North of Dargaville

Lake Kai-Iwi (Kai-Iwi Lakes), NRC Lake No. 236.

Lake Kai-Iwi, showing the boat access point on the north-eastern margin of the lake, with emergent oioi (*Apodasmia similis*), *Machaerina arthrophylla* in the foreground right of the boat and trailer, with a deeper zone of kuta (*Eleocharis sphacelata*) (2023 Inigo Zabarte-Maeztu).

Summary	Lake Kai-Iwi
Surveyed:	1985, 1987, 2001, 2005, 2007, 2011, 2014, 2018 and 2023.
Overall ranking:	**Outstanding**: A native plant dominated lake, with nationally rare plants and *U. gibba* the only pest plant species present. Water quality trends showed increases in chlorophyll a (planktonic algae) and total nitrogen with decreased water clarity and a change in TLI from oligotrophic to mesotrophic to a 2021 assessment of eutrophic over two years of monitoring.
Threats:	Moderate risk of pest plant introduction with subsequent impact likely to be high. Deteriorating water quality is likely to reduce the Ecological Value Score in the future and may consequently increase the biosecurity risk.
Management recommendations:	Pest plant surveillance should be undertaken at access points annually. Monitoring of native biodiversity value should be done every 5 years. Further investigate the causes of water quality decline. Monitoring of the critically threatened *Trithuria inconspicua* populations is recommended.

Description

This dune lake (1659066E, 6036450N) is 22.6 ha in area, with a 16 m maximum depth. The lake margin is predominantly vegetated by scrub (70%) and logged pine plantation (30%), with pasture in the larger catchment. A drain periodically flows into Lake Taharoa at the south of the lake with no other obvious inlets or other outlets. The outlet drain was flowing during the 2023 visit. There is no road access to this lake with a small track to the launch site and no formed boat ramp. Permission to use a powered boat is required from the Taharoa Domain Board.

Wetland vegetation

Most of the lake had a 3 - 10 m wide margin of emergent vegetation, with dense oioi (*Apodasmia similis*) and occasional *Schoenus brevifolius* closest to the terrestrial margin and *Machaerina arthrophylla* (especially on the exposed eastern shore). *Machaerina articulata* and *M. juncea* were common in shallow water up to 0.7 m deep and an outer zone of *Eleocharis sphacelata* extended up to 2.8 m deep on one transect in 2023. One patch of raupō (*Typha orientalis*) was noted for the first time on the south-western lake margin in 2014. This could indicate a local source of nutrient enrichment. *Isolepis prolifera* was reported at one dive transect in 2023, the first record from the Kai Iwi lakes.

The native restiad *Empodisma robustum* was found under manuka on the northern margin of the lake in 2023. This is the first Northland lake record of this species south of Te Hiku (Karikari, Kaimaumau and Parengarenga). Prior to the 2023 survey, there have been iNaturalist records of this species from Lake Kai-Iwi in 2018 and 2021[1].

Small saplings of the non-native conifer pond cypress (*Taxodium distichum* var. *imbricarium* (syn. *T. ascendens*)) were noted amongst the oioi on the eastern shoreline. This is the first known naturalised record of this plant.

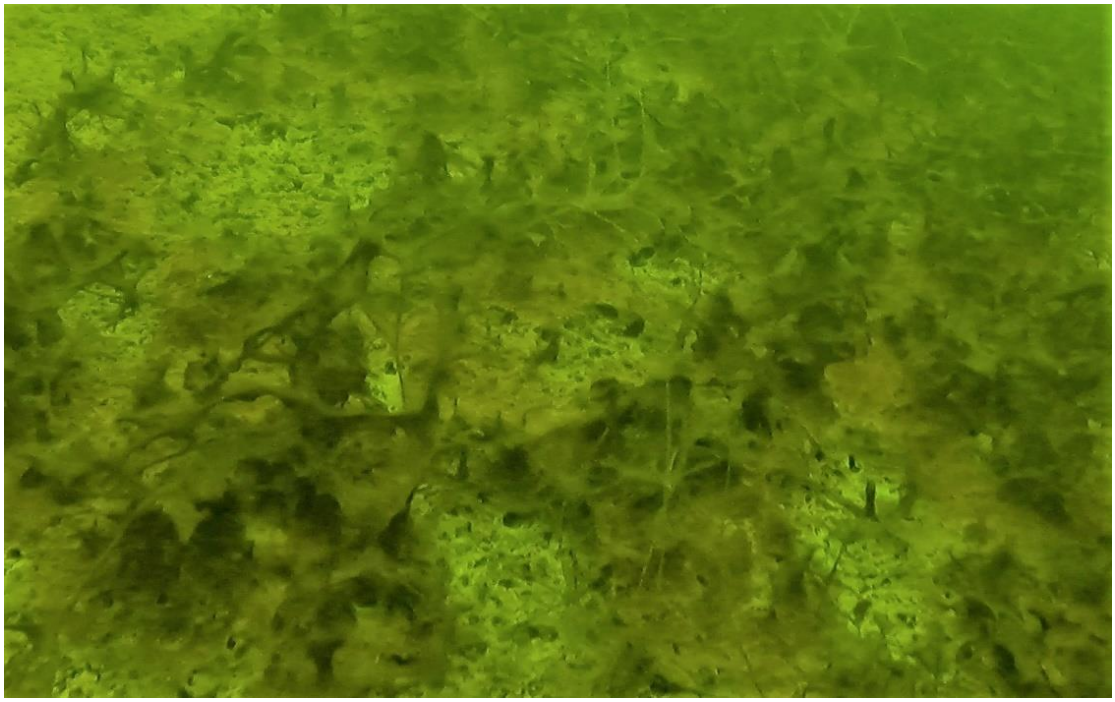
The remains of the rare spring annual *Centrolepis strigosa* was found in open moss banks under scrub at the northern end of the lake for the first time in 2023.

Submerged vegetation

In 2023, turf plants occurred to 2 m depth in several locations with abundant *Trithuria inconspicua, Triglochin striata, Lilaeopsis novae-zelandiae* and *Myriophyllum votschii*.

In 2023, deeper water vegetation was markedly sparse and covered in dense cyanobacterial mats. Charophyte meadows (>75% cover) were present from 1.5 m to a median depth of 8.8 m, being absent on one of the profiles. Dominant species were *Chara australis* (median cover >50%), *C. fibrosa* (median cover >5%) and *Nitella pseudoflabellata* and *N. leonhardii* (which grew to a maximum of 12.6 m). *Potamogeton cheesemanii* occurred at low covers in three profiles with a maximum depth of 5.2 m. The invasive *Utricularia gibba* was absent from the transect sites but did occur amongst erect emergent vegetation in water < 2 m depth.

[1] e.g., https://inaturalist.nz/observations/16543696

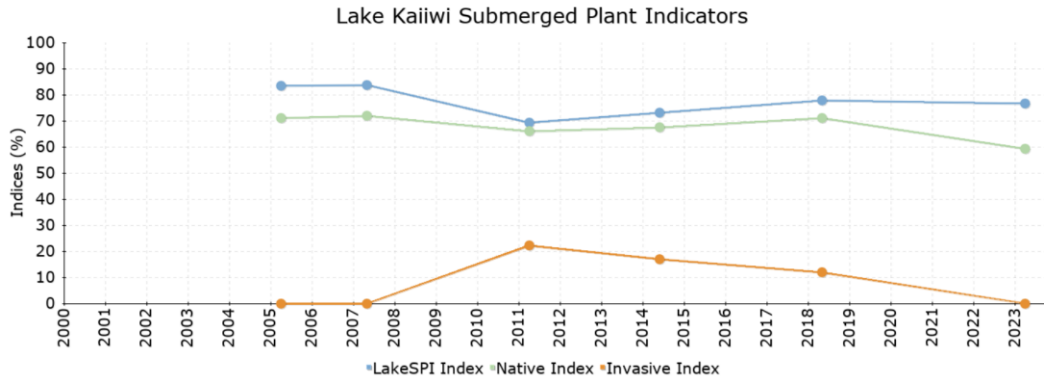


Lake Kai-Iwi showing charophytes covered by cyanobacterial mats (2023, Svenja David).

In 2018, Lake Kai-Iwi had record vegetation depth limits for submerged plants. *Chara australis* meadows extended to 13.3 m in three profiles and 13.9 m in another. *Utricularia gibba*, although present, was only found on three profiles, within the emergent zone with low covers.

Surveys prior to 2018 recorded charophyte meadows that extended from < 2 m to ~13 m, dominated by *C. fibrosa* to ~7 m and *Chara australis* to ~13 m deep. *Potamogeton cheesemanii* frequently occurred at low covers to about 4 m water depth. The invasive *Utricularia gibba* was found in deep water in three of the five profiles to depths approaching 10 m deep. However, it was localised and of low covers, not apparently impacting other submerged vegetation. Vegetation bottom limits varied from 2005 to 2014, averaging around 12-13 m. However, in 1985 the bottom limit was only 8.5 m and there was very poor visibility in the hypolimnion, suggesting anoxia.

LakeSPI



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
March 2023	Excellent	76.6%	59.3%	0.0%
April 2018	Excellent	77.9%	71.1%	11.9%
May 2014	High	73.2%	67.4%	17.0%
March 2011	High	69.4%	65.9%	22.2%
April 2007	Excellent	83.8%	71.9%	0.0%
March 2005	Excellent	83.4%	71.1%	0.0%

LakeSPI Index for Lake Kai-Iwi as % of potential score since 2005. Native Condition Index, and Invasive Impact Index are also shown.

Lake Kai-Iwi was categorised as being in Excellent ecological condition in 2023 with a LakeSPI Index of 77% and having a Native Condition Index of 59%. The LakeSPI Index was similar to 2018, but Native Condition Index had fallen by more than 10% despite the lack of any invasive species in the profiles. Thus, there has been a notable decline in the submerged vegetation.

Potentially, the impacts of recent extreme rainfall events during Cyclone Gabrielle and subsequent nutrient enrichment from erosion of the catchment may have led to this decline. Water clarity was still in excess of 3 m, but the dense mats of cyanobacteria would stress submerged vegetation in deeper waters.

Water birds

The isolated nature of much of this lake and extensive emergent and scrub vegetation provide good habitat for water birds, probably acting as a refuge from the human-mediated disturbance in the two adjacent lakes. There are earlier reports of large numbers of waterfowl utilising this lake, including the Nationally Threatened bittern (*Botaurus poiciloptilus*). A pair of dabchick (*Poliocephalus rufopectus*) were noted in 2018 and 2023, with additional records including scaup (*Aythya novaeseelandiae*) and grey duck (*Anas superciliosa*).

Fish

Native fish records include common bullies (*Gobiomorphus cotidianus*) and historically dune lakes galaxias were found, also a single fish was captured in a 2018 Department of Conservation (DOC) survey (Andrew Knock, DOC, pers. comm.). Exotic fish present include gambusia (*Gambusia affinis*). Previously both rudd (*Scardinius erythrophthalmus*) and a stocked population of rainbow trout (*Oncorhynchus mykiss*) was recorded as present in Lake Kai-Iwi. Trout are no longer stocked in the Kai-Iwi lakes.

Aquatic invertebrates

Invertebrates were abundant in the lake. No freshwater mussels (*Echyridella menziesii*) were seen but empty shells have been noted in previous surveys. The remains of koura (*Paranephrops planifrons*) were commonly observed along the water's edge in 2014.

Endangered species

Lake Kai-Iwi supports possibly the largest population of the Nationally Critical *Trithuria inconspicua* subsp. *inconspicua* with a c.10 m band of this species in shallow water or exposed sand (average cover of 10%) around much of the lake. The total population size was estimated at 2 ha.

Dead plants of the Nationally Endangered *Centrolepis strigosa,* an annual species, were found in 2018 and 2023, the first collections from Lake Kai-Iwi since the 1980's. The status of this species has improved from Nationally Critical based on surveys of the Kai-Iwi lakes, with the population assessed as stable and occupying ≤ 10 ha.

The At-Risk Declining *Empodisma robustum* is locally common on the northern edge of Lake Kai-Iwi, with a patch size of over 50 m of track observed.

The At-Risk Naturally Uncommon dune lakes galaxias (restricted to the Kai-Iwi lakes) may be present in extremely low numbers in this lake. An increase in threat status is advocated for this species, as is a targeted fish survey.

Threatened bird species reported from the lake in 2023 included Nationally Vulnerable grey duck (*Anas superciliosa*) and Nationally Threatened -Increasing dabchick (*Poliocephalus rufopectus*).

Lake Ecological Value

Lake Kai-Iwi Ecological Value rating is assessed as Outstanding, with a score of 14, a reduction from 15 in 2018. This reflects the reduction in water quality and, if submerged vegetation continues to decline in deeper water, further loss of Ecological Value could occur.

Threats

The lack of motorised boat traffic to this lake reduces the risk of pest introduction. However, conditions in this lake are suitable for the establishment and growth of invasive vascular weeds. If pest plants were introduced, they would be expected to establish quickly and would severely impact lake values.

Rudd have been present in the lake since c.1991 with little apparent impact on plants. However, these herbivorous fish have been implicated in the loss of vegetation elsewhere so remain a threat if a population still survives in the lake. This threat could increase significantly if water quality restricts plants from recovering from pest fish browsing losses.

The greatest threat to Lake Kai-Iwi appears to be declining water quality, with a TLI of 4.2 in 2021 (eutrophic reported for the first time since NRC monitoring of the lake began[2]).

[2] https://www.lawa.org.nz/explore-data/northland-region/lakes/lake-kai-iwi/

Management recommendations

Continuance of annual surveillance of the access point for pest plant incursion, with a possible 3-yearly surveillance being adequate.

A targeted fish survey is recommended for pest fish and also the At Risk Naturally Uncommon dune lakes galaxias. An increase in threat status of this fish would be advocated, should no fish be located during this survey.

Further investigations into the decline of water quality from oligotrophic (TLI of 2.8) in 2019 to mesotrophic (TLI of 3.3) to eutrophic (4.1) in 2021 are urgently required. This decline was prior to the unseasonably wet summer (including Cyclone Gabrielle) of 2023.