

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 (Figure 1). LakeSPI (Clayton & Edwards 2002; Clayton & Edwards in press) 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.

Presence of endangered and pest plant species were reported along with an estimate of population size.

1=1-5%
2=6-25%
3=26-50%
4=51-75%
5=76-95%
6=96-100%

Profile Length
S = <25m
M = 25-100m
L = >100m

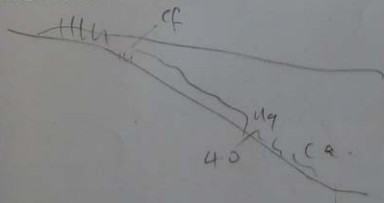
PROFILE FIELD SHEET

Lake <i>Marehwehe</i>	Station <i>2</i>	Date <i>3/3/09</i>	Collector <i>RW</i>	GPS <i>2510712 6729198</i>
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Species	Depth range (m)	Height		Cover		Station Description																											
		max	avg	max	avg																												
<i>Bast</i>	<i>0-11</i>	<i>1.5</i>	<i>1</i>	<i>2</i>	<i>2</i>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; margin: 0;">Additional LakeSPI Info.</p> <p>Maximum depths</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: 1px solid black; text-align: center;"><i>55</i></td> <td style="border: none;">Natives ≥10%</td> </tr> <tr> <td style="border: none;"></td> <td style="border: none;">Charophyte meadows >75%</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;"><i>40</i></td> <td style="border: none;">Invasive sps. ≥10%</td> </tr> </table> <table style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 20%;">Native</th> <th style="width: 50%;">Ratio (%)</th> <th style="width: 30%;">Invasive</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><i>✓</i></td> <td style="text-align: center;"><5</td> <td></td> </tr> <tr> <td style="text-align: center;"><i>✓</i></td> <td style="text-align: center;">6-25</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">26-50</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">51-76</td> <td style="text-align: center;"><i>✓</i></td> </tr> <tr> <td></td> <td style="text-align: center;">76-95</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;">>95</td> <td></td> </tr> </tbody> </table> <p>Cover</p> <p>Occasional <input type="checkbox"/> <10 plants</p> <p>Common <input type="checkbox"/></p> <p>Open Canopy <input type="checkbox"/></p> <p>Partly closed <input type="checkbox"/></p> <p>Closed <input checked="" type="checkbox"/> >2 x 2m</p> </div>	<i>55</i>	Natives ≥10%		Charophyte meadows >75%	<i>40</i>	Invasive sps. ≥10%	Native	Ratio (%)	Invasive	<i>✓</i>	<5		<i>✓</i>	6-25			26-50			51-76	<i>✓</i>		76-95			>95	
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<i>Ug</i>	<i>0-43</i>	<i>-</i>	<i>-</i>	<i>6</i>	<i>6</i>																												
<i>Es</i>	<i>0.8-1.8</i>	<i>2.5</i>	<i>2.3</i>	<i>3</i>	<i>2</i>																												
<i>Ca</i>	<i>0.6-5.6</i>	<i>0.5</i>	<i>0.25</i>	<i>5</i>	<i>5</i>																												
<i>Cf</i>	<i>1.6-3.0</i>	<i>0.2</i>	<i>0.2</i>	<i>3</i>	<i>2</i>																												
<i>Pc</i>	<i>2.7-3.0</i>	<i>0.8</i>	<i>0.6</i>	<i>1</i>	<i>1</i>																												
<i>Pa</i>	<i>2.6-3.6</i>	<i>0.7</i>	<i>0.7</i>	<i>2</i>	<i>2</i>																												

Max. depth of dive	<i>8</i>	Total vege Cover (%)	<i>6</i>	Visibility	<i>3m</i>	Mussels	<i>shell</i>	Koura	<i>x</i>
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PROFILE SKETCH:



= Suedt.
- Sponges

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.

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.

2.4 Prioritisation of lakes

An assessment of the ecological value of the lake was made based on representativeness of biota, intactness of vegetation, including the surrounding catchment, presence of significant species, absence of pest species impacts, and absence of detrimental impacts such as nutrient enrichment. The rankings are (from best to worst): 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. At the other end of the ranking, low ranked lakes are either de-vegetated with poor water quality, or severely impacted by exotic pest species.

The ecological value of each lake was based on the rankings for the following characters:

Submerged vegetation type scored:

- 1 Wholly indigenous, large areas of vegetation in lake e.g., Humuhumu.
- 2 Wholly indigenous with moderate to low areas of vegetation in lake, or limited alien species presence e.g., Kahuparere, Ngatu.
- 3 Mixed indigenous/alien vegetation e.g., Rotokawau (Pouto).

- 4 Alien dominated vegetation e.g., Roto-otuauru.
- 5 Limited to no vegetation e.g., Rotokawau (Karikari), Te Kahika.

Submerged vegetation cover scored:

- 1 96-100% cover over vegetated depths range e.g., Humuhumu, Roto-otuauru.
- 2 76-95% cover over vegetated depths range e.g., Morehurehu.
- 3 51-75% cover over vegetated depths range e.g., Ngakapua.
- 4 26-50% cover over vegetated depths range e.g., Matai roadside pond.
- 5 6-25% cover over vegetated depths range e.g., Rotokawau (Karikari).
- 6 0-5% cover over vegetated depths range e.g., Te Kahika.

Maximum depth of vegetation scored as:

- 1 > 10 m e.g., Taharoa.
- 2 5 - 10 m e.g., Kanono, Ngatu.
- 3 3 - 5 m e.g., Te Paki Dune, Ngakeketa North.
- 4 2 - 3 m e.g., Waiparera.
- 5 1 - 2 m e.g., Ngatuwhete.
- 6 no vegetation or < 1m e.g., Rotokawau (Karikari).

Species richness (all indigenous aquatic plant species) scored:

- 1 ≥ 20 e.g., Kanono, Humuhumu.
- 2 15 - 20 e.g., Kai iwi.
- 3 10 - 15 e.g., Carrot, Kihona.
- 4 5 - 10 e.g., Jacks, Salt.
- 5 < 5 e.g., Waimimiha S.
- 6 no submerged vegetation e.g., Bullrush.

The lake rankings are presented in the table in the executive summary.

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 condition 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.