Northland Lakes Ecological Status 2010

Hornwort is one of the greatest threats to Northland lakes with tall (5m) dense weed beds displacing native communities, and affecting sediments and water quality.

NIWA Client Report: HAM2010-058
May 2010

NIWA Project: NRC10202

Northland Lakes Ecological Status 2010

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Prepared for

Northland Regional Council

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Executive Summary

Northland Regional Council (NRC) engaged NIWA to assist achievement of its goal "to prevent deterioration in water quality and loss of biodiversity value in Northland lakes".

This report presents a summary of information on native biodiversity value gathered on 84 Northland lakes and wetland margins. The core information in this report is a 'living' document to be added to and modified to incorporate changes in lake values as they change. This information is key for the NRC Lakes Strategy as it is essential for managers to know what they are managing and monitor responses to management initiatives.

The report was updated in April 2010 by:

- Lake native biodiversity value monitoring for Lakes Yelavich, Carrot, Ngakapua N & S, Ngatu, Little Gem, West Coast Road, Waiparera (high ranking Waipapakauri lakes) and Shag (Kai-Iwi Lakes) with vegetation descriptions, and ecological observations.
- LakeSPI surveys (assessment of submerged plant indicators) for Lakes Yelavich, Carrot Ngakapua (north and south), Ngatu, Shag, Heather and Waiparera.
- Weed surveillance monitoring of Lakes Ngatu, Waiporohita, Kai-Iwi, Taharoa, Waikere, Humuhumu and Rotokawau (Pouto).
- Reconnaissance of the water bodies adjacent to Te Kahika and Morehurehu (Te Kahika South, Morehurehu South 1), Lake Taeore, Forest Lake, Lake Rotoroa (all Aupouri) and Lake Waingata (Pouto).
- Sampling for fish in Lake Ngatu to confirm the presence of the pest fish perch.
- Re-survey Lake Swan and assess effectiveness of grass carp since the May 2009 release.
- Re-survey and photograph submerged vegetation in Lake Heather for a baseline prior to grass carp release.
- Updating the Methods and Biosecurity sections.

Lakes Yelavich, Shag and Waiparera had more abundant and deeper submerged native vegetation since last surveyed; Lakes Ngakapua North and South, Ngatu had changed little; but Lakes Heather, Carrot, Little Gem and West Coast Road had decreased and their native biodiversity value ranking has been changed accordingly. *Egeria densa* was found in Lake Carrot for the first time but, as only a few plants were found, we attempted to remove them by hand (follow-up hand weeding as an attempt to eradicate it is recommended). Lake Little Gem's submerged vegetation had receded from 3.3 (in 2007) to 2.6 m in 2010, and was restricted to within the emergent's zone. West Coast Road Lake now has no open water with the spread of *Eleocharis sphacelata* and so was not assessed for lake biodiversity value monitoring.

Weed surveillance monitoring found no new invasions of pest plants, but *E. densa* was found in Lake Carrot during lake ecological condition monitoring. We hand-weeded what we found and a full lake search and follow-up control measures (hand-weeding and / or compression screens) are recommended. The discovery of *E. densa* in Lake Carrot has increased the likelihood of *E. densa* invading Ngakapua Sth so annual surveillance is now recommended.

Utricularia gibba, noted in previous surveillance reports as becoming increasingly more widespread and abundant in Northland lakes, was found in all surveillance lakes. Unfortunately little can be done to prevent the spread of this weed as waterfowl are likely to be dispersing it. Access to Lake Rotokawau (Pouto) has become more restricted due to changing farm practices and it is recommended that annual weed surveillance is discontinued.

Te Kahika South was found to be a small, remote 'high' ranked lake with endangered *Todea barbara* and *Utricularia australis* present. Along with Te Kahika this lake had a low pH (< 5) and the invasive *U. gibba* was absent. Lake Morehurehu South 1 was ranked 'low to moderate' as it had only the odd submerged plant but large amounts of the invasive *U. gibba*, although was surrounded by good wetland habitat. Lake Taeore at the time of survey was dry so was ranked 'low'. The lake bed however was moist and supported a range of wetland herbs and tall emergent species including the rare annual species *Fimbristylis velata* (northern most record in NZ), *Alternanthera nahui* and *Centipeda aoteorana*. Submerged vegetation had re-established in Forest Lake, comprised of *Chara australis, Nitella leonhardii* and *Potamogeton cheesemanii*, along with dense mats of *U. gibba*. Water clarity was poor in Lakes Rotoroa and Waingata and vegetation in these lakes was similar to previous surveys.

A combination of Gee minnow traps, siene and gill nets were deployed in Lake Ngatu in 2010 as a response to the possible sighting of perch during the 2009 surveillance survey, but only inanga, bullies, gambusia and a goldfish were caught.

In Lake Swan grass carp had removed virtually all the *E. densa* and about half the *Ceratophyllum demersum* since introduced nearly a year ago in May 2009.

Lake Heather had further significant invasion by tall-growing beds of *C. demersum* leaving little native submerged vegetation and a heightened risk of lake-wide de-oxygenation. Baseline profiles were recorded as a reference for lake vegetation present prior to grass carp release scheduled for later in 2010.

All lakes are ranked (summarised in table form below) based on assessment of ecological significance, and this information is intended to facilitate prioritisation of lakes for monitoring and assist managers to make decisions that could preserve, protect or enhance lake condition and ecological values.

Assessment of biosecurity risks posed by the freshwater pest plants are presented and updated, with recommendations for monitoring and control. This work is part of the NRC Regional Surveillance Strategy for management of freshwater pests within Northland Region. This approach is justified as native aquatic flora and fauna are highly susceptible to displacement by invasive species, and freshwater systems are much more vulnerable than forest and other terrestrial ecosystems. Northland

Region has some of New Zealand's highest ranked examples of intact natural aquatic ecosystems. They are being lost at an alarmingly rapid rate as new invasive species continue to be spread as a result of human activities. Most pristine lakes are now situated in remote areas with difficult access. With community support and active protection, such exceptional lakes could be maintained in a pristine state for perpetuity. Protection requires that no introductions occur via accidental means. Fishing nets, non-resident boats, boat trailers and drainage machinery need to be prohibited or strictly controlled from the highest ranking water bodies including any inflows and outflows within the catchment.

Recommendations

- Delimit the distribution of *E. densa* in Lake Carrot. If feasible consider eradication options such as hand-weeding and / or compression screens which may work at this early stage of invasion.

- Annual pest surveillance is now recommended for Ngakapua Sth. The discovery of *E. densa* in adjacent Lake Carrot has increased the likelihood of *E. densa* being introduced into Lake Ngakapua.

- Advocate maintaining an area of open water in West Coast Road Lake with localised glyphosate spraying. This will maintain habitat for the endangered *Myriophyllum robustum*.

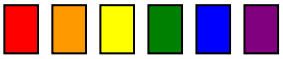
- Reduce biomass of *C. demersum* and *E. densa* in Lake Heather, one month prior to grass carp release, by applying 100L diquat. This will markedly reduce pest plant biomass and assist the effectiveness of grass carp.

- Trial the use of endothall to control *L. major* in Lake Ngatu. Use of curtains to temporarily section off target areas will increase contact times and efficacy.

- Erect signage at Lakes Ngatu and Waiparera to encourage checking and removal of pest plants on entering and leaving the lake.

- Advocate fencing the margins of Lake Shag and consider additional ways of reducing nutrient inputs. This lake is finely balanced between supporting submerged vegetation versus algal blooms; a small change in nutrients could make a big difference.

Table 1: Northland lakes ranked for native biodiversity value and summary of monitoring recommendations. Lakes are listed alphabetically within four geographic areas, with a Northland Regional Council lake number and rankings colour-coded (by colours of the rainbow) as outstanding (red), high (orange), moderate-high (yellow), moderate (green), moderate-low (blue), low (violet):



Name	NRC Lake Number	Rank	Lake Biodiversity Monitoring	Pest Plant Surveillance
Aupouri				
Austria	22	Moderate		
Bulrush	49	Low		
Carrot or Ngakapua West	118	Moderate		I yr
Forest Lake or Deans Swamp	14	Low		
Half Mile Lagoon	62	Low		
Heather	125	Moderate-low	5 yrs	1 yr
Katavich	103	Low		
Kihona	31	Low		
Little Gem	123	Moderate-high	5 yrs	
Mini (Split)	130	Low		
Morehurehu	32	Outstanding	5 yrs	
Morehurehu South 1	33	Moderate-low		
Morehurehu South 2	36	Moderate-high	5 yrs	
Ngakapua	115 & 117	Moderate-high	5 yrs	1 yr
Ngakaketa	14	Low		
Ngakaketa North (Te Paki)	13	Moderate-high	5 yrs	
Ngatu	120	Outstanding	5 yrs	1 yr
Ngatuwhete	23	Low		

Name	NRC Lake Number	Rank	Lake Biodiversity Monitoring	Pest Plant Surveillance
Pretty	24	Moderate		
Rotokawau	116	High	5 yrs	
Rotoroa	126	High	5 yrs	
Salt	48	Low		
Taeore	38	Low		
Te Arai Ephemeral Wetland & Pond	46	Moderate		
Te Arai Lake	47	Low		
Te Kahika	29	Outstanding	5 yrs	
Te Kahika South	30	High	5 yrs	
Te Paki dune	15	High	5 yrs	
Te Werahi Lagoon	6	Low		
Wahakari	35	Outstanding	5 yrs	
Waihopo	78	Outstanding	5 yrs	
Waimimiha North	136	Low		
Waimimiha South	137	Low		
Waipara/Dead	25	Moderate		
Waiparera	102	Moderate-high	5 yrs	
Waitahora lagoon	2	Outstanding	10 yrs	
Waitahora lakes	3 & 4	Outstanding	10 yrs	
West Coast Rd	121	Low	5 yrs	
Yelavich	105	High	5 yrs	

Name	NRC Lake Number	Rank	Lake Biodiversity Monitoring	Pest Plant Surveillance
Karikari Peninsula, central and east				
Horahora Dune	199A	Moderate		
Jacks	180	Low		
Roadside pond, Matai		Low		
Manuwai	146	Low		
Omapere	173	Low		
Ora	205	Low		
Owhareiti	177	Low		
Rotokawau East	96	Moderate		
Rotokawau West	95	Moderate		
Rotopokaka	104	Moderate		
Sand's Lake	309A	Moderate		
Smith's Dam	199B	Low		
Stanner's Rd Dam	148A	Low		
Tapui Rd Quarry Lake	199C	Low		
Waingaro	167	Low		
Waiporohita	99	Outstanding	5 yrs	1 yr
Waro	410	Moderate-high		
Whau Dam	206	Low		
Kai Iwi lakes & north Dargaville				
Freidrich's	282	Low		
Kai-Iwi	236	Outstanding	5 yrs	1 yr
McEvoy	277	Low		

Name	NRC Lake Number	Rank	Lake Biodiversity Monitoring	Pest Plant Surveillance
Midgeley	257	Moderate-high	5 to 10 yrs	
Shag	221	Moderate		
Taharoa	229	Outstanding	5 yrs	1 yr
Te Riu	201	High	5 yrs	
Waikere	227	Outstanding	5 yrs	1 yr
Waingata	200A	High	10 yrs	
Pouto Peninsula				
Grevilles Lagoon	295	Moderate		
Humuhumu	350	Outstanding	5 yrs	1 yr
Kahuparere	384	High	5 yrs	
Kanono	377	Outstanding	5 yrs	3-5 yrs
Kapoai	296	Moderate-low	5 yrs	
Karaka	347	High	10 yrs	5-10 yrs
Mokeno	356	Outstanding	5 yrs	5 yrs
Parawanui	297	Low		
Phoebe's	346	Low		
Rotokawau	364	High	5 yrs	
Roto-otuauru (Swan)	355	Moderate		1 yr
Rotopouua	348	Outstanding	5 yrs	
Rototuna	328	High	5 yrs	

Name	NRC Lake Number	Rank	Lake Biodiversity Monitoring	Pest Plant Surveillance
Waingata	371	Low		
Wainui	305	Moderate-high	5 yrs	
Wairere	339	Moderate-high	10 yrs	
Whakaneke	390	High	5 yrs	

1. Introduction

Northland Regional Council (NRC) engaged NIWA to assist in achieving its goal "to prevent deterioration in water quality and loss of biodiversity value in Northland lakes". The baseline report (Champion et al. 2005) has been updated annually and this is the 2010 update.

The report was updated in April 2010 by:

- Lake native biodiversity value monitoring for Lakes Yelavich, Carrot, Ngakapua N & S, Ngatu, Little Gem, West Coast Road, Waiparera (high ranking Waipapakauri lakes) and Shag (Kai-Iwi Lakes) and with vegetation descriptions, ecological observations and LakeSPI.

- LakeSPI surveys (assessment of submerged plant indicators) for Lakes Yelavich, Carrot Ngakapua (north and south), Ngatu, Shag, Heather and Waiparera.

- Weed surveillance monitoring of Lakes Ngatu, Waiporohita, Kai-Iwi, Taharoa, Waikere, Humuhumu and Rotokawau (Pouto).

- Reconnaissance of the water bodies adjacent to Te Kahika and Morehurehu (Te Kahika South, Morehurehu South 1), Lake Taeore, Forest Lake, Lake Rotoroa (all Aupouri) and Lake Waingata (Pouto).

- Sampling for fish in Lake Ngatu to confirm the presence of the pest fish perch.

- Re-survey Lake Swan and assess effectiveness of grass carp since the May 2009 release.

- Re-survey and photograph submerged vegetation in Lake Heather for a baseline prior to grass carp release.

- Updating the Methods and Biosecurity sections.

This report presents a summary of information gathered on each of the 84 lakes surveyed up to and including April 2010. The region is divided into 4 geographical areas: Aupouri; Karikari \ Central & East Northland; Kai-iwi lakes & North Dargaville; and Pouto Peninsula. Information includes vegetation descriptions (submerged and wetland), the LakeSPI method of assessing submerged plant indicators, records of water birds, fish and macroinvertebrates. Ecological and lake condition changes were identified by comparison with previous surveys and major

threats to the current lake condition are identified. Finally, management recommendations are presented for each lake.

Assessment of biosecurity risks posed by freshwater pest plants is discussed, with recommendations for monitoring and control.

This report presents a ranked inventory of lakes of high ecological value based on available ecological and water quality data. Data gathered on the lakes was analysed and used to prioritise the lakes for future monitoring, and to make recommendations on which lakes need to be monitored, for what purpose and what frequency, to assist managers aiming to preserve, protect and enhance water quality and ecological values.

The core information in this report is a living document to be further added to and modified as further information comes to hand, or if lake values change. This information is key for the NRC Lakes Strategy as it is essential for managers to rapidly respond to new incursions or other identified threats and monitor responses to past management initiatives.

2. Methods

An inventory of Northland lakes was assembled. The following information was gathered for each lake and is presented in Section 3 of this report.

2.1 Lake description

Lakes were referenced according to assigned lake number and location (NZTM Easting and Northing) in the NRC lakes database. In addition, water bodies were photographed and lake size, observations of catchment features and ease of access were noted.

2.2 Wetland vegetation

The extent of emergent vegetation (percentage of shoreline, width of beds and depth range), species present at profiles and elsewhere around the lake, and wetlands associated with the lake were described.

Presence of endangered species (de Lange et al. 2009; Forester and Townsend 2004 and discussion with DOC and NRC staff) and pest plants were reported along with an estimate of population size.

2.3 Submerged vegetation

The submerged vegetation was surveyed by divers using a method similar to Clayton (1983). Divers swam perpendicular to shore recording plant species present, their depth ranges, average and maximum heights and covers. These and other details were recorded on data sheets (Fig. 1). LakeSPI (Clayton & Edwards 2002; Clayton & Edwards 2006; http://lakespi.niwa.co.nz/index.do) information was extracted from this data, and by recording the following additional information: the maximum depth of native and invasive species with cover >10%, and the maximum depth of charophyte meadows with >75% cover. A sketch was made of the profile relief and spatial distribution of vegetation with notes on height and cover. Lakes were sampled at five localities where practical (less when small or de-vegetated) and the profile locations were selected as representative of the underwater vegetation and the range of plant communities present in the lake.

Presence of endangered species (de Lange et al. 2009; Forester and Townsend 2004 and discussion with DOC and NRC staff) and pest plants were reported along with an estimate of population size.

Vegetation survey data was entered into the NIWA Freshwater Biodata Information System (FBIS). Raw data can be viewed using spatial and textural searches at the web-site, fbis.niwa.co.nz. Tables that summarise the vegetation surveys can be extracted from the ‘reports’ menu, as ‘Lake Vegetation Summary Reports’, by first

selecting the lake of interest, and then selecting a survey date. Note that access to reports requires log-in; a username and password are provided upon request to fbis@niwa.co.nz.

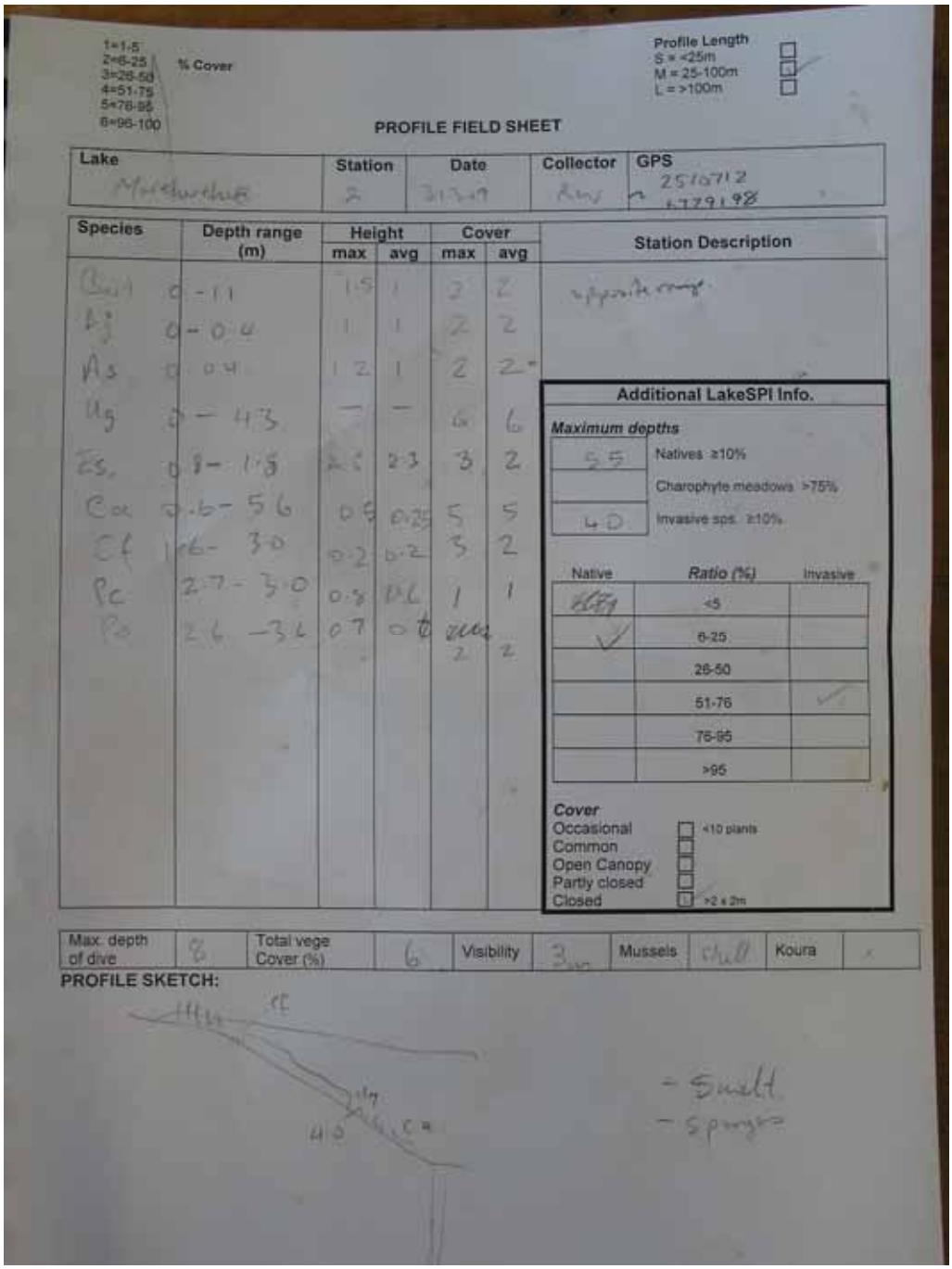


Figure 1: Survey sheet for submerged vegetation surveys.

LakeSPI data was entered into the NIWA LakeSPI database, to calculate three ecological indices. The Native Condition Index provides a measure (score) of the diversity, quality and abundance of indigenous submerged vegetation. The Invasive

Impact Index scores the impact by any of ten invasive alien plant species that may be present. A high Invasive Impact Index indicates large impacts by invasive alien plants. The LakeSPI Index integrates components of the previous indices, together with additional ecological information. The specific features that are assessed to generate each score are detailed on the web-reporting pages (lakespi.niwa.co.nz). In this report the indices are expressed as a percentage of their maximum potential score to enable direct comparisons between different types of lake. The LakeSPI Index provides a measure of how close a water body is to its potential or unimpacted (by human) state, and can be used to detect changes in lake condition over time and make comparisons between lakes. LakeSPI is not suitable for lakes where a factor such as salinity or pH restricts submerged vegetation communities, or where submerged plant growth is less than 10% cover.

This method should not be confused with the 'Lake Native Biodiversity Value Assessment' covered in Section 2.4.

LakeSPI results presented in this report are also available on NIWA's web-reporting pages (lakespi.niwa.co.nz), where a report can be generated for any lake, summarising all available assessments.

To place Northland's lakes in a national context, a comparison of regions and lakes nationally was made (Fig. 2) from national Lake SPI results to 2010. More than 50% of Northland's 46 lakes were in the High and Excellent categories. Only Otago and Southland (with only 6 records for each region) had a higher % (only a few lakes in Fiordland have been surveyed due to difficult access). Compared with other regions nationally, Northland has a large number of excellent and high ranked lakes using the LakeSPI ranking.

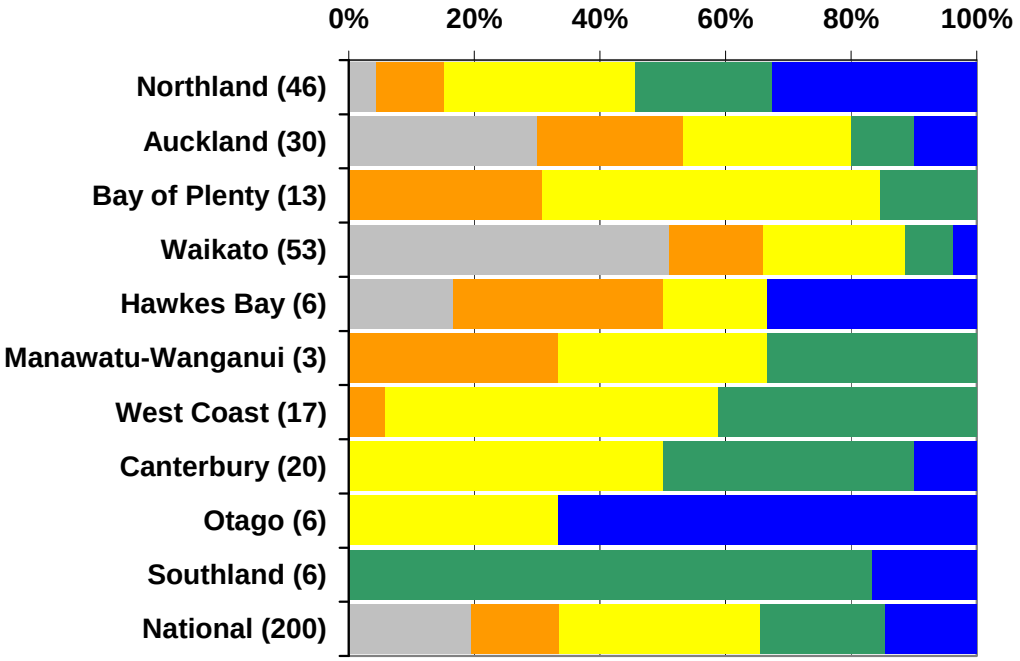


Figure 2: LakeSPI results for lakes regionally and nationally (number of lakes in brackets) with LakeSPI scores grouped into 5 colour coded categories:

LakeSPI score	Category
>75	Excellent
>50-75	High
>20-50	Moderate
>0-20	Poor
0	Non-vegetated*

*non-vegetated lakes have a submerged vegetation at <10% average cover and by default are scored as zero.

2.4 Prioritisation of lakes

The lakes were prioritised for ecological value based on three components: Indigenous biota, endangered species and habitat availability.

1. Indigenous biota

For native species or indigenous biota we assessed the value of what species were present at the time and the metrics scored were: species richness, abundance and representativeness:

- 'Species Richness' was the total number of indigenous macroscopic species (fauna and flora) in the lake and wetland margins.

- 'Abundance' was for native flora present and was assessed on the basis of area and cover, and for fauna it was population size.

- 'Representativeness' of the species assemblage was obtained by assessing the significance of the communities present (not species rarity) in regional and national context.

2. Endangered species

Endangered species were scored on the basis of the 'New Zealand Threat Classification System lists' (R. Hitchmough; L. Bull; P. Cromarty (Comp.) 2002; --2007) and also using de Lange et al. (2009). The categories are 'acute', 'chronic' and 'at risk':

Within 'acute' there are four categories:

- 'Extinct in the wild' (e.g., *Isoetes 'flabellata'*, Omapere) but was not used in this evaluation, as we were assessing what species were present at the time, not past species or potential;

- 'Critical' e.g., the white heron which is a casual visitor to Northland;

- 'Endangered' e.g., brown teal, grey duck, bittern, Northland mudfish, native bladderwort; and

- 'Vulnerable' e.g., *Trithuria inconspicua.*

'Chronic' has two sub-categories:

- 'Serious decline' e.g., dune lakes galaxias (dwarf inanga), *Myriophyllum robustum,* and black-billed gull.

- 'Gradual decline' e.g., longfin eel, giant kokopu, black mudfish, kakahi, koura, marsh fern, and red-billed gull.

The 'At-risk' category are for those naturally uncommon, relict (sparse) species such as NI fernbird, dabchick, crakes, freshwater crab, *Centipeda aotearana*, *Mimulus repens,* and *Sporodanthus ferruginea*.

3. Habitat availability

The extent \ area of indigenous vegetation (wetland, emergents and submerged vegetation) was quantified as it is a measure of habitat availability for native biota.

Each of the parameters was subjectively scored on a 1-6 metric and these metrics used to obtain rankings (from best to worst) of: outstanding; high; moderate-high; moderate; low-moderate; and low. Outstanding lakes are nationally important, containing a diverse indigenous biota, with sustainable populations of endangered species. Conversely, low ranked lakes are either de-vegetated with poor water quality, or severely impacted by exotic pest species.

Rankings for the lakes to date are presented in Table 1.

2.5 Water birds

Habitat suitability for birds was assessed during the field visit, with bird species presence and abundance observed with binoculars. Results were compared with previous records from OSNZ and DoC SSBI surveys, with any nationally or regionally threatened species noted. The combination of scuba divers and various water craft involved in this survey was not conducive to observing water birds, with many flying away before their identity was ascertained. However, some secretive species such as the nationally endangered bittern (*Botaurus poiciloptilus*) were often disturbed and flew allowing their detection, whereas shore-based observation would probably not detect such species.

2.6 Fish

Fish records for the Northland Region extracted from NIWA FBIS comprised 295 records since 1980. These records were assessed to identify lakes containing species of regional or national significance (Hitchmough et al. 2007) and those containing pest fish. While sampling plants, divers also recorded observations of fish but these were not specifically sampled for or quantified.

2.7 Aquatic invertebrates

Large aquatic invertebrates such as freshwater mussels (*Hyridella menziesi*), koura (*Paranephrops planifrons*) and snails were noted by divers in the course of macrophyte surveys. Mussels and koura are potentially important indicators of lake condition and are likely to be incorporated into LakeSPI methodology in the future.

2.8 Changes in indicators

Any significant changes in biota and lake condition compared with previous surveys were reported; for example new species records, and / or change in species dominance, or vegetation depth range.

2.9 Threats

Biosecurity threats (current pest plant and fish impacts, potential impacts and risk of introduction) and other threats to water quality or ecological condition (e.g., nutrient sources, livestock access and decreasing water levels) were considered for each lake based on the surveys and discussion with landowners, NRC and DoC staff. Water quality monitoring is carried out by NRC.

2.10 Management recommendations

Monitoring strategies for the highest ranked of the lakes were made (Section 3 and Executive Summary) including recommending:

- Lake native biodiversity value monitoring – LakeSPI protocol with additional assessment of nationally or regionally significant biota and assessment of any new threats to ecological condition.

- Pest plant surveillance – targeted monitoring of lake access and anchoring sites to detect early incursions of weed species.

2.11 Summary

A summary of overall ranking, identified threats and recommendations is presented for each lake in the inventory.

2.12 Biosecurity – managing the spread of aquatic weeds in Northland lakes

An evaluation of the risks posed by aquatic weeds to Northland lakes is presented in Section 4. Problem species were identified, current and potential impacts for each species, mechanisms and likelihood of spread, evaluation of threat posed by aquatic weed species and management implications are discussed. For selected water bodies prioritised for monitoring, the monitoring methods, areas searched, and results for the 2007 surveillance are reported.