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Recommendations for management of Auckland Region's freshwater pests

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Recommendations for management of Auckland Region's freshwater pests

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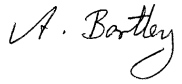

Executive Summary

Auckland Regional Council currently manages a range of aquatic pests under their Regional Pest Management Strategy. "Total Control Plants" under this strategy include fringed water lily (*Nymphoides peltata*) and purple loosestrife (*Lythrum salicaria*) for which control of all known sites has led to the eradication of most populations of these high-risk weeds. However, other species more widespread in their distribution that are known as "Surveillance Plants" under the strategy are not currently managed apart from enforcing their restriction of sale, propagation and distribution and undertaking localised control (e.g., egeria - *Egeria densa* control on Great Barrier Island).

Much of the spread of freshwater pests within the Auckland Region has been through deliberate introductions or associated with other deliberate pest liberations. Once established the management options for the water body is very limited, especially submerged weeds and pest fish. Therefore prevention of establishment of these transformer pests (those which transform an ecosystem in a profound and often irreversible direction) is essentially the only way to protect the few freshwater resources of the region that are not yet severely impacted.

To develop strategies to manage these pest species Auckland Regional Council has contracted NIWA to assist with their development of a freshwater pest management plan for the region. This project involved:

- Collection of baseline data on pest (plants and fish distribution) and identify their threats to Auckland water bodies, including lake, drain and ornamental pond surveys;
- Prioritising lakes for regional importance;
- Identifying weed introduction pathways and evaluating risks, including urban fish ponds as a potential weed sources;
- Suggested surveillance and control options for these species.

Based on available records, the pest plants hornwort (*Ceratophyllum demersum*), egeria, lagarosiphon (*Lagarosiphon major*), bladderwort (*Utricularia gibba*), alligator weed (*Alternanthera philoxeroides*), parrot's feather (*Myriophyllum aquaticum*), yellow flag (*Iris pseudacorus*), primrose willow (*Ludwigia peploides*), gypsywort (*Lycopus europaeus*) and reed sweet grass (*Glyceria maxima*) are apparently restricted in their distribution within Auckland, but are likely to be more widely distributed than the current records show. However, there are likely to be significant areas which are not impacted by these species.

Apart from Lake Ototoa, and the dams of the Waitakeres and Hunuas, Auckland lakes are highly impacted by pest plants. Pest fish are widely distributed where public access allows and even the highest ranked lake (Lake Ototoa) is impacted by several pest fish. Other highly ranked lakes include Pupuke, Whatihua, Wainamu, Karaka and Tomarata, but several of these lakes have not been resurveyed recently.

Some pest plants were found in ornamental ponds. Of 300 properties surveyed, 33 ponds were located, but only one pond contained the pest species egeria, lagarosiphon and eelgrass (*Vallisneria* - Meola Creek variety).

The following actions are recommended:

- Carry out surveillance for the above species to allow targeting of unimpacted areas and, if appropriate, implementing local or region-wide control.
- Carry out lake condition assessment of Auckland lakes including evaluation of native condition, presence of endangered biota, pest species, water quality and catchment activities.
- Where activities such as eel fishing, coarse fishing and drainage operations are threats to unimpacted water bodies (through the introduction of pests) develop information packages outlining risks and decontamination options.
- Undertake surveillance for aquatic pest plant incursion in high value/high risk water bodies (identified from previous recommended actions) including Lakes Ototoa, Pupuke, Whatihua, Wainamu, Karaka and Tomarata.
- Investigate options for restoration of submerged vegetation in Lake Tomarata.

Introduction

Once aquatic weeds or pest fish become established in a water body, eradication is rarely achievable and many of the problem weeds (like hornwort, egeria and alligator weed) and fish (like koi carp, gambusia and rudd) continue to spread through the country. Therefore a proactive approach, attempting to keep unaffected water bodies pest-free, would appear to be the best management method. This would fit into an aquatic weed strategy alongside education of water body users who's activities pose a high risk of spreading weeds and targeted control of low incidence aquatic weeds (e.g. eradication programmes for purple loosestrife (*Lythrum salicaria*) and marshwort (*Nymphoides geminata*) under the Auckland Regional Pest Management Strategy (RPMS) 2002-2007).

NIWA is proposing to develop national guidelines to assist with the prevention of continued aquatic weed spread throughout New Zealand. Auckland Regional Council (ARC) contracted NIWA to assist with their development of a freshwater pest management plan for the region.

This project had the following objectives:

- Collection of baseline data: Collection of current and historic data on aquatic weeds and pest fish within the region and survey lakes for current weed status. Map the distribution of weed species in drains/streams/rivers within Auckland Region.
- Prioritising water bodies: Rank lakes of regional importance for biodiversity, factoring in current weed status and vulnerability to weed invasion.
- Identify weed introduction pathways and risks: Identify nearest, or most accessible weed sources and vectors. Determine the probability of weed transfer and quantify the risk posed by urban fish ponds as a potential source of weeds.
- Develop a surveillance strategy for prioritised water bodies to:
    - determine feasibility of intercepting a weed invasion to allow eradication; and
    - design programmes (where, how and when) for each high priority water body.
- Recommend management of key weed sources, if these are isolated and clearly a threat to nearby water bodies.

This report outlines the steps required to design a region-wide freshwater pest management plan incorporating the current management programmes for low incidence/high risk species.

Methods

Collection of baseline data

An inventory of freshwater pest species distribution within Auckland Region was compiled from herbarium data; NIWA Freshwater Biodata Information System (FBIS) database; historical NIWA and other records (e.g., Coffey and Clayton 1987; Tanner et al. 1986; Champion 1995, 1999, 2003; Gibbs et al. 1999); pest fish records (NIWA Freshwater Fish Database now included within FBIS) and ARC Biosecurity Group records for the following pest species within Auckland Region (Table 1):

Table 1:

Freshwater pest plants and fish included in the ARC GIS database.

Common name	Scientific name	Designation under Auckland RPMS
Alligator weed	Alternanthera philoxeroides	Surveillance
Arrowhead	Sagittaria montevidensis	Total control
Bladderwort	Utricularia gibba	Surveillance
Eelgrass	Vallisneria gigantea and V. spiralis	Surveillance
Egeria	Egeria densa	Total control on Great Barrier Island, surveillance elsewhere
Fringed water lily	Nymphoides peltata	Total control
Gypsywort	Lycopus europaeus	Research organism
Hornwort	Ceratophyllum demersum	Surveillance
Lagarosiphon	Lagarosiphon major	Surveillance
Lizard's tail	Saururus cernuus	Research organism
Manchurian wild rice	Zizania latifolia	Surveillance in Lake Kereta area, total control elsewhere
Marshwort	Nymphoides geminata	Total control
Nardoo	Marsilea mutica	Surveillance
Parrot's feather	Myriophyllum aquaticum	Surveillance
Primrose willow	Ludwigia peploides	Surveillance
Purple loosestrife	Lythrum salicifolium	Total control
Reed sweet grass	Glyceria maxima	Surveillance
Sagittaria	Sagittaria platyphylla	Total control
Salvinia	Salvinia molesta	MAF eradication programme
Senegal tea	Gymnocoronis spilanthoides	Total control

Common name	Scientific name	Designation under Auckland RPMS
Water hyacinth	Eichhornia crassipes	MAF eradication programme
Water poppy	Hydrocleys nymphoides	Total control
Yellow flag	Iris pseudacorus	Surveillance
Catfish	Ameiurus nebulosus	Information only
Gambusia	Gambusia affinis	Information only
Koi carp	Cyprinus carpio	Information only
Perch	Perca fluviatilis	Information only
Rudd	Scardinius erythrophthalmus	Information only
Tench	Tinca tinca	Information only

Data on the lakes within Auckland Region were collected by surveys of 12 lakes undertaken as part of this project (Table 2):

Table 2:

Lakes within the Auckland Region, including map reference and date surveyed (as part of this project).

Lake	Date	NZMS 260 Map Series	Grid reference
Lake Slipper	-	R 8	574577
Lake Spectacle	-	R 8	576568
Lake Tomarata	-	R 8	591553
Lake Ototoa	20/10/2005	Q 9	213205
Lake Kuwakatai	-	Q10	215186
Lake Kereta	-	Q10	249116
Lake Karaka	03/11/2005	Q10	262097
Lake Poutoa	03/11/2005	Q10	281065
Lakes Ngakaru and Piripoua	03/11/2005	Q10	288046
		Q10	298037
Lake Pupuke	-	R11	681898
Lake Paekawau	04/11/2005	Q11	384890
Lake Okaihau	04/11/2005	Q11	389871
Lake Wainamu	19/10/2005	Q11	414783
Lake Kawaupaku	-	Q11	405777
Waitakere Reservoir	-	Q11	462767
Nihotupu Auxiliary Reservoir	-	Q11	490735
Nihotupu Reservoir	-	Q11	496715

Lake	Date	NZMS 260 Map Series	Grid reference
Parau Reservoir	-	R11	539704
Huia Reservoir	-	Q11	474698
Whatipu lakes	-	Q11	
Cosseys Dam-Reservoir	-	S12	976590
Upper Mangatawhiri Dam	-	S12	19564
Wairoa Dam		S12	
Mangatangi Dam		S12	
Pehiakura Lakes	02/08/2005	R12	537452
Lake Pokorua	02/08/2005	R12	552442
Lake Whatihua	02/08/2005	R12	583351

For these lakes a series of vegetation profiles were swum using Scuba or, where water depth was less than 2 m, by snorkel, and the presence of pest plant species recorded. Records of the pest plants and fish recorded from all Auckland lakes (historical and current) is presented in Section 4.1.

The drains, rivers and streams intersecting with the following roads were investigated on 20th and 21st October and 4th November 2005 to ascertain the distribution of pest plant species. Areas selected were State Highway 16 and South Head Road between Haranui Road (north of Parkhurst) and Waimauku, State Highway 17 between Silverdale and Dairy Flat and Karaka and Paerata Roads between Drury and Pukekohe. For each water body the species present and % area occupied, water flow and turbidity were estimated. Mapped locations of water bodies sampled and pest distributions are shown in Section 4.2.

These data and pond survey data (Section 4.3) are collated to produce distribution maps of all the pest species (Section 4.4).

Pest plant species are ranked using the Aquatic Weed Risk Assessment Model (AWRAM) which scores aquatic weeds according to their weediness and biological success so that the threat posed can be compared (Champion and Clayton 2000). Rankings and the potential threats posed by these pest plants are discussed in Section 5.1. There is no equivalent model for pest fish, but potential impacts of the 6 species are discussed by Rowe in Champion et al. (2002).

Prioritising water bodies

The lakes of Auckland Region were ranked for ecological value based on available ecological and water quality data including the 2005 surveys. Results are presented and discussed in Section 5.2.

Introduction pathways and risks

From the distribution data and knowledge of potential pathways and associated risks of pest transfer, the risks posed to water bodies in Auckland Region are discussed in Section 5.3. As part of this assessment one hundred properties were surveyed in three urban areas within Auckland Region (Pukekohe, Blockhouse Bay and Howick) to determine the frequency of ornamental ponds and the presence of pest plants in them. Areas were selected by ARC Biosecurity Officers and at each property presence/absence of ponds, pond type, area and plant species present were recorded. Results are reported in Section 4.3. Additional records of pest plant species found on these surveys are included in their distribution maps (Section 4.4).

Proposed surveillance and management of pest species

Once water bodies are ranked for regional importance, freshwater pests mapped, their vectors and associated risks quantified, then a strategy for the management and protection of high value water bodies, recommendations for targeted control of surveillance pests and education of persons carrying out activities with a high risk of pest transfer can be formulated as outlined in Section 4.4. These steps will compliment the current eradication (total control) programmes for low incidence/high impact species (see Table 4) which are currently carried out under the Auckland RPMS (2002-2007).

Results

Auckland lakes

1.1.1 Lake Slipper

In 1988 the lake had no submerged plants and was described as peat stained. Reed sweet grass (*Glyceria maxima*) was recorded together with emergent and marginal plants. There have been no vegetation surveys since.

1.1.2 Lake Spectacle

In 1988 the lake had no submerged plants, was shallow (<2 m) and turbid with a Secchi depth of less than 0.4 m and algal scums present. Reed sweet grass was recorded amongst beds of raupo (*Typha orientalis*) and *Baumea articulata* that grew on the swampy lake margins. Alligator weed (*Alternanthera philoxeroides*) was noted in the marginal vegetation for the first time in 1999 (Gibbs et al. 1999), when the lake was again described as highly turbid.

FBIS records the presence of rudd (*Scardinius erythrophthalmus*) and tench (*Tinca tinca*).

1.1.3 Lake Tomarata

The 1999 survey recorded no submerged vegetation. A dense fringe of native emergent vegetation including the regionally rare (at that time regarded as extinct from the region) wire rush (*Empodisma minus*) and the sedges *Baumea articulata* and *B. rubiginosa,* raupo and umbrella fern (*Gleichenia dicarpa*) was reported.

In 1988 the lake was relatively clear (Secchi depth of 3.7 m) and had a native submerged vegetation of charophytes growing to 6.6 m water depth. Reed sweet grass was noted amongst marginal emergents and manuka.

FBIS records the presence of rudd and tench.

1.1.4 Lake Ototoa

In 2005 the submerged vegetation comprised native charophytes growing to a water depth of c. 10 m (de Winton et al. 2005). No invasive weed species of concern were detected although the alien water lily-like plant swamp lily (*Ottelia ovalifolia*) was noted as present in shallow water at some shorelines. This submerged vegetation was almost identical to that described in 1988 (unpublished NIWA data), suggesting the

lake littoral condition has been stable for sometime. However, water quality data have indicated decreasing water clarity, and increasing hypolimnetic (bottom water) oxygen deficits and nutrient release (Gibbs et al. 1999).

FBIS records the presence of perch (*Perca fluviatilis*) rudd, tench and gambusia (*Gambusia affinis*). In the recent survey, dwarf inanga (*Galaxias gracilis*) were not observed and there are concerns that this population has declined. The lake has abundant mussel (*Hyridella menziesi*) beds, but freshwater crayfish (*Paranephrops planifrons*) were apparently sparse.

1.1.5 Lake Kuwakatai

In 1999 the lake was highly turbid, however hornwort (*Ceratophyllum demersum*) was well established, extending from the shore or emergent vegetation to depths exceeding 2.5 m. Anoxia events, nutrient release and algal blooms were documented (Gibbs et al. 1999).

In 1988 algal blooms were noted, the lake sediments were very organic and flocculent and no submerged plants were observed. A marginal fringe of emergent vegetation rafted out over water depths of up to 3 m.

In 1950 (Cunningham et al. 1953) the charophyte, *Chara globularis* was "present in isolated clumps" while *C. australis* occurred in sheltered bays to between 2 and 4 m water depth. *C. fibrosa* was also present.

FBIS records the presence of perch, rudd, tench and koi carp (*Cyprinus carpio*).

1.1.6 Lake Kereta

In 1999, the submerged alien hornwort completely covered the lake outside of emergent vegetation beds. Manchurian wild rice (*Zizania latifolia*) was present in southern marginal areas and water-lilies were present as patches close to shore. Turbidity and nutrient levels were showing improvement with the establishment of hornwort, but algal blooms also occurred. In 2005, brief observations confirmed hornwort forming surface reaching beds over much of the lake surface.

Bladderwort (*Utricularia gibba*) was well established at Lake Kereta in 1993. Primrose willow (*Ludwigia peploides*) was also recorded by ARC from the west side of the lake in 1993.

In 1988 an open band of native milfoil (*Myriophyllum triphyllum*) was recorded to 1.3 m deep in this shallow (2 m) lake. Marginal emergent vegetation included Manchurian wild rice, while red and yellow colour varieties of *Nymphaea* sp. were noted.

In 1950 (Cunningham et al. 1953), the eastern side of the lake had the native pondweed, *Potamogeton ochreatus,* growing to over 4 m deep. *Chara australis* and *C. fibrosa, Myriophyllum propinquum* and *P. cheesemanii* were also recorded. Manchurian wild rice was present as a dense stand around the southern third of the

shoreline at this time. Drifting sand was observed to have destroyed the vegetation along the western shoreline.

FBIS records the presence of rudd, tench, koi carp and mosquito fish.

1.1.7 Lake Karaka

In 2005 the lake was shallow c. (1.3 m depth) and turbid, with occasional shoots of pondweeds (*Potamogeton ochreatus*, *P. cheesemanii*) encountered in depths of c. 0.5 m or less. An extremely diverse marginal emergent assemblage included Manchurian wild rice together with nine other species. Repeated mapping of the Manchurian wild rice has shown little change in distribution over recent years (G. Hoskins pers comm.). Primrose willow was widespread at open margins and is a new record for this pest plant.

The lake supported an abundant and diverse water bird population, with good habitat including several islands. Lake Karaka had the highest bird numbers counted during recent Ornithological Society surveys (Bendall 2005).

Access is across private land, however a bridle trail extends from Lake Kereta, down the western side of Lake Karaka separated from the lake by a fence.

1.1.8 Lake Poutoa

In 2005 the lake was set in pastureland and grazed to the waters edge with a fence extending through the lake bed and *Juncus* species were present in swampy marginal areas. Submerged vegetation, dominated by the native species *Chara australis* together with *Potamogeton ochreatus,* extended to 1.5 m depth in this 1.6 m deep lake. Rafting growths of primrose willow (Figure 1) to 1 m depth were noted.

The lake could only be accessed through private land by 4WD. The lake is known to dry out to very little open water (Bendall 2005) and stock had access to the lake margins. Dead trees in the lake suggest large water level changes and recent maps refer to the fact that the water body dries at times.

Figure 1:
Lake Poutoa.

1.1.9 Lakes Ngakaru and Piripoua

In 2005 these lakes comprised a string of small water bodies typified in the photos below. Most water bodies were shallow (c. 1.3 m) with the exception of the north-easterly basin which was over 2 m deep. The lakes were turbid, with a dense algal bloom in one. Submerged plants were limited to native pondweeds (*Potamogeton ochreatus*, *P. cheesemanii*) and milfoil (*Myriophyllum propinquum*) in shallow waters <0.3 m. Primrose willow was present in sparse patches along the lakeshores. All water bodies were grazed to the waters edge, were often fenced through the lake bed and used for direct stock water supply. Recent maps refer to the fact that these water bodies dry at times.

The lakes were accessed across private land through a Maori Trust farm. Private forestry extended along one side of the catchment and the rest was pasture.

Figure 2:
Southern-most lake in the Lake Ngakarua-Piripoua series.

Figure 3:
Northeastern lake in the Lake Ngakarua-Piripoua series.

1.1.10 Lake Pupuke

In the early 1980's the submerged vegetation extended to 10 m water depth. It comprised eel grass (*Vallisneria gigantea*), lagarosiphon (*Lagarosiphon major*), elodea (*Elodea canadensis*), curled pondweed (*Potamogeton crispus*), with egeria (*Egeria densa*) at an early stage of invasion (Coffey and Clayton 1987). Whilst there was an array of submerged pest plants present, the lake had relatively clear waters with abundant plants extending down to 10 m.

Primrose willow was recorded from Kitchener Park in 1978 (FBIS) and parrot's feather (*Myriophyllum aquaticum*) was present on the east side of the lake in the 1990's (NIWA unpublished data).

FBIS records the presence of koi carp, perch, rudd and tench, while mosquito fish have also been documented at the lake (Coffey and Clayton 1987).

1.1.11 Lake Paekawau

In 2005 the lake had dark-stained, moderately turbid waters. Mats of milfoils (*Myriophyllum triphyllum* and *M. propinquum*) and the turf plant *Glossostigma elatinoides* were present in open shallow areas. Dense reeds fringed c. 20% of the lake to 2 m water depth. No submerged vegetation was present outside of these reeds and the depth of lake exceeded 3 m. Patches of water lilies (*Nymphaea* cultivar with pale yellow flower) were present in patches around the lake margin and appeared to be spreading from floating rhizome fragments. The landowner stated the lilies had been planted c. 20 years previously.

Pasture fringed the lake on one side while steep banks on the adjacent side had remnant scrub (Figure 4). The lake is used as a water supply to two adjacent paddocks with additional supply limited by the pump. The lake is also used for duck shooting.

Access is across private farmland using grassed farm tracks.

Figure 4:
Lake Paekawau viewed from the southeast, showing a catchment of predominantly pasture with pockets of scrub.

1.1.12 Lake Okaihau

In 2005 hornwort dominated the submerged vegetation of the southern end from shallow water to 3.9 m depth. Elsewhere surface-reaching clumps of native milfoil were dominant to 1.8 m and shoots of egeria and hornwort recorded to 2.2 m depth. The lake depth exceeded 5 m with much of the lakebed at the northern end covered with jelly like balls of the algae, *Nostoc*. Water lilies (*Nymphaea* sp.) were widely distributed around the lake edge, comprising at least 3 different cultivars/varieties with cream, white and crimson flowers. Much of the lake was surrounded by pasture that was grazed to the lake edge, with emergent vegetation restricted to swampy margins at the south of the lake which were inaccessible to livestock. Access was via 'grass track road' and the lake is a popular spot for visitors at the nearby camp.

In 1950 (Cunningham et al. 1953), the submerged vegetation was restricted to *Potamogeton ochreatus* on shallow peat deposits in the south of the lake, in water depths less than 4 m. *Chara australis* was also recorded.

FBIS records the presence of perch, rudd and tench.

Figure 5:
Lake Okaihau viewed from the southeast.

1.1.13 Lake Wainamu

In 2005 a substantial vegetation recovery had taken place following improvements in water clarity over the previous year. *Egeria densa* comprised a narrow band of dense growth immediately outside of reed beds, and extending as low cover (<10%) to a maximum of 4.8 m depth. Charophyte beds (>75% cover) were also recorded at several sites, comprising *Chara australis* or *Nitella pseudoflabellata*. Tall, dense, emergent reed beds of native species were widespread to a maximum of 2.2 m depth. Bladderwort (*Utricularia gibba*) formed floating rafts amongst and on the immediate

open edge of the reeds, while parrot's feather (*Myriophyllum aquaticum*) was also recorded on the outer edge of reeds as well as forming some anchored patches in open-water depths of up to 3.8 m.

In 1999, primrose willow and parrot's feather were recorded amongst the marginal emergents, and remnant plants of egeria and bladderwort were noted at one site (Gibbs et al. 1999). Water quality data suggested the egeria beds had declined in the mid 1990's (Gibbs et al. 1999). Prior to this (1995), egeria beds grew to 5.5 m depth with surface reaching beds extending to 4 m depth. Egeria invaded the lake after 1991, at which time a predominantly native plant community of *Chara australis* and *Potamogeton ochreatus* was present, together with the alien bladderwort (Champion 1995).

FBIS records the presence of catfish (*Ameiurus nebulosus*), perch, rudd and tench.

1.1.14 Lake Kawaupaku

In early 2004, egeria occupied the littoral zone to a depth of 3.8 m, and grew to 3 m in height. Prior to this, the lake was known to have predominantly native vegetation that in 1971 extended to 7.3 m depth (unpublished NIWA data). The only alien species recorded at that time was swamp lily (*Ottelia ovalifolia*), but alien bladderwort was noted sprawling over submerged species in the mid 1990's.

The invasion of egeria coincided with the introduction of coarse fish in Lake Kawaupaku, the species liberated were unknown (landowners pers. comm.)

1.1.15 Waitakere Reservoirs

In 1982, the Waitakere Reservoirs (Waitakere, Nihotupu, and Huia Reservoirs) had predominantly native submerged vegetation with the exception of the Upper Nihotupu, which was bare. Otherwise charophytes dominated the vegetation of all reservoirs to between 2 and 4 m depth, except the Upper Huia, which had abundant native milfoil beds to 4 m. Occasional alien plants encountered were *Ranunculus trichophyllus*, *Ludwigia palustris, Ottelia ovalifolia* and *Juncus bulbosus*. Native marginal emergent vegetation was also recorded at some water bodies.

None of the reservoirs permit boat access without arrangement. Restricted public road access to some reservoirs reduces the chance of weed introduction (e.g., Waitakere Reservoir). Large water level fluctuations in these reservoirs would also lessen the chance of many weeds establishing and would favour dominance by seed producing plants that can re-colonise after emersion. However hornwort, capable of forming free-floating mats, may be able to establish.

1.1.16 Whatipu lakes

The Whatipu Lakes comprise a number of small waterbodies that can be accessed from the beach and dunes. Existing records from FBIS include alligator weed