpublished report. 25 pp.

Not sighted.

157.

Hoare, R.A.; O'Donnell, S.R.; Nagels, J.W.; Freestone, H.J. 1976: Nitrogen and phosphorus content of flood waters in the Lake Rotorua catchment. Hamilton Science Centre, Ministry of Works and Development, Internal Report 76/15. 14 pp.

This was undertaken as part of the Lake Rotorua project, in order to understand the nutrient input processes of the lake. This report focuses on the flood waters of the tributaries of Lake Rotorua, and their soluble and insoluble nutrient load. Floods apparently carry a reasonable proportion of nutrients into the lake, although these might not become immediately available to algae.

Location: HWA.

158.

Hughes, H.R. 1976: Research into aquatic weeds in New Zealand waterways: a review. DSIR Information Series 116. Department of Scientific and Industrial Research. Wellington. 34 pp.

The research into the identification, ecology, distribution, physiology and control of aquatic weeds in New Zealand is outlined. The links between distribution of aquatic plants and the trophic status of the lake are also examined. Conclusions are given and recommendations made.

Location: WU.

159.

Lake Rotorua Scientific Coordinating Committee. 1976: Report on Lake Rotorua. Unpublished report, Lake Rotorua Scientific Coordinating Committee. 19 pp.

Not sighted.

160.

Mitchell, K. 1976: Nitrogen and phosphorus content of flood waters in the Lake Rotorua catchment. Unpublished report, Water and Soil Division, Ministry of Works and Development. 17 pp.

Not sighted.

161.

Richmond, C.J. 1976: Use of diquat herbicide in the Rotorua Lakes. Unpublished report, Department of Scientific and Industrial Research. 8 pp.

Not sighted.

162.

Richmond, C.J. 1976: Weed survey: Lake Rotorua. Unpublished report, Department of Scientific and Industrial Research. 3 pp.

Not sighted.

163.

White, E. 1976: Report on the role of Lake Rotorua sediments as nutrient sources and sinks. Unpublished report. 2 pp.

Not sighted.

1977

164.

Brown, J.M.A. 1977: The physiology, ecology and succession of lakeweeds with respect to increasing nutrient in New Zealand lakes. In: Lakeweed - friend or foe? The New Zealand Nature Conservation Council Symposium, Hamilton, 1977. Hamilton. 23 pp.

The response to additions or changes in nutrient concentrations or physical conditions, as well as methods of dispersal from lake to lake, colonisation patterns, growth forms and preferred locations are examined for the invasive *Lagarosiphon*, *Elodea* and *Egeria* species in the Rotorua and Waikato lakes.

Location: WN.

165.

Brown, J.M.A.; Dromgoole, F.I. 1977: The ecophysiology of *Lagarosiphon* in the Rotorua Lakes. In: Proceedings of the Thirtieth New Zealand Weed and Pest Control Conference. New Zealand Weed and Pest Control Society. Wellington. pp. 130-134.

The distribution, colonisation methods and trophic preferences of *Lagarosiphon* in Lakes Rotorua, Rotoiti, Tarawera, Okataina, Rotoma and Tikitapu are described.

Location: WU.

166.

Flint, E.A. 1977: Phytoplankton in seven monomictic lakes near Rotorua, New Zealand. *New Zealand Journal of Botany* 15: 197-208.

The types and abundance of phytoplankton in the Rotorua lakes were studied in order to determine the lakes' trophic levels and to provide a reference for later studies. Each lake was commented upon individually. According to the species and abundance of phytoplankton, Lakes Okaro and Ngapouri can be classified as eutrophic, Lakes Rotokakahi and Okataina as mesotrophic, and Lakes Okareka, Rotoma and Tikitapu as oligotrophic. However, if they are measured by their zooplankton or water chemistry the trophic levels of Lakes Rotokakahi, Okataina and Okareka differ from this. The phytoplankton seen in 1970-1971 are compared with those noted by Jolly (No.9) in 1955-

1956. The article also includes a list of which phytoplankton were present in which lakes.
Location: ROFO.

167.

Harding, A.F. 1977: Some aspects of weed control undertaken by Lands & Survey Department in the Rotorua Lakes. In: Lakeweed - friend or foe. New Zealand Nature Conservation Council Symposium, Hamilton, 1977. Hamilton. 4 pp.

The methods and history of lakeweed control in the Rotorua lakes by the Department of Lands and Survey are summarised.

Location: WN.

168.

Hoare, R.A. 1977: Assessment of the significance of nutrient concentration differences in stream waters from catchments with differing land uses. Hamilton Science Centre, Ministry of Works and Development, Internal Report 77/9. 6 pp.

The nitrate nitrogen concentrations at ten sites on streams draining into Lake Rotorua were measured between November 1975 and March 1976. There were few correlations between land use and water quality in these catchments. It is suggested that analysis of processes as well as correlations is important.

Location: HWA.

169.

John, P.H.; Lock, M.A. 1977: The spacial distribution of groundwater discharge into the littoral zone of a New Zealand lake. *Journal of Hydrology* 33: 391-395.

The spacial distribution of groundwater discharge into the littoral zone of Lake Rotorua was determined by direct measurement, and values for the different locations are given.

Location: WU.

170.

Jolly, V.H.; Chapman, M.A. 1977: The comparative limnology of some New Zealand lakes: 2. Plankton. *New Zealand Journal of Marine and Freshwater Research* 11: 307-340.

Qualitative plankton data from 24 New Zealand lakes is presented, 13 of which are in the volcanic plateau region of the North Island. The data covers phytoplankton, zooplankton, chemical limiting factors for phytoplankton, lake classification and trophic indicators and zoogeography. The lakes are ranked on phytoplankton and then on zooplankton with Lake Rotorua having a very high rating.

Location: WU.

171.

Ling, L.S. 1977: Biological studies on the Ohau Channel and its delta, Rotorua. MSc. thesis, University of Waikato.

A survey was made of benthic fauna from the Ohau Channel and its delta, and samples categorised according to substrate types. Fifty-one species were found in the study area, while the delta was found to be more productive than the Channel itself.

Location: HU.

172.

McColl, R.H.S. 1977: Chemistry of sediments in relation to trophic condition of eight Rotorua lakes. *New Zealand Journal of Marine and Freshwater Research* 11: 509-523.

Chemical parameters were measured in the surface layers of sediment collected from various depths in several lakes in the Rotorua area. The sediments of Lake Rotowhero, which were markedly different from those of the cold water lakes, all had relatively low pH values, high carbon and organic phosphorus concentrations, and a very high total phosphorus concentration, probably as a result of enrichment by hot springs.

Location: WU.

173.

Paerl, H.W. 1977: Ultraphytoplankton biomass and production in some New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 11: 297-305.

It is suggested that ultraphytoplankton occur in many New Zealand lakes including Lakes Rotorua and Tarawera. It is possible that ultraphytoplankton have previously been ignored due to the difficulties of analysis but may use up most of the carbon dioxide present and thus be very important in the primary production occurring in lakes. It seems they are more prominent in an oligotrophic environment.

Location: WU.

174.

Taylor, C.B.; Freestone, H.J.; Nairn, I.A. 1977: Preliminary measurements of tritium, deuterium and oxygen-18 in lakes and groundwater of volcanic Rotorua region, New Zealand. Unpublished report, Department of Scientific and Industrial Research; Environmental Studies Unit, University of Waikato File 5.3.2. 10 pp.

Not sighted.

175.

White, E. 1977: Eutrophication of Lake Rotorua - a review. *DSIR Information Series* 123. Department of Scientific and Industrial Research. Wellington. 16 pp.

This review covers the history of the problems of lakewater quality, algae and weed growth in Lake Rotorua and actions taken, and the effects of the different types of land use on the lake. It recommends methods of restoration and indicates areas for future research. The review is intended to provide an overall picture of the eutrophication of Lake Rotorua.

Location: WKRG.

1978

176.

Cassie, U.V. 1978: Seasonal changes in phytoplankton in four North Island lakes, 1973-74. *New Zealand Journal of Marine and Freshwater Research* 12: 153-166.

The phytoplankton species from Lakes Rotoiti, Rotoehu, Rotoma and Waikaremoana were studied for distribution and abundance. A cyanobacterial bloom was commented upon. It is concluded that the dominant phytoplankton of Lakes Rotoiti, Rotoma and Waikaremoana appear to have shown little change in the past eighteen years, but in Lake Rotoehu they have responded to eutrophicating conditions.

Location: WU.

177.

Clayton, J.S. 1978: The submerged vegetation of Lake Rotoma. Ph.D. thesis, University of Auckland.

A study was carried out on the early development of the transformation of Lake Rotoma from an oligotrophic lake with native flora to an exotic-dominated community, and on the native hydrophytes in residence. The study describes the vegetation of quadrats in the lake which were examined over 1972-1973, and from these extrapolates the lake community. It also discusses the effects of lake levels and causes of erosion and sedimentation in the lake. Methods and results are also discussed.

Location: AU.

178.

Donovan, W.F.; Don, G.L.; Cross, C.R. 1978: The water quality and ecology of sections of the Puarenga Stream and Sulphur Bay, Lake Rotorua - winter 1978. Bioresearches Ltd. Auckland. 68 pp.

A study was carried out as a follow-on to the summer survey and report by Bioresearches (No.179), gathering information on winter conditions. The survey was carried out in early September 1978. It is much the same format as the other, with the addition of a control area, and the changing of some of the analyses.

Location: WKRG.

179.

Donovan, W.F.; Don, G.L.; Cross, C.R.; Thomson, M.R. 1978: A report on the water quality and ecology of sections of the Puarenga Stream and Sulphur Bay, Lake Rotorua. Bioresearches Ltd. Auckland. 62 pp.

Details are given of a study which examined the Puarenga Stream-Sulphur Bay area of Lake Rotorua in February-March 1978, during periods of low summer flows. It reports the condition of the water and sediment, without drawing any conclusions from the measurements. There is an error in the reported chloride results - some need to be multiplied by $\times 10^{-1}$, while others have been corrected. The study describes the ecology as

well as the chemistry and biology of the area.

Location: WKRG.

180.

Fish, G.R. 1978: Lake Rerewhakaaitu - an apparently phosphate-free lake. *New Zealand Journal of Marine and Freshwater Research* 12: 257-263.

Limnological data for Lake Rerewhakaaitu is presented and interpreted. The data includes phosphorus, nitrogen, chlorophyll, water clarity and flora analysis and these results are compared to those of Lake Rotorua. Results show that although very similar to Rotorua, Rerewhakaaitu has no detectable dissolved phosphate and a lower productivity. It is concluded that probably this lake can not support many plants or plankton and therefore is unlikely to become eutrophic even if the catchment is fully developed.

Location: WU.

181.

Forsyth, D.J. 1978: Benthic macroinvertebrates in seven New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 12: 41-49.

The benthic macroinvertebrate fauna populations of Lakes Okataina, Rotoma, Tikitapu, Okareka, Rotokakahi, Ngapouri and Okaro are examined. Worms, chironomids and molluscs together comprise at least 99% of all the fauna in the lakes. It was concluded that benthic invertebrates are poor indicators of trophic status although crops are higher in eutrophic than oligo-mesotrophic lakes.

Location: WU.

182.

Freestone, H.J. 1978: Lake Rerewhakaaitu hydrology. Hamilton Science Centre, Ministry of Works and Development, Internal Report 78/95. 11 pp.

The hydrology of Lake Rerewhakaaitu was studied, and a summary made, including inflows, lake depth, rainfall, sediment, outflows, and catchment ratios. It concludes that the lake is very sensitive to pressure from its land catchment.

Location: HWA.

183.

Grinstead, M.J.; Wilson, A.T. 1978: Nitrate concentrations in the groundwater around Lake Rotorua. *New Zealand Journal of Marine and Freshwater Research* 12: 463-466.

An analysis of groundwater around Lake Rotorua is presented, focussing on the nitrate concentrations. It was found that nitrate concentrations were higher under native bush than exotic forests. It is concluded that the levels of nitrate in the groundwater around Lake Rotorua are generally not high enough to be a health hazard, but are high enough to possibly affect the nutrient budget of the lake.

Location: WU.

184.

Hoare, R.A. 1978: A nutrient budget for Lake Rotorua. Hamilton Science Centre, Ministry of Works and Development, Internal Report 78/91. 15 pp.

This report is one of a series describing measurements made on Lake Rotorua and its tributaries since 1975. It includes the results of extensive measurements of flood flows, and measurements of sewage, which has been changing its flow rate and composition as a result of changes to the city's reticulation system and treatment plant since 1973.

Location: HWA.

185.

Hoare, R.A. 1978: Nutrients in flood flows of the Lake Rotorua catchment. Hamilton Science Centre, Ministry of Works and Development, Internal Report 78/87. 28 pp.

Measurements were made of nutrient concentrations in flood waters of streams entering Lake Rotorua between 1976-1977. The report shows that nitrate and dissolved reactive phosphorus concentrations hardly vary at all from base flow levels, ammonia concentrations increase with flow rate but are still very small, and total phosphorus concentrations correlate with flow rates. The Waiohewa Stream does not correspond with the other streams measured, and should always be studied independently.

Location: HWA.

186.

Hoare, R.A. 1978: Particulate matter in the tributaries of Lake Rotorua. In: Proceedings of the conference on erosion assessment and control in New Zealand. New Zealand Association of Soil Conservators. Christchurch. pp. 244-251.

Measurements designed to assess the nutrient input to Lake Rotorua from the main tributaries of the lake can be used to estimate both the impact of erosion processes on the water quality of the lake and the amount of erosion occurring in some of the lake catchments. The phosphorus concentrations in these tributaries are also examined.

Location: WU.

187.

Nagels, J.W.; Hoare, R.A. 1978: Interlaboratory analysis of Lake Rotorua inflows 12-13/1/76. Hamilton Science Centre, Ministry of Works and Development, Internal Report 78/35. 17 pp.

Three laboratories conducted a study for nitrogen and phosphorus in Lake Rotorua and its catchment. Each laboratory used its own analysing method on identical samples, and any differences in interpretation or results were discussed. However, most results were fairly close to each other.

Location: HWA.

188.

Raymond, R.K. 1978: An in-shore sediment study carried out on Lake Rotorua. Hamilton

Science Centre, Ministry of Works and Development, Internal Report 78/51. 11 pp.

A study was carried out to determine the percentage of organic material in the layer 0-15mm of the lake bed of Lake Rotorua from a series of sediment samples. A high level of sediment was found at Sulphur Bay, probably accumulated from the outflow of the Puarenga Stream. Otherwise the percentage of organic material in the upper layer of the lake bed was lower than expected. Another analysis after a flood is recommended.

Location: HWA.

189.

Richmond, C.J. 1978: Zooplankton in conservancy lakes: distribution of Cladocera and Copepoda. Environmental Studies Unit, University of Waikato, File 5.3.3. 2 pp.

Not sighted.

190.

Rutherford, J.C. 1978: Lake Rotorua water quality: synopsis of research conducted to date and an outline of proposed mathematical analysis. Hamilton Science Centre, Ministry of Works and Development, Internal Report 78/90. 18 pp.

The history of the Lake Rotorua water quality problems is outlined, and a review and list of the research which has been done on the lake is included.

Location: HWA.

191.

Rutherford, J.C. 1978: Prediction of nitrogen and phosphorus concentration in Lake Rotorua. Hamilton Science Centre, Ministry of Works and Development, Internal Report 78/84. 26 pp.

A mass balance model for predicting annual average total nitrogen and total phosphorus is described and is compared with the nutrient loading plot theory. The model is then used to predict nutrient concentrations in Lake Rotorua under different management strategies, using nutrient measurements by Fish and Hoare. It is predicted that sewage diversion from Lake Rotorua, combined with soil conservation measures would improve the trophic level of the lake to near-mesotrophic.

Location: HWA.

192.

White, E.; Don, B.J.; Downes, M.T.; Kemp, L.J.; Mackenzie, A.L.; Payne, G.W. 1978: Sediments of Lake Rotorua as sources and sinks for plant nutrients. *New Zealand Journal of Marine and Freshwater Research* 12: 121-130.

Nutrient exchanges between the sediments of Lake Rotorua and the lake water were quantified using a mass balance approach.

Location: WU.

193.

White, E.; Payne, G.W. 1978: Chlorophyll production, in response to nutrient additions, by the algae in Lake Rotorua water. *New Zealand Journal of Marine and Freshwater Research* 12: 131-138.

The results of experimentation on chlorophyll production from algae cultures from Lake Rotorua water are given. The cultures used were treated with phosphorus, nitrogen and trace element solutions. It is suggested that the larger chlorophyll responses to the nitrogen show a persistent shortage of nitrogen in the Lake Rotorua environment.

Location: WU.

1979

194.

Bioresearches Ltd. 1979: The water quality and biology of sections of the Puarenga Stream and Sulphur Bay, Lake Rotorua - findings and conclusions. Bioresearches Ltd. Auckland. 47 pp.

The findings of the two earlier reports carried out by Bioresearches (Nos.178, 179) are discussed, and conclusions drawn from them with respect to the natural water quality, particularly concentrating upon the effect of the waste treatment works which discharges into the Puarenga Stream. The report goes into detail about the circumstances and landforms surrounding the Puarenga Stream-Sulphur Bay area, as well as the Hamurana Springs, which were used as a control area in the second survey.

Location: WKRG.

195.

DSIR. 1979: Current reference file of DSIR Science Information Division: New Zealand freshwaters. Science Information Division, Department of Scientific and Industrial Research.

This computer printout is a list of references retrieved from the bibliography of "New Zealand Freshwaters" from the Science Information Division, DSIR. The references cover material from all sources, not only DSIR. It covers all the main lakes in the district as well as two smaller ones and some other land-based locations.

Location: DH.

196.

Fish, G.R. 1979: Recent stratigraphy of sediments in Lake Rotorua. *New Zealand Journal of Marine and Freshwater Research* 13: 529-532.

The sediments and sedimentation rates from cores extracted from Lake Rotorua are examined. Generally the sediment is planktonic in origin with diatoms dominant, sediment from the 1886 Tarawera eruption decreases in a north-westerly direction, and water depth controls the amount of sediment accumulating. Little or no change in the rate of sedimentation over the last 92 years has occurred.

Location: WU.

197.

Matthews, R.J. 1979: Chemical analysis of Lake Rotorua sediments. MSc. thesis, University of Waikato.

An X-ray fluorescence analysis technique was used to determine element concentrations in sediments from Lake Rotorua in this study. Preliminary studies on the water content and loss on ignition of sediment samples were also carried out. An approximate sedimentation rate was determined. Estimates of the phosphorus amounts lost to the lake water and remaining in the sediment are made.

Location: HU.

198.

Williamson, R.B.; Cooke, J.G. 1979: Water quality survey of the Waiohewa Stream, Rotorua, summer 1978-79. Hamilton Science Centre, Ministry of Works and Development, Internal Report 79/29. 27 pp.

Two longitudinal surveys of the Waiohewa Stream were made. The report assesses the current impact of the discharge from the Tikitere geothermal field on water quality and discusses the transformation of the nitrogen in the lower Waiohewa.

Location: HWA.

1980

199.

Biggs, B.J. 1980: Lake Rotorua: the state of eutrophication. *Soil and Water* 16 no.3: 9-13.

The history of lakeweed and eutrophication in Lake Rotorua and the recent research about eutrophication in the lake is summarised. The implications of the research on how the lake could be managed in the future are also examined.

Location: ROFO.

200.

Burnet, A.M.R.; Davis, J.M. 1980: Primary production in Lakes Rotorua, Rerewhakaaitu and Rotoiti, North Island, New Zealand, 1973-78. *New Zealand Journal of Marine and Freshwater Research* 14: 229-236.

The primary production in Lakes Rotorua, Rerewhakaaitu and Rotoiti was measured in order to help determine the condition of the lakes, and predict the effect upon the fisheries. The results were combined with chlorophyll *a*, extinction coefficient, and insolation data. Each lake had different seasonal patterns.

Location: WU.

201.

Cooke, J.G.; Williamson, R.B. 1980: Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/57. 26 pp.

An investigation was made on the possible effects of the hydrologic regime on apparent nitrification rates in the Waiohewa Stream. It is suggested that sulphur oxidation may be as important as nitrification in any study of the oxygen dynamics of the stream.

Location: HWA.

202.

Cooper, A.B. 1980: Nitrification in the Waiohewa Stream, Rotorua: a microbiologists viewpoint. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/30. 51 pp.

A summary is presented of an investigation into nitrification in the Waiohewa Stream.

Location: HWA.

203.

Fish, G.R.; Andrew, I.A. 1980: Nitrogen and phosphorus in the sediments of Lake Rotorua. *New Zealand Journal of Marine and Freshwater Research* 14: 121-128.

Sediment cores were retrieved from Lake Rotorua during 1976-1979 to examine the nitrogen and phosphorus concentrations of the sediment. The results were compared with sediment samples from Lake Rotoiti. No significant proportion of the nitrogen and phosphorus appears to be lost to the lake water during stratification.

Location: WU.

204.

Hoare, R.A. 1980: Inflows to Lake Rotorua. *Journal of Hydrology (N.Z.)* 19: 49-59.

A study was carried out on the tributaries of Lake Rotorua in order to determine their average flows and percentage of input into the lake. It was discovered that nine streams carry the majority of the total input into the lake, while rainfall makes up most of the balance. Flood flows are relatively unimportant to the water balance of the lake.

Location: WU.

205.

Hoare, R.A. 1980: Nitrogen and phosphorus in the base flow of the major tributaries of Lake Rotorua. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/5. 23 pp.

The concentrations of phosphorus and nitrogen species in samples of the base flows of tributaries of Lake Rotorua are discussed, and it is determined that correlations with flow rates are a consequence of seasonal variations of concentration as well as flow, instead of being caused by the flow variations. The twenty-five tributaries were monitored intensively from November 1975 to March 1977, and monitoring of some of the tributaries was continued until 1979. Nutrients transported in flood flows were described

in a separate report (No.185).

Location: WKRG.

206.

Hoare, R.A. 1980: Nutrients in flood flows of the Lake Rotorua catchment. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/4. 28 pp.

This report appears to be a reprinting of the Ministry of Works and Development Internal Report 78/87 (No.185).

Location: HWA.

207.

Hoare, R.A. 1980: Phosphorus load on Lake Rotorua. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/19. 23 pp.

Measurements of phosphorus concentration in both flood and base flow samples of the streams in the catchment of Lake Rotorua are combined with flow data to estimate the total phosphorus loads. The methods used enable accurate estimates both of flood particulate loads and dissolved base flow loads, which are equally important in this situation, and are thoroughly described.

Location: HWA.

208.

Hoare, R.A. 1980: The sensitivity of Lake Rotorua, New Zealand, to additions of phosphorus and nitrogen. In: Proceedings of 10th Conference, International Association on Water Pollution Research. Toronto.

Not sighted.

209.

Hoare, R.A. 1980: The sensitivity to phosphorus and nitrogen loads, of Lake Rotorua, New Zealand. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/59. 11 pp.

The loads and outflows of phosphorus and nitrogen in Lake Rotorua between 1976-1977 are reported. Much of the nitrogen load appears to be lost to the atmosphere. Estimates are made of the effect that changes in sewage load will have on the annual mean phosphorus and chlorophyll concentration in the lake.

Location: HWA.

210.

Rutherford, J.C. 1980: Trends in Lake Rotorua water quality. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/33. 15 pp.

Water quality measurements in Lake Rotorua between 1967 and 1980 are examined for trend and variability. The data exhibit strong seasonality and also low frequency "cycles"

with a period of between three and five years which appear to correlate with "cycles" in the weather. No consistent trend in water quality is apparent over the whole period. Because of the "cycles" a misleading impression of trend could be obtained by examining data from a two or three year period.

Location: HWA.

211.

White, E.; Payne, G.W. 1980: Relative importance of microflora and allophanic clays to the phosphorus dynamics of Lake Rerewhakaaitu. *New Zealand Journal of Marine and Freshwater Research* 14: 83-85.

Water from Lake Rerewhakaaitu was studied, in order to examine the proposal that allophanic clays in Lake Rerewhakaaitu are a major influence in reducing the availability of phosphorus to plants. It was found that phosphate spikes added to lake water are removed from solution by biotic mechanisms rather than by clays.

Location: WU.

212.

Williamson, R.B.; Cooke, J.G. 1980: Water quality studies on the Waiohewa Stream - Part 2. Hamilton Science Centre, Ministry of Works and Development, Internal Report 80/10. 17 pp.

Laboratory experiments show that nitrification rates are an order of magnitude greater in water samples from the Waiohewa Stream containing sediment from the stream than in the water alone. A diurnal survey conducted on 10-12 December 1979 show no diurnal variation in apparent nitrification rates in the stream. A description of the catchment and of the laboratory analytical methods is included.

Location: HWA.

1981

213.

Chapman, M.A.; Jolly, V.H.; Flint, E.A. 1981: Limnology of Lake Rerewhakaaitu. *New Zealand Journal of Marine and Freshwater Research* 15: 207-224.

The limnology of Lake Rerewhakaaitu was studied over three years and comparisons made between the main lake and the crater lake. While the main lake was usually homothermal, the crater had strong thermal and chemical stratification for much of the year.

Location: WU.

214.

Clayton, J.S.; Chapman, V.J.; Brown, J.M.A. 1981: Submerged vegetation of the Rotorua and Waikato lakes: 4. Lake Rotoma. *New Zealand Journal of Marine and Freshwater*

Research 15: 447-457.

The aquatic vegetation of Lake Rotoma was surveyed over 1972-1973 and note taken of the species present and their distribution and dominance. This data was then related to probable environmental influences. At the time the lake was oligotrophic and had a predominantly native vegetation.

Location: WU.

215.

Coulter, G.W. 1981: Influence of stratification on trophic status in Lake Rotoiti and some other central North Island lakes. Ecology Division, Department of Scientific and Industrial Research, File Report 46.

Not sighted.

216.

Fish, G.R. 1981: Aquatic fauna and sensitive areas of the Rotorua Lakes District. Environmental Studies Unit, University of Waikato, File 3.1.5.

Not sighted.

217.

Forsyth, D.J. 1981: The benthic macroinvertebrates of seven Rotorua lakes in 1970 and 1980. Ecology Division, Department of Scientific and Industrial Research, Report 37.

Not sighted.

218.

Forsyth, D.J. 1981: The macroinvertebrate fauna of the Rotorua Lakes. In: Chapman, V.J. (ed.): Handbook of the Rotorua Lakes District. Guardians of the Rotorua Lakes. Rotorua. pp. 52-60.

The various species of macroinvertebrate fauna in the Rotorua lakes are summarised and their presence or abundance is related to the trophic or geothermal states of the lakes.

Location: DUS.

219.

Hoare, R.A. 1981: Lake Rotorua Project (WL 3): Closing Report. Hamilton Science Centre, Ministry of Works and Development, Internal Report 81/15. 9 pp.

This report describes the original objectives of the Lake Rotorua project, and what has been achieved. It also gives a list of all the papers and internal reports produced from this project.

Location: HWA.

220.

Hoare, R.A. 1981: Modelling of phosphorus in New Zealand lakes. Hamilton Science Centre, Ministry of Works and Development, Internal Report 81/3. 27 pp.

Some of the simple lake nutrient models in the literature are reviewed in order to define the best present approach. This is then used to discuss the management of six lakes, including Lake Rotorua, in some cases with conclusions differing from those of the original authors.

Location: HWA.

221.

Kemp, L.J. 1981: Seasonal variations in the limnology of Lakes Okareka and Tikitapu. Ecology Division, Department of Scientific and Industrial Research, File Report 27/T/35. 7 pp.

Lakes Okareka and Tikitapu were studied between November 1979 - January 1981 in order to make comparisons with a study made in 1971. The purpose was to detect any major shifts in trophic state over ten years, and to examine seasonal phytoplankton dynamics in detail. No long-term trend in the lakes' trophic status was definitely identified, but it is possible that deoxygenation is occurring earlier and lasting for a longer period for both lakes.

Location: WKRG.

222.

Mann, B.; Crawford, J.; Williams, K. 1981: Institutional roles. *Future Options for the Rotorua Lakes District: The Implications of Alternative Patterns of Environmental Resource Use and Management for the Rotorua Lakes: Progress Report 3. Planning Consultants. Hamilton. 102 pp.*

An overview is given of the various government departments, local authorities and other organisations which have responsibilities or authority over the management of the Rotorua Lakes. Suggestions are also made for developing an ideal management system which would entail the Bay of Plenty United Council exercising its powers to undertake regional planning including appointing a lake advisory committee.

Location: AEC.

223.

Manners, I.R. 1981: Lake quality assessment. *Future Options for the Rotorua Lakes District: The Implications of Alternative Patterns of Environmental Resource Use and Management for the Rotorua Lakes: Progress Report 14. Planning Consultants. Hamilton. 68 pp.*

A survey was taken of experts' opinions on such areas as the current trophic status of the Rotorua lakes, influences and probable impacts on that status, anticipated changes in resource use, and management issues. The responses of the participants and their feedback as they saw the results of the questionnaire were then commented upon. The intent of this study was to provide information about the lakes, identify areas of disagreement or insufficient information, and to stimulate the participants to further

efforts and ideas on behalf of the lakes.

Location: AEC.

224.

Planning Consultants. 1981: FORLD: Rotorua Project bibliography. *Future Options for the Rotorua Lakes District: The Implications of Alternative Patterns of Environmental Resource Use and Management for the Rotorua Lakes: Bibliography*. Hamilton. 171 pp.

The copy viewed was a printout of a FAMULUS Gallery computer file, printed in August 1981, apparently as one of four copies. It contained references to all of the works cited in the previous fourteen Future Options for the Rotorua Lakes District reports, covering a wide range of topics. The copy viewed was incomplete, containing references only to authors from D onwards.

Location: ROFO.

225.

Richmond, C.J. 1981: Lake Okaro - summary of limnological and fisheries data. Unpublished report, Wildlife Service, Department of Internal Affairs, File 9/1/51, 10 February 1981.

Not sighted.

226.

Savage, C.M. 1981: Hydrology of the lakes. *Future Options for the Rotorua Lakes District: The Implications of Alternative Patterns of Environmental Resource Use and Management for the Rotorua Lakes: Progress Report 7*. Planning Consultants. Hamilton. 8 pp.

The physical characteristics and hydrology of the lakes in the Rotorua district are summarised.

Location: HWA.

227.

Silvester, W.B. 1981: Water weeds and algae. *Future Options for the Rotorua Lakes District: The Implications of Alternative Patterns of Environmental Resource Use and Management for the Rotorua Lakes: Progress Report 11*. Planning Consultants. Hamilton. 47 pp.

The species of aquatic macrophytes in the Rotorua lakes are identified and their physical characteristics and preferred habitats summarised, as well as their history and distribution in the Rotorua lakes. Methods of controlling the weeds are discussed. The phytoplankton species in the lakes are also described.

Location: DOC.

228.

Timmins, S.; Savage, C.M. 1981: Lake water quality - land use relationships. *Future Options for the Rotorua Lakes District: The Implications of Alternative Patterns of*

Environmental Resource Use and Management for the Rotorua Lakes: Progress Report 10.
Planning Consultants. Hamilton. 50 pp.

The study attempts to identify the effects of land use upon water quality in the Rotorua Lakes, and the key issues. This is mainly taken up with an attempt to model the phosphorus yield from the lake catchments, using estimated values; and with the effects of land use on water quality in general, not focussing on the Rotorua Lakes. The writers come to no certain conclusion about the effects of land use on water quality, finding that the evidence is conflicting and confusing, and urging caution in deciding land use or management practices.

Location: WKRG.

229.

University of Waikato. 1981: Natural sciences aspects of the Rotorua Lakes area.
Environmental Studies Unit, University of Waikato, File 5.3.8.

Not sighted.

230.

Vincent, W.F. 1981: Rapid physiological assays for nutrient demand by the plankton: I. Nitrogen. *Journal of Plankton Research* 3: 685-697.

Three assays for nitrogen demand were compared on samples of plankton and green and blue-green algae from Lakes Okaro, Rotorua and Tikitapu, among others, to find the most reliable guide. Ammonium enhancement assays were also undertaken on Lake Rotorua, and correlations were found between ammonium enhancement and dissolved inorganic nitrogen: phosphorus ratios. All the assays provided evidence of a shortage of nitrogen relative to phosphorus for algal production in Lake Rotorua.

Location: AU.

231.

Vincent, W.F. 1981: Rapid physiological assays for nutrient demand by the plankton: II. Phosphorus. *Journal of Plankton Research* 3: 699-710.

Not sighted.

1982

232.

Hoare, R.A. 1982: Nitrogen and phosphorus in the Ngongotaha Stream. *New Zealand Journal of Marine and Freshwater Research* 16: 339-349.

The nitrogen and phosphorus loads of the Ngongotaha Stream are calculated, with emphasis on the variations over time or streamflow.

Location: WU.

233.

Rutherford, J.C. 1982: Deoxygenation rates in twelve New Zealand lakes. *Aquatic oxygen seminar proceedings, Hamilton, November 1990: Water and Soil Miscellaneous Publication* 29. Water and Soil Division, Ministry of Works and Development. Wellington. pp. 179-186.

The methods used to quantify oxygen depletion rates and the factors affecting the dissolved oxygen concentrations in lakes are discussed. Twelve New Zealand lakes, including several of the lakes in the Rotorua district, were examined and no simple relationship could be found between either gross volumetric hypolimnion oxygen depletion or areal hypolimnion oxygen depletion and Secchi disc clarity.

Location: HWA.

234.

Vant, W.N. 1982: Lake Rotorua water quality: summary of results of summer 1981-82 monitoring of chemical and biochemical parameters. Hamilton Science Centre, Ministry of Works and Development, Internal Report 82/12. Hamilton. 4 pp.

A summary is made of changes in nutrient and chlorophyll *a* levels in Lake Rotorua following a release of phosphorus and nitrogen from the lake sediments in January 1982.

Location: WKRG.

1983

235.

Fish, G.R. 1983: Some limnological effects and possible geothermal causes of sediment heat transfer in Lake Rotoiti, New Zealand. Fisheries Research Division, Ministry of Agriculture and Fisheries. Rotorua. 16 pp.

The development of the land catchment of Lake Rotoiti is insufficient to explain the eutrophic state of this lake compared to that of similar lakes nearby. Surveys of the lakes suggest that a small, geothermal heat input through the sediments of Lake Rotoiti enhances the nutrient recycling in this lake. The influence of waters from the Ohau Channel is seen to be minimal. The points where heat enters the lake can also allow solutes from sediment to re-enter the lake and reduce dissolved oxygen in the water, causing a more eutrophic state than other lakes in the area.

Location: ERFG.

236.

Forsyth, D.J.; Salonen, K. 1983: Carbon content of crustacean zooplankton in Lakes Okaro, Rotongaio and Taupo. Taupo Research Laboratory, Department of Scientific and Industrial Research, File Report 27/T/64.

Not sighted.

237.

Gibbs, M.M.; Spigel, R.H.; Vincent, W.F. 1983: Penetration of Ohau Channel water into Lake Rotoiti. Taupo Research Laboratory, Department of Scientific and Industrial Research, File Report 27/T/63. 9 pp.

Not sighted.

238.

Hoare, R.A. 1983: Nutrient load on Lake Rotorua. In: Hoare, R.A. (ed): Design of water quality surveys: proceedings of a symposium, Hamilton, 17-18 November 1982. Water and Soil Miscellaneous Publication 63. Water and Soil Division, Ministry of Works and Development. Wellington. pp. 147-163.

The variation in nutrient concentrations in some tributaries of Lake Rotorua under both base and flood flow conditions between 1975-1978 is described, as is how these variations can affect the choice of sampling strategies and techniques used to calculate nutrient loads.

Location: WU.

239.

Spigel, R.H.; Timperley, M.H. 1983: Geothermal influences on the limnology of Lake Rotoiti: preliminary conclusions from the 1982 field data. Taupo Research Laboratory, Department of Scientific and Industrial Research, File Report 27/T/58. 18 pp.

This report examines the effects of geothermal heating of the bottom waters of Lake Rotoiti. This heating maintains a steady circulation of the hypolimnion ensuring it remains almost completely mixed, in an isothermal state. Most of the heat is introduced to the bottom of the lake as hot liquid or steam. Once surface and bottom waters reach approximately the same temperature, in early winter, there is a complete mixing of the surface and bottom waters. The impact of this geothermal heating may cause an increase in metabolic activity in the hypolimnion, both due to the heat and to the stirring of the waters.

Location: ERFG.

240.

Stoffers, P.; Glasby, G.P.; Plüger, W.L.; Walter, P. 1983: Reconnaissance survey of the mineralogy and geochemistry of some New Zealand lake and nearshore sediments. *New Zealand Journal of Marine and Freshwater Research* 17: 461-480.

Sediments from New Zealand lakes, including Lake Rotoma, were taken for geochemical analysis. The differences in the sediments are related mainly to the lithology of the sediment and the productivity of the lake waters.

Location: WU.

241.

White, E. 1983: Lake eutrophication in New Zealand - a comparison with other countries

of the Organisation for Economic Co-operation and Development. *New Zealand Journal of Marine and Freshwater Research* 17: 437-444.

The findings of the Organisation for Economic Co-operation and Development Co-operative Programme on Eutrophication with regard to lake eutrophication are largely inapplicable to New Zealand lakes, due to differences in the relative distributions of nitrogen and phosphorus in the lakes. Data on nitrogen and phosphorus limitation from New Zealand lakes, including several in the Rotorua district, is given, and compared to lakes in other parts of the world.

Location: WU.

1984

242.

Hoare, R.A. 1984: Nitrogen and phosphorus in Rotorua urban streams. *New Zealand Journal of Marine and Freshwater Research* 18: 451-454.

A study of the stream catchments near Rotorua show that the urban streams draining into Lake Rotorua carry much higher nitrate concentrations than the nearby rural streams, but have similar phosphorus concentrations. The nitrogen load in the urban streams corresponds to the load on the septic tanks in the catchments, while the phosphorus load is less than 2% of the load on the septic tanks. The nitrate load in the streams is decreasing as the sewerage reticulation system is completed.

Location: WU.

243.

Mackenzie, L. 1984: Acetylene reduction and nitrogen fixation potential in some eutrophic lake sediments. *New Zealand Journal of Marine and Freshwater Research* 18: 241-249.

The acetylene-reducing activities in the sediments of two North Island lakes, Lake Okaro and Lake Rotongaio, were examined to determine whether this process plays a significant role in the enhancement of nutrient enrichment in these lakes.

Location: WU.

244.

Rawlence, D.J. 1984: A study of pigment and diatoms in a core from Lake Rotorua, North Island, New Zealand, with emphasis on recent history. *Journal of the Royal Society of New Zealand* 14: 119-132.

Sedimentary pigment and diatom distribution were determined in a core from Lake Rotorua, representing over 120 years. Particular attention was paid to the sediment deposited after the Mt. Tarawera eruption in 1886 and the sediment deposited over the last 20 years. It is shown that there is an increasing instability in algal populations over recent years.

Location: WU.

245.

Rowe, D.K. 1984: Factors affecting the foods and feeding patterns of lake-dwelling rainbow trout (*Salmo gairdnerii*) in the North Island of New Zealand. *New Zealand Journal of Marine and Freshwater Research* 18: 129-141.

Differences in feeding patterns between age and sex groups in trout, as well as between wild and hatchery-reared, are described. Other influences on feeding patterns were seasonal variations, lake eutrophication and water temperature and turbidity.

Location: WU.

246.

Rutherford, J.C. 1984: Trends in Lake Rotorua water quality. *New Zealand Journal of Marine and Freshwater Research* 18: 355-365.

Data on fourteen variables relating to the water quality of Lake Rotorua was examined for trends over the period 1966-1983. It was determined that over this time lake water quality deteriorated, originally as a result of unfavourable weather conditions, later due to an increase in nutrient input from sewage effluent.

Location: WU.

247.

Vant, W.N.; Davies-Colley, R.J. 1984: Factors affecting clarity of New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 18: 367-377.

Variables such as Secchi disc readings, turbidity, algal pigment, and suspended solids were measured and examined to determine their relationship to the average values of the optical properties of 27 New Zealand lakes, including four in the Rotorua district.

Location: WU.

248.

Vincent, W.F.; Gibbs, M.M. 1984: Trophic status of Lake Rotoiti - algal production and standing crop; evidence of deteriorating water quality; and speculations on the impact of the Ohau Channel inflow. Taupo Research Laboratory, Department of Scientific and Industrial Research, File 27/T/65. Taupo. 22 pp.

This report details the findings of a study on Lake Rotoiti in 1981-82. It studies algal production and standing crop, nutrient limitation and water clarity in order to compare Rotoiti with other lakes in the area. The results showed that Rotoiti was considerably more eutrophic than other deep lakes in the area with similar land use characteristics. The report also examines the possibilities concerning the impact of the water from the Ohau Channel on the water quality of the main part of Lake Rotoiti.

Location: ERFG.

249.

Vincent, W.F.; Gibbs, M.M.; Dryden, S.J. 1984: Accelerated eutrophication in a New Zealand lake: Lake Rotoiti, Central North Island. *New Zealand Journal of Marine and*

Freshwater Research 18: 431-440.

The eutrophication of Lake Rotoiti is examined and the symptoms, such as high algal production, complete deoxygenation of the hypolimnion, blue-green algal blooms, and decline in water clarity, are discussed. This accelerated eutrophication has happened recently, and is probably a consequence of the inflow from Lake Rotorua.

Location: WU.

250.

Viner, A.B. 1984: Resistance to mixing in New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research 18: 73-82.*

Data from New Zealand lakes, including several from the Rotorua district, has been used to show a predictive relationship between the seasonal maximum stability of the water column and the mean depth. This can be used to estimate light penetration and growth conditions for phytoplankton.

Location: WU.

251.

Wells, R.D.S.; Coffey, B.T. 1984: Fluridone - Lake Rotoiti efficacy trial. *In: Proceedings of the Thirty-seventh New Zealand Weed and Pest Control Conference. New Zealand Weed and Pest Control Society. Wellington. pp. 42-45.*

The value of fluridone as an aquatic herbicide was examined by a test in Lake Rotoiti and the results summarised. It was found that fluridone had no lasting effect upon the vegetation.

Location: WU.

1985

252.

Chapman, M.A.; Green, J.D.; Jolly, V.H. 1985: Relationships between zooplankton abundance and trophic state in seven New Zealand lakes. *Hydrobiologia 123: 119-136.*

The zooplankton communities in seven of the Rotorua Lakes were studied in 1977-1978 and analysed to see if the populations showed any relationship with the lakes' trophic status. Population levels were found to be higher in more productive lakes, whereas breeding levels were inversely related to trophic status and population abundance indices. Groupings of the lakes based on this data are in general agreement with groupings derived from different variables.

Location: WKRG.

253.

Hoare, R.A. 1985: Inferred geothermal inflows to Lake Rotorua. *New Zealand Journal of Marine and Freshwater Research 19: 151-156.*

Data on chemical samples from tributaries to Lake Rotorua shows that a large percentage of the chloride load on the lake is probably coming from a geothermal inflow to the lake.

Location: WU.

254.

Pridmore, R.D.; Vant, W.N.; Rutherford, J.C. 1985: Chlorophyll - nutrient relationships in North Island lakes (New Zealand). *Hydrobiologia* 121: 181-189.

A model for the prediction of chlorophyll *a* depending upon the nutrient concentrations in the upper waters of twelve lakes, including several in the Rotorua district, was developed using annual data for chlorophyll *a*, nitrogen and phosphorus.

Location: AU.

255.

Rutherford, J.C. 1985: Trends in Lake Rotorua water quality. *Streamland* 36. Wellington. 4 pp.

A summary is given of Lake Rotorua's water quality, and the causes and effects of eutrophication.

Location: WSU.

256.

Vincent, W.F. 1985: Winter cyanobacterial bloom on Lake Tarawera - report to Wildlife Service, Department of Internal Affairs. Taupo Research Laboratory, Department of Scientific and Industrial Research, Contract Report 29.

Not sighted.

257.

White, E.; Law, K.; Payne, G.W.; Pickmere, S.E. 1985: Nutrient demand and availability among planktonic communities - an attempt to assess nutrient limitation to plant growth in 12 central volcanic plateau lakes. *New Zealand Journal of Marine and Freshwater Research* 19: 49-62.

Assays of nitrogen and phosphorus demand were carried out in the lakes of the Rotorua district in order to determine the nutrients limiting plankton growth. Orthophosphate turnover times, chlorophyll and analyses for nitrogen and phosphorus were made as well as the bioassays.

Location: WU.

1986

258.

Bay of Plenty Catchment Commission. 1986: The degradation of Lake Rotoiti. Guardians

of the Rotorua Lakes. Bay of Plenty Catchment Commission File 146/5/52.

This report is intended to highlight the importance of the problem in water quality in Lake Rotoiti and to urge an effort to find a solution. It gives a list of the evidence found to indicate increasing productivity and decreasing water quality of the lake, and the actions taken by various organisations in response.

Location: LWQS.

259.

Clayton, J.S. 1986: Review of diquat use in New Zealand for submerged weed control. In: Proceedings of the European Weed Research Society/ Association of Applied Biologists 7th International Symposium on Aquatic Weeds. Amsterdam. pp. 73-79.

The background to the use of diquat herbicide as the controlling mechanism for submerged weeds and its history in New Zealand lakes is discussed.

Location: WU.

260.

Dryden, S.J.; Vincent, W.F. 1986: Phytoplankton species of Lake Okaro, Central North Island. *New Zealand Journal of Marine and Freshwater Research* 20: 191-198.

The composition, physical characteristics and dominance of the phytoplankton species in Lake Okaro are described and related to the trophic status of the lake.

Location: WU.

261.

Gibbs, M.M. 1986: The role of underflow in the transport of oxygen into Lake Rotoiti, North Island, New Zealand. Taupo Research Laboratory, Department of Scientific and Industrial Research, Report 91.

This was contained as a supplementary report at the end of the DSIR report "The Impact of the Ohau Channel Outflow from Lake Rotorua on Lake Rotoiti" (No.269). It examined the mechanics of the transportation of oxygen from the Ohau Channel to Lake Rotoiti which relieves hypolimnetic oxygen depletion. Management of the channel inflow from Lake Rotorua was considered.

Location: WKRG.

262.

Howard-Williams, C.W.; Rutherford, J.C.; White, E.; McColl, R.H.S.; Vant, W.N. 1986: Rotorua sewage disposal: a statement of the significance of phosphorus and nitrogen in the management of Lake Rotorua. Water Quality Centre, Ministry of Works and Development; Taupo Research Laboratory, Department of Scientific and Industrial Research. pp. 21-23.

A summary of the state of Lake Rotorua and the possible management solutions which are available is given. Particular emphasis is given to the limitation of phosphorus and nitrogen.

Location: AEC.

263.

Livingston, M.E.; Biggs, B.J.; Gifford, J.S. (eds.) 1986: Inventory of New Zealand lakes. Part 1: North Island. *Water and Soil Miscellaneous Publication 80*. Water and Soil Division, Ministry of Works and Development. Wellington. 200 pp.

An alphabetical list is compiled of the lakes in the North Island. Each entry contains information about the lake's physical characteristics, water chemistry, catchment data, and biological data. References to further information are included.

Location: WKRG.

264.

McIntosh, J.J. 1986: Some properties of the lakes with reference to the Rotorua lakes. Unpublished report, Bay of Plenty Catchment Commission. 12 pp.

This report summarises the dynamic systems and annual cycles of lakes, illustrating them with examples from the lakes in the Rotorua district. At the end it comments on some of the problems of Lake Rotorua.

Location: WKRG.

265.

Priscu, J.C.; Spigel, R.H.; Gibbs, M.M.; Downes, M.T. 1986: A numerical analysis of hypolimnetic nitrogen and phosphorus transformations in Lake Rotoiti, New Zealand: a geothermally influenced lake. *Limnology and Oceanography* 31: 812-831.

Measurements of chlorophyll, oxygen, and particulate and dissolved forms of nitrogen and phosphorus from Lake Rotoiti were used in a model to calculate rates of generation or loss in the hypolimnion of the lake. When the lake was stratified in the summer the hypolimnion was a sink for chlorophyll, particulate nitrogen and phosphorus and dissolved oxygen, and was a source of ammonium ions.

Location: WU.

266.

Timperley, M.H.; Vigor-Brown, R.J. 1986: Water chemistry of lakes in the Taupo Volcanic Zone, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 20: 173-183.

The waters of the lakes in the volcanic plateau were examined to determine the ionic composition of the water. The ion concentrations were related to the sources contributing the waters studied.

Location: WU.

267.

Vant, W.N.; Davies-Colley, R.J. 1986: Relative importance of clarity determinants in Lakes Okaro and Rotorua. *New Zealand Journal of Marine and Freshwater Research* 20: 355-363.

Measurements were made of water clarity and algal effects upon water clarity in Lakes Rotorua and Okaro, and the results compared. In Lake Okaro, algal biomass was the dominant influence on water clarity, while in Lake Rotorua inorganic sediments were the dominant factor.

Location: WU.

268.

Vant, W.N.; Davies-Colley, R.J.; Clayton, J.S.; Coffey, B.T. 1986: Macrophyte depth limits in North Island (New Zealand) lakes of differing clarity. *Hydrobiologia* 137: 55-60.

The seasonal variation in water clarity was measured over the course of a year in nine North Island lakes, including Lakes Rotorua, Rotokakahi, Ngapouri and Okaro, and the maximum depth of water colonized by macrophytes in these lakes was also determined. It was shown that average annual water clarity is likely to be a useful predictor of the macrophyte depth limits in lakes in this area, but that the depth limits varied from estimations derived from northern hemisphere lakes.

Location: AU.

269.

Vincent, W.F.; Spigel, R.H.; Gibbs, M.M.; Payne, G.W.; Dryden, S.J.; May, L.M.; Wood, P.; Pickmere, S.E.; Davies, J.; Shakespeare, B. 1986: The impact of the Ohau Channel outflow from Lake Rotorua on Lake Rotoiti. Taupo Research Laboratory, Department of Scientific and Industrial Research, File Report 92. 6 pp.

Details are provided of a series of measurements in Lake Rotoiti and the Ohau Channel over 1985-1986. The study sought to define the physical processes, and determined that during winter the Ohau Channel penetrates into the lake's eastern basin as a bottom current, while during summer the diurnal cycle of the Ohau Channel's heating and cooling controls whether it flows into the main body of the lake or down the Okere Arm. Management options for the Ohau Channel are considered.

Location: WKRG.

1987

270.

Edwards, J.A. 1987: *Lagarosiphon* algal aufwuchs in Lake Okataina and Lake Rotoehu. MSc. thesis, University of Waikato.

The composition, variation, preferences and distribution of algal aufwuchs on *Lagarosiphon major* in Lakes Okataina and Rotoehu are described. It is determined that the algal communities cannot be used as indicators of the trophic status of these lakes.

Location: HU.

271.

Hoare, R.A. 1987: Nitrogen and phosphorus in the catchment of Lake Rotorua. *Water Quality Centre Publication 11*. Water Quality Centre, Ministry of Works and Development. Hamilton. 110 pp.

The results are given of a study of the nitrogen and phosphorus concentrations in streams and springs in the catchment of Lake Rotorua. Variations over time are also described, and the total annual loads of nutrients transported are estimated, and used to calculate a nutrient budget for the lake.

Location: WKRG.

272.

Howard-Williams, C.W.; Gibbs, M.M. 1987: Comments on the potential of artificial wetlands to remove nutrients from small scale sewage plants in the Rotorua lakes area. *In: Proceedings of the Seminar on nutrient retention in small wastewater effluents, organised by the Guardians of the Rotorua Lakes, 27 May 1987. Guardians of the Rotorua Lakes. Rotorua. 22 pp.*

The effects of nutrient input from small sewage plants in the Rotorua lakes area and the current septic tank effluent loads on the lakes are estimated. The potential of artificial wetlands to remove nutrients at a sewage collection point is examined, and compared with other removal systems of a similar size.

Location: AEC.

273.

Imberger, J.; Spigel, R.H. 1987: Forum on cyanobacterial dominance: circulation and mixing in Lake Rotongaio and Lake Okaro under conditions of light to moderate winds: preliminary results. *New Zealand Journal of Marine and Freshwater Research* 21: 515-519.

A study was made of water circulation and mixing in Lake Okaro, and compared with data gathered from Lake Rotongaio.

Location: WU.

274.

Lean, D.R.S.; Mitchell, S.F.; Pick, F.R.; Rueter, J.G.; Downes, M.T.; Payne, G.W.; Pickmere, S.E.; White, E.; Woods, P.H. 1987: Forum on cyanobacterial dominance: the effects of changes in both the abundance of nitrogen and phosphorus and their ratio on Lake Okaro phytoplankton, with comment on six other central volcanic plateau lakes. *New Zealand Journal of Marine and Freshwater Research* 21: 539-542.

The responses of phytoplankton in Lake Okaro to changes in the nutrient environment were examined. The results were then used to examine phytoplankton communities in other lakes in the Rotorua district.

Location: WU.

275.

Pridmore, R.D.; Etheredge, M.K. 1987: Planktonic cyanobacteria in New Zealand inland waters: distribution and population dynamics. *New Zealand Journal of Marine and Freshwater Research* 21: 491-502.

The distribution and characteristics of the cyanobacteria of New Zealand lakes, including those in the Rotorua district, are described. Their preferred habitats are examined, and algal blooms are commented upon.

Location: WU.

276.

Rutherford, J.C.; Pridmore, R.D. 1987: The significance of phosphorus and nitrogen in the management of Lake Rotorua. In: Proceedings of the New Zealand Water Supply and Disposal Association Annual Conference. New Zealand Water Supply and Disposal Association. Hamilton. pp. 71-84.

The likely results to the water quality of Lake Rotorua of removing either phosphorus or nitrogen inputs alone from the sewage treatment plant, or removing both phosphorus and nitrogen at the same time are estimated, as well as the degree of nutrient reduction needed to reach various water quality targets. The recent trends in sewage nitrogen and phosphorus inputs are also described.

Location: PU.

277.

Vincent, W.F.; Gibbs, M.M. 1987: The impact of the outflow from Lake Rotorua on Lake Rotoiti. In: Proceedings of the New Zealand Water Supply and Disposal Association Annual Conference. New Zealand Water Supply and Disposal Association. Hamilton. pp. 85-101.

The magnitude of water transfer from Lake Rotorua to the main body of Lake Rotoiti through the Ohau Channel and its impact on the environment of Lake Rotoiti was investigated over 1985-1986. It was found that underflow to the main basin of the lake was happening at certain times of the year, with both positive and negative effects such as flushing, oxygenation and the introduction of high nutrient concentrations and algal growth.

Location: PU.

278.

Walsby, A.E.; McAllister, G.K. 1987: Forum on cyanobacterial dominance: buoyancy regulation by *Microcystis* in Lake Okaro. *New Zealand Journal of Marine and Freshwater Research* 21: 521-524.

The buoyancy and distribution of *Microcystis* in Lake Okaro was investigated. The cyanobacteria shows a buoyancy change in response to light intensity.

Location: WU.

1988

279.

Coffey, B.T.; Clayton, J.S. 1988: Changes in the submerged macrophyte vegetation of Lake Rotoiti, central North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 22: 215-223.

The decline of *Lagarosiphon*, *Elodea* and *Myriophyllum* and the invasion of *Ceratophyllum* in Lake Rotoiti between 1969 and 1985 is described and commented upon in connection with the eutrophication of the lake, along with the presence of other aquatic macrophytes of lesser abundance.

Location: WU.

280.

Cryer, M. 1988: Predatory impact of New Zealand smelt on natural populations of zooplankton. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 23: 1778-1783.

The smelt in Lake Tarawera and another lake are examined, with particular reference to their diet composition, prey selectivity and impact on zooplankton populations.

Location: CU.

281.

Davies-Colley, R.J. 1988: Mixing depths in New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research* 22: 517-527.

The seasonal mixing depth in 24 stratified lakes in New Zealand, including 9 lakes in the Rotorua area, has been examined, and compared to lakes in the Northern hemisphere. Previously published material is used. It is determined that lakes in New Zealand's climate mix more deeply than lakes in continental areas. The mixing depth may affect the nutrient load and productivity of the lake, as well as the light available to reach phytoplankton and the water temperature and density necessary to support aquatic fauna.

Location: WU.

282.

Forsyth, D.J.; Dryden, S.J.; James, M.R.; Vincent, W.F. 1988: The Lake Okaro ecosystem: 1. Background limnology. *New Zealand Journal of Marine and Freshwater Research* 22: 17-28.

The limnological status and history of Lake Okaro is described and earlier studies on the lake commented on.

Location: WU.

283.

Gibbs, M.M. 1988: Lake Rotoiti Project 77/23: Bathythermograph data August

1981/August 1982. Taupo Research Laboratory, Department of Scientific and Industrial Research, Report 104.

Not sighted.

284.

Mitchell, C.P. 1988: Environmental assessment of the proposed Lake Rotorua control structure: impacts on fisheries. Unpublished report, Ministry of Agriculture and Fisheries. 13 pp.

This report discusses the impact of a proposed level control structure on the Ohau Channel on fish populations and fisheries in Lakes Rotorua and Rotoiti.

Location: WKRG.

285.

Mylechreest, P.H.W. 1988: The links between exotic forest land use and trout growth. Unpublished report, Department of Conservation. 68 pp.

The possibility is discussed that changing land use such as pine plantations and agriculture have deprived the lake catchment of nitrogen, causing the lake to produce more cyanobacteria, and thus to negatively affect trout growth. The natural states of the New Zealand lakes and what effect nitrogen limitation has in the lakes are examined. Comments on this hypothesis by A.B. Cooper, R.D. Pridmore, and E. White are also included as appendices.

Location: DOC.

286.

Payne, G.W.; White, E.; Pickmere, S.E.; Woods, P.H. 1988: Algal responses to nitrogen and phosphorus additions in four central North Island, New Zealand, lakewaters. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 23: 602-606.

Lakes Okataina, Rotoiti, Tarawera and Waikaremoana were sampled in summer and winter, using a series of short-term physiological assays in order to determine the reactions of the phytoplankton to additions of nitrogen or phosphorus.

Location: CU.

287.

Rutherford, J.C. 1988: Internal nitrogen and phosphorus loads in Lake Rotorua, New Zealand. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 23: 828-831.

The internal nitrogen and phosphorus loads in Lake Rotorua were estimated and related to the estimated external nutrient loads.

Location: CU.

288.

Rutherford, J.C.; Burns, N.M.; Cooper, A.B. 1988: Statement on the likely impact on Lakes Rotorua and Rotoiti of the proposed spray irrigation of Rotorua sewage effluent. Water Quality Centre, Ministry of Works and Development, Consultancy Report T71125. Hamilton. 30 pp.

The ecological and trophic consequences of the spraying of sewage effluent onto the catchments of Lakes Rotorua and Rotoiti are estimated.

Location: AEC.

289.

White, E.; Payne, G.W.; Pickmere, S.E.; Woods, P.H. 1988: Phosphorus reduction required to control eutrophication at Lake Rotorua, New Zealand. *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie* 23: 607-610.

The change in concentrations of phosphorus in Lake Rotorua needed to limit chlorophyll and algal growth is estimated.

Location: CU.

1989

290.

Clayton, J.S.; Wells, R.D.S. 1989: Aquatic weed control in the Rotorua Lakes - a technical evaluation. Aquatic Plant Section, Ministry of Agriculture and Fisheries. Hamilton. 88 pp.

The various options available to control the lake weeds in the Rotorua lakes are discussed. The report describes the plant communities involved and the history of weed control, with a view to providing an informed background for future decisions.

Location: WKRG.

291.

Clayton, J.S.; de Winton, M.D.; Wells, R.D.S.; Tanner, C.C.; Miller, S.T.; Evans-McLeod, D. 1989: The aquatic vegetation of 15 Rotorua lakes. Aquatic Plant Section, Ministry of Agriculture and Fisheries. Hamilton. 101 pp.

The distribution and dominance of the species of aquatic vegetation in the various Rotorua lakes are examined, and the possible management measures commented upon.

Location: WKRG.

292.

Lean, D.R.S.; Pick, F.R.; Mitchell, S.F.; Downes, M.T.; Woods, P.H.; White, E. 1989: Lake Okaro enclosure experiments: test ecosystems to evaluate plankton phosphorus and nitrogen deficiency. *Archiv für Hydrobiologie. Biehefte. Ergebnisse der Limnologie* 32: 195-211.

Several different nutrient-deficiency indicators were examined by relating them to growth

responses of the phytoplankton community in Lake Okaro. It was found that the phytoplankton responded better to additions of nitrogen and phosphorus together than either singly.

Location: WU.

293.

Mitchell, S.F. 1989: Responses of the zooplankton to nutrient enrichment of large enclosures in Lake Okaro, New Zealand. *Archiv für Hydrobiologie. Biehefte. Ergebnisse der Limnologie* 32: 189-193.

The macrozooplankton levels in Lake Okaro showed detrimental effects as the result of nutrient enrichment as an experiment on the phytoplankton of the lake. It is likely that the higher population of phytoplankton caused this inhibition of the zooplankton.

Location: WU.

294.

Rattray, M.R. 1989: An ecophysiological evaluation of the growth and nutrition of three submerged macrophytes in relation to lake eutrophication. Ph.D. thesis, University of Auckland.

For this thesis, four large-scale *in situ* experiments comparing Lake Taupo and Lake Rotorua were undertaken to examine the effects of nutrient sources and availabilities on the growth and nutrient content of *Lagarosiphon*, *Potamogeton* and *Myriophyllum*. The study looks at the effect of lake or sediment nutrient sources, photosynthesis, dissolved inorganic carbon, differences in biomass, and effects of temperature on seasonal growth. Both laboratory and *in situ* experiments were carried out. Recommendations are also given for weed management schemes based on the results. The study discusses methods and the results of the experiments.

Location: AU.

295.

Rutherford, J.C.; Pridmore, R.D.; White, E. 1989: Management of phosphorus and nitrogen inputs to Lake Rotorua, New Zealand. *Journal of Water Resources Planning and Management* 115: 431-439.

The condition of Lake Rotorua is described and the need to remove both phosphorus and nitrogen from the lake system to restrict the growth of phytoplankton. It is suggested that the aim be to restore the lake condition to that which existed in the 1950s.

Location: HU.

296.

Vincent, W.F. 1989: Cyanobacterial growth and dominance in two eutrophic lakes: review and synthesis. *Archiv für Hydrobiologie. Biehefte. Ergebnisse der Limnologie* 32: 239-254.

Lake Okaro and another lake of similar physical characteristics were studied to determine possible causes of their different phytoplankton compositions.

Location: WU.

297.

Vincent, W.F.; Dryden, S.J. 1989: Phytoplankton succession and cyanobacterial dominance in a eutrophic lake of the mid-temperate zone (Lake Okaro, New Zealand). *Archiv für Hydrobiologie. Biehefte. Ergebnisse der Limnologie* 32: 137-163.

The phytoplankton species in Lake Okaro were studied to determine how they reacted to changes in their environment such as seasonal changes.

Location: WU.

298.

Viner, A.B. 1989: Buoyancy and vertical distribution of *Anabaena spiroides* in Lake Okaro (New Zealand). *Archiv für Hydrobiologie. Biehefte. Ergebnisse der Limnologie* 32: 221-238.

The phytoplankton species *Anabaena spiroides* had attained an almost total dominance in Lake Okaro and was studied to determine its buoyancy control and adaption to environmental conditions.

Location: WU.

299.

White, E.; Downes, M.T.; Payne, G.W.; Pickmere, S.E.; Woods, P.H.; Rueter, J.G. 1989: Community responses of the late summer plankton of Lake Okaro (New Zealand) to experimental changes in nutrient abundance: evidence of nitrogen limitation in the presence of phosphorus deficiency. *Archiv für Hydrobiologie. Biehefte. Ergebnisse der Limnologie* 32: 165-175.

The phytoplankton community in Lake Okaro was studied while their nutrient environment was altered. It was determined that while additions of iron or phosphate alone had no impact upon the biomass indicators, additions of nitrate created increases in all the biomass indicators, and additions of nitrate and phosphorus together produced a greater increase.

Location: WU.

1990

300.

Cooper, A.B.; Williamson, R.B.; Smith, C.M. 1990: Assessment of soil conservation work in the Ngongotaha catchment and the implications to Lake Rotorua. Water Quality Centre, Ministry of Works and Development, Consultancy Report 7061. Hamilton. 111 pp.

The effectiveness of soil conservation works which have been undertaken in the Ngongotaha Stream catchment since the early 1980s as part of the Upper Kaituna Catchment Control Scheme to prevent the further deterioration of the water quality of Lakes Rotorua and Rotoiti is examined. The report comments on land use, riparian

retirement, the hydrological and nutrient loading history of the Ngongotaha catchment before and after the soil conservation works were initiated, community attitudes towards the scheme, and the effect that the measures are likely to have for the quality of the water in Lake Rotorua.

Location: WKRG.

301.

Froude, V.A.; Richmond, C.J. 1990: Aquatic weed control in the Rotorua lakes - a discussion paper on management issues and options. Department of Conservation Technical Report Series 2. Department of Conservation. Rotorua. 46 pp.

Management issues and options for weed control in the Rotorua lakes are examined, as part of developing a comprehensive management strategy for aquatic plants in the lakes. The paper examines how the weed has been controlled in the past, and possible methods for the future. It also looks at management issues for each lake separately, and provides maps of the location of the weedbeds in each lake.

Location: DOC.

302.

Hoare, R.A. 1990: Particulate phosphorus load on Lake Rotorua. Unpublished draft report, Department of Scientific and Industrial Research. 11 pp.

A description is given of methods of estimating the phosphorus concentration and load in base and flood flows of the tributaries of Lake Rotorua, particularly the Ngongotaha Stream, using the data for 1975-1976.

Location: WKRG.

303.

Mylechreest, P.H.W. 1990: Tarawera selective breeding - the big fish programme. Unpublished report, Fish & Game New Zealand, Eastern Region. Rotorua. 43 pp.

The trout breeding programme on Lake Tarawera is described and the links between trout size and nitrogen limitation explored.

Location: ERFG.

1991

304.

Bioresearches Ltd. 1991: Lake Rotoehu lake nutrient input report. Bioresearches Ltd. Auckland. 55 pp.

Lake Rotoehu and its catchment were studied in preparation for a new district plan. The sources and amounts of nutrients input into the lake are estimated, and their relative impacts upon the lakewater quality. The report also gives recommendations for future actions to reduce the nutrient inputs into the lake, and to monitor the lake, as well as

commenting on whether the lakeshore settlements need sewerage reticulation.
Location: WKRG.

305.

Bioresearches Ltd. 1991: Lake Rotoiti - eastern basin lake nutrient input report. Bioresearches Ltd. Auckland. 60 pp.

This report for the Rotorua District Council in preparation for a new district plan summarises the characteristics of the eastern basin of Lake Rotoiti and its catchment, and estimates the sources and amounts of nutrients input into the lake, and their relative impacts upon the lakewater quality. The authors give recommendations for future actions to reduce the nutrient inputs into the lake, and to monitor the lake, and call for a greater level of research into some areas. The report also comments on whether the lakeshore settlements need sewerage reticulation.

Location: RDC.

306.

Donald, R.C.; Park, S.G.; McIntosh, J.J. 1991: Lakes overview report. Bay of Plenty Regional Council Technical Publication 5. Whakatane. 100 pp.

Summarised information is given on the lakes in the Rotorua district, as well as several other lakes in the Bay of Plenty. The information covered includes physical characteristics, history, hydrology, water quality and ecology. The intent is to provide the Bay of Plenty Regional Council with up-to-date information and to identify areas where the knowledge of the lakes is unsatisfactory.

Location: AEC.

307.

Donovan, W.F.; Don, G.L. 1991: Lake Okareka lake nutrient input report. Bioresearches Ltd. Auckland. 57 pp.

A summary is given of the characteristics of Lake Okareka and its catchment in preparation for a new district plan, and estimates are made of the sources and amounts of nutrients input into the lake, and their relative impacts upon the lakewater quality. The report also gives recommendations for future actions to reduce the nutrient inputs into the lake, and to monitor the lake, and comments on whether the lakeshore settlements need sewerage reticulation.

Location: WKRG.

308.

Donovan, W.F.; Don, G.L. 1991: Lake Rotoiti - western basin lake nutrient input report. Bioresearches Ltd. Auckland. 54 pp.

In preparation for a new district plan, this report summarises the characteristics of the western basin of Lake Rotoiti and its catchment, and estimates the sources and amounts of nutrients input into the lake, and their relative impacts upon the lakewater quality. The

authors conclude that the Ohau Channel is the main determinant of the water quality in the Western Basin, and that at the time Okawa Bay had a higher water quality than the rest of the Basin. They also give recommendations for future actions to reduce the nutrient inputs into the lake, and to monitor the lake, and call for a greater level of research into some areas. The report also comments on whether the lakeshore settlements need sewerage reticulation.

Location: WKRG.

309.

Donovan, W.F.; Don, G.L. 1991: Lake Rotoma lake nutrient input report. Bioresearches Ltd. Auckland. 54 pp.

A summary is given of the characteristics of Lake Rotoma and its catchment in preparation for a new district plan, and estimates are made of the sources and amounts of nutrients input into the lake, and their relative impacts upon the lakewater quality. The report also gives recommendations for future actions to reduce the nutrient inputs into the lake, and to monitor the lake, and comments on whether the lakeshore settlements need sewerage reticulation.

Location: WKRG.

310.

Donovan, W.F.; Don, G.L. 1991: Lake Rotorua lake nutrient balance report. Bioresearches Ltd. Auckland. 67 pp.

The characteristics of Lake Rotorua and its catchment are summarised in preparation for a new district plan, and the sources and amounts of nutrients input into the lake, and their relative impacts upon the lakewater quality are estimated. The report also gives recommendations for future actions to reduce the nutrient inputs into the lake, and to monitor the lake. It also comments on whether the lakeshore settlements need sewerage reticulation if this is not already provided. This report has two titles: while the cover states it to be a Lake Nutrient Balance Report, the title page calls it a Lake Nutrient Input Report, like the rest of the series produced by Bioresearches Ltd. in 1991.

Location: WKRG.

311.

Forsyth, D.J.; James, M.R. 1991: Population dynamics and production of zooplankton in eutrophic Lake Okaro, North Island, New Zealand. *Archiv für Hydrobiologie* 120: 287-314.

The population dynamics and production of the species *Calamoecia lucasi*, *Ceriodaphnia dubia* and *Bosmina "meridionalis"* in Lake Okaro were studied as part of an attempt to define the ecosystem of an eutrophic lake.

Location: CU.

312.

Forsyth, D.J.; James, M.R. 1991: Species composition and abundance of zooplankton in

Lake Tarawera. Taupo Research Laboratory, Department of Scientific and Industrial Research, File Report 121. 10 pp.

This investigation was undertaken in order to examine the zooplankton of Lake Tarawera and its relationships with the phytoplankton and small fish in the lake. Samples were taken from August 1989-August 1990. The dominant species was found to be *Calamoecia*, and no links were found between phytoplankton and zooplankton abundance or species changes.

Location: WKRG.

313.

Gibbs, M.M. 1991: Temperature and BOD differentials inshore and offshore in Lake Rotorua near Ohau Channel. Taupo Research Laboratory, Department of Scientific and Industrial Research. 13 pp.

Data on the distribution of temperature, nutrients and BOD in Lake Rotorua near the Ohau Channel was collected, and confirmed the existence of differentials between inshore and offshore water. This suggested that the water quality of Lake Rotorua could be improved and the BOD load reduced by managing the source of the inflow of water into the Ohau Channel. Wings extending out into Lake Rotorua are recommended.

Location: DOC.

314.

Hawes, I.; Wells, R.D.S.; Clayton, J.S.; Howard-Williams, C.W. 1991: Report of the status of water net (*Hydrodictyon reticulatum*) in New Zealand and options for its control. Department of Scientific and Industrial Research; Ministry of Agriculture and Fisheries. Taupo; Hamilton. 64 pp.

The biology and habitat of water net are examined, as well as its current distribution in New Zealand, including the Rotorua lakes, its impact, and the control options available.

Location: DOC.

315.

Power, F.M. 1991: Bay of Plenty Regional Council Regional Monitoring Network: bathing beach suitability survey 1991. Bay of Plenty Regional Council Technical Report 3. Whakatane. 42 pp.

A report is given of the testing of ocean and lake beaches in the Bay of Plenty over January 1991 for enterococcal bacteria, in order to determine whether they present a health risk. The survey gives the levels of bacteria at the various sites, determining whether they are suitable for swimming at. It also measured water temperatures, dissolved oxygen, ammonium nitrogen and dissolved reactive phosphorus levels for each site.

Location: WKRG.

316.

Reid, V. 1991: The phytoplankton of Lake Tarawera. Taupo Research Laboratory, Department of Scientific and Industrial Research, Report 120. 12 pp.

The phytoplankton of Lake Tarawera were examined to investigate the possible dominance of blue-green algae in the lake. Samples were taken from August 1989-August 1990. The phytoplankton species and chlorophyll *a* concentrations found were typical of an oligotrophic lake. Blue-green algae were present and composed at most a third of the cell numbers over the summer months but were far less prominent over the rest of the study.

Location: WKRG.

317.

RDC. 1991: Rotorua effluent purification project: souvenir handbook. Rotorua District Council. Rotorua. 31 pp.

An overview is given of the history of sewage treatment in Rotorua, how this has affected the water quality of Lake Rotorua, and what actions have been taken to redress this in the past. It describes how the new sewage treatment station operates, and contains brochures and articles about the effluent purification project.

Location: AEC.

318.

Wells, R.D.S.; Clayton, J.S. 1991: Submerged vegetation and spread of *Egeria densa* Planchon in Lake Rotorua, central North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 25: 63-70.

Scuba surveys of Lake Rotorua show that between 1980-1988 changes have occurred in the distribution and abundance of aquatic macrophytes. *Lagarosiphon* weed beds disappeared at the same time as a marked reduction in water clarity, while *Egeria* became the most abundant macrophyte in the lake.

Location: WU.

319.

White, E.; Cooper, A.B. 1991: A desk study of the nutrient load on Lake Tarawera, with an assessment of prospects for lake water quality management by manipulation of land use or point nutrient sources. Division of Marine and Freshwater Science, Department of Scientific and Industrial Research. 32 pp.

This was undertaken in order to better understand and assess the reliability of estimates of the nutrient load on Lake Tarawera, by studying existing data and possible changes and their effects. It offers recommendations for further study and modification of the nutrient loads of Lake Tarawera.

Location: WKRG.

320.

White, E.; Forsyth, D.J.; Reid, V. 1991: The plankton of Lake Tarawera - with an assessment of features promoting blue-green algae (cyanobacteria). Taupo Research Laboratory, Department of Scientific and Industrial Research. 18 pp.

A study was made of the plankton in Lake Tarawera, focussing on the dominance, location and abundance of the several species. The plankton were examined over time to determine seasonal variability and nutrient availability and demand. The possibility of a growth in blue-green algae was considered. The total nitrogen and phosphorus content of the lake was also measured, and showed Lake Tarawera to be oligotrophic.

Location: WKRG.

1992

321.

Gibbs, M.M. 1992: Influence of hypolimnetic stirring and underflow on the limnology of Lake Rotoiti, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 26: 453-463.

A study was made of the effects of an underflowing density current and geothermally induced hypolimnetic stirring in Lake Rotoiti.

Location: WU.

322.

McIntosh, J.J. 1992: Investigation of septic tank effluent disposal in the Bay of Plenty. Bay of Plenty Regional Council Technical Publication 6. Whakatane.

This report was undertaken to review the use and performance of septic tank systems in the Bay of Plenty, to examine the factors influencing their effectiveness, and to assess their impact. It includes an examination of septic tank systems in the Rotorua district and brief information on the Rotorua district nutrient budgets and the effects of septic tank populations on the nutrient budget.

Location: RDC.

323.

White, E.; Payne, G.W.; Pickmere, S.E. 1992: The restoration of Lake Rotorua - comment on progress. Taupo Research Laboratory, Department of Scientific and Industrial Research, File Report 138. 15 pp.

Lake water conditions between 1988 and 1992 are summarised in relation to the nutrient reduction targets determined necessary to restore Lake Rotorua to the conditions of the 1960s. Since 1987, phosphorus loads were reduced but then increased to the same levels as before. Nitrogen levels remained stable until the new sewage treatment system became operative in 1991, when the nitrogen load was substantially reduced. The lake was inspected both before and after the nitrogen stripping plant became effective, and water quality variables including water clarity, water temperature, nutrient content and algal

biomass were assessed.

Location: WKRG.

1993

324.

Coffey, B.T. 1993: Lake Rotorua: status report - 1993. Brian T. Coffey and Associates Ltd. Hamilton. 46 pp.

A review of the current status of Lake Rotorua was made for the organisation World Wide Fund for Nature - New Zealand (WWF-NZ), in order to identify conservation issues, and to make suggestions regarding the management of the lake in the future. It gives a brief history of the lake and catchment, including lakeweed, algal blooms, nutrient input and current management issues, and emphasises its cultural and national significance. It also comments on the interest which WWF-NZ has in protecting and rehabilitating the lake, and suggests that WWF-NZ has relevant expertise in habitat management and could have a constructive role to play.

Location: WKRG.

325.

Donald, R.C. 1993: Bay of Plenty Regional Council Natural Environment Regional Monitoring Network: freshwater ecology programme, lakes component, 1991/92. Bay of Plenty Regional Council Technical Report 40. Whakatane. 113 pp.

The results of the August 1991-November 1992 monitoring of the Rotorua lakes under the Freshwater Ecology Monitoring Network scheme are given. Most of the monitoring was concerned with phytoplankton in the lakes, and a list of the species recorded in the lakes is included. Chlorophyll *a*, nutrients in the lake water and water clarity were also analysed.

Location: WKRG.

326.

Gifford, J.S.; Hannus, I.M.; Judd, M.C.; McFarlane, P.N.; Anderson, S.M.; Amoamo, D.H. 1993: Assessment of chemical contaminants in the Lake Rotorua catchment. Forest Research Institute. Rotorua. 93 pp.

An assessment was made of the potential contaminants, including wood treatment chemicals, in the catchment of Lake Rotorua, and their possible significance to the environment and to public health. It examined where contaminants entered the catchment and what their fate was afterwards. The primary contaminants considered were chemicals related to wood preservation such as pentachlorophenol and boron, but others were also examined.

Location: WKRG.

327.

McIntosh, J.J. 1993: Bay of Plenty Regional Council Regional Monitoring Network: bathing suitability survey, 1993. Bay of Plenty Regional Council Environmental Report 93/1. Whakatane. 77 pp.

The testing of ocean and lake beaches and river swimming holes in the Bay of Plenty for enterococcal bacteria, in order to determine whether they conform to Department of Health (1992) guidelines, is described. A list is given of the top 10 of each type, and gives their levels of bacteria, determining whether they are suitable for swimming at. Other variables tested were water temperature, dissolved oxygen, dissolved reactive phosphorus and ammonium and nitrate nitrogen.

Location: WKRG.

328.

McIntosh, J.J. 1993: Water Quality Regional Monitoring Network Annual Report 1990/91. Bay of Plenty Regional Council Technical Report 35. Whakatane. 93 pp.

The results are detailed of the June 1990-December 1991 monitoring of the Bay of Plenty rivers and lakes under the Freshwater Ecology Monitoring Network scheme. This includes eleven of the lakes in the Rotorua district. Most of the lakes monitoring was concerned with oxygen depletion, but water temperature, nutrients in the lake water and water clarity were also analysed. Each lake is examined separately in the report.

Location: WKRG.

329.

Power, F.M.; Donald, R.C. 1993: Blue-green algal bloom - Lake Rotoehu. Unpublished report, Bay of Plenty Regional Council. Whakatane. 12 pp.

The recent algal bloom in Lake Rotoehu is studied and its impact on the community and lake ecology commented upon. A letter and journal article on blue-green algae are attached.

Location: WKRG.

330.

Sigma Consultants; Bioresarches Ltd.; NIWA; Forest Research Institute. 1993: Report on rural land use practices in the Rotorua District. Rotorua.

The aim of this study was to identify desirable land use parameters which could be incorporated into the Rotorua District Plan to protect water quality in the district. It identified key sources of nutrient input to fourteen lakes and identified desirable water quality targets for each. In this study, water clarity is used as the measure of water quality. The report describes catchment characteristics and land uses, geothermal fields, lakes and main rivers, and springs. It plans for water quality in the future, looks at options, and produces a scenario reflecting controls developed such as riparian planting, septic tank management, and no further conversion to pasture, and examines how these would affect Lake Rotorua.

Location: RDC.

1994

331.

Downes, M.T.; Hawes, I. 1994: Plant pigment stratigraphy in Lake Okaro. NIWA Consultancy Report SCJ135. Hamilton.

Not sighted.

332.

Robinson, B.H. 1994: Pollution of the aquatic biosphere by arsenic and other elements in the Taupo Volcanic Zone. MSc. thesis, Massey University.

A study was made of probable sources of polluting elements entering waterways in the Taupo Volcanic Zone, including several of the lakes in the Rotorua district. The main element discussed was arsenic, but other elements were included in the study. The survey was carried out using water and sediment samples and analysis of trout and freshwater mussel samples.

Location: WKRG.

333.

Rowe, D.K. 1994: Vertical segregation and seasonal changes in fish depth distributions between lakes of contrasting trophic status. *Journal of Fish Biology* 45: 787-800.

The depth distributions of fish species in Lakes Rotoiti, Rotoma and Okataina were studied over time to determine seasonal changes and vertical structuring between species and lakes of differing trophic status.

Location: WU.

1995

334

Blomkvist, D.; Lundstedt, L. 1995: Sediment investigation of the Rotorua Lakes. Environment B.O.P. Environmental Report 95/23. Whakatane. 38 pp.

The sediments in twelve lakes in the Rotorua area were examined to help determine the geochemistry and trophic status of the lakes.

Location: AEC.

335.

Burns, N.M. 1995: Rotorua Lakes monitoring and assessment. NIWA Consultancy Report BPR301. Hamilton.

Not sighted.

336.

Deely, J.M.; McIntosh, J.J.; Gibbons-Davies, J. 1995: Water Quality Regional Monitoring Network: Lakes report, 1990-1995. Environment B.O.P. Environmental Report 95/22.

Whakatane. 222 pp.

Methodology and results are discussed for the years 1990-1994 (and in some cases 1995) of the Lake Water Quality Regional Monitoring Network, which is a part of the Natural Environment Regional Monitoring Network (NERMN). It sampled thirteen lakes in the District, and gives details for each of levels of dissolved oxygen, water clarity, chlorophyll *a* concentration, nutrients, and rate of oxygen depletion.

Location: RDC.

337.

Hall, J.A.; Payne, G.W.; Smith, R. 1995: Review of Rotorua water quality. NIWA Consultancy Report BPR302. Hamilton. 13 pp.

This survey of Lake Rotorua was intended to determine whether the water quality of the lake has improved since the removal of sewage effluent from the inputs to the lake. It continues the monitoring of the lake from the results published by White et. al. in 1991 (No.323). Nutrient loads, water clarity and phytoplankton population have been considered in this analysis.

Location: WKRG.

338.

Kim, J.P. 1995: Methylmercury in rainbow trout (*Oncorhynchus mykiss*) from Lakes Okareka, Okaro, Rotomahana, Rotorua and Tarawera, North Island, New Zealand. *The Science of the Total Environment* 164: 209-219.

Measurements of methyl mercury were taken from the muscle tissue of rainbow trout from five lakes in the Rotorua district in order to estimate the variation of methyl mercury levels both between fish of different age and size in the same lake and between fish from different lakes. It was determined that both fish size and geothermal inputs into the lakes influenced the levels found in the trout.

Location: DH.

339.

Rowe, D.K.; Chisnall, B.L. 1995: Effects of oxygen, temperature and light gradients on the vertical distribution of rainbow trout, *Oncorhynchus mykiss*, in two North Island, New Zealand, lakes differing in trophic status. *New Zealand Journal of Marine and Freshwater Research* 29: 421-434.

The vertical distribution of rainbow trout in Lakes Rotoiti and Rotoma was determined, and limiting factors such as water temperature, oxygen levels and water clarity were related to the results.

Location: WU.

340.

Ruff, K.; Deely, J.M. 1995: Natural Environment Regional Monitoring Network: bathing suitability survey (1995). Environment B.O.P. Whakatane. 85 pp.

A report is made of the testing of ocean and lake beaches and river swimming holes in the Bay of Plenty for enterococcal bacteria, in order to determine whether they conform to Department of Health (1992) guidelines. The report lists the top 10 of each type, and gives their levels of bacteria, determining whether they are suitable for swimming at.

Location: RDC.

341.

Wells, R.D.S.; Hall, J.A. 1995: Report to the Water Net Technical Committee. NIWA Internal Report 95/05. 27 pp.

Details are given of the state of water net in areas of the North Island over the summer of 1994-1995. The report comments on the growth of the weed, on the state of the habitat where it grew, and on actions taken to prevent the growth and spread of the plant. Over this summer there was less water net than over the last several years.

Location: HWA.

1996

342.

Donald, R.C. 1996: Rotorua lakes algal monitoring 1991-1995. Environment B.O.P. Environmental Report 96/21. Whakatane. 69 pp.

This report continues the NERMN lakes monitoring undertaken in 1991-1992. It focusses mainly on phytoplankton, but also examines stratification, nutrients in the lake, water clarity, and other determinands which can give indications of a lake's trophic state. Each lake is examined separately in the report. Since 1991, there have been intense blooms of blue-green algae in Lake Rotoehu and it has decreased from a mesotrophic to a eutrophic state.

Location: WKRG.

343.

Gibbs, M.M.; Lusby, F.E. 1996: Lake edge wetlands: Their environmental significance to the Rotorua Lakes. NIWA Consultancy Report BPR005/2. Hamilton. 45 pp.

The findings are given of the second year of a 2-year study "to provide scientific information on the role of lake edge wetlands in controlling the quality of ground water entering lakes and hence their value in protecting lake water quality". It evaluates in detail nutrient transformation processes within one wetland at Lake Okareka and interprets these findings with respect to the other lake edge wetlands studied in the Rotorua district.

Location: RDC.

344.

Rutherford, J.C.; Dumnov, S.M.; Ross, A.H. 1996: Predictions of phosphorus in Lake Rotorua following load reductions. *New Zealand Journal of Marine and Freshwater Research* 30: 383-396.

The rate of recovery of Lake Rotorua following external load reductions is estimated by modelling temperature, dissolved oxygen, and phosphorus in both lakewater and sediment. The model was mostly accurate, and predicts a noticeable reduction in lakewater phosphorus concentration but only a slow reduction in sediment phosphorus within the next 20 years.

Location: WU.

345.

Wells, R.D.S.; Clayton, J.S. 1996: The impacts of weed beds and diquat spraying on the freshwater mussel, *Hyridella menziesi*. NIWA Consultancy Report DOC312. Hamilton. 23 pp.

The impact of the invasion of adventive aquatic weeds and the spraying of these weeds with diquat on freshwater mussels in Lake Rotorua is discussed. The freshwater mussels were chosen for study as they can be used as a biomonitoring mechanism, providing indications of the contaminants in their environment, and are a major component of the benthic community in Lake Rotorua. No evidence was found to suggest that diquat spraying had had any effect upon mussel abundance or distribution.

Location: DOC.

346.

Williamson, R.B.; Smith, C.M.; Cooper, A.B. 1996: Watershed riparian management and its benefits to a eutrophic lake. *Journal of Water Resources Planning and Management* 122: 24-32.

Sediment and nutrient loads from the Ngongotaha Stream catchment were measured before and after retirement of the catchment, and predictions made of the impact to the entire Lake Rotorua catchment if these measures were undertaken throughout the lake catchment.

Location: AUEN.

1997

347.

Burns, N.M.; Deely, J.M.; Hall, J.A.; Safi, K. 1997: Comparing past and present trophic states of seven Central Volcanic Plateau lakes, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 31: 71-87.

An examination was made of data on seven lakes in the Rotorua area to determine what changes in their trophic states had occurred since 1970. The analysis was designed to identify small changes in the lakes' trophic status, and uses many variables including

phosphorus, nitrogen, water clarity, chlorophyll *a* and phytoplankton. The results of the study show that Lakes Rotorua and Rotoiti have become less eutrophic, Lakes Okareka and Rotoma may have done the same, Lakes Okataina and Rotokakahi remain the same, and Lake Tikitapu may be more eutrophic.

Location: ROFO.

348.

Burns, N.M.; Rutherford, J.C. 1997: Results of monitoring New Zealand lakes, 1992-1996: Volume 3 - Data and Results. NIWA Client Report MFE70210. Hamilton.

Seventeen New Zealand lakes, including Lakes Rotorua, Rotoiti, Okataina, Tarawera, Rotokakahi and Okareka, were monitored from 1992-1996. The survey collected information on chlorophyll *a* concentrations, total phosphorus and total nitrogen, water clarity, dissolved oxygen depletion rate, and phytoplankton species and biomass, which might provide indications of the lakes' trophic status. This volume contains the data gathered, and the results of analysis of the data collected on each lake, viewed individually.

Location: WKRG.

349.

Deely, J.M.; Hodges, S.; McIntosh, J.J.; Bassett, D. 1997: Enterococcal numbers measured in waters of marine, lake, and river swimming sites of the Bay of Plenty, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 31: 89-101.

Coastal, lake and river swimming sites in the Bay of Plenty were sampled for enterococci as indicators of bathing suitability, and the results compared to the health guidelines, and to the presence of sewage effluent.

Location: ROFO.

350.

Donald, R.C. 1997: Rotorua lakes summary report. Environment B.O.P. Environmental Report 97/21. Whakatane. 39 pp.

A summary of information on the Rotorua lakes is given in order to contribute towards the development of the Rotorua Lakes Strategy. The report covers areas such as land cover percentage, resource consents held, and water quality of the lakes. The summarised statistics of water quality, however, only cover the periods 1955-56, 1990-1991, and 1992-1994. The summary also gives a ranking of restoration priority to each lake based on trophic status, and options for this restoration.

Location: AEC.

351.

Gall, M.P.; Downes, M.T. 1997: Algal pigment stratigraphy in four Rotorua lakes: Okataina, Okareka, Okaro and Rotorua. NIWA Client Report CHC97/78. Christchurch. 42 pp.

A study was made of the algal productivity in the lakes over the last hundred years. Analyses of sediment core samples show some increase in algal pigments and a steady increase in algal productivity in the lakes studied, although over varying timescales in the different lakes. The lakes were chosen to represent a range of trophic states and catchment developments. The chlorophyll pigments also indicate the species of algae present in the lakes at the time.

Location: WKRG.

352.

Macaskill, J.B.; Cooper, A.B.; Bowman, E.J. 1997: Nitrogen and phosphorus in streams draining catchments of different landuse in the Rotorua Lakes region. NIWA Client Report BPR223. Hamilton. 26 pp.

This report was undertaken to assist Environment B.O.P.'s Lake Management Plan. It contains a study on nitrogen and phosphorus levels in baseflow of streams from different landuse catchments, such as pasture, exotic forest and native forest. It focuses on the nitrogen/phosphorus ratio in surface waterways, with the streams sampled exiting catchments so that results reflect both landuse and instream processes, reflecting the reality of water entering a lake. The study also refers to the Mylechreest hypothesis (No.285).

Location: RDC.

353.

Miller, N.C. 1997: Okawa Bay, Lake Rotoiti: environmental impact of resort wastewater effluent. Analytical & Environmental Consultants. Rotorua. 23 pp.

The aquatic and terrestrial vegetation of Okawa Bay were examined to determine whether the wastewater of the area has any effects upon the environment. The nutrient input from the Okawa Bay wastewater is also compared with other inputs in the same area.

Location: AEC.

354.

Rodda, H.; Thorrold, B.; Stroud, M. 1997: Predicting the effects of land use on the water quality of the Ngongotaha Stream. NIWA Client Report BOP60207. Hamilton.

Not sighted.

355.

Wells, R.D.S. 1997: An assessment of the Rotorua Lakes for aquatic weed control (1996). NIWA. Hamilton. 40 pp.

This is an annual assessment of the weed in the Rotorua lakes in order to determine the level of control needed. It gives information as to where the weed beds are, what growth they have achieved, and what treatment they should be given that year, as well as any relevant history for that area.

Location: DOC.

356.

Wells, R.D.S. 1997: Lake Rotoiti diquat treatment (Spring 1996) Post-spray evaluation. NIWA Client Report DoC70212/Phase 2. Hamilton. 34 pp.

An assessment was made of the weed in Lake Rotoiti in order to determine the effect of diquat spray on previously sprayed sites. It gives information as to where the weed beds are, what growth each site has achieved, and whether they need to be re-treated that year, as well as providing any relevant history for that area.

Location: WKRG.

357.

Wells, R.D.S.; Clayton, J.S. 1997: An assessment of the Rotorua Lakes for aquatic weed control and recommended programme for (1997/98). NIWA. 54 pp.

Not sighted.

358.

Wells, R.D.S.; de Winton, M.D.; Clayton, J.S. 1997: Successive macrophyte invasions within the submerged flora of Lake Tarawera, central North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 31: 449-459.

The invasion of Lake Tarawera by the four water weeds *Lagarosiphon major*, *Ceratophyllum demersum*, *Egeria densa*, and *Elodea canadensis* is described, as well as their competitive interactions since the 1970s. The submerged vegetation patterns of both native and adventive water weeds were studied in successive expeditions and are examined. Lake Tarawera is so far the lake with the clearest water in New Zealand to be invaded by these weeds.

Location: ROFO.

359.

Young, K. 1997: Lakeweed management in the Rotorua Lakes: a working guide. Department of Conservation. Rotorua.

This provides a guide in weed management and history for NIWA, who took over the control of lakeweed in the Rotorua Lakes from the Department of Conservation. It looks at issues such as assessment, monitoring, public consultation, Resource Management Act requirements and weed control. In the appendices it contains examples of previous assessment of the weed in the Rotorua lakes, which give information as to where the weed beds are, what growth they have achieved, and what treatment they should be given that year, as well as any relevant history for that area.

Location: DOC.

1998

360.

Burns, N.M.; Rutherford, J.C. 1998: Results of monitoring New Zealand lakes, 1992-1996: Volume 1 - General findings. NIWA Client Report MFE80216. Hamilton. 30 pp.

Seventeen New Zealand lakes, including Lakes Rotorua, Rotoiti, Okataina, Tarawera, Rotokakahi and Okareka, were monitored from 1992-1996. The survey collected information on chlorophyll *a* concentrations, total phosphorus and total nitrogen, water clarity, dissolved oxygen depletion rate, and phytoplankton species and biomass, which might provide indications of the lakes' trophic status. This volume of the study presents a summary of the findings.

Location: WKRG.

361.

Burns, N.M.; Rutherford, J.C. 1998: Results of monitoring New Zealand lakes, 1992-1996: Volume 2 - Commentary on results. NIWA Client Report MFE80216. Hamilton. 125 pp.

Seventeen New Zealand lakes, including Lakes Rotorua, Rotoiti, Okataina, Tarawera, Rotokakahi and Okareka, were monitored from 1992-1996. The survey collected information on chlorophyll *a* concentrations, total phosphorus and total nitrogen, water clarity, dissolved oxygen depletion rate, and phytoplankton species and biomass, which might provide indications of the lakes' trophic status. This volume of the study contains the methodology used and a commentary on the results of the analysis of the data and recommendations for monitoring strategies.

Location: WKRG.

362.

Deely, J.M. 1998: Summary of water quality of Lakes Okareka and Tarawera and the channel connecting these two lakes. Environment B.O.P. Whakatane. 57 pp.

The water quality of both Lakes Okareka and Tarawera is described, as well as the effects which high flood water levels have upon the residential properties and septic tanks surrounding Lake Okareka. This report was created to accompany and support Environment B.O.P.'s application for consent to control the water level of Lake Okareka.

Location: WKRG.

363.

Wells, R.D.S. 1998: Lake Rotoiti diquat treatment December 1997 post-spray evaluation. NIWA Client Report LINZ80201/Phase2. Hamilton. 40 pp.

An assessment is made of the weed in Lake Rotoiti and Lake Rotoehu in order to determine the effect of diquat spray on previously sprayed sites. Information is given on the location of weed beds, what growth has been achieved at each site, and whether they need to be re-treated that year, as well as providing any relevant history for that area.

Location: WKRG.

1999

364.

Burns, N.M. 1999: Lake Rotorua and its inputs in the 1990's. Lakes Consulting. Pauanui. 55 pp.

The Waipa and Puarenga Streams are studied, examining the effects of the wastewater land treatment scheme and the sewage input to these streams during the 1990s. The amounts, sources and concentrations of non-sewage nutrient inputs into Lake Rotorua in the 1990s are also compared with those in the 1970s, referring to Hoare's study on inputs (No.204), and conclusions drawn.

Location: WKRG.

365.

Burns, N.M.; Rutherford, J.C.; Clayton, J.S. 1999: A monitoring and classification system for New Zealand lakes and reservoirs. *Journal of Lake and Reservoir Management* 15: 255-271.

New Zealand lakes were monitored for five variables - chlorophyll *a*, total phosphorus and total nitrogen, water clarity and dissolved oxygen depletion rate. These were evaluated as indicators of change (Percent Annual Change) and trophic status (Trophic Level Index).

Location: LWQS.

366.

Chapman, M.A.; Green, J.D. 1999: Crustacean zooplankton communities in a New Zealand lake during four decades of trophic change. *New Zealand Journal of Marine and Freshwater Research* 33: 361-373.

The results of three studies of crustacean zooplankton in Lake Rotorua in 1955-1956, 1967-1969, and 1994-1995 are examined. There has been no change in species composition over this time, despite the increased eutrophication of the lake. However, species abundance has changed. Abundance cycles are irregular, perhaps depending mainly on storms or other stochastic events. Each species of zooplankton is examined separately as well as an overall summary being given.

Location: ROFO.

367.

Kim, J.P.; Burggraaf, S. 1999: Mercury bioaccumulation in rainbow trout (*Oncorhynchus mykiss*) and the trout food web in Lakes Okareka, Okaro, Tarawera, Rotomahana and Rotorua, New Zealand. *Water, Air, and Soil Pollution* 115: 535-546.

Rainbow trout, their food chain and the ambient waters were examined for methyl mercury and total mercury concentrations in five lakes in the Rotorua district in order to study the bioaccumulation of methyl mercury in the trout food web. The greatest bioaccumulation occurs at the lower trophic levels.

Location: DH.

368.

Wells, R.D.S. 1999: Aquatic weed control in the Rotorua Lakes (summer 1998/9). NIWA Client Report LNZ90201. Hamilton. 65 pp.

An annual assessment was carried out on the weed in Lakes Rotorua, Rotoiti, and Tarawera in order to determine the effect of diquat spray on previously sprayed sites. It gives information on the location of weed beds, what growth has been achieved at each site, and whether they need to be re-treated that year, as well as providing any relevant history for that area.

Location: WKRG.

2000

369.

Burns, N.M. 2000: Trophic level index values for six Rotorua district lakes, 1990-2000. Lakes Consultancy Client Report 2000/1. Pauanui. 90 pp.

The results of monitoring six lakes in the Rotorua district between 1990-2000 are given in order to determine the lakes' relative trophic levels and status.

Location: WKRG.

370.

Pitkethley, R. 2000: Lake fisheries summer creel surveying - 1999-2000 summer monitoring report. Fish & Game New Zealand, Eastern Region. Rotorua. 20 pp.

A survey was taken of the size and number of the trout caught on Lakes Rotoiti, Tarawera and Rotorua, and the results compared with those of previous years. It was suggested that the water quality and algal content of the lakes has an affect upon the trout fishery.

Location: ERFG.

371.

Ray, D.; Gibbs, M.M.; Turner, S.; Timpany, G. 2000: Septic tanks leachate study for Rotorua Lakes. NIWA Client Report RDC00205/2. Hamilton. 74 pp.

The potential for septic tank leachate contamination of lake margins on Lakes Rotorua, Rotoiti and Okareka is examined. The authors were commissioned to determine a minimum horizontal setback between the tank soakage field and the lake margins, but instead recommended a minimum vertical setback between the bottom of the tank soakage field and the top of the groundwater table. They also prioritised such problem areas as Mourea, Hinehopu, Hamurana and Okareka.

Location: RDC.

372.

Rutherford, J.C.; Nguyen, L.; Charleson, T. 2000: Nitrogen removal in natural wetlands below the Rotorua land treatment site. In: Proceedings of the New Zealand Water and Wastes Association 42nd Annual Conference. New Zealand Water and Wastes Association. Rotorua. 10 pp.

The copy viewed was a CD-ROM containing the proceedings of the conference. The authors examined the wetlands below the sewage land treatment site in the Whakarewarewa Forest, and used a computer model to examine possible remedial measures for the problem of increased nitrification, which were then discussed.

Location: HU.

373.

Wells, R.D.S.; Dugdale, T.M.; Taumoepeau, A.T. 2000: Aquatic weed control in the Rotorua Lakes (1999/2000). NIWA Client Report LNZ00202. Hamilton. 50 pp.

Not sighted.

374.

Wilding, T.K. 2000: Rotorua lakes algae report. Environment B.O.P. Environmental Report 2000/06. Whakatane. 98 pp.

The results of phytoplankton monitoring of the Rotorua Lakes since 1991 are given. The incidence of blue-green algal blooms in three of the lakes has also been commented upon. The water quality of Lake Rotoehu, Lake Rerewhakaaitu and Okawa Bay has deteriorated over the last few years. Lake Rotorua may have improved slightly but has suffered blooms of algae, and has also been invaded by a new algal species which created foam outbreaks in 1998.

Location: WKRG.

2001

375.

Burns, N.M. 2001: Trophic level index baselines and trends for 12 Rotorua district lakes, 1990 to 2000. Lakes Consultancy Report 2001/2. Pauanui. 81 pp.

The results are given of a monitoring programme carried out on twelve lakes in the Rotorua district between 1990-2000 in order to determine their relative trophic levels and status. The evaluation system used is quantitative rather than qualitative, allowing a baseline to be made for comparison with future trophic values, and with the desired state of the lake. Over the decade studied, Lakes Okareka, Okaro, Rerewhakaaitu and Rotoehu have deteriorated, Lakes Rotorua and Rotoiti have remained stable, rather than improving, and Lakes Okataina, Rotokakahi, Rotoma, Rotomahana, Tarawera and Tikitapu have also remained stable, and are close to their desired management levels.

Location: WKRG.

376.

Burns, N.M. 2001: Trophic level trends in 12 Rotorua District Lakes: 1990 to 2000. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 37-54.

The trends in Trophic Level Index ratings of twelve of the Rotorua lakes between 1990-2000 are shown, and the data is discussed.

Location: LWQS.

377.

Clayton, J.S.; Wells, R.D.S. 2001: Weed management in the Rotorua Lakes. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 113-126.

The history of lakeweed and weed management in the Rotorua lakes is outlined, and recommendations for management in the future are given.

Location: LWQS.

378.

Gibbons-Davies, J. 2001: Rotorua lakes water quality. Environment B.O.P. Whakatane. 43 pp.

This report examines and updates the trophic status of seven lakes in the Rotorua District, using the LakeWatch software programme to analyse the water quality data.

Location: LWQS.

379.

Gibbs, M.M.; Matheson, F.E. 2001: Lake edge wetlands and their importance to the Rotorua Lakes. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 99-106.

The findings are summarised of a study to provide scientific information on the role of lake edge wetlands in controlling the quality of groundwater, particularly dissolved inorganic nitrogen, entering lakes and hence their value in protecting lake water quality.

Location: LWQS.

380.

Gunn, I. 2001: Review of on-site effluent treatment and disposal for specific communities. Auckland UniServices Ltd. Auckland. 45 pp.

Several Bay of Plenty rural communities' methods of effluent treatment are examined, including settlements in the Rotorua lakes district. The report gives statistics of systems which have failed inspection.

Location: AEC.

381.

Hall, J.A. 2001: The impact of potential blue-green algal blooms on catchment management in the Rotorua lakes. NIWA Client Report BOP01203. Hamilton. 11 pp.

The theories put forward by Mylechreest (1988) regarding 'the importance of low nitrogen: phosphorus ratios to blue-green algae occurrence in the Rotorua lakes and how this relates to catchment management practices' are considered. This study reviews points of the hypothesis in the light of new knowledge about catchment and lake processes. It concludes that if possible, nitrogen and phosphorus loads in a lake should not be increased.

Location: WKRG.

382.

Hall, J.A.; James, M.R.; Rowe, D. 2001: The impact of eutrophication on aquatic food webs as it applies to the Rotorua Lakes. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 107-111.

The nutrient status of a lake is a key factor in determining the structure of the lake's food web. Examples are given from the Rotorua lakes.

Location: LWQS.

383.

Hendy, C.; Paku, L. 2001: Shallow groundwater chemistry in the Whakarewarewa Forest and its implications for Lake Rotorua. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 89-97.

Analysis was carried out on the water chemistry of groundwaters from sites in the Whakarewarewa Forest, and the sources of the groundwater identified.

Location: LWQS.

384.

McIntosh, J.J. 2001: Environment B.O.P.'s lake management plans, present and future. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 71-75.

The management of the Rotorua Lakes by Environment B.O.P. over time and the methods and plans used for this management are summarised.

Location: LWQS.

385.

McIntosh, J.J.; Futter, P.; Gibbons-Davies, J. 2001: Monitoring of on-site effluent treatment regional plan. Environment B.O.P. Whakatane. 92 pp.

The implementation of the monitoring programme is described, and tables of the results

are also provided. The monitoring programme covered not only the Rotorua lakes, but the coastal sites in the Bay of Plenty, as this is an Environment B.O.P. initiative.

Location: AEC.

386.

McIntosh, J.J.; Ngapo, N.; Stace, C.E.; Ellery, G.R.; Gibbons-Davies, J. 2001: Lake Rerewhakaaitu Project. Environment B.O.P. Environmental Report 2001/15. Whakatane. 84 pp.

Details are given of the results of a study of Lake Rerewhakaaitu, carried out to examine the water quality and its inflows, the aquatic macrophytes, to determine the effectiveness of the conservation plantings in retirement areas, determine the intensity of land use in the catchment, and develop a plan for the future management of the lake and catchment.

Location: WKRK.

387.

Miller, N.C. 2001: Tarawera Landing water quality study. Analytical & Environmental Consultants. Rotorua. 26 pp.

The impact on water quality of the current activities being carried out at the Landing at Lake Tarawera was assessed. Streams, stormwater runoff and wastewater disposal were examined for nutrients, bacteria and other variables.

Location: AEC.

388.

Mylechreest, P.H.W.; Burdon, R.D. 2001: Nitrogen: guardian of lakewater quality? In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 77-81.

It is suggested that undue reduction of nitrogen inflows into nitrogen-limited lake waters may cause cyanobacterial blooms in the Rotorua lakes, and that fluctuations in nitrogen inputs can be a major cause of declines in water quality.

Location: LWQS.

389.

Pang, L.; Davies, H.; Hall, C.; Stanton, G. 2001: Setback distance between septic tanks and bathing shores of Lake Okareka. NIWA Client Report CSC0110. Hamilton. 91 pp.

An investigation is made into the minimum distance which should be recommended between septic tank soakage fields and the lakeshore of Lake Okareka, particularly where there is public bathing.

Location: RDC.

390.

Pitkethley, R. 2001: Exploring the links between Lake Rotorua's trout fishery and algal communities. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 193-202.

An investigation was made of trout catch rates and algal monitoring data from Lake Rotorua and correlations between the two sets of data made.

Location: ERFG.

391.

Silvester, W.B. 2001: Opinion on the paper: "The links between exotic forestry land use and trout growth" by Peter Mylechreest (1988). University of Waikato. Whakatane. 21 pp.

The theories put forward by Mylechreest (1988) regarding 'the importance of low nitrogen: phosphorus ratios to blue-green algae occurrence in the Rotorua lakes and how this relates to catchment management practices' are considered. This study was requested by Environment B.O.P., and considers the arguments underpinning the hypothesis and the questions which it asks. It agrees that the phosphorus load on the lakes should be reduced, but not that further nitrogen be added.

Location: AEC.

392.

Wilding, T.K. 2001: Rotorua Lakes blue-green algae monitoring. In: Miller, N.C.; Miller, E.M.; McLean, I. (eds.): Proceedings and report: Rotorua Lakes 2001: a symposium on research needs of the Rotorua Lakes. LakesWater Quality Society Inc. Rotorua. pp. 25-36.

The monitoring of the Rotorua Lakes for blue-green algae by Environment B.O.P. is summarised, as well as the results of this monitoring. The report covers spatial and temporal trends, algal species present, toxicity, and predictions for the future.

Location: AEC.

2002

393.

Don, G.L.; Donovan, W.F. 2002: First order estimation of the nutrient and bacterial input from aquatic birds to twelve Rotorua lakes. Bioresearches Ltd. Auckland. 58 pp.

A study was made to assess the contribution of waterbirds to the nutrient and bacterial input to several of the Rotorua lakes. Previous literature on this topic, which was researched, was limited. The report uses data from the 1996 wildlife survey of the lakes. It is determined that black swans make the greatest contribution but the total input per year is only equivalent to that provided by fewer than thirty dairy cows. The input to each lake is estimated.

Location: WKRG.

394.

Gibbons-Davies, J. 2002: Rotorua lakes water quality. Environment B.O.P. Whakatane.

This report examines and updates the trophic status of seven lakes in the Rotorua District, using the LakeWatch software programme to analyse the water quality data.

Location: DH.

395.

Matheson, F.E.; Clayton, J.S. 2002: Aquatic plant harvesting in lakes for nutrient renovation. NIWA Client Report HAM2002-010. Hamilton. 29 pp.

The issues of lakeweed harvesting and the likely benefits of such a programme with regard to nutrient renovation are outlined. This study looks at a wide range of sources, but it attempts to concentrate particularly on the Rotorua lakes and the probable consequences of a lakeweed harvesting programme.

Location: LWQS.

396.

Ray, D.; Gibbs, M.M.; Broekhuizen, N.; Rutherford, J.C.; Stephens, S. 2002: Okawa Bay water quality study. NIWA Client Report HAM2002-030. Hamilton. 85 pp.

The effectiveness of sewerage reticulation and/or diverting some flow from the Ohau Channel in improving water quality in Okawa Bay is examined, using computer modelling, measurements and monitoring. It was determined that these measures will affect the typical summer algae concentrations in the short term by only about 15%, as most of the nutrients in the bay water are from the lake bed and there is already a fairly large 'exchange flow' with the main lake. In the long term, improvements in the water quality of Lakes Rotorua and Rotoiti, combined with no sewage inputs, may have beneficial effects. The report also describes the history of the bay.

Location: RDC.

397.

Ray, D.; Gibbs, M.M.; Timpany, G. 2002: Septic tanks leachate study for Rotorua Lakes - Stage 2. NIWA. Hamilton. 94 pp.

This builds on the earlier report by Gibbs et. al. (No.371). It presents the findings of recent investigations at Hamurana, Okawa Bay, Okareka and Gisborne Point, and examines how much reticulating the Okawa Bay-Mourea area or diverting part of the Ohau Channel into Okawa Bay to flush it out and reduce residence time in Okawa Bay would change the water quality in the bay. Includes a separate report "Setback Distance between Septic Tanks and Bathing Shores of Lake Okareka" by Pang, L. et. al., 2001 (No.389).

Location: RDC.

398.

Ray, D.; Timpany, G. 2002: Measurement(s) of nitrogen inputs to Lake Okareka. NIWA

Client Report BOP01202/1. Hamilton. 16 pp.

Estimates are made of the nitrogen inputs into Lake Okareka from the whole catchment by measuring groundwater nitrogen concentrations along the lake shore over the course of a week and multiplying these by estimated flow rates to obtain mass flows of nitrogen. It also examined surface flow from Millar Road Stream. The report was intended to compare septic tank nitrogen inputs, which had been previously estimated, with the nitrogen inputs from the rest of the catchment. The title page has the title "Measurements of nitrogen inputs to Lake Okareka", but the inside title uses the word "Measurement" instead.

Location: WKRK.

399.

Rutherford, J.C.; Cooper, A.B. 2002: Lake Okareka trophic state targets. NIWA Draft Client Report BOP, July 2002. 12 pp.

This report was prepared for a draft Action Plan for Lake Okareka, to calculate the target lake water quality, reduce the Trophic Lake Index, and estimate the nitrogen and phosphorus load reductions required to achieve these targets. To date only a draft copy of this report has been viewed.

Location: RDC.

400.

Wells, R.D.S.; Champion, P.D.; Clayton, J.S.; Taumoepeau, A.T. 2002: Rotorua Lakes aquatic weed update to January 2002. NIWA Client Report DOC02240. Hamilton. 31 pp.

The changes in condition of the lakes since the last survey held in 1988 are summarised. Each lake is examined individually and the presence of new and current aquatic weed colonies noted and ranked for risk assessment on invasiveness, impact and opportunity. The report also comments on the possibility of integrating various monitoring programmes, and the various statutes which bear on the management of aquatic vegetation in the lakes.

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