

Te Hiku

Lake Ngatu, (Sweetwater) NRC Lake No. 120.



Lake Ngatu, viewed from the northern access point, showing a mat of the invasive alligator weed (*Alternanthera philoxeroides* - centre left) growing between the mown grass and erect emergent vegetation (2023, Paul Champion).

Summary	Lake Ngatu
Surveyed:	1984, 2001, 2004, 2006, 2010, 2014, 2016, 2020, 2021, 2022 and 2023.
Overall ranking:	Outstanding: Good emergent and submerged vegetation is present with some endangered biota, including the nationally critical <i>Trithuria inconspicua</i> . Pest plants are present but currently having a limited impact. Three pest fish species were recorded. Water quality varies considerably but appears to have recently declined to a eutrophic condition.
Threats:	Threats include eutrophication from residential development, farming intensification and possibly kauri log recovery from wetlands. The invasive submerged weed lagarosiphon was controlled in 2020 with no evidence of this plant in 2023, but there is a high risk of further species introductions.

Management recommendations:	<p>Lake ecological monitoring is recommended annually to 2025, then a reversion to five-yearly monitoring.</p> <p>Annual pest plant surveillance should be undertaken at access points.</p> <p>Annual monitoring of the critically threatened <i>Trithuria inconspicua</i> populations is required under the National Policy Statement – Freshwater Management.</p> <p>Eradication of marginal weed species should be achieved before they spread.</p> <p>Investigate pest fish control targeting spawning aggregations of goldfish and potentially rudd. Use eDNA monitoring to find evidence for pest fish such as perch, rudd and trout.</p>
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Description

Lake Ngatu (1618069E, 6123394N) is a large (50.3 ha) dune lake with a maximum depth of 6.5 m. The catchment is primarily kānuka scrub and fenced pasture. There is low density housing overlooking the lake on the north-western fringe. It is a popular recreational lake with easy access from West Coast Road to the north and from Sweetwater Road along the eastern shore, with a footpath completely encircling the lake. Boat access to the northern end of the lake has been prevented using bollards. Lake access at the southern end is possible but difficult. The lake is a very popular recreational resource and a large number of waka ama are stored on the south western edge of the lake.

Wetland vegetation

In 2023, most of the lake margins had large beds of emergent species, with up to 100 m wide beds on the eastern margin associated with islands in this area. The dominant emergent is kuta (*Eleocharis sphacelata*) growing from the lake margin to 2 m depth, with other species including *Apodasmia similis*, *Machaerina articulata*, *M. arthrophylla*, *M. juncea* and *Schoenoplectus tabernaemontani* all common. *Eleocharis sphacelata* appears to be declining in parts of the lake.

A number of emergent weeds have been recorded at Lake Ngatu. One small clump of the invasive alien yellow flag iris (*Iris pseudacorus*) was removed in 2007. The invasive alligator weed (*Alternanthera philoxeroides*) was noted for the first time in 2012 and has been repeatedly treated with the herbicide metsulfuron-methyl (Kevin Matthews, pers. comm.), but plants remain with the plants occupying 5 m² in 2023.

In 2023, the path around the lake was walked, with the following pest plants noted as starting to establish. The climbers moth plant (*Arauja hortorum*), jasmine (*Jasminum polyanthum*), blue morning glory (*Ipomoea indica*), black and banana passionfruit (*Passiflora edulis* and *Passiflora* sp.), Cape and German ivy (*Senecio angulatus* and *Senecio mikanioides*), woody coastal banksia (*Banksia integrifolia*), she-oak (*Casuarina cunninghamiana*) and Christmas berry (*Schinus terebinthifolia*), the scrambling bushy asparagus (*Asparagus aethiopicus*) and purple taro (*Colocasia esculenta*) which was seen in an inlet drain.

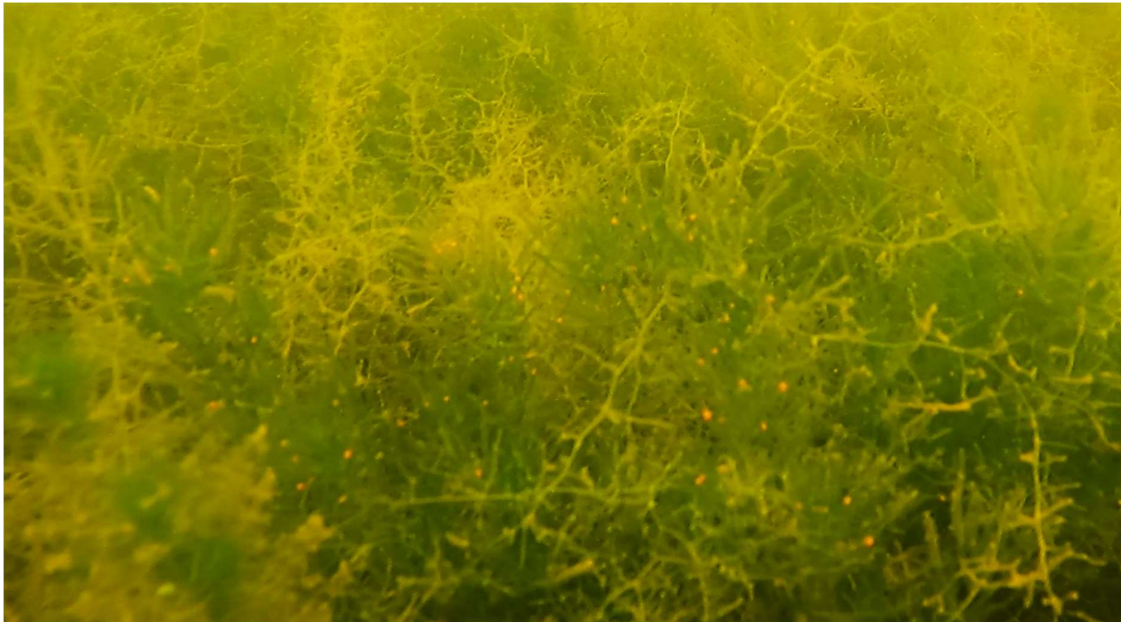
The invasive climber mile-a-minute (*Dipogon lignosus*) was found near an inlet drain at the northern end of the lake in 2014. This was removed by hand weeding and picloram gel was applied to

remaining stems. Christmas berry has been found and removed amongst mānuka on the eastern edge of the lake in 2014, 2021 and 2022, with a 2023 record at a different location.

Submerged vegetation

In 2023, the water level was high, reflecting the heavy rainfall over the previous few months. Underwater visibility was reported to be 2 m or more at all five transect sites, with submerged vegetation (comprised of charophyte meadows <75% cover) extending to 5 m depth.

Healthy populations of *Trithuria inconspicua* were found in four of the profiles, with large plants up to 5 cm in diameter and height were common. The native *Glossostigma elatinoides*, *Lilaeopsis novae-zealandiae*, *Myriophyllum propinquum* and non-native *Juncus bulbosus* were also recorded in shallow areas.



Lake Ngatu charophyte meadow at 3.5 m depth (2023 Inigo Zabarte-Maeztu).

Charophytes were the dominant submerged species, with charophyte meadows (>75% cover) extending to a maximum of 5 m in 2023. The dominant species were (in descending order of cover) *Chara fibrosa*, *Chara australis*, *Nitella leonhardii* and *Nitella pseudoflabellata*. Maximum depth of charophyte meadows had continually increased from 2020 to 2023.



Lake Ngatu charophyte meadow covered by *Utricularia gibba* at 2 m depth (2023 Inigo Zabarte-Maeztu).

The invasive *Utricularia gibba* was common in shallow parts of four profiles in 2023, especially at the boat ramp. It grew to a maximum depth of 2.4 m and covers >50% at two profiles, 1.5 m and covers <25% at two profiles and was absent at the fifth profile.

In 2021, no turf species were recorded. Water levels were extremely low, with exposure of the zone previously occupied by turf species. Prior to 2021, turf communities were common in areas to ~ 1 m deep where *E. sphacelata* did not form dense emergent beds. Common species were *Lilaeopsis novae-zelandiae*, *Myriophyllum votschii*, *Trithuria inconspicua*, *Triglochin striata*, *Utricularia gibba* and the exotic *Juncus bulbosus*. In 2020, *Limosella lineata* was recorded for the first time since it was recorded in 1984 (Tanner et al. 1986). It was growing in recently flooded areas amongst submerged terrestrial grasses and Asteraceae species near the northern access.

Prior to 2020, the average cover class of charophytes had been declining over the years from nearly 100% cover up to 2006, reducing to average covers of 51 -75 % in 2010 and 2014, but in 2016 was less than 5% with occasional patches only across the main body of the lake.

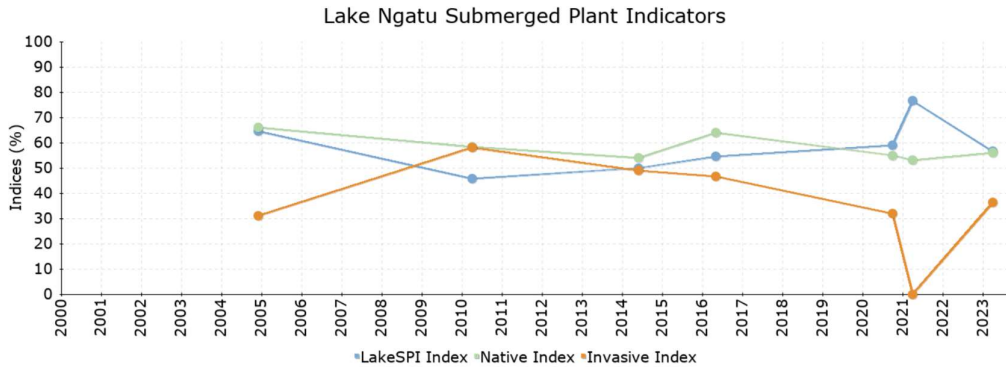
Prior to 2010, *Chara fibrosa* and *Nitella leonhardii* were the dominant charophytes with only low covers of other species present (although Cunningham et al. (1953) indicated some areas of the lake were dominated by *C. australis*).

No tall vascular species have been recorded since 2020. Prior to a control programme initiated in September 2020¹, the alien invasive weed lagarosiphon (*Lagarosiphon major*) was present in the northeast of the lake at depths between 0.5 and 3.0 m with an average cover less than 25% and was also present at <5% cover at another site. There has been no detection of lagarosiphon in Lake Ngatu since 2020, with diverse charophyte meadows re-establishing in the area previously occupied by lagarosiphon.

Utricularia australis was once common in Lake Ngatu but has not been seen since 2007.

¹ a Freshwater Improvement Fund (FIF) MfE and NRC funded project for lagarosiphon eradication in Lake Ngatub undertaken using the herbicide endothall dipotassium.

LakeSPI



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
March 2023	High	56.5%	56.0%	36.3%
March 2021	Excellent	76.5%	53.0%	0.0%
September 2020	High	59.0%	55.0%	31.9%
April 2016	High	54.5%	64.0%	46.7%
May 2014	Moderate	50.0%	54.0%	48.9%
March 2010	Moderate	45.8%	58.3%	58.0%
November 2004	High	64.5%	66.0%	31.1%

LakeSPI for Lake Ngatu. Seven LakeSPI surveys are recorded between 2004 and 2023. Native Condition Index, and Invasive Impact Index are also shown.

Lake Ngatu was categorised as being in High ecological condition in 2023 with a LakeSPI Index of 57% and with a Native Condition Index of 56%. The decrease of LakeSPI Index from 77% to 57% between 2021 (Excellent condition) and 2023 is likely due to the impact of the invasive *Utricularia gibba* which had an Invasive Impact Index of 36% in 2023 but which was absent from profiles in 2021. Despite this decrease, the slight increase in Native Condition Index from 2021 to 2023 reflects the deeper and denser charophyte meadows compared to 2021.

Previous decreases in the LakeSPI Index from 65% in 2004 to 46% in 2010 was a result of increasing invasive impact from *U. gibba*, and a decrease in Native Condition Index. A minor improvement driven by reduced impact from weeds was indicated between 2010 and 2020, but the Native Condition Index had declined slightly. Despite charophyte meadows re-establishing in 2020 and 2021, the Native Condition Index was still slightly lower. However, the absence of lagarosiphon and *U. gibba* in 2021 had led to an improved (>15%) LakeSPI score.

Water birds

Extensive emergent vegetation provides a good habitat for water birds, however human disturbance reduces the habitat suitability for more secretive species. The 2023 survey recorded dabchick (*Poliiocephalus rufopectus*) and Caspian tern (*Hydroprogyna caspia*). Bittern (*Botaurus poiciloptilus*) were seen on previous lake surveys.

Fish

Common bullies (*Gobiomorphus cotidianus*), īnanga (*Galaxias maculatus*) and the exotic pest gambusia (*Gambusia affinis*) were observed in 2023. The landlocked population of īnanga are of special status, possibly a new species with a larger number of gill rakers than migratory (diadromous) īnanga (B. David, D. Rowe pers. comm.). The introduced rainbow trout (*Oncorhynchus mykiss*), rudd (*Scardinius erythrophthalmus*) and goldfish (*Carassius auratus*) were also reported in the New Zealand Freshwater Fish Database database. A rudd was noted amongst emergent vegetation at the southern end of the lake in 2009. The pest fish perch (*Perca fluviatilis*) was reported by a diver in 2009, but presence was not confirmed.

A combination of Gee minnow traps, seine and gill nets were deployed in 2010 but only īnanga, bullies, gambusia and a goldfish were caught. An attempt was made to confirm perch presence in April 2010 by overnight gill netting but only goldfish were caught. Perch could have a major impact on other fish species. Holes in vegetation and sediment surface, indicative of bottom feeding pest fish were noted in 2010.

DOC conducted a fish survey during 2014 using a combination of Gee minnow (10) and fyke nets (9). They recorded a total of >13,000 gambusia, 369 common bullies, 1,249 īnanga, 5 longfin and 1 shortfin eels (all large ≥680 mm long) with 56 diving beetles (*Onychohydus hookeri*) also caught.

In 2021, a mass spawning event of goldfish was observed in a small area of emergent vegetation on the southeastern shore.

Aquatic invertebrates

The introduced ramshorn snail (*Planorbis corneus*) was abundant in the lake in 2023. The introduced snail *Planorbella scalaris* was reported from Lake Ngatu and identified by Brian Smith (NIWA, Hamilton) in March 2007. It is endemic to the central and southern part of the Florida peninsula where it is found in marshes and lakes. This was the first record of this species in New Zealand. However, it has not been found during the later surveys. Large numbers of New Zealand's largest dytiscid beetle *Onychohydus hookeri*, were caught in the Gee minnow traps deployed in 2010. They are carnivorous and were observed feeding on gambusia in the nearby Little Gem Lake.

Endangered species

The Nationally Critical *Trithuria inconspicua* subsp. *inconspicua* was locally common amongst open emergent beds of *Machaerina arthropylla* from depths of 0.3 to 0.9 m. Locations were assessed near the northern boat ramp (1618160E, 6123725N) and three areas in the southernmost bay (1618125E, 6122850N; 1617950E, 6122765N and 1617930E, 6122935N). In 2022, several thousand plants were observed covering a total area of 200 m². This species was found at all those sites in 2023, with much larger specimens noted. This species was restricted to Lakes Ngatu, Rotoroa and Rotokawau in the Te Hiku lakes.



Lake Ngatu, the Nationally Critical *Trithuria inconspicua* subsp. *inconspicua* (foreground) amongst open emergent beds of *Machaerina arthrophylla* near the boat ramp (2022, Daniel Clements)

The Nationally Critical *Utricularia australis* was a common component of the submerged vegetation up to 2004 but was last seen in this lake in 2007. The At-Risk Declining fern *Cyclosorus interruptus* was reported from the marginal vegetation for the first time in 2007 and appears to persist in the same area.

The At-Risk Declining īnanga were sampled by DOC in 2014. These fish are land-locked and differ from migratory (diadromous) īnanga by having a larger number of gill rakers. The lake population of this fish appears to be secure, despite huge numbers of gambusia.

Nationally Threatened – Increasing dabchick (*Poliocephalus rufopectus*) and Nationally Vulnerable Caspian tern (*Hydroprogne caspia*) were recorded in 2023.

Lake Ecological Value

In 2023, the Ecological Value Score of Lake Ngatu was assessed as Outstanding, with a score of 13. This was a slight decrease from 2022 (Ecological Value Score of 14) after the most recent water quality data² recorded an eutrophic water quality, reducing from mesotrophic on earlier occasions. Prior to 2023, the Ecological Value Score of Lake Ngatu had shown an improving trend from 2012 to 2022 due to improving TLI, LakeSPI and species richness over that time.

Threats

Lagarosiphon had been present in the lake since 1988 but appears to have been successfully extirpated from Lake Ngatu following a joint Freshwater Improvement Fund (FIF) (Ministry for the Environment) and Northland Regional Council dune lake project for the control of lagarosiphon using the herbicide endothall dipotassium. Other weed species, such as hornwort (*Ceratophyllum demersum*), could displace all other submerged vegetation. Access to Ngatu is easy and the risk of spread of freshwater pests from other lakes and water bodies by boat traffic is assessed as high, although recent prevention of boat access to the northern end of the lake would likely reduce this risk.

² <https://www.lawa.org.nz/explore-data/northland-region/lakes/lake-ngatu/>

A number of marginal weeds have been detected at an early stage of invasion at Lake Ngatu. Alligator weed had markedly increased in abundance at the northern lake access point in 2023, perhaps a consequence of cooler, wetter summer conditions which may have reduced the effectiveness of the biocontrol agent *Agasicles hygrophila*. Two patches of water lily (*Nymphaea* sp. – possibly *N. mexicana*) have been discovered and removed in October 2016 at the northern end of the lake (A. Macdonald pers. comm.). Both sites were around 10m² in knee deep water. The water lily was previously thought to have been eradicated in the 1990's where it was found at the southern end of the lake.

A 2014 infestation of Christmas berry was eradicated but subsequent plants (distant from the first incursion) were found in 2021, 2022 and 2023. Efforts to eradicate these and the source tree are recommended. It has yet to invade wetland margins in New Zealand as it does in warm temperate Australia and Florida.

A further 11 marginal weeds were detected for the first time in 2023. All these species are likely to become major weeds and attempts to delimit them and eradicate where possible are advocated.

The pest fish *Gambusia affinis* may have a deleterious impact on other fish like the nationally significant īnanga. Rudd do not appear to be impacting submerged vegetation under current conditions. Perch (reported in 2009) were not captured in the 2010 fish survey. Perch could have a major impact on other fish species as they are piscivorous. Large numbers of goldfish were found in 2021. While their impacts have not been well evaluated in New Zealand (Rowe 2014), such large numbers of fish are likely to impact on other benthivorous species.

Concerns have been raised about nutrient and other water quality impacts related to land use change, septic tanks and kauri log removal from the catchment. TLI is apparently deteriorating.

Management recommendations

It is recommended that lake native biodiversity value monitoring is undertaken every year until 2025 to ensure lagarosiphon eradication has been achieved (five years with no plants recorded) and that other components of the vegetation have re-established. Annual pest plant surveillance is also recommended at access points.



Lagarosiphon (*Lagarosiphon major*) in submerged vegetation of Lake Ngatu (September 2020 (Tracey Burton) left), and native charophytes growing in the same area following herbicide application (March 2021 (Aleki Taumoepeau) right).

Annual monitoring of the critically threatened *Trithuria inconspicua* populations is required under the National Policy Statement – Freshwater Management.

Continued management of other marginal weeds and water lilies towards eradication is recommended.

An investigation of pest fish control targeting spawning aggregations of goldfish and potentially rudd is recommended (Champion 2021).

eDNA monitoring should be attempted to find evidence for pest fish such as perch, rudd and trout in Lake Ngatu, with a follow up netting survey should these species be detected.

References

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