AQUATIC MACROPHYTES OF THE WAIAU CATCHMENT - A REVIEW

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EXECUTIVE SUMMARY

Baseline information on the aquatic macrophytes of the Waiau catchment is reasonably good for the shorelines of Lakes Te Anau and Manapouri. The studies done on these lake shorelines and the Te Anau mires, as a result of proposals to raise the level of Lake Manapouri, have provided worthwhile information which includes the aquatic macrophytes. Dive surveys of the water plants in the lakes were conducted after hydro development, and given the sometimes slow rate of change in water plant communities, this information could be used as a baseline for future surveys.

Information on aquatic macrophytes in wetlands connected to the Waiau catchment is reasonably good, with Burrows and Dobson (1972) and the WERI database giving a good basic coverage. This information may be useful in the future, particularly in assessing the effectiveness of future wetland enhancement projects in the catchment.

Resurveys of the shoreline transects established in 1972 show the effectiveness of controls of lake levels in preventing damage to shoreline vegetation and habitats. The lack of information on deeper rooted aquatic plants shows that such information may be necessary to gauge the effects of sediment transport within the lakes. The aquatic plants database information from MAF Ruakura should help to provide the extra information needed to give a full vegetation sequence from the lake bed to upper shoreline. It may be worthwhile updating this information by doing a resurvey.

The shoreline survey of Lake Monowai gives a good indication of the eventual vegetation sequence which occurs when a more widely fluctuating lake level regime has operated for a long period. A general increase in more tolerant, adventive species (mainly introduced species) has occurred. Little can now be done to reverse this pattern, and the shoreline appears to have reached a new stability. Ongoing monitoring of existing transects is recommended, with the possibility of extending them to greater depth to get information on changes to the macrophyte beds.

Little information is available on the possible effects of eutrophication and silting of the lakes and lower Waiau river. Although no accidental discharges have been reported, more detailed information on eutrophication may be desirable. Phytoplankton monitoring close to the oxidation ponds may show up any excessive eutrophication. The effects of silting of macrophyte beds of the lakes and lower Waiau have not been studied. Theoretical studies of this issue suggest there may be a problem.

Other lakes could be used as "controls" for comparative studies of aquatic macrophytes. The Mavora lakes or nearby Lake Hauroko could be used for this purpose, although Hauroko is not part of the same catchment. Lake Gunn is another possiblity.

Lakeweeds pose a significant threat to environmental, aesthetic and tourism values within the Waiau catchment. *Lagarosiphon* and waternet (*Hydrodictyon*) could colonise the lakes of the region within the next ten years. Prevention measures are recommended.

5.1 SUMMARY OF RECOMMENDATIONS

1. Ongoing monitoring of shoreline vegetation transects in Lakes Manapouri, Te Anau and Monowai is worthwhile. If possible, the transects should be extended to lower depths to cover the full range of aquatic macrophytes.

2. Discharge from oxidation ponds and surface stormwater runoff into Lakes Manapouri and Te Anau could be assessed through monitoring phytoplankton, blue-green algae and rooted aquatic plants near discharge sites.

3. Studies from other nearby "control" lakes (e.g. Lake Hauroko) could be used for comparisons of aquatic vegetation with Lakes Te Anau, Manapouri and Monowai.

4. Techniques should be in place for preventing the introduction and establishment of noxious waterweeds, particularly *Lagarosiphon* and waternet (*Hydrodictyon*). Control of existing lakeweeds is not recommended as such control is unlikely to be cost-effective, given that the resources could probably be spent elsewhere to better effect.

5. A comparative study of the aquatic macrophytes, and periphyton, could be done for the upper Waiau (Wairau) and Lower Waiau rivers, and the Mararoa river. The effects of flow fluctuations, silting and water abstraction on aquatic plant growth in the Lower Waiau may then be determined.

1. INTRODUCTION

Repeated glacial advances and retreats to the east of Fiordland during the last ice age formed the main lakes of the Waiau catchment: Te Anau, Manapouri, Monowai and the Mavora lakes. These lakes are noted for their unspoilt nature, outstanding landscapes and high recreation and tourism values. They are further characterised by their clarity and oligotrophic (low nutrient) status.

Water plants are an important ecological component of these lakes and the rivers draining them. They provide the primary productivity to form the first link in the food chain. They provide and consume oxygen, and act as filters for organic nutrients. The aquatic flora present in a water body can either enhance or detract from its the environmental values.

Accordingly, as a preliminary to detailed investigations into the aquatic ecosystems of the Waiau catchment, a review of information on the aquatic macrophytes has been commissioned by the Waiau River Working Party. Issues involving aquatic macrophytes which this report will focus on include:

1. The effects on water plants of frequent lake level fluctuations caused by hydro power generation.
2. The effects of nutrient input into lakes Te Anau and Manapouri from township oxidation ponds i.e. the Te Anau discharge into the Upukorora stream, and the Manapouri discharge into Home creek. Water plants may be able to act as indicator species of eutrophication.
3. Silting of the lakeshores and the lower Waiau, and the possible effects of this on water plants.
4. Threats to the Waiau catchment from introduced lakeweeds.

1.1 BACKGROUND

Various texts outline the importance of submerged macrophytes as habitat and feeding grounds for invertebrates, fish and wildlife. Such plants are vulnerable to exposure and desiccation during times of prolonged low lake levels. Moreover, they do not readily establish on the beds of artificial or raised natural lakes if water levels are fluctuated widely. Rare and endangered native species of lakeshore plants and animals require careful management if biological and aesthetic values are to be maintained. Early plans to raise the levels of Lakes Manapouri and Te Anau would have caused loss of ecological stability along their shorelines, resulting in loss of wetland ecosystems that contain several rare indigenous plants.

Guidelines were established for lake operations which largely preserve the existing lakeshore communities. The upper third of the lake levels for Manapouri and Te Anau restrict both the duration of high levels, and the intervals between excursions to these levels; to provide for adequate drainage of root systems. There are no serious restrictions in operating within the middle third of the ranges for these lakes. In the lower third, however, there are limitations on both the rates of draw-down, and the duration of low

lake levels. This ensures adequate drainage of fine sediments and minimises losses of beach sediments.

2. METHODS

Records of shoreline and dive surveys of the main lakes (Te Anau, Manapouri, Mavora and Monowai) have been searched, along with investigations into management of river macrophytes and lakeweed threats. People with information on aquatic macrophytes in the Waiau have also been approached.

The information on aquatic macrophytes is presented with a description of the format in which the information is contained, brief notes on the information itself, and a comment on the potential the information may have as a baseline for future studies.

2.1 SUMMARY OF SOURCES APPROACHED FOR INFORMATION

The following sources were used to find information on aquatic macrophytes in the Waiau catchment:

Department of Conservation Files: (includes previous Lands and Survey, Wildlife Service and NZFS files)
Dunedin Conservancy Office
Invercargill Conservancy Office
Tuatapere Field Centre
Te Anau Field Centre

Southland Fish and Game Council Files
Otago Fish and Game Council files
Department of Conservation (Dunedin) Library

People approached for further information included:

- Dr John Clayton (MAFTech, Aquatic Plants Group, Ruakura)
- Mr Barry Knox (Electricorp Production, Dunedin)
- Mr Bill Jarvie (Southland Fish and Game Council, Te Anau)
- Dr Peter Johnson (DSIR Botany Division, Dunedin)
- Mr Harry Maher (DoC Te Anau)
- Mr Peter Murdoch (Monowai Power Station)
- Dr Greg Ryder (Otago Regional Council)
- Mr John Whitehead (Te Anau)

3. RECORDS PRIOR TO HYDRO DEVELOPMENT (1974).

3.1 WILDLIFE SERVICE SURVEY MAPS

Three separate bibliographies refer to weed bed surveys conducted by the Wildlife Service in 1966 and 1970, by H.W. Axbey (Hughes 1976, Pickrill and Maciver 1978, Moore 1980). Despite extensive enquiries as to the whereabouts of these survey maps, they have not yet been found. It may yet be possible to get copies of these maps from the National Archives in Wellington, where old Wildlife Service files are kept. In the meantime, Mr

Axbey and Mr Richard Hutchinson have been contacted, and has been able to describe the weed survey which took place. The surveys were undertaken to provide information on potential aquatic plant growth impact on the operation of the West Arm hydro station designers, Bechtel Pacific, and the operators, NZED. The survey was visual, done from a jet boat and the shoreline around the shallow areas of Lake Manapouri and the lower end of Lake Te Anau. Dive surveys were not conducted. The survey gave details on the location of the littoral weed beds and their species composition. Efforts are continuing to get copies of these survey maps.

3.2 SHORELINE SURVEYS

Comprehensive baseline shoreline vegetation surveys were carried out by Drs Alan Mark and Peter Johnson, for Lakes Te Anau and Manapouri in 1972. These are reported in the Proceedings of the New Zealand Ecological Society, Vol 19, 1972 (Mark 1972, Johnson 1972a, 1972b, Mark et al 1972, Mark and Johnson 1972). Permanent transects were established at right angles to the shoreline from as far as possible below lake level (without having to use diving equipment) to about 15 metres vertically above the lake. Maps showing transect locations are given in Appendix I. A full plant species list is given for Manapouri and Te Anau, along with plant community relationships in Johnson (1972b).

Notes on the aquatic vegetation in Lake Manapouri from Johnson (1972a):

On shores of gentle to moderate slopes Isoetes alpinus, Myriophyllum elatinoides and, in places, Elodea canadensis form a dense carpet up to 30cm thick, extending about 6 metres below the mean lake level. Scattered plants of Chara corallina, C. fibrosa and Nitella sp. occur within this carpet while in shallower water Potamogeton cheesemanii then Myriophyllum propinquum become important. One metre below mean level plants of Isoetes and M. elatinoides are smaller and more scattered and are joined by sub-aquatic herbs of the lake-edge turf.

These shoreline surveys provided evidence for recommending maximum water use for Lakes Te Anau and Manapouri commensurate with conservation of the shoreline features. They provide an excellent baseline for ongoing monitoring of the vegetation of the lake-edge. They are, however, of more limited use in monitoring aquatic plants growing at a greater depth.

3.3 WETLAND SURVEYS

A survey of wetland vegetation in the mires of the Manapouri - Te Anau lowlands was also conducted in 1972 to determine the effects of raising the level of Lake Manapouri (Burrows and Dobson 1972). This survey gave a general description of 13 separate mires in the Te Anau basin (see Appendix II for locality map), as well as a quantitative record of the vegetation present. The study reported these wetlands to be endangered by continuing farm development in the area, and the proposed raising of Lake Manapouri. Wetlands of this nature were seen as beneficial to the catchment for water retention during floods and droughts. Uncommon water plants in the area include *Eleocharis sphacelata, Liparophyllum gunnii* and *Carex capillacea*. Other aquatic macrophytes recorded include:

Baumea rubiginosa, B. tenax (jointed twig-rush)
Potamogeton suboblongus (floating-leaved pondweed)

These particular mires also have scientific importance, with interesting fossils present and an unique wetland morphology not recorded elsewhere in New Zealand.

4. RECORDS AFTER HYDRO DEVELOPMENT (1974)

4.1 RESURVEYS OF SHORELINE TRANSECTS

Resurveys of the baseline transects established by Johnson and Mark in 1972 were done in 1988 (Johnson 1988a, 1988b). These resurveys indicated only minor changes in shoreline vegetation between 1972 -1988. For Lake Manapouri in particular, a tendency for the lake to be held for long periods around the upper level of the main operating range has resulted in the turf zones becoming more aquatic in nature, and "upper zone" turf species have become confined to a narrower range in elevation. There was no evidence to suggest loss of the many plant species that comprise the shoreline communities.

Although there were no excessive detrimental effects on the vegetation as a result of lake level management of Lake Manapouri, Johnson (1988b) mentioned concern with longshore sediment transport caused by frequent changes in lake levels. The diverse arrays of shoreline vegetation are dependent on the often localised envelopes of sediments, especially silts and gravels. Any major losses of these would produce more major changes to the distribution and diversity of shore communities.

4.2 SURVEYS OF OTHER LAKES IN FIORDLAND

A series of surveys of the shoreline vegetation of lakes in Fiordland National Park was conducted by Peter Johnson during 1974-75. A species list which includes aquatic macrophytes is available from these surveys, and is included as Appendix III. Of particular note is the presence of the waterweeds *Elodea canadensis* in Lake Monowai, and *Ranunculus fluitans* in lakes Gunn and Fergus. Peter Johnson mentions that *Elodea canadensis* has been present in lakes Te Anau, Manapouri and Monowai since the 1950's. *Elodea* is also present in the mainstem Waiau river above and below the Mararoa weir. There are considerable numbers of species of adventive (introduced) plants in Fiordland National Park, highlighting the ease with which new species can establish in the area.

4.3 AQUATIC PLANTS DATABASES

4.3.1 MAF RUAKURA

A nationwide database holding information on aquatic plants in waterways is held at MAF Ruakura. Dr John Clayton was contacted for information on aquatic macrophytes in the Waiau catchment. Dr Clayton replies that there are species lists for water plants from lakes Te Anau, Manapouri and Mavora lakes, gained from scuba dives at various locations within each lake. This data includes depth ranges and some abundance ratings. There is also limited species data on lake Monowai from shoreline observations. These summaries are provided in Appendix VII.

None of this data is on computer, since it was mostly taken between 1976 and 1980. The raw data and survey location maps remain at MAF Ruakura. A resurvey of these areas would be possible with MAF Ruakura involvement.

This is the only data on aquatic macrophytes taken from scuba dives, which includes depth ranges. This type of data would be important for future studies of the aquatic ecosystems, as it would enable a profile of aquatic macrophytes throughout different depths.

4.3.2 WETLANDS OF ECOLOGICAL AND REPRESENTATIVE IMPORTANCE (WERI) DATABASE

A database exists with information on significant wetlands throughout New Zealand. This inventory is designed to enable identification of significant wetland habitats. Computerised data are recorded on forms for 79 significant wetland habitat sites in the Waiau catchment. Information on rare and threatened species is not readily available to non-DoC staff through this database, but can be provided to organisations by formal request. A paper is available which allows more detailed interpretation of the data. An example of a wetland habitat record is given in Appendix IV.

This information has some brief but worthwhile information on the aquatic macrophytes found in wetlands in the Waiau catchment. Identification of rare plant species or communities could be made from this database. More information on this database is available from DoC Science and Research Directorate. Contact person is Helen Adcock, DoC Science and Research, P.O. Box 10-420, Wellington.

4.4 SHORELINE SURVEY OF LAKE MONOWAI

Johnson (1991) reports on a survey of shoreline vegetation of Lake Monowai conducted in November 1990. This was done to gauge the effects of the raised lake level when power generation began. 12 permanent vegetation transects were established (see Appendix V for transect locations). A full plant species list is given in the report. Aquatic macrophytes recorded from the lake included:

Callitriche petriei
Chara fibrosa
Elatine gratioloides
Elodea canadensis
Glossostigma elatinoides
Isoetes kirkii
Myriophyllum propinquum
M. pedunculatum
Pilularia novae-zelandiae
Potamogeton cheesemanii

Johnson (1991) concludes that many shoreline plant species at Lake Monowai were present because of their tolerance of being both under and above water. Introduced adventive plant species are frequent for this reason, but the author sees no reason to now classify them as weeds which should be controlled, as they appear to have reached their limits for expansion.

Elodea canadensis is widespread around the lake, and has certainly had an effect on the native water plants, but to what extent is uncertain. Only scant observations of the aquatic macrophytes was done, and further underwater survey would be needed to record the effects of *Elodea* and lake level fluctuations for power generation.

4.5 Effects of Eutrophication

Very little published information is available on this topic for lakes in the Waiau catchment. There are waste water treatment oxidation ponds at the mouth of the Upukororo stream in Te Anau, and at Home creek in Manapouri. A discussion with the Southland Regional Council consents officer about these facilities shows no known excessive discharges of waste water into the adjoining lakes. Protection from floodwaters also seems to be adequate. At present, no monitoring of the aquatic macrophytes or shoreline vegetation has been done at lake sites near the oxidation ponds. Monitoring of phytoplankton near discharge sites may be worthwhile to assess any possible eutrophication of the lakes. A method for this is available in Pridmore (1987).

4.6 Effects of Silting

Silting could affect the aquatic macrophytes of the Waiau from two sources:

1. Silt and sand deposits in shallow lake areas caused by excessive shoreline sediment transport, as a result of rapid fluctuations in lake levels.

2. Excessive silt deposition caused by the diversion of Mararoa floodwaters down the lower Waiau.

Studies of shoreline sediment transport are ongoing for lakes Te Anau and Manapouri. The effects of this sediment transport on aquatic macrophytes are unclear at present, as the shoreline vegetation transects probably do not go deep enough. Mason (1975) mentions the Charophytes *Chara* and *Nitella* found in Lakes Te Anau and Manapouri as sensitive to eutrophication and silting.

Unfortunately there is no information on aquatic macrophytes in the mainstem Waiau river. However, a recent PHD thesis (Ryder 1989) has worthwhile information on the effects of silting on fast-running (lotic) waters, which could be of value in assessing future effects of Mararoa floodwaters on the lower Waiau. Ryder (1989) found that diatomaceous algal growth is affected by suspended silt. Fine silt particles can also build up in the periphyton "matrix" growing on rocks and water plants, rendering it unpalatable to aquatic invertebrates. The effects of extreme flow fluctuations on aquatic macrophytes in the Waiau river below the Mararoa weir are also unknown.

4.7 Lakeweed Threats

The presence of the lakeweed *Elodea canadensis* in Lakes Te Anau, Manapouri, Monowai and connecting waterways has been well recorded on Fiordland National Park files since

1957. This weed was probably introduced to the region through its use in aquaria in those times, and spread to nearby lakes through boat trailers etc.

Lagarosiphon major is a lakeweed which forms dense growths to depths over 6 metres. It is recorded throughout New Zealand, still spreading, and likely to become more common in the South Island (Coffey and Clayton 1988). It has not yet been recorded from the Waiau catchment, but is present in lake Wanaka, and will likely invade Lake Dunstan when it is filled, making the Southern lakes area more vulnerable to invasion. *Lagarosiphon* has also been recorded in Invercargill.

Lagarosiphon competes with and displaces native water plants, creates boating hazards and adversely affects tourism values (McKinlay 1991). Control of this lakeweed in Lake Wanaka shows that such an exercise is difficult and expensive, with no chance of eradication. Clearly, preventing the introduction of this weed is better than ongoing control. Ongoing publicity through posters, and signs at boat ramps, should be continued.

Water buttercup (*Ranunculus fluitans*) is present in lakes Te Anau, Manapouri, Gunn and Fergus. It may have arrived in the catchment through boat trailers, or possibly waterfowl. Although it is not a particularly aggressive waterweed, it can compete with and replace native plants.

Waternet (*Hydrodictyon reticulatum)* has established in lakes in the Rotorua region. A recent report by Gerbeaux (1991) predicts that migrating birds known to spread this lakeweed will probably bring it to the South Island in the near future. Waternet is a serious plant pest, which clogs engine intakes, degrades shorelines with rotting masses in warm weather, and has an unpleasant odour.

Appendix VI gives a diagrammatic representation of the likely effects of lakeweeds on the aquatic macrophytes in the lakes of the Waiau catchment from studies by Dr J. Clayton in Lake Wanaka.

It is recommended that there is liaison with other Regional Councils to warn of the spread and likeliness of introduction of *Lagarosiphon* and waternet, so that more extensive measures can be taken (such as regular monitoring around boat ramps) if required. Further monitoring of water bodies in the catchment should take note of the effects of *Elodea canadensis* and *Ranunculus fluitans* on the native flora; and keep a lookout for *Lagarosiphon* and waternet.

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