



TC ENVIRONMENTAL

West Coast Lakes Aquatic Weed Surveillance 2022

Prepared for

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Introduction

The West Coast Regional Council (WCRC) and Department of Conservation (DOC) use an annual surveillance programme to detect incursions of introduced aquatic weeds within the West Coast Lakes. Each summer a number of lakes are selected for surveillance based on incursion risk and previous surveillance.

While a number of problem species have previously been recorded in West Coast waterbodies (Champion & Clayton, 2004; Champion & Larned, 2015; Lass, 2019; BOPRC, 2021), of most concern are the submerged macrophytes; *Lagarosiphon major*, *Ceratophyllum demersum* and *Egeria densa*, of which *L. major* is already known in Lake Paringa, lanthe and the Kapitea Reservoir.

Despite the presence of several problem species in the region, the West Coast Lakes still have outstanding natural value and early detection is vital in managing new incursions.

This report provides diver surveillance results for 28 sites within 11 West Coast Lakes located between Haast and Greymouth, West Coast. Multi-species eDNA samples were also collected at numerous sites as an additional tool for early detection.

Methods

Eleven West Coast Lakes located between Haast and Greymouth were visited between the 10th and 16th of April 2022. Within these lakes a total of 28 sites were surveyed for invasive aquatic macrophytes following similar methodology to previous surveys (BOPRC, 2019 & 2021). The lakes surveyed are presented in Table 1.

Underwater visual surveillance

Underwater surveillance was undertaken by divers using SCUBA or snorkel (where less than 2m depth) who performed a systematic grid search at each site (tracks and dive times displayed in Appendix 3). The spacing between divers varied between 1 and 2 m depending on the nature of the lake bathymetry, vegetation cover and in-water visibility. To begin the search, divers entered the water via shore or vessel and swam to the deepest extent of the submerged macrophytes before undertaking a grid pattern back and forward working their way into the shallows. At some sites it was not possible for divers to reach any depth due to the shallow nature of the lakes, therefore divers focussed on the shallow area surrounding the entry points.

GoPro footage representative of each site was captured during the dives, and of any species of particular interest. A GPS unit was also towed above one diver to track the area of survey and a buffer included using ArcGIS to account for the area covered by the second diver (Appendix 3). Details of common plant species were also recorded during each dive (Appendix 1).

Shoreline surveillance directly adjacent to each site was also conducted on foot for any washed up weeds.

To ensure no transfer of weed species between lakes, dive gear, field equipment and the vessel were thoroughly disinfected and lakes with known *L. major* were left to the end of the fieldwork.

Table 1 Lakes, dates and sites surveyed for invasive aquatic macrophytes in April 2022.

Lake	Date Surveyed	Sites Surveyed
Haupiri	12/04/2022	Main Ramp
Lady	12/04/2022	Roadside
Brunner	11/04/2022	Moana Boat Ramp, Yacht Club, Crooked River Mouth, Cashmere Bay, Orangipuku River Mouth, Mitchells Boat Ramp, Hohonu River Mouth
Poerua	10/04/2022	Main Ramp and Northeast Arm
Kaniere	12/04/2022	Canoe Cove, Sunny Bight, Hans Bay
Mahinapua	13/04/2022	Main Ramp, Daylight Bight, Picnic Bay
Ianthe	16/04/2022	Jetty, Ianthe Creek Outlet, The Landing
Mapourika	15/04/2022	Boat Ramp, DOC Area, Okarito River Outlet
Wahapo	13/04/2022	Western Outflow
Paringa	15/04/2022	Main Ramp, Lodge Ramp
Moeraki	14/04/2022	North and South Ramps

LakeSPI

A LakeSPI field sheet template was adapted to describe each surveyed site. Sheets have been provided for future reference of these sites.

LakeSPI has been developed as a management tool, which utilises Submerged Plant Indicators (SPI) to assess the ecological condition of New Zealand Lakes (Clayton & Edwards, 2006). The method can be repeated over time to monitor trends in lake condition.

A more extensive understanding of LakeSPI methodology can be gained from the user manual and technical report: https://niwa.co.nz/sites/niwa.co.nz/files/import/attachments/lakespi_report.pdf

https://niwa.co.nz/sites/niwa.co.nz/files/import/attachments/lakespi_manual.pdf

eDNA

Water samples were collected from above the macrophytes at 19 specified sites and processed for eDNA according to Wilderlab NZ methodology (Appendix 2). These samples were later processed by Wilderlab for multi-species presence of plants and animals. Sites where eDNA samples were taken are displayed in Table 2 below and key introduced species are presented in Appendix 1 (an additional spreadsheet with all eDNA results is provided).

It should be noted that six replicates per site are recommended for comprehensive eDNA analyses. While divers gathered composite sampling where possible, only one sample was processed for most sites. Currently, eDNA can be considered a complementary tool rather than a stand-alone approach and molecular techniques will likely improve in accuracy with time.

Table 2 eDNA sample sites and details.

Site	Sample No.	Date Sample Taken	Volume	Lat	Long	Analysis
Lady 1	507110	12/04/2022	1000	-42.59936	171.58083	Multispecies PCR
Lady 2	518252	12/04/2022	500	-42.59957	171.58066	Multispecies PCR
Lady 3	518251	12/04/2022	500	-42.59902	171.58061	Multispecies PCR
Brunner Main Ramp 1	518237	11/04/2022	1000	-42.57635	171.47053	Multispecies PCR
Brunner Main Ramp 2	518238	11/04/2022	1000	-42.57645	171.47125	Multispecies PCR
Brunner Yacht Club	518240	11/04/2022	1000	-42.57745	171.47820	Multispecies PCR
Brunner Mitchell's Ramp	518239	11/04/2022	1000	-42.63495	171.39938	Multispecies PCR
Brunner Orangipuku River	518236	11/04/2022	1000	-42.65119	171.43306	Multispecies PCR
Brunner Cashmere Bay	518241	11/04/2022	1000	-42.61045	171.50117	Multispecies PCR
Brunner Crooked River	502856	11/04/2022	1000	-42.59898	171.46816	Multispecies PCR
Kaniere Sunny Bight	518246	12/04/2022	1000	-42.80413	171.12982	Multispecies PCR
Kaniere Canoe Cove	518245	12/04/2022	1000	-42.79878	171.13921	Multispecies PCR
Kaniere Hans Bay	518247	12/04/2022	1000	-42.80655	171.15478	Multispecies PCR
Mahinapua Main Ramp	518244	13/04/2022	350	-42.79620	170.90256	Multispecies PCR
Mahinapua Daylight Bight	518243	13/04/2022	500	-42.803178	170.922246	Multispecies PCR
Mahinaupua Picnic Bay	518242	13/04/2022	1000	-42.79591	170.93236	Multispecies PCR
Wahapo 1	518248	13/04/2022	360	-42.79620	170.90256	Multispecies PCR
Wahapo 2	518250	13/04/2022	500	-43.25313	170.24403	Multispecies PCR
Wahapo 3	518253	13/04/2022	650	-43.25487	170.27047	Multispecies PCR

Results and Discussion

No new incursions of *Lagarosiphon major*, *Egeria densa* or *Ceratophyllum demersum* were detected in the sites surveyed or through eDNA in 2022 (Appendix 1). *Lagarosiphon major* remains a dominant species at sites in Lake Paringa and lanthe and *E. canadensis* was present in all lakes surveyed.

Other exotic weeds of less concern due to most presenting a non-invasive nature included, *Ranunculus trichophyllus*, *Potamogeton crispus*, *Ludwigia palustris*, *Utricularia geminiscapa* and *Juncus bulbosus*. *Aponogeton distachyos* (Cape pondweed) was also recorded in Lake Mahinapua at two sites. Sites where introduced species were recorded during the present survey:

Elodea canadensis - Haupiri, Lady, Brunner, Poerua, Kaniere, Mahinapua, lanthe (main ramp and the landing), Mapourika, Wahapo, Paringa, Moeraki. The dominant invasive at all sites aside from those with *L. major*.

Lagarosiphon major – lanthe and Paringa (Figure 1). Already known in these lakes.

Ludwigia palustris – Haupiri, Lady, Brunner (Main Ramp and Mitchell’s Ramp), Poerua NE, Mahinapua (daylight bight and Picnic Bay), Mapourika (DOC area), Paringa (lodge). Previous records for Haupiri, Brunner, Poerua, Kaniere and Mahinapua (Champion & Clayton, 2004).

Ranunculus trichophyllus – Brunner (Orangipuku) and Poerua (main ramp). Present as a minor component of the vegetation among indigenous species and recorded in these lakes previously (Champion & Clayton, 2004).

Potamogeton crispus – Brunner (main ramp – Figure 1, Orangipuku River Mouth) and Mahinapua (main ramp). Minor component of overall vegetation and present among indigenous vegetation rather than displacing. Previously recorded in Lake Brunner (BOPRC, 2021).

Utricularia geminiscapa – Mahinapua (main ramp, Picnic Bay and daylight bight) and Mapourika (DOC area) but does not appear to displace indigenous vegetation. First recognised in Lake Mahinapua and Okarito Lagoon by Champion and Clayton (2004).

Juncus bulbosus – Submerged form recorded in Kaniere (Hans Bay and Canoe Cove) and Mahinapua (Daylight Bight and Picnic Bay). Appears to be a minor component of submerged vegetation, growing among native species. Also known in Paringa.

Aponogeton distachyos - Mahinapua (main ramp and Picnic Bay) (Figure 1), known in Mahinapua since 1950 (Champion & Clayton, 2004). It does not appear to be displacing native species at these sites.



Figure 1 Examples of several introduced species, *P. crispus* (left), *A. distachyos* (middle) and *L. major* (right).

Lake Haupiri

The area surveyed at Lake Haupiri was directly adjacent to the boat ramp and was very shallow across the whole survey area, with dark, tannin-stained water (Figure 2). Elodea was the only recorded invasive species at less than 5% invasive ratio. The site was dominated by native vegetation including charophytes, isoetes, milfoils and pondweeds. The shallow water introduced species, *L. palustris* remained present at low densities in <1m depth.

A smothering algal mat was also noted across large areas of the site (see additional video footage).



Figure 2 Site photo and location (red circle), Lake Haupiri.

Lady Lake

The Lady Lake survey area was accessed via the road through a narrow gap in the Raupō (Figure 3). The very dark water made observations difficult. Elodea was recorded at 6-25% compared to natives. *L. palustris* was very common along the shallow margin. Native vegetation included emergents, turf, charophytes, isoetes, milfoils and pondweeds.



Figure 3 Site photo and location (red circle), Lady Lake.

Lake Brunner

Seven sites were surveyed at Lake Brunner (Figures 4 & 5).

Main Ramp

The surveyed area was shallow (<3m) with *E. canadensis* (95%) and *P. crispus* (5%) the invasives recorded. Native presence included emergents, turf, charophytes, isoetes, milfoils and pondweeds at a ratio of 51-75% compared to 26-50% invasives, with dense areas of *E. canadensis*. Introduced, *L. palustris* was also observed.

Yacht Club

The surveyed area was also consistently shallow (<2m) with dense areas of invasive *E. canadensis*. Native turf, charophytes, isoetes, milfoils and pondweeds were observed at 76%-95% compared to 6-25% invasives.

Hohonu River Mouth

The area surrounding Hohonu River Mouth was very patchy and bare in most places. *Elodea canadensis* was occasional, but present at 6-25% ratio compared to natives at 76% -95%. Charophytes, milfoils and pondweeds were recorded. The bank dropped off relatively steeply, with vegetation recorded down to 3.6m.

Mitchell's Ramp

The bank adjacent to Mitchell's Ramp sloped off with vegetation recorded down to 5m (natives) and 3.8m (invasives). *Elodea canadensis* accounted for the invasive species, with introduced *L. palustris* also present. Native vegetation included emergents, turf, charophytes, isoetes, milfoils and pondweeds, at a ratio of 51-75% compared to 26-50% invasives. Kākahi (freshwater mussels) were abundant near the deepest margin of macrophytes.

Orangipuku River Mouth

The area surrounding the river mouth was shallow with dense *E. canadensis* dominating the site. A small amount of *P. crispus* and *R. trichophyllus* were noted. Native vegetation present included emergents, turf, charophytes, isoetes, milfoils and pondweeds, at a ratio of <5% compared to invasives at >95%. An unusual sample suspected to be *E. densa* was collected however was later confirmed as *E. canadensis*.

Cashmere Bay Ramp

The site at Cashmere boat ramp was dark and silty with vegetation dominated by *E. canadensis*. Native vegetation included charophytes, milfoils and pondweeds at 6-25% ratio compared to invasives at 76-95%. Charophytes were recorded down to 4.4m and *E. canadensis*, 3.5m.

Crooked River Mouth

The area surrounding the Crooked River Mouth was bare, with patchy vegetation. Native vegetation consisted of charophytes extending to 2.6m and *E. canadensis* the invasive to 2m. The ratio of vegetation was 26-50% native to 51-75% invasive.

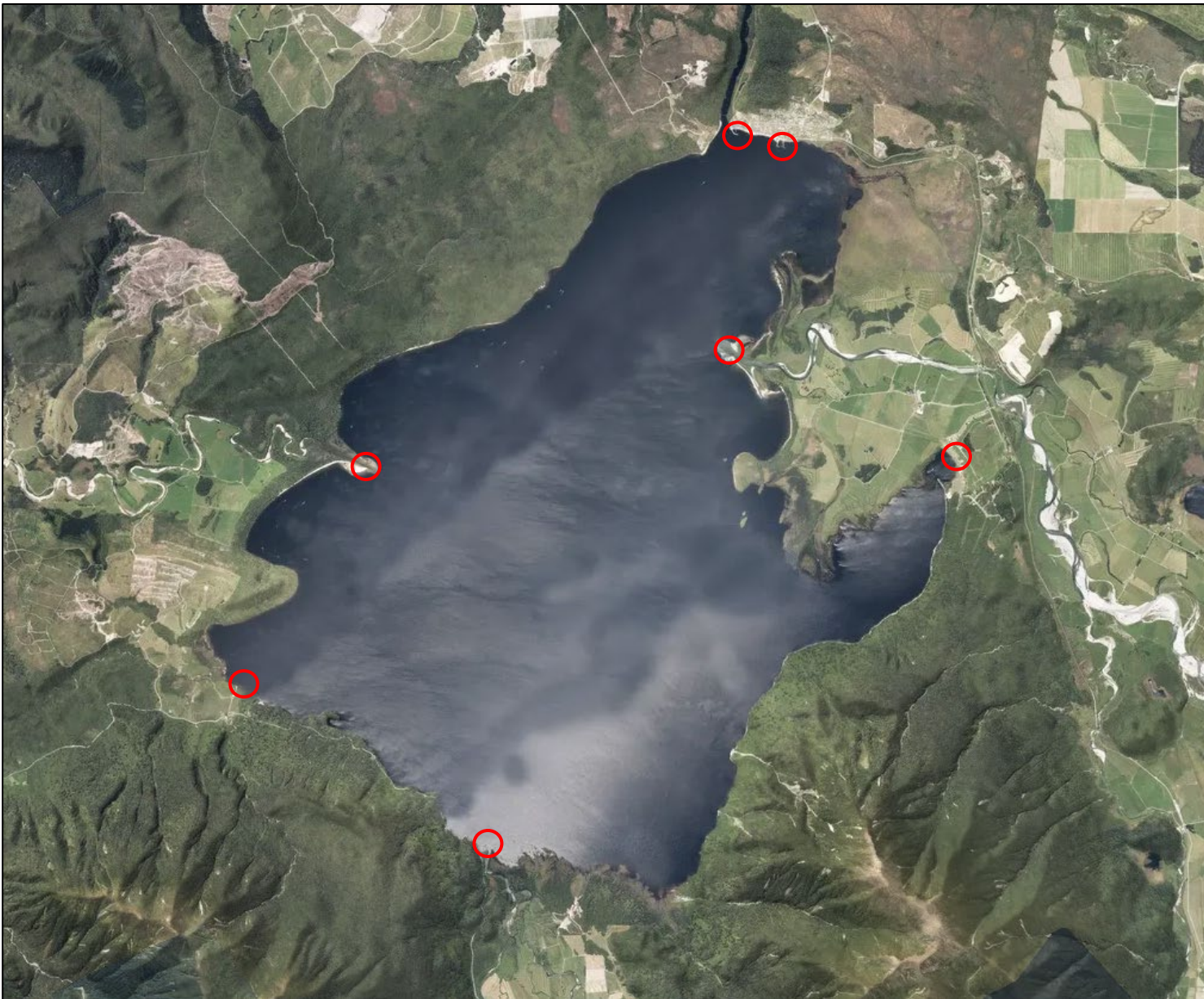


Figure 4 Lake Brunner and location of sites (red circles). Top left moving anticlockwise: Main Ramp, Hohonu River Mouth, Mitchell's Ramp, Orangipuku River Mouth, Cashmere Bay, Crooked River Mouth, Yacht Club.

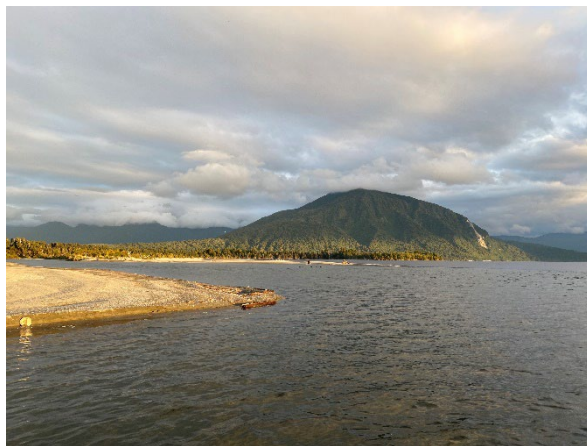
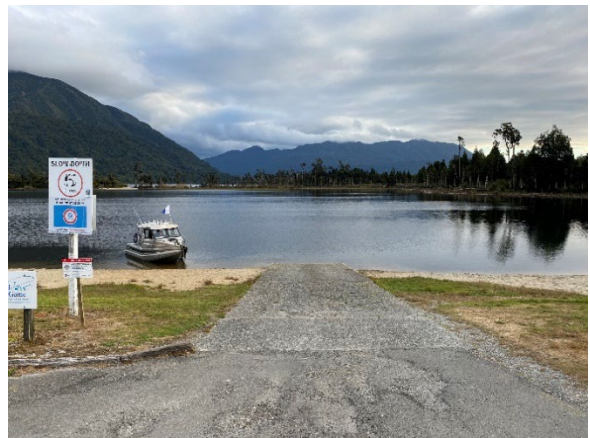


Figure 5 Site Photos left to right. Main Ramp, Yacht Club, Hohonu River Mouth, Mitchell's Ramp, Orangipuku River Mouth, Cashmere Bay and Crooked River Mouth, Lake Brunner.

Lake Poerua

Poerua Boat Ramp

The area adjacent to the boat ramp was characterised by a shallow plateau with vegetation extending out a significant distance (Figure 6). Divers were unable to reach the edge of the vegetation due to the large extent, however the vessel echo sounder indicated a maximum invasive depth of 4m and native of 4.8m. Native vegetation included emergents, turf, charophytes, isoetes, milfoils and pondweeds, at a ratio of 6-25% compared to 76-95% invasive. Invasive species present were dense areas of *E. canadensis* (95%) and to a much lesser amount, *R. trichophyllus* (5%).

Poerua NE arm

The northeast arm itself was not accessed due to the draft of the vessel, however divers swam across the expansive shallow area at the intersection of the main lake and northeast arm (Figure 6). The echo sounder showed taller vegetation (likely *E. canadensis*) to 4m depth and shorter vegetation (likely charophytes) to 5.4m. Divers observed native emergents, turf, charophytes, milfoils and pondweeds. Invasives were dense areas of *E. canadensis* at 26-50% ratio compared to 51-75% native. Introduced *L. palustris* was also present in the shallow margins.



Figure 6 Site photo (main ramp) and birds eye view of sites (main and northeast arm) Lake Poerua.

Lake Kaniere

Sunny Bight

Sunny Bight surveillance included a shallow shelf area which sloped off to 6.5m (Figures 7 & 8). Native vegetation was diverse and included emergents, turf, charophytes, isoetes, milfoils and pondweeds at 26-50% ratio compared to 26-50% invasives. Invasive species included dense areas of *E. canadensis* down to 5.2m.

Hans Bay

Hans Bay surveillance included a band of vegetation adjacent to the boat ramp (Figures 7 & 8). Native charophytes extended to 7.5m beyond which an algal mat could be seen. Other natives present included turf plants, isoetes, milfoils and pondweeds at 51-75% ratio compared to invasive, 26-50%. Dense areas of *E. canadensis* were present down to 5.4m, with a small amount of *J. bulbosus* at the margin.

Canoe Cove

Canoe Cove surveillance included the area around the outlet and walkway where charophytes grew down to 7.3m and invasive *E. canadensis* reached 4m (Figures 7 & 8). The site was characterised by large charophyte meadows and other natives including turf, isoetes, milfoils and pondweeds. *Elodea* was occasional and *J. bulbosus* was also present. Invasive ratio was 5% compared to 95% natives.



Figure 7 Site locations Lake Kaniere. Sunny Bight (left), Canoe Cove (centre) and Hans Bay (left).



Figure 8 Sunny Bight, Hans Bay and Canoe Cove sites, Lake Kaniere.

Lake Mahinapua

Main Ramp

Mahinapua main ramp surveillance included the very shallow (<2m) area to the left and lakeward from the jetty (Figures 9 & 10). Two introduced species already known in this lake were observed, the dominant *E. canadensis* and *A. distachyus*. In addition, *P. crispus* and *U. geminiscapa* were also recorded. Native vegetation included emergents, charophytes, milfoils and pondweeds at 95% compared to 5% invasives. The nature of *E. canadensis* was noted as occasional.

Daylight Bight

Daylight Bight was also very shallow (<1m) across the entire survey site, directly out from Johnnies Creek and the treetop walkway (Figures 9 & 10). Native vegetation included emergents, turfing, charophytes, isoetes, milfoils and pondweeds at 95% ratio. Invasive species were occasional <5% and included *E. canadensis* and *J. bulbosus*. Other introduced species present were *U. geminiscapa* and *L. palustris*.

Picnic Bay

Picnic Bay surveillance was conducted at the end of Picnic Point Track (Figures 9 & 10). The majority of the area was shallow (<1m), with a drop-off to 3m offshore. Native emergents, turf, charophytes, milfoils and pondweeds were all present at 95% ratio compared to 5% invasives. *Elodea canadensis* was the main invasive present, with *J. bulbosus* and *A. distachyus* recorded along the lake margins.



Figure 9 Lake Mahinapua sites - Main ramp (left), Daylight Bight (centre) and Picnic Bay (right).



Figure 10 From left to right, Lake Mahinapua main ramp, Daylight Bight and Picnic Bay.

Lake lanthe

Lagarosiphon major is known in both Lakes lanthe and Paringa. During the survey, *L. major* was present at all sites surveyed (Figure 11).

Main Ramp

Lagarosiphon major was the dominant submerged vegetation species at the main ramp at a ratio of 51-75% compared to 26-50% natives. *L. major* was dense and extended to depths of 3.5m with natives to 5.5m. Native vegetation included emergents, turf, charophytes, isoetes, milfoils and pondweeds. A small amount of *E. canadensis* was also present.

The Landing

Native vegetation surrounding the landing extended to 5.1m, with emergents, charophytes, isoetes, milfoils and pondweeds all present. The ratio of natives to invasives was 51-75% to 26-50%. Both *E. canadensis* and *L. major* were present, however *L. major* was dominant with partly closed areas from the shallows down to 2.6m.

lanthe Creek Outlet

The shallow area surrounding lanthe Creek Outlet had a ratio of 26-50% natives to 51-75% invasives. The invasive present was *L. major* in dense patches among charophytes and other natives. Native emergents, turfing species, charophytes, isoetes, milfoils and pondweeds were present. An algal mat was noted covering all vegetation in the shallow area surrounding the creek mouth (Figure 11).

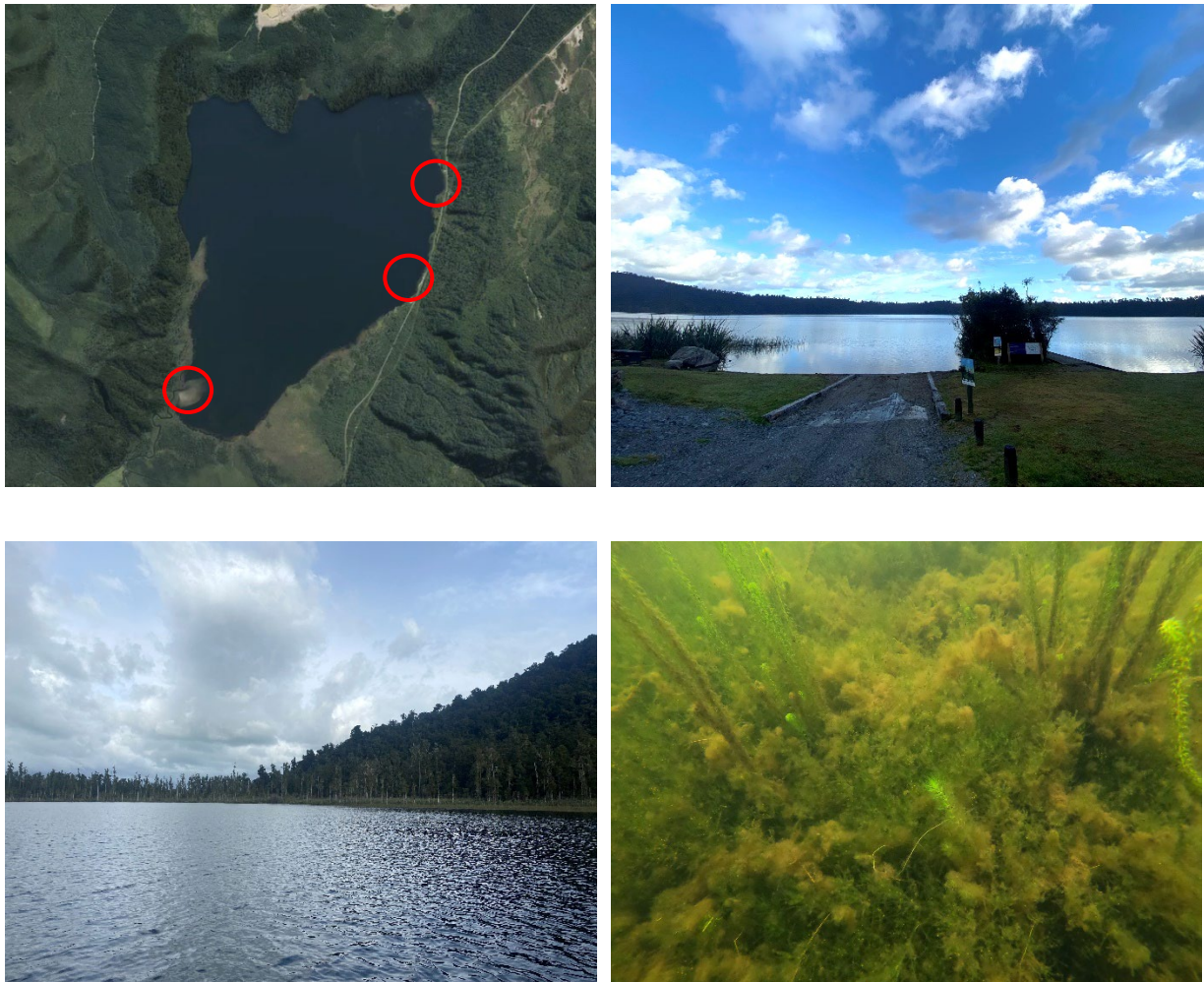


Figure 11 Top images - Lake Lanthe showing sites (red circles) and main ramp (right). Bottom images - , lanthe creek outlet topside (left) and lanthe Creek Outlet (right) showing algae atop of submerged vegetation. (bottom right).

Lake Mapourika

Main Ramp

The main ramp was surveyed out to 4m depth where natives and invasives were present (Figures 12 & 13). Natives included emergents, turf, charophytes, isoetes, milfoils and pondweeds at a ratio of 51-75% natives to 26-50% invasives. *Elodea canadensis* was the invasive species present with areas of dense cover.

DOC Area

Native vegetation ratio was 51-75% compared to 26-50% invasives in the area surrounding the DOC camp and boat ramp (Figures 12 & 13). Native emergents, turf, charophytes, isoetes, milfoils and pondweeds were present and charophytes extended to 5.5m. Invasive *E. canadensis* was dense where present and observed to 4m depth. Introduced species, *L. palustris* and *U. geminiscapa* were also recorded at this site. A dense kākahi bed was noted below the vegetation margin at this site.

Okarito River Mouth

The vegetation observed surrounding Okarito River Mouth was dominated by native species including emergents, turf, charophytes, isoetes and milfoils at 76-95%, with charophytes to 4.7m. The areas of *E. canadensis* were dense and observed to 3m depth, accounting for 6-25% of the

vegetation. Large eel numbers were noted at this site, particularly in terrestrial vegetation and debris washed out of the river mouth.



Figure 2 Lake Mapourika sites (red circles), main ramp (bottom), DOC area (middle) and Okarito River Outlet (top).



Figure 13 Lake Mapourika sites, main ramp, DOC area and Okarito River mouth.

Lake Wahapo

Surveillance at Wahapo proved difficult due to the limited visibility (<0.5m), however divers were able to note the main species in the western outlet area (Figure 14). No footage was taken due to the limited visibility. Native species observed by divers included charophytes and milfoils extending past 4m depth. *E. canadensis* was observed at 4m and accounted for 26-50% invasives compared to 51-75% natives. Kākahi were abundant in the channel.



Figure 14 Lake Wahapo showing the western outlet site.

Lake Paringa

Main Ramp

Native vegetation included turf, charophytes, isoetes, milfoils and pondweeds, at a ratio of 51-75% compared to 26-50% invasive. Invasives included *L. major* (90%) and *E. canadensis* (10%). A tuft-like algae covered much of the vegetation (see attached footage). *Lagarosiphon major* extended down to 4m and charophytes to 5.4m. Kākahi were common in shallow at 0.5m.

Paringa Lodge

Lagarosiphon major was dense at the lodge site across the shallow area (<1.5m) lakeward of the jetty (Figure 15). It accounted for 76-95% of the observed vegetation and *E. canadensis* was also present to a lesser extent. Emergents, turf, charophytes, isoetes and milfoils were among the native vegetation observed. The site was also largely covered by a fluffy algal mat.

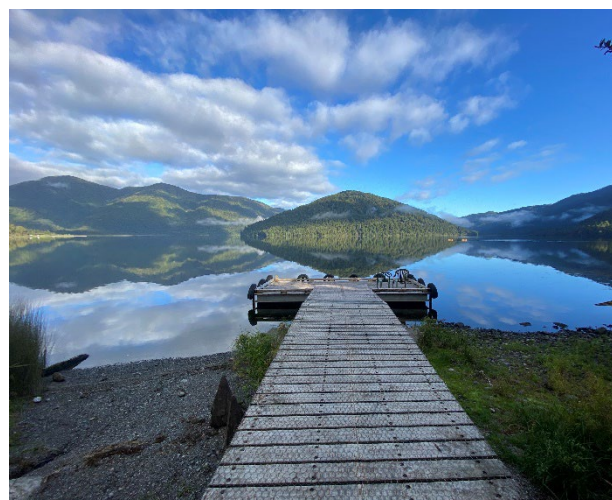


Figure 35 Lake Paringa showing main ramp and lodge sites. Lodge jetty (right image).

Lake Moeraki

Northern Ramp

The northern ramp site was dominated by dense *E. canadensis* down to 5m at 76-95% compared to 6-25% native vegetation (Figure 16). Emergents, turf, charophytes, isoetes, milfoils and pondweeds were present to 5.5m.

Southern Ramp

Dense *E. canadensis* was the only invasive recorded at the southern ramp site in Moeraki down to 5.6m depth (Figure 16). Emergents, turf, charophytes, isoetes, milfoils and pondweeds were native vegetation present at 26-50% compared to 51-75% invasives. Kākahi were abundant near the deeper vegetative margin.



Figure 46 Lake Moeraki sites (red circles), north (top) and south (bottom) ramps. Right image is the southern ramp.

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Appendices

Appendix 1

Common indigenous vegetation observed at each lake

	Haupiri	Lady	Brunner Main Ramp	Brunner Yacht Club	Brunner Hohonu River Mouth	Brunner Mitchel's Ramp	Brunner Orangipuku Mouth	Brunner Cashmere Bay	Brunner Crooked River Mouth
<i>Chara sp.</i>	+	+	+	+	+	+	+	+	+
<i>Nitella sp.</i>	+	+	+	+		+			
<i>Elatine gratioloides</i>			+	+					
<i>Glossostigma sp.</i>			+	+		+	+		
<i>Isoetes sp.</i>	+		+	+		+	+		
<i>Lilaeopsis novae-zelandiae</i>			+			+			
<i>Myriophyllum triphyllum</i>			+	+		+	+	+	
<i>Myriophyllum propinquum</i>	+	+	+	+	+	+	+	+	
<i>Potamogeton cheesemanii</i>				+			+		
<i>Potamogeton ochreatus</i>	+		+	+	+	+	+	+	
<i>Ranunculus amphitrichus</i>	+		+			+	+		
<i>Ranunculus limnosella</i>			+	+		+	+		
<i>Lobelia perpusilla</i>									
<i>Callitriche petriei</i>	+								

	Poerua Main Ramp	Poerua Northeast arm	Kainere Sunny Bight	Kaniere Hans Bay	Kaniere Canoe Cove	Mahinapua Main Ramp	Mahinapua Daylight Bight	Mahinapua Picnic Bay	Wahapo
<i>Chara sp.</i>	+	+	+	+	+	+	+	+	+
<i>Nitella sp.</i>			+	+	+			+	
<i>Elatine gratioloides</i>	+		+	+	+				
<i>Glossostigma sp.</i>	+	+	+	+	+				+
<i>Isoetes alpina</i>	+		+	+	+		+	+	
<i>Lilaeopsis novae-zelandiae</i>	+	+		+	+				
<i>Myriophyllum triphyllum</i>	+	+	+	+	+		+		+
<i>Myriophyllum propinquum</i>	+	+	+	+	+	+	+	+	+
<i>Potamogeton cheesemanii</i>			+	+	+	+	+		
<i>Potamogeton ochreatus</i>	+	+	+	+	+	+	+	+	
<i>Ranunculus amphitrichus</i>			+				+	+	
<i>Ranunculus limnosella</i>	+		+	+	+				
<i>Lobelia perpusilla</i>			+	+			+	+	
<i>Callitriche petriei</i>			+	+			+	+	

	Ianthe Main Ramp	Ianthe The Landing	Ianthe Creek Outlet	Mapourika Main Ramp	Mapourika DOC area	Mapourika Okarito River	Paringa Main Ramp	Paringa Lodge jetty	Moeraki North	Moeraki South
<i>Chara sp.</i>	+	+	+	+	+	+	+	+	+	+
<i>Nitella sp.</i>	+	+		+	+	+	+	+	+	+
<i>Elatine gratioloides</i>	+		+				+			+
<i>Glossostigma sp.</i>	+		+		+	+	+	+	+	+
<i>Isoetes</i>	+	+	+		+	+	+	+	+	+
<i>Lilaeopsis novae-zelandiae</i>	+		+	+	+	+	+	+	+	
<i>Myriophyllum triphyllum</i>	+	+	+	+	+	+	+	+	+	+
<i>Myriophyllum propinquum</i>	+	+	+	+	+	+	+	+	+	+
<i>Potamogeton cheesemani</i>	+	+	+							+
<i>Potamogeton ochreatus</i>	+	+	+	+	+		+		+	+
<i>Ranunculus amphitrichus</i>			+	+	+			+		+
<i>Ranunculus limnosella</i>			+		+					
<i>Lobelia perpusilla</i>							+	+	+	+
<i>Callitriche petriei</i>	+		+		+		+	+		+

Introduced surveillance species detected in eDNA sampling

	Plants					Fish			
	<i>Ceratophyllum demersum</i>	<i>Lagarosiphon major</i>	<i>Egeria densa</i>	<i>Elodea canadensis</i>	<i>Aponogeton distachyos</i>	<i>Ameiurus nebulosus</i>	<i>Carassius auratus</i>	<i>Perca fluviatilis</i>	<i>Salmo trutta</i>
Lady 1									+
Lady 2									+
Lady 3									+
Brunner Main Ramp 1				+			+		+
Brunner Main Ramp 2				+			+		+
Brunner Yacht Club				+			+		+
Brunner Mitchell's Ramp									+
Brunner Orangipuku River				+					+
Brunner Cashmere Bay				+			+		+
Brunner Crooked River				+			+		+
Kaniere Sunny Bight								+	+
Kaniere Canoe Cove								+	
Kaniere Hans Bay								+	
Mahinapua Main Ramp					+		+	+	
Mahinapua Daylight Bight							+	+	
Mahinaupua Picnic Bay					+	+	+	+	
Wahapo 1									
Wahapo 2									+
Wahapo 3									

Appendix 2

eDNA Methodology (as per Wilderlab NZ instructions)

1. Take the gloves out of the sample bag, put them on, and take out the large syringe.
2. Draw up 50 ml of water from just below the surface of the water. Take care not to suck up any sediment from the bottom.
3. Screw the filter on the large syringe taking care not to overtighten.
4. Push the plunger down to squeeze the water out through the filter. Avoid getting air bubbles in the filter as they can be difficult to push through.
5. Unscrew the filter from the large syringe.
6. Repeat steps 2-5 until the filter is clogged and water is only dripping out, or until 1L is filtered (20 syringe-fuls), whichever comes first. If using a caulking gun do not force water through too hard or the filter may rupture.
7. Unscrew the filter, draw 50 ml of air into the large syringe, re-attach the filter, and holding the syringe vertically with the filter pointing down, force the air through to squeeze out the remaining water from the filter. Leave the filter attached to the large syringe for the next step.
8. Holding both the large syringe (with filter attached) and the small syringe (with black cap attached) in the same hand and in an upright position, unscrew the black cap from the small syringe and screw the black cap on to the outlet end of the filter. See figure (A) below.
9. Unscrew the filter (with the black cap still attached) from the large syringe and screw it on to the small syringe (B-C). Push the plunger to inject the preservative into the filter (D). Shake well while holding the plunger down. Do not remove the syringe or cap from the filter. Don't worry if there are air bubbles in the filter or if the plunger springs back – this is normal.
10. Place the filter with both the black cap and small syringe still attached into the clear zip-lock sample bag and seal (E).
11. Record the sample details on the ziplock bag in the space provided. Ensure that the coordinates are entered in WGS84 decimal format (for example -41.30951, 174.82110 as displayed on google maps).
12. Fill out the eDNA sample submission form at wilderlab.co.nz/submit-samples and include a hard copy with the samples.
13. Send the samples by standard courier (no refrigeration necessary) to:
Wilderlab NZ Ltd
Level 2, 129 Park Road
Miramar
Wellington 6022

Appendix 3

Table of lakes and sites surveyed by divers with total dive times followed by images showing GPS tracks and search area.

Lake	Site	Dive time (min)
<i>Haupiri</i>	Main Ramp	45
<i>Lady</i>	Roadside	35
<i>Brunner</i>	Main Ramp	45
<i>Brunner</i>	Yacht Club	55
<i>Brunner</i>	Hohonu River Mouth	36
<i>Brunner</i>	Mitchell's boat ramp	48
<i>Brunner</i>	Orangipuku River Mouth	50
<i>Brunner</i>	Cashmere Bay	33
<i>Brunner</i>	Crooked River Mouth	31
<i>Poerua</i>	Northeast Arm	51
<i>Poerua</i>	Main Ramp	55
<i>Kaniere</i>	Sunny Bight	71
<i>Kaniere</i>	Canoe Cove	31
<i>Kaniere</i>	Hans Bay	36
<i>Mahinapua</i>	Main Ramp	40
<i>Mahinapua</i>	Daylight Bay	44
<i>Mahinapua</i>	Picnic Bay	34
<i>Ianthe</i>	Main Ramp	50
<i>Ianthe</i>	The Landing	40
<i>Ianthe</i>	Ianthe Creek Outlet	35
<i>Mapourika</i>	Boat Ramp	45
<i>Mapourika</i>	DOC Area	60
<i>Mapourika</i>	Okarito River Outlet	35
<i>Wahapo</i>	Western Outflow	40
<i>Paringa</i>	Main Ramp	41
<i>Paringa</i>	Lodge Ramp	24
<i>Moeraki</i>	North Ramp	69
<i>Moeraki</i>	South Ramp	45

