3.20 Lake Rotokawau (Aupouri), NRC Lake No. 116; surveyed in 2005 and 2009

Plate: Lake Rotokawau from access point**.**

Summary

Overall ranking

High: Impacted by *Utricularia gibba*. The 'Nationally Endangered' *U. australis* was re-discovered in 2009 raising the ranking from Moderate-High to High.

Threats

Biosecurity, possible introduction of *Ceratophyllum demersum* or *Egeria densa*

Management recommendations

Lake native biodiversity value monitoring required at 5 year intervals. Survey lake for land-locked inanga.

Description

A dune lake (1618821E, 6124849N) accessed through private land via 2-wheel drive under fair weather conditions, and accessible for small boats. A small (14.2 ha), shallow (3.1 m) water body within a catchment of fenced pasture (70%), scrub (30%) and planted forest, with no major inflows or outflow. Access is through private land managed by owners who are aware of lake threats.

Wetland vegetation

The lake was encircled by a reed bed of *Eleocharis sphacelata* extending out 10-30 m to a maximum depth of 2 m (90% cover). *Baumea arthrophylla*, *B. articulata*, *B. juncea*, *Apodasmia similis* and *Eleocharis acuta* were also present.

Submerged vegetation

Turf plants were occasional at the inshore edge of the reed bed, and included the regionally rare *Gratiola sexdentata* and *Triglochin striata*. The submerged vegetation was dominated by the charophyte *Chara fibrosa* to the maximum lake depth (3.1 m), but with the exotic invasive species *Utricularia gibba* covering much of the lake vegetation (cover >50%) between 0.5 and 2.8 m. The only other exotic plant, *Juncus bulbosus*, was limited to shallow water at one site only. The 'Nationally Endangered' *Utricularia australis* was present low to medium covers at ~2 m depth (amongst *U. gibba*) throughout the lake in 2009, after not being recorded in 2004.

LakeSPI

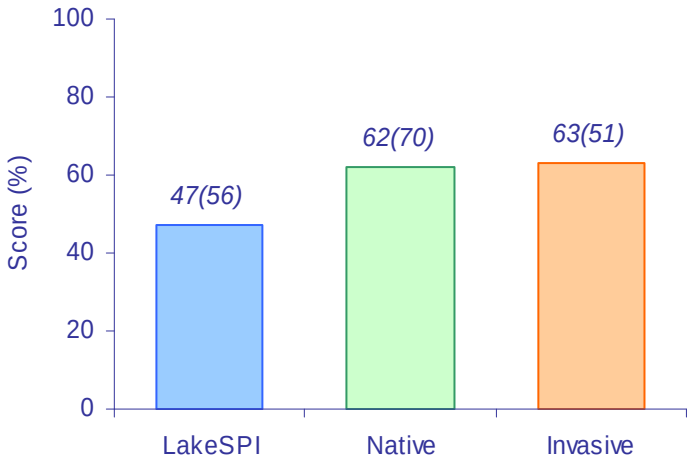

Figure: LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right) with 2004 results in brackets.

The LakeSPI score of 47% is moderate, reflecting the presence of several key native plant communities, but impacted by the extent of the invasive exotic, *U. gibba*. Relative to 2004 there was a slight decrease in maximum depth of native species and an increase in the depth of *U. gibba* lowering the LakeSPI score.

Water birds

The extensive emergent beds and adjacent scrub areas provide good habitat for water birds. The nationally threatened bittern (*Botaurus poiciloptilus*) and regionally significant dabchick (*Poliocephalus rufopectus*), Australasian little grebe (*Tachybabptus novaeholandiae*) and fernbird (*Bowdleria punctata vealeae*) were all previously recorded from this lake.

Fish

Common bullies (*Gobiomorphus cotidianus*) and the exotic pest gambusia (*Gambusia affinis*) were observed. There are also reports of a landlocked population of inanga (*Galaxias maculatus*), which may be of special status (cf. recent evaluation of Lake Ngatu population of inanga (B. David pers. comm).

Aquatic invertebrates

The introduced snail *Physella acuta* was noted.

Changes in indicators

Both the exotic species *U. gibba* and *J. bulbosus* were new records for this lake in 2004. *U. gibba* is now one of the dominant plants within the lake. The charophyte meadows have survived despite the extensive covering by *U. gibba*, and at the time of the 2009 survey were of lower cover than recorded in 2004. Previous observations recorded the 'Nationally Vulnerable' *Trithuria inconspicua* (1988, 1991). The 'Nationally Endangered' *U. australis* was prominent in 2009 raising the lake ranking from Moderate-High to High.

Threats

U. gibba a recent invader in 2004 appeared to have displaced the native *U. australi*s, but in 2009 *U. australi*s was recorded on all profiles growing amongst the *U. gibba*. Access through private land minimises the risk of further exotic plant introductions. The exotic pest fish gambusia will have impacts on other fish.

Management recommendations

Lake native biodiversity value monitoring every 5 yrs.

Sample for land-locked inanga to determine their status and compare with Lake Ngatu fish.

3.21 Lake Rotoroa (Aupouri), NRC Lake No. 126; surveyed in 2005 and visited in 2010

Plate: Lake Rotoroa, approaching from the north-east and showing the predominantly pastoral catchment and much of the lake edge fenced with riparian plantings.

Summary

Overall ranking

High: Submerged vegetation dominated by invasive *Egeria densa*, but large population of the endangered *Trithuria inconspicua*, moderate water quality and good water bird habitat.

Threats

Current high level of impacts from *E. densa*. *C. demersum* is present in adjacent Lake Heather and poses a risk to this lake. Alligator weed (*Alternanthera philoxeroides*) could displace other emergent species. Margins fenced, re-vegetation of riparian zone undertaken, but cattle access to the lake is still evident.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Description

Part of the Sweetwater group of lakes (1617883E, 6120400N). The lake is fairly large (26.5 ha) and relatively deep (8 m). This lake is accessed across 2 km of private pastoral land that comprises most of the catchment; boat access is difficult. The lake has no defined inflows or outflows.

Wetland vegetation

The south-western half of the lake is encircled by dense beds of emergent species extending over 20 m wide, dominated by *Eleocharis sphacelata* to 1.8 m deep, with lesser amounts of *Schoenoplectus tabernaemontani*. The northern part of the lake has much sparser emergent vegetation, with extensive turf communities in shallow waters.

The invasive pest plant alligator weed (*Alternanthera philoxeroides*) was noted in small patches adjacent to mai-mais on the south-western part of the lake.

Submerged vegetation

Species-rich turf vegetation occurred at shallow (<2 m) shoreline areas, except where dense emergents occurred. Turfs were dominated by *Lilaeopsis novae-zelandiae* and in some areas the nationally rare *Trithuria inconspicua*. *Utricularia gibba* was present at low covers in association with stands of emergents, extending to 2.5 m deep on one profile. The exotic *Egeria densa* dominated from depths of 2 m to c. 5 m depth, forming dense beds up to 3.5 m tall. Isolated clumps and shoots of *E. densa* were present to the maximum surveyed depth of the lake at 7 m. *Potamogeton ochreatus* and *Chara australis* co-existed with low covers of *E. densa*.

LakeSPI

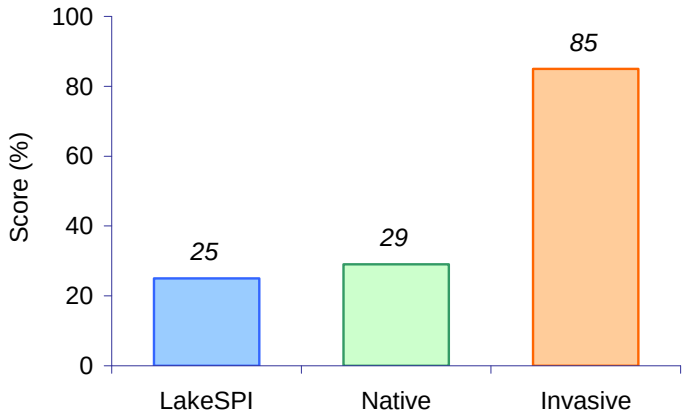

Figure: LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right).

The low LakeSPI score of 25% reflects the pervasive nature of invasion by *E. densa* and reduced extent of native plant communities.

Water birds

The extensive emergent vegetation provided good water bird habitat. Black swans (*Cygnus atratus*) and paradise shelduck (*Tadorna variegata*) were noted during the field visit. Recent OSNZ records include the nationally threatened bittern (*Botaurus poiciloptilus*) and regionally significant scaup (*Aythya novaezeelandiae*), dabchick (*Poliocephalus rufopectus*) and Australasian little grebe (*Tachybaptus novaehollandiae*).

Fish

Common bullies (*Gobiomorphus cotidianus*), smelt (*Retropinna retropinna*) and inanga (*Galaxias maculatus*) were seen on the vegetation survey. Both smelt and inanga are lake-bound populations. NIWA FBIS database also reports shortfin eels (*Anguilla australis*) from this lake. Mosquito fish (*Gambusia affinis*) were recorded for the first time in 2010.

Aquatic invertebrates

Freshwater mussels (*Hyridella menziesi*) and pea mussels (*Sphaerium novaezelandiae*) were abundant in the north eastern end of the lake.

Changes in indicators

The maximum recorded depth for submerged plants has varied somewhat over four vegetation surveys, from 4.5 m in 1985, greater than 5.5 m in 1988, 5.3 m in 2001 and at least 7 m in the current survey. The vegetation composition remains similar, with the exception of the introduction of the exotic *Utricularia gibba* since 2001, and absence of the regionally significant *Triglochin striata*. Alligator weed was recorded for the first time in 2004.

Threats

The pest plant *E. densa* has been well established since 1985 and has had a substantial impact on the native vegetation. *C. demersum* is present in adjacent Lake Heather and would pose a risk to this lake. *U. gibba* is a new pest record, however it is not expected to have a large impact in this large, and relatively wave exposed lake. The exotic plants *Otellia ovalifolia* and *Potamogeton crispus* have been recorded at times, probably when introduced as seed by water fowl, but have minimal impact. Access to the lake is difficult and the likelihood of future pest plant or fish introductions is low.

Floating mats of *Alternanthera philoxeroides* could threaten shallow sheltered areas by smothering other vegetation.

The lake is now completely fenced and development of riparian and emergent vegetation in formerly grazed lake margins is likely to reduce nutrient inputs from the catchment. However, cattle access to the lake margin is still evident.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

The status of inanga and relation to Lake Ngatu fish needs further investigation.

3.22 Salt Lake (Aupouri), NRC Lake No. 48; surveyed in 2005

Plate: Salt Lake showing the large beds of emergent raupo (*Typha orientalis*) surrounding open water.

Summary

Overall ranking

Low: Poor submerged vegetation, recent vegetation clearance.

Threats

Already appears to be nutrient enriched. No pest species but low value habitat.

Management recommendations

No monitoring recommended.

Description

Salt Lake (1602314E, 6159583N) is 2.2 ha in area with a maximum recorded depth of 1.5 m. It is situated in a pasture catchment, with a surrounding fringe of wetland, much of which was recently drained. There are no inflow streams but the lake discharges into the Tauwhia Stream via a wetland at the southern end of the lake. This

stream flows to the East Coast. Access is off the Onepu Block Road through approximately 500 m of private farmland. Boat access is difficult.

Wetland vegetation

Tall (2.5 m) *Typha orientalis* dominated the emergent vegetation and occupied 50% of the lake area to a depth of 0.5 m, although rhizome mats had rafted over water 1 m deep in some areas. At one site *Baumea articulata* and *Eleocharis sphacelata* were also present. The wetland on the northern lake boundary was of similar composition to the emergent vegetation with additional cabbage trees (*Cordyline australis*), and mat-forming *Persicaria decipiens*, *Ranunculus amphitrichus* and the exotic *Ludwigia palustris.*

Submerged vegetation

A sparse submerged vegetation was present at one of the three profiles with low covers of *Potamogeton ochreatus* (0.5 to 1 m deep) and *Nitella* aff. *cristata* (0.5 m deep).

LakeSPI

No LakeSPI score generates as vegetation cover <10%.

Water birds

The dense raupo vegetation provides good shelter for water birds. Paradise shelduck (*Tadorna variegata*) were the only species seen during the field visit. No rare species were reported in previous surveys.

Fish

No fish were observed.

Aquatic invertebrates

Backswimmers (*Sigara arguta*) were common.

Changes in indicators

Not previously surveyed. It appears that much of the wetland and scrub vegetation described in the 1991 DoC SSBI report has been cleared, some relatively recently.

Threats

No pest species present, but low habitat value. Drainage and clearance of surrounding native vegetation, especially wetland, further reduces value.

Management recommendations

No monitoring.

3.23 Lake Taeore (Aupouri), NRC Lake No. 38 reconnaissance in 2010

Plate: Lake Taeore with no water in April 2010.

Summary

Overall ranking

Moderate-low: Ephemeral lake.

Threats

Further decline in water table would reduce the habitat value.

Management recommendations

No monitoring.

Description

Lake Taeore (2512332E, 6725132N) is a wetland of 14.7 ha area. The catchment is in farmland with a wetland margin. There are no inlets or outlets. Access is through private farmland by permission only.

Wetland vegetation

The lake basin was surrounded by *Typha orientalis* and *Schoenoplectus tabernaemontani*.

Submerged vegetation

No water present. The dry lake bed was mainly covered in *Ludwigia palustris* and seedling *Typha orientalis*. The rare annual species *Fimbristylis velata* (northern most record in NZ) *Alternanthera nahui* and *Centipeda aoteorana* were present on the drying mud along with a range of weed species.

LakeSPI

No LakeSPI score could be generated.

Water birds

Fish

Desiccated eels.

Aquatic invertebrates

Desiccated mussels.

Changes in indicators

First visited in 2010. The 2010 drought is likely to be the first time this lake has dried up as recently mussels were present.

Threats

A lowering water table is the main threat to this lake and many other Northland lakes and wetlands.

Management recommendations

No monitoring.

3.24 Te Arai Ephemeral Wetland and Pond (Aupouri), NRC Lake No. 46; surveyed in 2005

Plate: Te Arai Pond with grazed margins and sparse emergent vegetation, note the exotic floating fern (red) *Azolla pinnata*.

Summary

Overall ranking

Moderate: Small areas of water, with decreasing water level, grazing damage by horses.

Threats

Further decline in water table would reduce the habitat value.

Management recommendations

No monitoring.

Description

This dune wetland area (1598022E 6159812N) supports a small pond ~ 0.2 ha in area with a maximum depth of ~ 1 m and an adjacent shallow ephemeral turf area (total area 2.3 ha). The catchment is pine plantation forestry with a fringe of grass and scrub around the wetland margin. There are no inlets or outlets. Access is through 2 km of forestry roads past Bulrush Lake.

Wetland vegetation

Much of the area accessible to grazing had scattered clumps of *Typha orientalis* (pond) and *Eleocharis sphacelata* with widespread turf communities in the ephemeral wetland. Dominant species here were the native *Centella uniflora, Myriophyllum propinquum, Centipeda aotearana* and the introduced *Ludwigia palustris, Callitriche stagnalis* and *Paspalum distichum*.

Submerged vegetation

The pond was dominated by *Chara australis* forming a 0.8 m tall turf across the bottom (1 m) with surface-reaching *Potamogeton cheesemanii* occasionally present.

LakeSPI

Reconnaissance only – no LakeSPI score generated.

Water birds

Approximately 20 mallard (*Anas platyrhynchus*) and pairs of Canada goose (*Branta canadensis*) and paradise shelduck (*Tardorna variegata*) were seen.

Fish

No fish were seen.

Aquatic invertebrates

Backswimmers (*Sigara arguta*) were noted.

Changes in indicators

First visited in November 2004.

Threats

Decreasing water table and horse grazing appear to be the main threats to this area.

Management recommendations

No monitoring.

3.25 Te Arai Lake (Aupouri), NRC Lake No. 47; surveyed in 2006

Plate A: Te Arai Lake with scrub and forestry margins and mobile sand dunes to the north west.

Summary

Overall ranking

Low: remote dune lake, little invasive species impact, low macrophyte abundance, high wildfowl values.

Threats

Further decline in water table would reduce the habitat value.

Management recommendations

No lake native biodiversity value monitoring.

Description

This dune lake (1597154E 6159761N) is recorded as a 12.9 ha area in the NRC database, but the lake occupies ~ 6 ha, with an ephemeral wetland to the west of the lake formerly contiguous with this. The lake had a maximum depth of 1.9 m. The catchment is mostly scrub, with pine forest to the south and mobile dunes to the north west. There are no inlets or outlets. Access is through 3 km of forestry roads past Bulrush Lake and ~ 100 m of steep sided scrub margin.

Wetland vegetation

The eastern half of the lake was predominately vegetated with emergent *Typha orientalis* and *Baumea arthrophylla* (0 to 0.5 m deep) with *Eleocharis sphacelata* growing in deeper water (to 1 m) on about 25% of the lake margin. Other parts of the lake were fringed with a narrow (<5 m) emergent margin of the same species but with significant sections without emergent vegetation. Here turfs were dominated by *Elatine gratioloides* and *Glossostigma diandrum.*

Submerged vegetation

When visited in 2005 only the east end of the lake was accessed and shallow areas of the lake (up to 0.5 m), amongst emergent vegetation was dominated by a dense bed of *Chara australis* and small amounts of the exotic *Utricularia gibba,* with *Potamogeton cheesemanii* dominated the vegetation from 0.5 m to a maximum of 1.5 m deep. In 2006 only the west end of the lake was accessed. The same species were recorded but cover was very sparse with just the odd plant present due to heavily stained water. Lisa Forester (pers. comm.) recalled this was the situation in 2005, so it does not represent a change in Lake Condition.

Plate B: Lake Te Arai west end 2006, showing highly stained water not suitable for submerged vegetation.

LakeSPI

Reconnaissance only – no LakeSPI score generated as the submerged vegetation was too sparse.

Water birds

The regionally threatened dabchick (*Poliocephalus rufopectus*) and mallard (*Anas platyrhynchus*) were seen. DoC SSBI records from 1991 report regionally rare fernbird (*Bowdleria punctata vealeae*) and nationally threatened bittern (*Botaurus poiciloptilus*).

Fish

No fish were seen.

Aquatic invertebrates

Backswimmers (*Sigara arguta*) and the introduced snail *Physella acuta* were noted.

Changes in indicators

First visited in November 2004, no change in indicators.

Threats

Few invasive threats noted as access to lake difficult, but water levels are receding.

Management recommendations

No monitoring recommended.

3.26 Lake Te Kahika (Aupouri), NRC Lake No. 29; surveyed in 2006 and 2009

Plate A: Lake Te Kahika showing marginal emergent vegetation and scrub/pine catchment.

Summary

Overall ranking

Outstanding: This clear-water acidic lake is unique, with submerged vegetation limited to some *Sphagnum* and high covers of *Utricularia australis* in an inflow.

Threats

Low risk of introduction and establishment of invasive pests. Low to moderate risk of nutrient enrichment from pine plantation fertilisation with urea. Pine harvesting could impact water quality and nutrient status.

Management recommendations

Leaving the zone of scrub would offer some buffer for the lake from nutrient additions associated with logging activities. Lake native biodiversity value monitoring every 5 years.

Description

The lake (1600007E 6168587N) is approximately 18 ha in area with a maximum recorded depth of 10.8 m. It is situated on Holocene sand dunes, formed by a stream system impounded by dunes. The catchment is vegetated by pine plantation forestry with an intermediate zone of scrub (manuka and hakea). The lake is comprised of two arms each fed by an inflow, with the outflow (Kahika Stream) at the western edge of the lake discharging into Great Exhibition Bay (East Coast). Access is through private forestry roads (4-WD) through a locked gate and permission to cross Maori-owned land is required. There are no formed tracks leading to the lake edge and no formed boat access.

Wetland vegetation

There was a complete fringe of emergent vegetation, 5 to 20 m across dominated by *Eleocharis sphacelata* which grew to depths of 2.5 m, with swamp millet (*Isachne globosa*) and *Gleichenia dicarpa* also common. Several species typical of bog vegetation (including *Baumea teretifolia* and the regionally significant *Empodisma minus*) bounded much of the lake in shallow water (to 0.2 m deep) especially surrounding the inflows and outflow stream. In 2009 the 'Nationally Endangered' *Todea barbara* was recorded in tall manuka.

Submerged vegetation

There was no submerged vegetation reported in this lake despite good water clarity apart from high covers of the moss *Sphagnum* sp. amongst *E. sphacelata* at two sites and the nationally endangered *Utricularia australis* formed 100% covers in the inlet stream (Plate B). It is one of the few Northland lakes currently without *U. gibba*.

Plate B: Lake Te Kahika showing *Sphagnum* (LEFT)at 1.0 m in marginal emergent vegetation and a rare sight, *Utricularia australis* (RIGHT) abundant in an inflow stream, >3 m deep.

LakeSPI

No LakeSPI score generated as vegetation cover <10% and pH is an overriding factor.

Water birds

The isolated nature of the lake and large areas of emergent and wetland vegetation provide good habitat for many wetland birds, although lack of submerged vegetation and fish would limit the habitat for some species. Few birds were noted during the field visit. Fernbirds (*Bowdleria punctata vealeae*) were noted at the southern end of the lake, dabchick (*Poliocephalus rufopectus*) were present and little black shag (*Phalacrocorax silcirostis*). The endangered spotless crake (*Porzana tabuensis plumbea*), and Caspian tern (*Sterna caspia*) were previously recorded.

Fish

No fish were seen in the lake, however a shortfin eel (*Anguilla australis*) was noted in one inlet stream, and eel holes were common in places.

Aquatic invertebrates

Few aquatic invertebrates were noted, with *Sigara arguta* the most prevalent, with caddisfly (*Trichoptera*) and dragonfly larvae (*Odonata*). The rarely seen whirligig beetle *Gyrinus convexiusculus* was noted at the access point. It is a self-introduced Australian species which lives in ponds and lakes in Waikato and Northland.

Changes in indicators

The lake has been sampled on three previous occasions, in summer 1991, 1996 and 2005. With a lack of vegetation, plants cannot be used as an indicator unless they start growing in the lake. Water quality records would be the best indicator. The source of the lakes increasing acidity (pH 3.95 in 2005) and sulphate concentrations is not known and warrants further investigation.

Threats

There are currently no alien plants or fauna reported from this lake. Due to the acid nature of the lake and poor access, the likelihood of introduction and establishment is low.

Fertilisation of pine forests and run-off as a result of harvesting could result in nutrient enrichment. As the lake is possibly N limited, urea fertiliser application could deleteriously affect clarity and increase planktonic algal abundance.

The greatest threat to the lake would be increasing acidity and sulphate concentrations.

Management recommendations

Biosecurity threats are low. The chemistry of the lake is very unusual and warrants further study to explain the source of acidity (pH 3.95) and elevated sulphate concentrations. It is likely to be geothermally influenced. It is recommended that lake native biodiversity value of this unusual and outstanding lake should be monitored every 5 years.

3.27 Te Kahika Sth (Aupouri), NRC Lake No. (30); reconnaissance 2010

Plate: Te Kahika South, a coastal dune lake surrounded by a narrow wetland \ scrub margin within pine plantation forestry.

Summary

Overall ranking

High: A small remote lake, with the endangered *Todea barbara* and *Utricularia australis.*

Threats

Low risk of introduction and establishment of invasive pests. Low to moderate risk of nutrient enrichment from pine plantation forestry fertilisation with urea. Pine harvesting could impact water quality and nutrient status.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Description

The lake (2511204E, 6730451N) is small (1.43ha), shallow 3 m+ deep. Peat-stained acidic water (pH 4.7). The catchment is plantation forestry, lake and wetland. Access is through forest track and walking. No boat access.

Wetland vegetation

Emergent species encircled the lake and were *Baumea arthrophylla*, *B. rubiginosa*, *B. juncea*, *Empodisma minus*, *Eleocharis sphacelata* and *Phormium tenax* growing to a depth of 1.8 m. Several plants of the endangered *Todea barbara* were seen.

Submerged vegetation

The nationally endangered *Utricularia australis* was locally common amongst marginal emergents.

LakeSPI

None generated.

Water birds

No birds seen.

Fish

No fish seen.

Aquatic invertebrates

Dragonfly nymphs and adults and *Sigara arguta* were noted. No mussels or koura seen.

Changes in indicators

Not previously surveyed.

Threats

Access for vectors of pest species is difficult, and low water clarity and acid pH would make this threat unlikely. Forestry fertilising would have impacts on lake nutrients pH and clarity, although wetland and scrub vegetation is likely to buffer much of this impact.

Management recommendations

Monitoring recommended every 5 years.

3.28 Te Paki Dune Lake (Aupouri), NRC Lake No. 15; surveyed in 2005 and 2007

Plate 1: Te Paki Dune Lake with emergent *Baumea articulata* (foreground) and *Eleocharis sphacelata* (centre left) and showing the manuka and sand dune catchment.

Summary

Overall ranking

Outstanding: This isolated shallow lake, within native scrub and dunes, has an outstanding indigenous vegetation including an endangered species but with isolated plants of *Utricularia gibba* and *Ottelia ovalifolia*.

Threats

Low risk of introduction of invasive pests, but future expansion of *U. gibba* is likely. There are few threats of nutrient enrichment.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Description

The lake (1580999E, 6178871N) is 2.2 ha, about 2.5 m deep and situated between mobile dunes and areas vegetated by manuka and hakea, Plate 1. The lake has no inflows or outflows. Access is through private land and a narrow sandy overgrown track (4-WD). There are no formed tracks for lake entry and no boat access.

Wetland vegetation

Approximately 60% of the lake was covered with emergent vegetation, dominated by *Baumea articulata* and *Eleocharis sphacelata* growing to depths of 1.0 and 2.5 m respectively. There was no emergent vegetation in the vicinity of the dune face. Other emergents reported from water less than 0.2 m depth were *Baumea juncea, Eleocharis acuta* and the regionally uncommon *Sparganium subglobosum*.

Submerged vegetation

Charophyte meadows of *Chara fibrosa* (Plate 2) or *C. australis* (~ 0.5 m tall) and *Nitella* aff. *cristata* were present in open areas of water and amongst emergents with some areas of tall *Potamogeton cheesemanii* (2.5 m tall) and *Myriophyllum propinquum* (2 m tall), (Plate 3). The nationally endangered *Utricularia australis* was abundant (about 50% cover) throughout the lake (Plate 2). A small infestation of the invasive exotic *Utricularia gibba* was also found. Some turf species *Callitriche petriei, Myriophyllum votschii, Limosella lineata* and *Lilaeopsis novae-zelandiae* were located on the dune face at the western edge of the lake. *Ottelia ovalifolia* was also found for the first time.

Plate 2: Te Paki Dune Lake with 'nationally endangered' *Utricualria australis* abundant on top of *Chara fibrosa* with tall-growing *Potamogeton cheesemanii* in the background. This assemblage of native species is very rare.

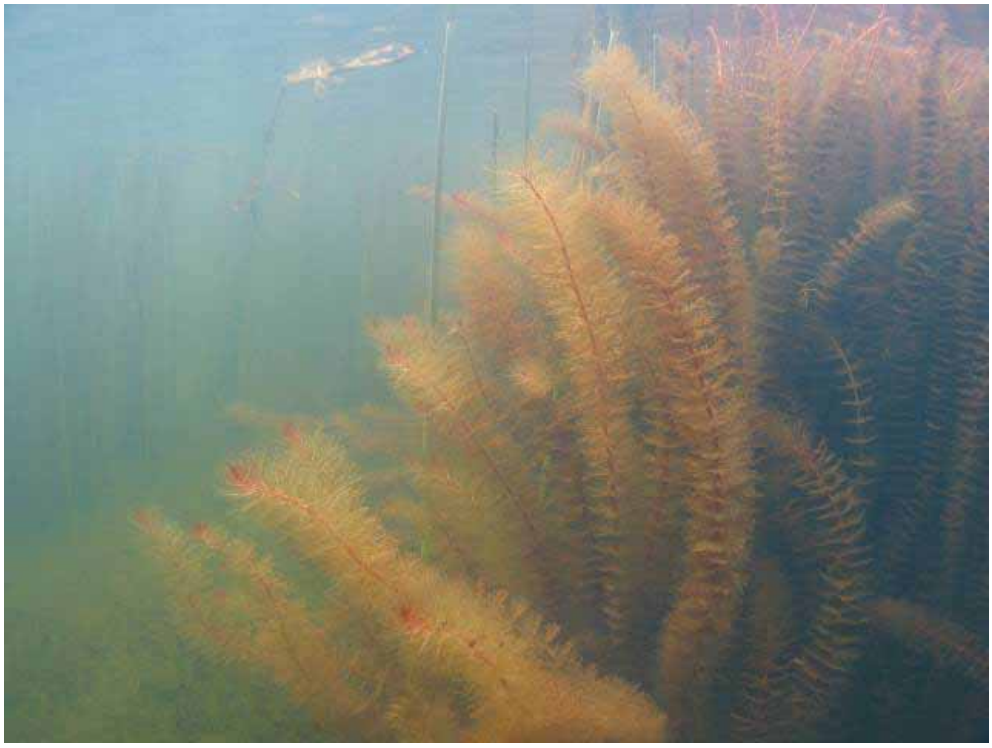

Plate 3: Te Paki Dune Lake with tall-growing *Myriophyllum propinquum* reaching the surface.

LakeSPI

A high LakeSPI score of 97% reflected the extent of native vegetation development in the lake.

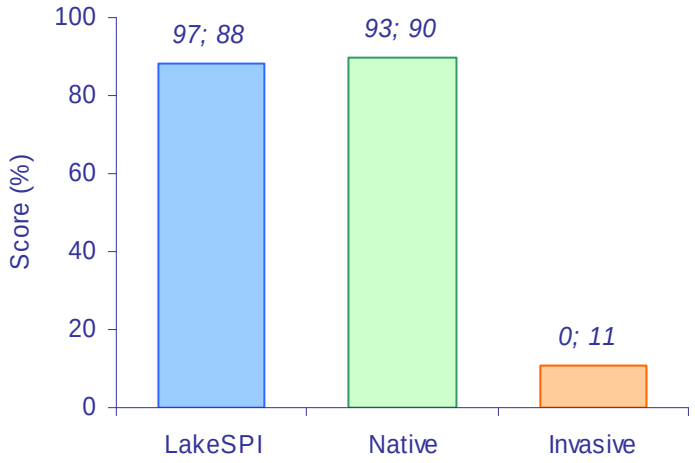

Figure: 2007 LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right). 2005; 2007 values shown.

Water birds

The isolated nature of the lake and large areas of emergent and wetland vegetation provide good habitat for many aquatic birds. Few birds were seen during the field visit, but it is likely that several endangered species utilise this area. Fernbird (*Bowdleria punctata vealeae*) were reported on the DoC SSBI from 1991.

Fish

Several large shortfin eels (*Anguilla australis*) were noted in the lake.

Aquatic invertebrates

Few aquatic invertebrates were noted, with the native leech *Richardsonianus mauianus* encountered on the 2007 survey.

Changes in indicators

The invasive index has increased with *Utricularia gibba* found in the lake but at the time of survey it was having no impact being only one strand found.

Threats

Since last surveyed, *Utricularia gibba* has appeared in the lake. Currently it is so scarce it has had no impact on native species, but is expected to become abundant. Also *Ottelia ovalifolia* was found in the lake, but this is a seed dispersed exotic species that usually has very low impact on native species. Other than that there are currently no alien plants or fauna reported from this lake. Due to the poor access and isolated nature, the likelihood of further introductions is very low.

Threats of modification of the scrub/mobile dune catchment are not foreseeable. Dune encroachment could fill in the lake.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

3.29 Te Werahi Lagoon (Aupouri), NRC Lake No. 6; surveyed in 2005

Plate: Te Werahi Lagoon showing the pasture and mobile sand dune catchment and low (possibly grazed) beds of raupo (*Typha orientalis*).

Summary

Overall ranking

Low: This lagoon is surrounded by unfenced pasture or mobile dunes, with a range of pest plant species established.

Threats

Already impacted by problem submerged weeds *Ceratophyllum demersum* and *Egeria densa*, margins are browsed by cattle.

Management recommendations

None. A more comprehensive survey of the wetlands surrounding the Te Werahi Stream is recommended.

Description

This lagoon (1573420E, 6184962N) is an 11 ha waterbody with a maximum recorded depth of 3 m. It is situated on sand dunes, formed by a stream system impounded by dunes. The catchment is unfenced pasture (cattle grazed) apart from mobile dunes to the west and a few wetlands associated with inflow streams. The lagoon is the largest impounded waterbody on the Te Werahi Stream which flows from the south, draining land from Scotts Point and discharging to the north in Te Werahi Bay (West Coast). Access is through private farmland (4-WD) with no formed tracks leading to the lagoon edge and no boat access.

Wetland vegetation

There was a complete fringe of pasture at the one site visited, however a floating mat of wetland vegetation dominated by *Typha orientalis* with *Baumea articulata, Eleocharis sphacelata, Carex maorica* and *Phormium tenax* was noted. This vegetation was much shorter than expected and had either been recently grazed or cleared by fire. The nationally threatened herb *Mazus novae-zeelandiae* ssp. *impolitus* was collected from this area in 1966.

Submerged vegetation

There were high covers of the tall exotic weeds *Ceratophyllum demersum* and *Egeria densa* and also the native pondweed *Potamogeton ochreatus*. Lower covers of the exotic *Potamogeton crispus* and the native charophytes *Nitella* aff. *cristata, N. leonhardii* and *Chara australis* were noted.

LakeSPI

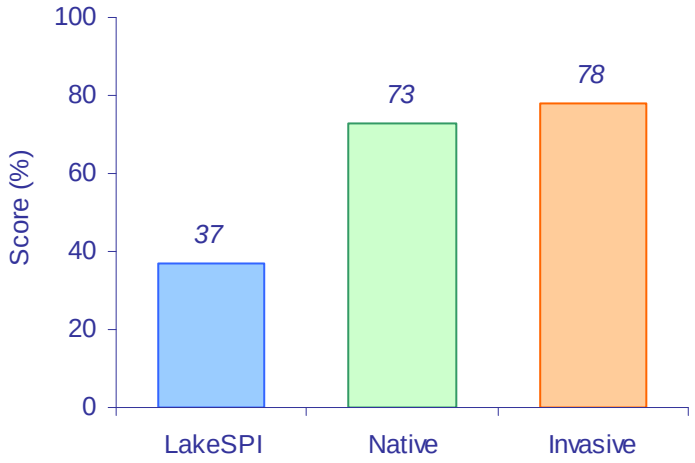

Figure: LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right).

The low LakeSPI score of 37% reflects the impact of invasion by *C. demersum* and *E. densa*, but still with some areas of native plant communities remaining. Profiles were limited so this LakeSPI assessment should be considered provisional.

Water birds

The large areas of wetland may provide good habitat for many aquatic birds, although grazing access may disturb some species. Hundreds of black swans (*Cygnus atratus*) and a flock of Canada geese (*Branta canadensis*) were noted during the field visit. No endangered birds were recorded.

Fish

Grey mullet (*Mugil cephalus*) were observed.

Aquatic invertebrates

No aquatic invertebrates were noted.

Changes in indicators

This lake was surveyed for the first time in November 2004.

Threats

Although situated in farmland, the lagoon is easily observed from State Highway 1 and access is relatively easy.

The highest ranked submerged weed species *C. demersum* is already present in the lagoon. This lagoon may provide the local source of this species and also *E. densa*, both also located in the lakes near Te Paki (Ngakeketa and Ngakeketa North respectively).

Transfer would most likely be from fishing nets, so local fishers should be informed of the risks. Control of these weeds is not recommended, as only short-term reduction in abundance would be achieved at this site.

Management recommendations

No monitoring is recommended.

A more comprehensive survey of the wetlands surrounding the Te Werahi Stream is recommended.

3.30 Lake Wahakari (Aupouri), NRC Lake No. 35; surveyed in 2005 and 2008

Plate: Lake Wahakari.

Summary

Overall ranking

Outstanding: Good emergent and submerged vegetation with numerous endangered biota. Pest plants and fish present, possible water quality decline.

Threats

Introduction of invasive species.

Management recommendations

As access to this water body is now severely restricted, annual surveillance for pest plants should be discontinued. Lake native biodiversity value monitoring every 5 years.

Description

Lake Wahakari (1592960E, 6165597N) is a large (84.4 ha) lake with a maximum depth c. 12 m. The lake is ponded between dunes to the west and weathered hill country, with heavy clay soils, to the east. The catchment is primarily recently

harvested plantation pine forestry (50%) manuka/kanuka scrub (40%) and fenced pasture (10%). There is an inflow at the north-western end of the lake, apparently surrounded for much of its 3 km length by bog vegetation. The outlet at the south-eastern end passes through a raupo/flax swamp and discharges into Parengarenga Harbour via the Te Kao Stream. Access is a rough gravel track via a locked gate from Te Ahu Road. The lake serves as a water supply to the district and boat access is difficult even for 4-WD launching.

Wetland vegetation

Most of the lake margins have beds of emergent species of up to 10 m wide. The dominant emergent species were *Eleocharis sphacelata, Apodasmia similis, Baumea juncea, B. arthrophylla, B. articulata* and *Typha orientalis* growing from the lake margin to 2.6 m depth. *Baumea rubiginosa* was noted as emergent in the south eastern bay during the 2008 survey.

Submerged vegetation

Turf communities were sparse due to extensive and dense emergent beds. The nationally threatened species *Utricularia australis* was relocated at one site and *Isolepis fluitans* (Plate below) was found in three locations. This included two profiles, amongst *E. sphacelata* beds and also amongst *Apodasmia similis* at the south eastern bay. Charophytes (mostly *Chara fibrosa, C. australis,* and *Nitella* aff. *cristata*) were found from the edge of emergent communities to a maximum depth of ~3 m in 3 profiles. Below this, the pondweed, *Potamogeton ochreatus* formed scattered low density growths (~ 0.5 m tall) to 5.7 m. *Utricularia gibba* had recently spread to this lake (since 2004). It was restricted to the emergent vegetation zone to a maximum depth of 1.5 m, occasionally with high covers of 50-75%.

Plate: *Isolepis fluitans*

In the previous 2003 survey the vegetation was much more abundant, with tall growths of *Potamogeton ochreatus* to 2.5 m tall growing at high covers to depths of 7.3 m.

LakeSPI

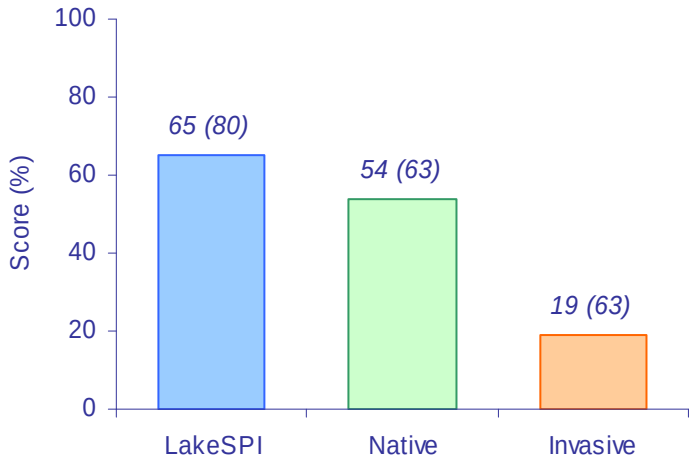

Figure: LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right).

A high LakeSPI score of 80% in 2004 reflected a high and diverse cover of indigenous plants extending to over 7 m deep. In 2008 LakeSPI had dropped to 65% with *Utricularia gibba* now present and a reduction in submerged plant cover and depth.

Water birds

Extensive emergent vegetation and a relatively isolated lake provides good habitat for water birds. The regionally threatened dabchick (*Poliocephalus rufopectus*), scaup (*Aythya novaezeelandiae*) and fernbird (*Bowdleria punctata vealeae*) were reported in DoC SSBI records. Canada geese (*Branta canadensis*) were noted during the 2008 survey.

Fish

Common bullies (*Gobiomorphus cotidianus*), eels (*Anguilla* spp.) and the exotic pest gambusia (*Gambusia affinis*) were observed during vegetation surveys. NIWA FBIS also records smelt (*Retropinna retropinna*) caught in this lake.

The Golden Bell frog (*Litoria aurea*) was also common in the margins.

Aquatic invertebrates

Freshwater mussels (*Hyridella menziesi*) were common throughout the lake including below the vegetated zone. The snail *Potamopyrgus antipodarum* and freshwater sponges were also seen.

Changes in indicators

The vegetation in Lake Wahakari has been sampled since 1984. Between 1988 and 2001 the dominant submerged vegetation switched from charophytes to *Potamogeton ochreatus* although bottom limit was similar. In 2008 the *P. ochreatus* was much less abundant and much of the deeper depth range had little vegetation present.

Threats

The restricted access to this lake reduces the threat of introduction of pest plants. Should invasive species be introduced to the lake it is likely that they would displace much of the current vegetation.

The pest fish *Gambusia affinis* may have a deleterious impact on other fish such as smelt.

The indicators of lake condition are showing a decline. The drivers of vegetation decline in this lake need further consideration such as looking to see if there is a decline in water quality with increased TN, TP and chlorophyll a.

Management recommendations

An assessment of lake native biodiversity value at 5 yearly intervals is recommended.

Annual monitoring of water quality should be undertaken to determine the extent of nutrient enrichment.

3.31 Lake Waihopo (Aupouri), NRC Lake No. 78; surveyed in 2006 and 2009

Plate: Lake Waihopo from the boat access point, note the extensive emergent vegetation.

Summary

Overall ranking

Outstanding: Well developed submerged vegetation, with dense emergent beds supporting numerous endangered biota.

Threats

Utricularia gibba impacting on submerged vegetation, risk of further invasive species introductions.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Description

Lake Waihopo (1603898E, 6154039N) is a small (3.3 ha) dune lake with a maximum depth of ~3 m. The catchment is primarily pasture (80%) with areas of grazed manuka/kanuka scrub. However, the lake is completely fenced to exclude livestock. There are no inlet streams, but the outlet, Waihopo Stream, flows through a wetland area at the eastern end of this lake discharging into Houhora Harbour (East Coast). Access is through private farmland off Kimberley Road. Power Boat access is difficult

due to emergent vegetation, shallow water and deep peaty-muddy lake bottom though relatively easy for light boats.

Wetland vegetation

Much of the lake (70%) is occupied by large beds of emergent species, up to 50 m wide. The dominant emergent is *Eleocharis sphacelata* growing from the lake margin to 1.8 m, with other species including *E. acuta, Baumea articulata, B. juncea, B. rubiginosa, Isolepis prolifer* and *Typha orientalis* all common. The regionally significant maru (*Sparganium subglobosum*) was noted in the peaty marginal vegetation. The nationally threatened *Thelypteris confluens* is reported from this lake. A large population of another nationally threatened fern *Cyclosorus interruptus* was found in 2006.

Submerged vegetation

In 2005, the dominant submerged vegetation was a meadow of the charophyte *Nitella* aff. *cristata* extending from the edge of emergent vegetation to a maximum depth of 2.4 m. The exotic *Utricularia gibba* was recorded sprawling over this meadow, with a median cover of 26-50%. The nationally threatened *Utricularia australis* was found in pools among the emergent vegetation. The maximum depth of vegetation increased to 2.7 m in 2006, with an increase to 3.4 m recorded in the 2009 survey. Essentially the entire bottom of this shallow lake is now vegetated, with median covers of 75-95%. Dominant species were *Nitella* aff. *cristata* and *Chara australis* with lesser amount of *Potamogeton cheesemanii*. *U. gibba* extended over this charophyte dominated vegetation to depths of ~ 3m but median cover was reduced from 2005 assessments to 6-26% cover.

LakeSPI

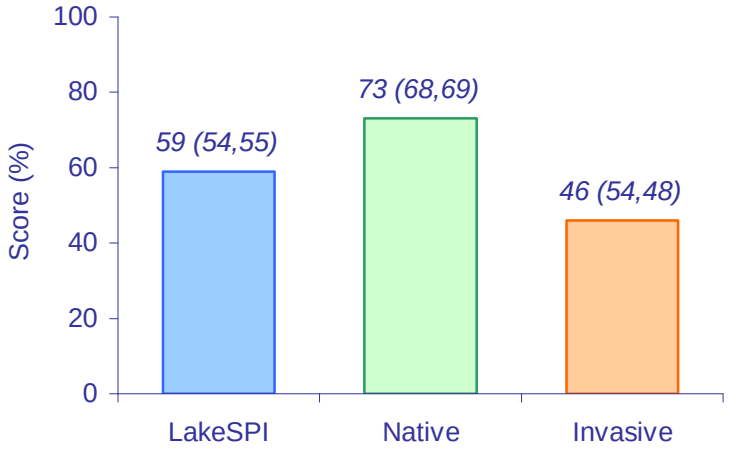

Figure: LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right) for 2009, with 2006 and 2005 data in brackets.

A moderate LakeSPI score of 54% in 2006 reflected the impact of the invasive *U. gibba* which sprawled over much of the submerged vegetation. The 2009 LakeSPI score has improved to 59 reflecting the increased extent of charophyte dominated vegetation and lower covers of the invasive *U. gibba*.

Water birds

Extensive emergent vegetation and surrounding scrub areas provide excellent habitat for water birds. The nationally threatened bittern (*Botaurus poiciloptilus*) and the regionally rare fernbird (*Bowdleria punctata vealeae*), scaup (*Aythya novaezeelandiae*) and spotless crake (*Porzana tabuensis plumbea*) were seen on the field trip. Dabchick (*Poliocephalus rufopectus*) and the Australian vagrant chestnut-breasted shelduck (*Tardorna tardornoides*) were reported in OSNZ records from 2000.

Fish

No fish were seen during the survey. The nationally threatened black mudfish (*Neochanna diversus*) is reported from this lake.

Aquatic invertebrates

Freshwater sponges, hydra and backswimmers (*Sigara arguta*) were recorded in the lake.

Changes in indicators

The vegetation in Lake Waihopo has been sampled on 4 previous occasions. The 1985 survey reported charophyte beds dominated by *Chara australis* with *U. australis* common throughout the vegetation profile. In 2001 the lake was essentially de-vegetated, with *N.* aff. *cristata* the dominant species. In the 2005 and 2006 surveys submerged vegetation had re-established with *N.* aff. *cristata* the dominant species extending to 2.7 m in 2006, but the alien *U. gibba* was covering much of this meadow. The 2009 showed further increase in bottom limit of the vegetation to 3.4 m, with *C. australis* also a common component of this vegetation. No *U. australis* was found on this occasion.

Threats

Utricularia gibba may affect the submerged vegetation. Other submerged weed species are unlikely to be introduced in Lake Waihopo, but could further impact on lake vegetation if this occurs. Lake water quality is currently poor; the recent fencing could result in an improvement in lake condition, but cattle were present inside the fenced zone during the 2009 visit and were noted wading into the lake.

Management recommendations

Carry out lake native biodiversity value monitoring every 5 years.

3.32 Lake Waimimiha North (Aupouri), NRC Lake No. 136; surveyed in 2005

Plate: Lake Waimimiha North showing surface-reaching beds of *Ceratophyllum demersum* (bottom left) on the margin of emergent vegetation.

Summary

Overall ranking

Low: The pest plant *Ceratophyllum demersum* has displaced all other submerged species, but emergent vegetation provides valuable habitat for endangered waterbirds.

Threats

Highly impacted by pest plants and nutrient enrichment.

Management recommendations

No monitoring recommended.

Description

This lake (1615456E 6111245N) is 2.2 ha in area, with a maximum recorded depth of ~ 2 m. It is situated on sand dunes. The catchment is predominantly pasture with some market gardening. The Wairoa Stream (running parallel to the coastline for 5 km north of this lake) discharges into this lake via a wetland on the eastern side and the lake is linked to Waimimiha South from the south. The outflow stream passes through a further lake before flowing into Ahipara Bay (West Coast). Access is via 2 km of rough track on private property. No boat access.

Wetland vegetation

There is a dense fringe of emergent vegetation up to 10 m across comprised predominantly of *Typha orientalis*, with a deep water outer edge of *Eleocharis sphacelata* to depths of 1 m.

Submerged vegetation

The submerged vegetation was dominated by surface-reaching (~ 2 m tall) beds of *Ceratophyllum demersum* covering the entire lake outside of the emergent beds.

LakeSPI

Reconnaissance only – no LakeSPI score generated.

Water birds

The large areas of dense tall emergent vegetation provide good habitat for many aquatic birds, although no endangered species were observed during the field visit. The regionally significant spotless crake (*Porzana tabuensis plumbea*) and fernbird (*Bowdleria punctata vealeae*) are reported from this lake complex.

Fish

No fish were seen in the lake.

Aquatic invertebrates

No aquatic invertebrates were noted.

Changes in indicators

This lake was surveyed for the first time in November 2004.

The limited available data suggest there has been little change in lake water quality between 1991 and 2003.

Threats

The worst invasive submerged weed *C. demersum* completely dominated the lake. Alligator weed (*Alternanthera philoxeroides*) was found further downstream and possibly could occupy the open lakeward edges of *T. orientalis* dominated emergent vegetation in the future.

Water quality is already poor (hypereutrophic status).

Management recommendations

No monitoring is recommended.

3.33 Lake Waimimiha South (Aupouri), NRC Lake No. 137; surveyed in 2005

Plate: Lake Waimimiha South showing margin of emergent vegetation. Note the green tinge to the water indicating an algal bloom.

Overall ranking

Low: No submerged species were seen, but emergent vegetation provides valuable habitat for endangered water birds.

Threats

Highly impacted by pest plants and nutrient enrichment.

Management recommendations

No monitoring recommended.

Description

This lake (1615561E, 6110795N) is 9.2 ha in area. It is situated on sand dunes. The catchment is predominantly pasture with some market gardening. There is a small stream entering the southern end of this lake and an outlet to the north linking to Lake

Waimimiha North. Access is via 12 km of rough track on private property. Difficult boat access.

Wetland vegetation

There is a dense fringe of emergent vegetation up to 10 m across comprised predominantly of *Typha orientalis*, with occasional clumps of *Eleocharis sphacelata* in deeper water. No investigation of depth of vegetation was attempted due to possibly toxic algal blooms. The problem weed *Glyceria maxima* was collected from this lake in 1988, but not seen on the reconnaissance visit.

Submerged vegetation

No investigation of submerged vegetation was attempted due to possibly toxic algal blooms, however development of plants with such restricted clarity is unlikely.

LakeSPI

Reconnaissance only – no LakeSPI score generated.

Water birds

The large areas of dense tall emergent vegetation provide good habitat for many aquatic birds, with one nationally endangered bittern (*Botaurus poiciloptilus*) observed during the field visit. Conning and Holland (2003) report the regionally significant spotless crake (*Porzana tabuensis plumbea*) from this lakes complex, while OSNZ survey in 2000 recorded fernbird (*Bowdleria punctata vealeae*).

Fish

No fish were seen in the lake.

Aquatic invertebrates

No aquatic invertebrates were noted.

Changes in indicators

This lake was surveyed for the first time in November 2004.

The limited available data suggest there has been little change in lake water quality between 1991 and 2003.

Threats

Poor water clarity would restrict the development of submerged vegetation. Alligator weed (*Alternanthera philoxeroides*) was found further downstream and possibly could occupy the open lakeward edges of *T. orientalis* dominated emergent vegetation in the future.

Water quality is already poor (hypereutrophic status).

Management recommendations

No monitoring is recommended.

3.34 Lake Waipara / Dead Lake (Aupouri), NRC Lake No. 25; surveyed in 2005

Plate: Lake Waipara showing the margin of scrub vegetation with pine forestry behind this. Note the narrow emergent zone.

Summary

Overall ranking

High: Indigenous lake with indigenous scrub margin, reduced submerged vegetation due to humic staining, endangered birds present.

Threats

Low; isolated lake, possible threat from diggers, buffered from groundwater nutrient additions.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Description

Lake Waipara (1586647E, 6172834N) is 1.3 ha in area and > 5 m deep. Ringed by a narrow margin of manuka scrubland, a forest road and then plantation pine forestry. No inflow or outflow streams. Access is through 7 km of forestry roads with trailer access possible at one point (bulldozed track to lake margin).

Wetland vegetation

The lake was ringed by a narrow (2 to 5 m wide) emergent band of *Baumea articulata* (edge to 0.5 m deep) and *Eleocharis sphacelata* (0.5 to 2 m deep).

Submerged vegetation

Submerged vegetation was native but depauperate due to low light penetration. *Chara australis* the most common charophyte extending from the edge of emergent vegetation to a maximum depth of 2.8 m. *Potamogeton cheesemanii* was the only tall-growing species.

LakeSPI

Reconnaissance only – no LakeSPI score generated.

Water birds

The isolated nature of this lake with a scrub margin, but relatively poorly developed emergent vegetation provides a moderate habitat for water birds. The nationally threatened bittern (*Botaurus poiciloptilus*) and regionally significant fernbird (*Bowdleria punctata vealeae*) were both recorded at this lake during the vegetation survey.

Fish

No fish were recorded.

Aquatic invertebrates

Pea mussels (*Sphaerium novaezelandiae*) and freshwater sponges were observed during the vegetation survey.

Changes in indicators

No previous surveys.

Threats

Risk of introduction is low, unless drainage machinery accesses the lake. Pest impacts would be minimal due to low light penetration. Good buffer to nutrient addition via ground water/run-off.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

3.35 Lake Waiparera (Aupouri), NRC Lake No. 102; surveyed in 2005 and 2010

Plate: Lake Waiparera.

Summary

Overall ranking

Moderate-high: Submerged native vegetation to 3 – 4 m deep with invasive species (weeds and fish) present, but good water bird habitat and threatened plants and fish present.

Threats

An easily accessed lake with *C. demersum* introduction a threat. The lake is nutrient enriched and submerged vegetation is threatened by further enrichment.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Description

The lake (1616526E, 6133135N) is the largest of the Aupouri lakes (103 ha) but relatively shallow (6 m). This catchment is approximately 70% pasture (mostly fenced) with the remainder in native scrub or wetland. The lake has several inflows, mostly drains on the south western side, but also a drain on the north-western and north eastern shores. There are no obvious outflows. Access for vehicles and boats is easy with a driveway off SH1.

Wetland vegetation

Emergent vegetation nearly encircled the lake extending over 10 m wide in many places. Vegetation was dominated by monocultures of: *Typha orientalis, Apodasmia similis, Baumea articulata, B. arthrophylla* and *Eleocharis sphacelata* to 0.2 m deep. Water levels were low at the time of survey, perhaps by 05 - 1.0 m

The alien invasive alligator weed (*Alternanthera philoxeroides*) formed floating mats on the south western shore and appeared to be well established around the southern part of this lake. One 2 m tall royal fern (*Osmunda regalis*) was located at the north western end of the lake amongst manuka, the first record of this species north of Kaipara District. This species is a major wetland weed. Several plants of the endangered fern *Cyclosaurus interuptus* were found amongst emergent vegetation.

Submerged vegetation

The lake is shallow and gently slopes, so the area vegetated is large with all profiles over 100 m long and some ~200m long. Low cover turf vegetation occurred at shallow (<1 m) shoreline areas, except where dense emergents occurred. Turfs were dominated by *Lilaeopsis novae-zelandiae* with several charophytes including *C. globularis, Nitella hyalina* predominantly restricted to this vegetation. The exotic *Utricularia gibba* was present at low covers in 2005 but not recorded in 2010. The exotic oxygen weeds *Egeria densa* and *Lagarosiphon major* formed low average covers (<26%) from 1 m to 3 m deep. The native *Potamogeton ochreatus* had a similar depth range but much higher average covers (79 – 95%). *Nitella* aff. *cristata* also formed dens covers 51 - 75% as did *Chara australis*, though the latter was mostly found >2 m deep. The native vegetation cover and depth range was greater than in 2005.

LakeSPI

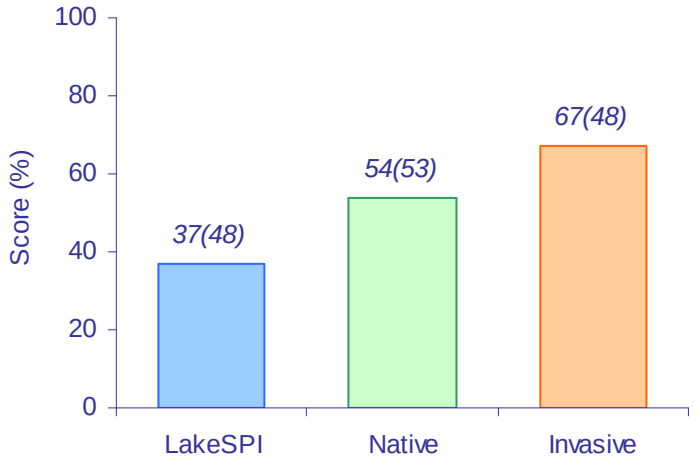

Figure: 2010 LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right). 2005 score in brackets.

The low LakeSPI score of 37% reflects the increased impact (deeper growing) of the invasive alien species *E. densa* and *L. major* in 2010 compared to 2005.

Water birds

The extensive emergent vegetation and fenced areas provided good water bird habitat. Several of the regionally significant scaup (*Aythya novaezeelandiae*) were present on the lake at the time of survey with other common species such as black swans (*Cygnus atratus*) and paradise shelduck (*Tadorna variegata*). DoC SSBI records include the nationally threatened bittern (*Botaurus poiciloptilus*).

Fish

NIWA FBIS database reports common bullies (*Gobiomorphus cotidianus*), lake-bound inanga (*Galaxias maculatus*), long and shortfin eels (*Anguilla dieffenbachii* and *A. australis*) and the pest fish *Gambusia affinis* from this lake. DoC sampling on the 2005 field trip sampled many goldfish (*Carassius auratus*), but no rudd (*Scardinius erythrophthalmus*) were caught, despite being seen in 2001.

Aquatic invertebrates

Freshwater sponges and the native snail *Potamopyrgus antipodarum* were commonly observed in the lake.

Changes in indicators

The submerged vegetation declined between the 1980's and 2001 with reduced cover (~ 90% to <5%) and bottom limit (4 to 2.5 m). The 2005 survey reported a denser vegetation ~50% with a slightly deeper bottom limits (2.8 m). This 2010 survey again had covers comparable to the 1980's with average vegetation covers around 90% and bottom limits may have been as deep if the water level had not been so low at the time of survey (2010 was a drought year). The pest plants *E. densa* and *L. major* were first recorded in Lake Waiparera in 1990 and 1975 respectively, but *A. philoxeroides* and *U. gibba* were reported for the first time in 2005. The nationally endangered turf species *Trithuria inconspicua*, was last recorded here in 1993.

Threats

The lake is already impacted by introduced species with further impacts likely if *C. demersum* was introduced. Access to the lake is easy and has resulted in several pest plant incursions in the last 40 years. Neither of the current submerged oxygen weed species form dense tall beds in this lake. *U. gibba* and alligator weed are also predicted to have limited impact. *U. gibba* was present in 2005 but not found in 2010. Pest fish may impact on the vegetation and other fish within the lake.

Royal fern (*Osmunda regalis*) was located at the north western end of the lake amongst manuka, the first record of this species north of Kaipara District. Department of Conservation is managing this species (G. Williams pers.comm.).

The lake is now fenced and development of riparian and emergent vegetation in formerly grazed lake margins is likely to reduce nutrient inputs, however drains entering provide point sources of nutrients draining from pastoral land.

Management recommendations

The lake may provide a source of pest plants and fish to other water bodies. Signage and possible weed control in the vicinity of the boat ramps are suggested.

Lake native biodiversity value monitoring every 5 years.

The status of inanga and relation to Lake Ngatu fish needs further investigation.

3.36 Waitahora Lagoon (Aupouri) NRC Lake No. 4; surveyed in 2007 and 2009

Plate 1: LEFT 2007 showing the east end of Waitahora Lagoon, showing a saline influenced wetland dominated by the green oioi (*Apodasmia similis*) and brown sea rush (*Juncus kraussii* var. *australiensis*)., RIGHT 2009 showing a closer of the same area but with the oioi impacted by saltwater intrusion.

Summary

Overall ranking

Outstanding: Pristine wetland complex with both saline and freshwater components, numerous endangered biota, and an indigenous catchment. No pest species were recorded.

Threats

Low risk of introduction of invasive pests. The isolated nature of this lagoon and the surrounding indigenous vegetation indicates there is little immediate invasive threat to this site. Saline intrusions due to cyclical changes at the outlet could impact freshwater components.

Management recommendations

Ecological condition monitoring every 5 years.

Description

Waitahora Lagoon (NZMG 2493880E, 6749715N) is a large (20.7 ha) coastal lagoon surrounded by indigenous vegetation. It was linked to the sea at the western end and most of the lagoon was saline. The catchment was primarily scrub although a large wetland was present around the Waitahora Stream and other unnamed streams, at the east end of the lagoon. This section of the lagoon and links with smaller freshwater

lakes (see next section). The lagoon is accessed from the Cape Reinga Walkway some 6 km west of the Kapowairua Camp Ground. It can be accessed through a locked gate under DoC control and a 4 WD track.

Wetland vegetation

The west half of Waitahora Lagoon lacked significant wetland margins being situated between scrub on the southern side and dunes to the north. Dune vegetation included the nationally rare grass *Austrofestuca littoralis*. The east half of the lagoon was surrounded by an extensive wetland dominated by oioi (*Apodasmia similis*) and sea rush (*Juncus kraussii* var. *australiensis*). Marginal areas contained *Baumea juncea*, *Cyperus ustulatus* and the nationally endangered *Hibiscus diversifolius*. In 2009, salt water intrusion into the lagoon had killed shoots of oioi, and *Baumea juncea*, but seedlings of *Lilaeopsis novaezelandiae*, *Mimulus repens* and *Selliera radicans* were noted. Amongst the tall emergent vegetation and along the channels of the upper lagoon were typical salt marsh species such as *Selliera radicans* and *Samolus repens* and large areas of the nationally 'Ar-risk' *Mimulus repens*. It is a rare plant in Northland with only two other sites known and the Waitahora Lagoon site comprises the largest and least vulnerable population for the species.

Submerged vegetation

Most of the lagoon was saline with no submerged vegetation. However, some sparse vegetation (5-25% cover) was noted in 2007 in the upper channels (as shown in Plate 1). Species present included *Ruppia polycarpa, Triglochin striata, Mimulus repens* and a charophyte in the genus *Lamprothamnium*. All these species are typical from brackish areas, although the first of these plants is also relatively common in freshwater lakes. Prior to the 2007 survey one species of *Lamprothamnium* (*L. macropogon*) was recorded from the southern North Island, the South Island and Chatham (Rekohu) Island, with the northernmost record from the Whakaki Lagoon near Wairoa (Hawkes Bay). The Waitahora Lagoon plant appears to be a different species (M. de Winton pers. comm.) and has been planted to grow on to enable its identification. In 2009 the *Lamprothamnium* site had recently been affected by a saline intrusion and no submerged plants were found and surrounding rushes / sedges were brown. A channel closer to the freshwater wetland supported *Utricularia australis* growing over dead rushes / sedges.

LakeSPI

LakeSPI score not generated for this lagoon.

Water birds

Extensive emergent vegetation and relatively undisturbed nature of this lake provides a good habitat for water birds. The regionally significant fernbird (*Bowdleria punctata vealeae*) was heard in the wetland areas at the east end of Waitahora Lagoon. OSNZ records from this locality include the nationally endangered brown teal (*Anas chlorotis*) and one of the few Northland records of marsh crake (*Porzana pusilla*).

Fish

About a 40 strong school of grey mullet (*Mugil cephalus*) up to 30 cm long was observed in the clear waters of the lagoon in 2007. There are no NIWA FBIS records of fish from this location.

Aquatic invertebrates

No invertebrates were noted.

Changes in indicators

Too shallow for LakeSPI.

Threats

The isolated nature of this lagoon (with locked gate) and the surrounding indigenous vegetation indicates little immediate threat to this site. Periods of saline inflow when the western end of the sand bar is open (as was the case in 2009) along with periods where the lagoon is dominated by freshwater results in a highly dynamic habitat.

Management recommendations

Carry out 5 - year ecological condition monitoring.

A fish survey is advocated to determine the fauna of the saline and freshwater parts of the Waitahora wetland complex.

3.37 Waitahora Lakes (Aupouri) NRC Lake No. 3; surveyed in 2007 and 2009

Plate 2: Freshwater lake, east of Waitahora Lagoon dominated by *Eleocharis sphacelata*.

Summary

Overall ranking

Outstanding: Pristine wetland complex with both saline and freshwater components with numerous endangered biota and an indigenous catchment. No pest species recorded.

Threats

Low risk of introduction of invasive pests. The isolated nature of these lakes and the surrounding indigenous vegetation indicates little immediate threat to this site. Wetland is dependent on water banking up behind the dune complex.

Management recommendations

Ecological condition monitoring every 5 years.

Description

There were several small freshwater bodies to the east of Waitahora Lagoon (NZMG 2494230E, 6749760N), the largest being 2.3 ha in area, although most of this was covered by tall emergent vegetation. The catchment was primarily manuka scrub with a large wetland around the Waitahora Stream, other unnamed streams, and surrounding the freshwater lakes. Water was tea-stained indicating high humic content (Plate 3). The lakes are accessed from the Cape Reinga Walkway some 5.5 km west of the Kapowairua Camp Ground.

Wetland vegetation

The water bodies were predominantly filled with the emergent sedges *Eleocharis sphacelata* (Plate 2) and *Baumea articulata* growing to depths of 1 m. The nationally endangered *Hibiscus diversifolius* (classified as 'National Vulnerable') was common in the marginal vegetation of these lakes.

Submerged vegetation

In 2007, open areas of water had some *Chara australis* and *C. fibrosa*, with pondweeds (*P. cheesemanii* and *P. ochreatus*), the milfoil *Myriophyllum propinquum* and the introduced swamp lily (*Ottelia ovalifolia*). The nationally endangered *Utricularia australis* was commonly found (Plate 3). The introduced water purslane (*Ludwigia palustris*) was found at the margin of the lake.

In 2009 in the same area was covered in *Azolla pinnata* covered open water amongst the *Baumea articulatata* and *Eleocharis sphacelata* with submersed *Myriophyllum propinquum* and sprawling *Percicaria decipiens*.

LakeSPI

No LakeSPI score was generated for this lagoon.

Water birds

Extensive emergent vegetation and relatively undisturbed nature of this lake provides a good habitat for water birds. The nationally threatened bittern (*Botaurus poiciloptilus*) was seen and the regionally significant fernbird (*Bowdleria punctata vealeae*) was heard.

Fish

No fish were seen and there are no NIWA FBIS records of fish sampled from this location.

Aquatic invertebrates

No invertebrates were noted

Changes in indicators

First sampled in 2007.

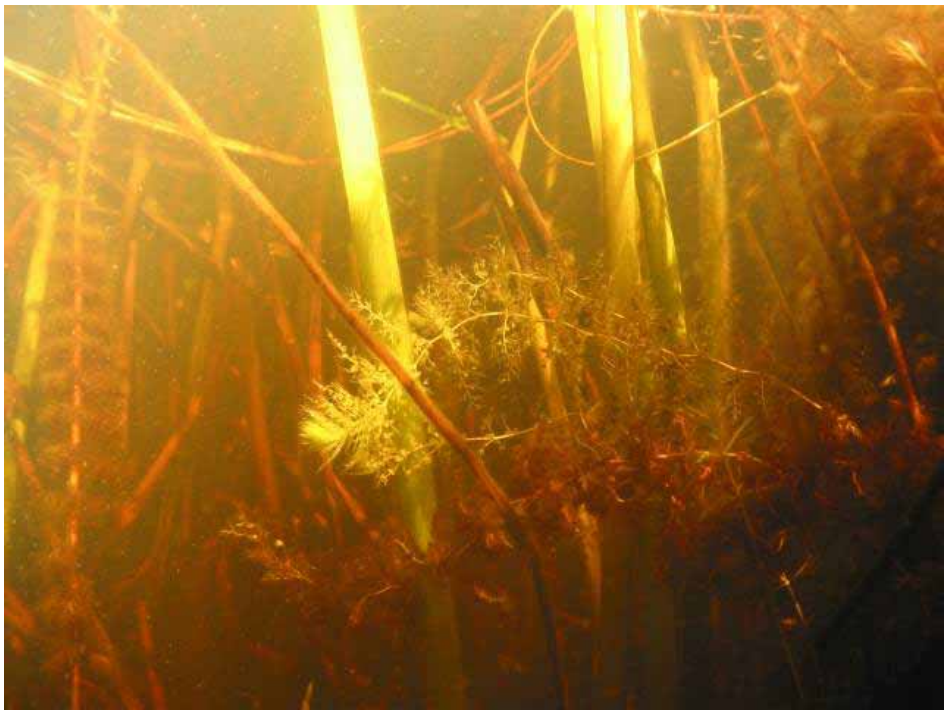

Plate 3: Freshwater lake east of Waitahora Lagoon with the endangered bladderwort (*Utricularia australis* – centre) and the milfoil *Myriophyllum propinquum* (left and right) in open water amongst the culms of *Eleocharis sphacelata* (centre background).

Threats

The isolated nature of this lagoon and the surrounding indigenous vegetation indicates little immediate threat to this site. The introduced swamp lily and water purslane are common species in Northland and pose little threat to the ecology of this otherwise pristine system.

Management recommendations

Ten year ecological condition monitoring.

A fish survey is advocated to determine the fauna of the saline and freshwater parts of the Waitahora wetland complex.

3.38 West Coast Road (Aupouri), NRC Lake No. 121; surveyed in 2005, visited in 2007 and 2010

Plate: West Coast Road Lake showing emergent dominated water body with the endangered *Myriophyllum robustum* (bottom right) 2005, However (without disturbance spraying) emergents have taken over the whole lake and there is no open water and no *M. robustum* was seen in 2010.

Summary

Overall ranking

Low: Outstanding water bird habitat, but endangered plants now displaced by the dense *Eleocharis sphacelata*, and invasive *Utricularia gibba* present.

Threats

U. gibba may be out-competing some endangered species, but dense reedbeds of *E. sphacelata* are likely to have a greater impact on the endangered *Myriophyllum robustum.*

Management recommendations

Control the *E. sphacelata* to maintain some open water. Lake native biodiversity value monitoring every 5 years.

Description

This dune lake (1616741E 6123403N) is 1.6 ha in area with a maximum depth of ~ 1.5 m. The catchment is pine plantation forestry (50%), wattle scrub (20%), pasture and roadside grassland (30%). There are no inlets or outlets. Access is directly off the West Coast Road, but boating is not an option in this lake. The emergent cover in 2010 had increased leaving no open water habitat.

Wetland vegetation

Approximately 90% of the lake was covered with dense emergent vegetation dominated by *Eleocharis sphacelata* with local patches of the taller *Baumea articulata*. In the early 1990's *Salvinnia molesta* covered the water surface. An aerial spray programme to eradicate the *S. molesta* also reduced the cover of *E. spacelata* providing areas of open water. In 2005 the nationally endangered *Myriophyllum robustum*, a sprawling emergent species, was restricted to areas of open water amongst the taller sedges (see plate). However when visited in 2007 these plants could not be found and sedges occupied its former habitat. In 2010 the whole lake had been colonised by *E. sphacelata*.

Submerged vegetation

In 2005 vegetation in the roadside pools were dominated by dense mats of the exotic *Utricularia gibba*, in full flower, with *M. robustum, M. propinquum, Isolepis prolifer* and *Persicaria decipiens* emergent through the mat. In 2010 however, the open water was gone with *E. sphacelata* now growing densely at that location. At the eastern end of the lake the landowners had cleared the emergent vegetation with an area of open water resulting. Submerged vegetation was sparse in this area.

LakeSPI

Reconnaissance only – no LakeSPI score generated.

Water birds

The dense tall emergent vegetation provided excellent habitat for many aquatic birds, including the nationally threatened bittern (*Botaurus poiciloptilus*) and regionally significant dabchick (*Poliocephalus rufopectus*) and spotless crake (*Porzana tabuensis plumbea*).

Fish

The pest fish *Gambusia affinis* were abundant in the lake, the only species seen and recorded in the NIWA FBIS database.

Aquatic invertebrates

No aquatic invertebrates were noted.

Changes in indicators

The invasion of *U. gibba* into this sheltered shallow water body may have displaced a range of submerged species previously recorded (1984 to 2001) including the charophytes *Nitella* aff. *cristata* and *N. leonhardii* and the nationally threatened *U. australis*. Emergent vegetation appears to have encroached on previously open water areas also out-competing *M. robustum*.

Threats

The free-floating pest plant *Salvinia molesta* previously dominated the vegetation of this lake but was eradicated in the mid-1990's. Control measures (aerial application of herbicide) opened up the wetland vegetation and provided habitat for other species. Invasive submerged species are unlikely to impact this water body.

Management recommendations

Lake native biodiversity value monitoring every 5 years.

Control some areas of *E. sphacelata* with glyphosate to provide open water habitat for growth of the endangered *M. robustum*.

3.39 Lake Yelavich (Aupouri), NRC Lake No. 105; surveyed in 2008 and 2010

Plate: Lake Yelavich, a dune lake within plantation pine forestry

Summary

Overall ranking

High: A shallow lake with a large population of the endangered *Myriophyllum robustum*, a large entire marginal fringe of emergent species, and a *Chara australis* dominated submerged vegetation to 2.5 m but with high covers of *Utricularia gibba*.

Threats

Low: Isolated with access through private forestry, but it is visited by duck shooters.

Management recommendations

Monitoring for nutrient status and 5 yearly condition monitoring

Description

Lake Yelavich (1614575E, 6132392N) is about 3 ha in area. The lake was tannin stained, but not turbid with visibility of around 2.5 m. The lake lies in a scrub and pine plantation catchment. Access was through Juken Nissho Ltd. forestry roads.

Wetland vegetation

The lake was encircled with emergent vegetation 10 – 20 m wide dominated by *Eleocharis sphacelata* extending to 2 m depth.

Submerged vegetation

There was submerged vegetation (mainly *Chara australis* with some *Potamogeton cheesemanii* and *Nitella* aff. *cristata*) beyond the emergent vegetation. *Utricularia gibba* was thick to 2 m deep with covers exceeding 95% on all profiles. The nationally threatened *Myriophyllum robustum* was widespread at low covers from 1.4 to 1.7 m deep amongst less dense fringes of *E. sphacelata*.

LakeSPI

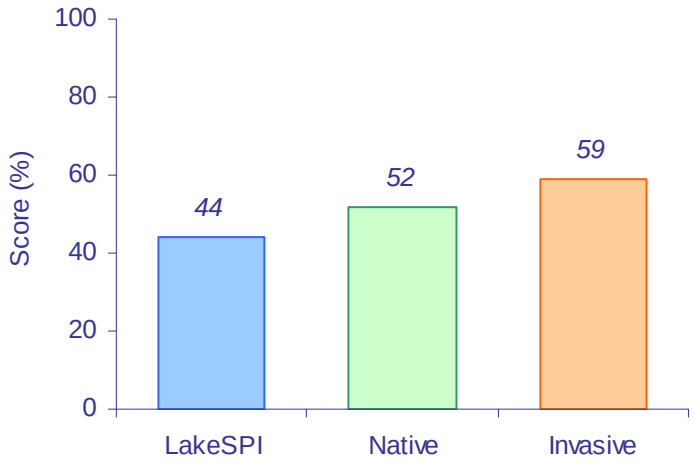

Figure: LakeSPI Index as % of potential score, Native Condition Index, and Invasive Impact Index (from left to right).

LakeSPI Index was low (as this measure focuses on submerged plants) due the large amount of *Utricularia gibba* present and limited (shallow) development of native submerged vegetation.

Water birds

The lake has good habitat for birds (large expanses of tall emergent vegetation) although none were recorded during the visit.

Fish

Bullies were seen on this visit with visibility about 2.5 m in 2010.

Aquatic invertebrates

None seen.

Changes in indicators

Overall submerged vegetation has increased in abundance since 2008, but so has the *Utricularia gibba.*

Threats

Pines were recently harvested but no effects (e.g., high suspended sediments) were recorded. The isolated nature of the lake and large surrounding wetland indicate that there are few threats of nutrient enrichment or invasive species. Duck shooting was evident from empty cartridges around the margins; hopefully pest plants such as alligator weed, willow and oxygen weeds are not introduced misguidedly to 'enhance' the habitat for wildfowl.

Management recommendations

This is a good example of a shallow tannin-stained lake, with intact fringe of emergents and no livestock access. An assessment of lake native biodiversity value at 5 yearly intervals is recommended.

Annual monitoring of water quality should be undertaken to determine the extent of nutrient enrichment.