

Assessment of hornwort status in Lake Kereta

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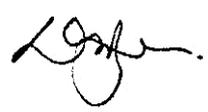
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1 Introduction

Grass carp (*Ctenopharyngodon idella*) were stocked into Lake Kereta, (Auckland Region) to improve amenity values of the lake for boating and water skiing. This lake had been invaded by the submerged weed hornwort (*Ceratophyllum demersum*) prior to 1999 (Gibbs et al. 1999) and hornwort then dominated the open lake area.

In a privately funded lake restoration programme, four grass carp stocking events were made between **March 2008 and April 2009** (see Appendix 1), comprising a total of 14,799 fish of a size greater than 6 cm and less than 25 cm fork length (G. Jamieson pers comm. 6/03/2012). The losses of these small fish to predation are unknown, but suspected to be high based on predatory perch (*Perca fluviatilis*) activity in the lake (G. Jamieson pers comm. 6/03/2012). Recent observations by local land owners suggest grass carp grazing effects were evident and NIWA was asked to assess the current status and success of weed management by grass carp.

1.1 Scope of work

NIWA was engaged by New Zealand Waterways Restoration to:

- Undertake a site visit at Lake Kereta and survey sites where submerged vegetation had been documented in the past, as well as make an overall reconnaissance for weed status in the lake.
- Provide a brief report describing the current vegetation status, estimate the biomass of hornwort that has been removed, and identify further requirements to confirm hornwort eradication.

2 Survey methods

Lake Kereta was visited by NIWA on 27 February 2012. A combination of surface observations, snorkel diving, sonar, bottom rake and grapnel drags were used to detect hornwort and describe vegetation characteristics. As well as spot checks for hornwort at c. ten sites in open water, the entire margins of Lake Kereta were inspected for likely refuges for hornwort from grass carp grazing, such as backwaters, swampy margins and dense marginal vegetation. Site locations were recorded by handheld GPS (Garmin 62s) in New Zealand Map Grid format.

3 Survey results

Sites where hornwort was detected are shown as an asterisk on Figure 3-1 below, with a brief description of the locations investigated (refer to site letters A-L), and grid references provided in Appendix 2.

- A. A blackened stem of hornwort was recovered from soft sediment in 1.5 m depth of water, approximately 20 m from shore. No hornwort was detected around the jetty and ramp structures or at the shore. An open association of marginal vegetation was present at the shore on a firm substrate. Submerged plants, *Glossostigma elatinoides* and *Nitella hyalina*, were restricted to the water's edge.

- B. Beds of water lilies (at least two *Nymphaea* cultivars) and adjacent lake bed were inspected without the detection of hornwort. We noted the extent of water lilies was markedly reduced from a previous lake visit on 31 October 2008, and rhizomes had been disturbed with fragments being widely dispersed in the lake.
- C. Ponding water extended at depths of 0.1 to 0.3 m throughout a wetland dominated by the marginal plants *Eleocharis acuta* and *Isolepis prolifera*. Heavy grazing and uprooting of these species was noted at the lake margin, with the past grazing removal being estimated as a band of up to 4 m width. In more open areas of water within the wetland we noted *Utricularia gibba*, *Landoltia punctata* and *Azolla pinnata*. Hornwort was not detected.
- D. A shoot of hornwort was found washed into and lodged within a narrow wetland fringe of similar composition to Site C.
- E. Hornwort was abundant within the margins and open water (1.5 m depth) of this cut-off basin of Lake Kereta. Also recorded were marginal species raupo (*Typha orientalis*), *Ludwigia peploides*, *Utricularia gibba*, *Azolla pinnata*, and the submerged species *Myriophyllum triphyllum*.
- F. A raupo stand extended into the lake in front of an open backwater. Grass carp grazing on raupo was apparent and no hornwort was detected.
- G. A 3 m-wide shoreline band of Manchurian wild rice (*Zizania latifolia*) had numerous green and healthy hornwort patches dispersed amongst its stems. Although the majority of the wild rice material was showing herbicide damage with most stems bleached, there was still dense standing vegetation that had apparently been little grazed by grass carp.
- H. A mixed raupo and *Machaerina articulata* (formerly *Baumea*) stand had been opened up by grass carp grazing but had no detectable hornwort.
- I. This site was at an island or marginal plant bed that separated the two lake basins. The dense wild rice checked at this site had hornwort fragments as found for site G.
- J. Similar association of wild rice stands and hornwort accumulations.
- K. Similar association of wild rice stands and hornwort accumulations.
- L. A small indented bay fringed by emergents included *Eleocharis sphacelata* and *Ludwigia peploides*. No hornwort seen.



Figure 3-1: Map of sites investigated for hornwort presence (A-L) with an asterisk indicating presence of the weed.

4 Discussion

It is apparent that most of the weed biomass (>99.9% of previous levels) has been removed from the lake, and the aim of an improvement to amenity values of the lake has been achieved.

Observations made by NIWA in 2008 (de Winton et al. 2009) showed hornwort extended at >75% cover over most of the open water areas of the lake, with heights of between 0.5 and 2 m. Previously estimated hornwort biomass values for tall beds (c. 8 m) in Lake Tarawera was 1489 g dry weight (DW) m⁻², and the summer average for biomass in Waikato drains was

173 g DW m⁻² (Wells et al. 2003). Given the area of the lake at 23.58 ha given by Freshwater Ecosystems of New Zealand (a geodatabase of lake and catchment attributes: Leathwick et al. 2010), we estimate approximately 20 vegetated hectares of hornwort has been removed, or a biomass probably exceeding 35 tonne and less than 298 tonne dry weight of weed, based on the values for drains and Lake Tarawera above.

Target stocking rates for grass carp are usually calculated on the basis of 40 to 50 fish (\geq 20 cm fork length) per vegetated hectare to remove weed beds within 5 years. In the case of Lake Kereta, this indicates sufficient fish ($>$ 5-7% of those stocked) survived predation to exert a significant grazing pressure.

However, NIWA investigations confirmed that hornwort has yet to be eradicated and there is a high likelihood of hornwort persisting under the current lake conditions for some time yet. Of concern was the refuge habitat provided by the beds of Manchurian wild rice, and the presence of hornwort in an adjacent (currently disconnected) basin of the lake to the north.

Manchurian wild rice (*Zizania latifolia*) is designated as a 'total control' species under the Auckland Regional Pest Strategy 2007–2012 (ARC 2007), and is also a National Interest Pest with a MAF run eradication programme for all areas outside of Northland. We note that for Manchurian wild rice, the objective is to remove or destroy all detectable plant matter at currently known sites in Auckland Region (Lake Kereta and Karaka systems) over the next 10 years (ARC 2007). It is highly likely that hornwort will persist until removal of these marginal beds has been achieved. The future role of grass carp in grazing these beds once other marginal plants are removed is unknown.

The separated northern basin of Lake Kereta remains a potential re-introduction source for hornwort. No hydrological connection was apparent at the time, but there was low ground and little distance between the two basins. High water level events, differential water levels, and ease of human transfer of fishing or boating equipment increase the probability of transfer, although there is no risk while significant grass carp grazing remains. The option of creating access for grass carp into the northern basin could be explored.

We would recommend another assessment of hornwort status once the Manchurian wild rice beds have been removed, and to achieve eradication, grass carp should be left within a lake for at least two years following the last detected weed fragments.

5 Acknowledgements

Rohan Wells and Aleki Taumoepeau (NIWA) assisted with the survey. Gray Jamieson (New Zealand Waterways Restoration) provided information on the grass carp stocking. Many thanks to Ed Donald for lake access permission and use of launch facilities.

6 References

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7 Appendix 1

Grass carp stocking dates, numbers, and fish lengths were:

- 1 March 2008, 1600 >15 cm and ≤20 cm
- 2 May 2008, 5000 >6 cm and ≤10 cm
- 3 March 2009, 2208 >15 cm and ≤20 cm
- 4 April 2009, 5991 >15 cm and ≤20 cm

Gray Jamieson pers comm. 6/03/2012

8 Appendix 2

Grid references for locations of hornwort:

Site	Easting	Northing
A	2625170	6511374
B	2624895	6511497
C	2624862	6511753
D	2624658	6511948
E	2624657	6511947
F	2624532	6511812
G	2624810	6511400
H	2624989	6511186
I	2625336	6510920
J	2625452	6510674
K	2625560	6510800
L	2625391	6510979