Te Hiku

Wairaupo (formerly lake north of Ngakeketa) NRC Lake No. 13

Wairaupo (head of Kauaeparaoa Stream), showing the forested surrounds, with pasture and mobile dunes also in the catchment.

Summary	Lake Wairaupo
Surveyed:	2004, 2006, 2009 and 2021
Overall ranking:	**Moderate**: The invasive weed egeria has spread throughout the lake with little indigenous aquatic vegetation. Lake margins are surrounded by native scrub/forest, with mostly fenced pasture or mobile dunes surrounding this vegetation.
Threats:	The lake is isolated, so further human-mediated incursions seem unlikely. However, the egeria incursion is likely a consequence of eel fishing. There are indications of nutrient enrichment and benthic oxygen depletion. Cows were observed in the lake during 2021.
Management recommendations:	Advocate the exclusion of cattle from the lake, with alternative water supply provided. No monitoring recommended.

Description

This lake (1577791E, 6180590N) is situated north of Ngakeketo and is 12.7 ha in area with a depth >7 m. It was formed by a stream system impounded by dunes. The lake level has continued to rise as evident by the flooding and death of trees (mostly kanuka – *Kunzea linearis*) on the margins. The

catchment is cattle grazed pasture (70% of the perimeter), but most of the steep-sided lake edges are fenced, with native kanuka dominated bush surrounding most of the lake except for mobile dunes near the outlet stream (Te Paki or Kauaeparaoa Stream). However, cattle were accessing the lake in 2021, being seen in the lake margins causing pugging and browsing on emergent vegetation. There is a small inflow to the north of the lake. Access is through private farmland (4-WD) with no boat access to the lake apart from up the Te Paki Stream or through bush on the steep sided lake margins.

Wetland vegetation

There was an almost complete fringe of emergent vegetation (apart from the dune face), mostly narrow, about 1 m across due to the steep sided lake edges, apart from the northern area where a larger emergent band was present. Vegetation was dominated by kuta (*Eleocharis sphacelata*) or raupo (*Typha orientalis*) which both grew to depths of up to 2 m. Swamp millet (*Isachne globosa*) was also common amongst the emergent species. In 2009, the lake level was assessed as higher than in 2007 with some marginal plants such as harakeke (*Phormium tenax*) and ti kouka (*Cordyline australis*) being partially submerged and dying. Further increase in water level from 2009 to 2021 was evident, with deeper emergent vegetation and dead woody vegetation at several sites.

Wairaupo, at the access point showing the dead woodland, caused by water level rise [Susie Elcock, 2021].

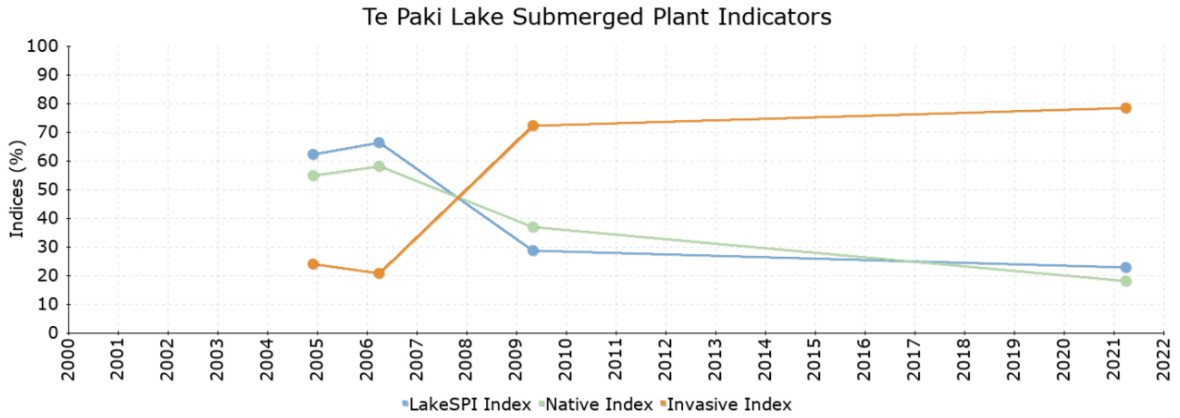
Submerged vegetation

In 2021, no turf species were recorded. Egeria (Egeria densa) dominated the submerged vegetation with average covers up to 50%, up to 2.5 m tall and extending to 5.8 m depth at one site. *Utricularia*

gibba was common, occurring at three of the five transects to a depth of 4 m. The native species *Potamogeton ochreatus* also occurred at three transects, but with covers ≤ 5%. *Chara australis* was found on two transects, forming meadows down to 3 m at one site.

In the first two visits (2004 and 2007), a few areas of turf plants were present including *Ranunculus amphitrichus, Myriophyllum propinquum*, *Myriophyllum votschii*, *Glossostigma elatinoides* and *Ludwigia palustris*. The native pondweed *P. ochreatus* dominated the vegetation with tall (up to 2.5 m) beds extending from 0.3 to 4.4 m depth. In 2007, egeria was within the mid-depth range at all profiles and up to 2.5 m tall, but with low average covers <25%. Egeria was more abundant in 2009, with depth range and cover increasing, although *P. ochreatus* was still common. Other submerged species included *Potamogeton crispus*, *Myriophyllum propinquum*, *Chara fibrosa*, and *Chara australis*.

LakeSPI



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
March 2021	Moderate	22.9%	18.1%	78.5%
April 2009	Moderate	28.7%	36.9%	72.2%
March 2006	High	66.3%	58.1%	20.7%
November 2004	High	62.2%	54.8%	24.1%

LakeSPI Index for Wairaupo. Four LakeSPI surveys are recorded between 2004 and 2021.

The LakeSPI score of 23% has reduced markedly from 62% in 2004 reflecting the increasing impact of the invasive egeria. Despite a small reduction in LakeSPI and Invasive Impact Index from 2009 to 2021, the Native Condition index has halved from 37 to 18%.

Water birds

The isolated nature of the lake provided good habitat for many aquatic birds, although lack of large emergent vegetation beds would limit habitat value for some species. Marginal trees provided a nesting and roosting site for pied shag (*Phalacrocorax varius*) with nests less than 1 m above the lake level. Large numbers of paradise shelduck (*Tardorna variegata*) were also noted in 2009 with some black swan (*Cygnus atratus*) and pukeko (*Porphyrio melanotus*).

Fish

Bullies (*Gobiomorphus cotidianus*) were widespread in the lake, however none were reported in 2021.

Aquatic invertebrates

The snail *Potamopyrgus antipodarum*, was common as were a freshwater sponges and empty shells of freshwater mussels (*Echyridella menziesii*).

Endangered species

No threatened species were observed in Wairaupo.

Lake Ecological Value

Based on the 2021 and 2009 surveys a Lake Ecological Value rating of 6 (Moderate) was calculated. Although much of the lake is surrounded by indigenous kanuka dominated vegetation, the lake is steep sided with limited buffering. The invasive submerged weed egeria has increased to dominate the submerged vegetation. There was low indigenous species diversity and no threatened species recorded.

Threats

Egeria now dominates the submerged vegetation. The isolated nature of and difficult access to this lake make further introductions of other pest species (e.g. hornwort (*Ceratophyllum demersum*) from Ngakeketo or Te Ketekete) a low probability. However, egeria was introduced to the lake, presumably by eel nets and further introductions may occur.

Fertilisation of pasture near the inflow stream would result in some nutrient addition, although marginal scrub and the fringe of emergent vegetation may reduce the level of lake enrichment. The presence of dead mussel shells likely indicates periods of benthic anoxia.

Access to the lake by cattle is likely to further degrade the lake, with direct browsing of emergent vegetation, pugging and nutrient addition.

Management recommendations

Advocate the exclusion of cattle from the lake, with alternative water supply provided. No monitoring recommended.