

**INTERNAL**



**RUNANGA LAKE  
ECOLOGICAL  
MONITORING  
2006**

**June 2007  
EMI 0711  
HBRC Plan No. 3951**

## **Environmental Management Group Technical Report**

**Internal**

**Environmental Monitoring Section**

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# **Runanga Lake Ecological Monitoring 2006**

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Prepared by:  
Andrew Lamason - Data Technician

Reviewed by:  
Brett Stansfield - Scientist Surface Water Quality

Approved:  
**Murray Buchanan**, Group Manager – Environmental Management

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# **RUNANGA LAKE ECOLOGICAL MONITORING 2006**

**Report prepared for Hawke's Bay Regional Council**



**Andrew Lamason  
Data Technician  
HBRC**

**April 2006**

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Cover photo View across the southern end of the lake showing lush raupo growth backed by a low forest of willow. A juvenile paradise duck can be seen making its way across the water in the lower right hand corner.

## INTRODUCTION

Regular monitoring of ecological condition and trend is built into the planned management of Runanga Lake, Hawke's Bay, by the Hawke's Bay Regional Council. The name Runanga Lake is used in preference to Lake Runanga, because it appears to be the more traditional name.

In December 2001, a regime for monitoring the ecological condition and trend of the lake was set up by Geoff Walls on contract for the Hawke's Bay Regional Council. This was done using four years' experience gained in establishing a similar monitoring regime in Pekapeka Swamp and other wetlands in Hawke's Bay. It also had the benefit of the local knowledge of adjacent landowners and Department of Conservation staff. Baseline surveys of vegetation and fauna were carried out at the same time.

The findings of the baseline survey and ecological monitoring establishment were reported on in Walls 2002b (Runanga Lake Ecological Monitoring 2001). A companion report provides more background information and forms a monitoring plan (Walls 2002a: Runanga Lake Ecological Monitoring Plan, February 2002). Surprisingly, the draft management plan commissioned by the Council (Lake Runanga Draft Management Plan 2001-2006) does not include the concept of ecological monitoring. However, the monitoring plan and this monitoring report are designed to fill that gap and mesh with the management principles in the draft management plan.

In November 2006 the wetland was revisited and the monitoring was repeated. This document reports on the findings.

## 1. VEGETATION

### 1.1 Terrestrial vegetation

There were two aspects to monitoring of the terrestrial vegetation of the lake: mapping of the current vegetation cover; establishment of photopoints. A third technique used in other wetlands in Hawke's Bay, the establishment of permanent vegetation monitoring plots, was not considered necessary at this particular wetland.

#### 1.1.1 Vegetation map

##### *Method:*

The patterns of terrestrial vegetation were mapped in December 2001 using recent colour aerial photos. A copy of this map is shown in Appendix 1. Re-mapping is scheduled for 2008.

##### *Observations:*

Five major vegetation types were identified and mapped in 2001 (see below). In 2004, the patterns had not changed significantly.

- W** Willows dominant: forest and patches of trees, mostly grey (pussy) willow but also some crack willow, a few weeping willows and very occasional silver poplar. Large stands at each end of the lake; smaller patches and strips elsewhere. Typically associated with cabbage trees, harakeke (lowland flax), raupo and sedges (particularly *Carex secta*, which forms a genuine understorey in places). Various exotic grasses (such as swamp millet) and herbs beneath also. A stronghold of swamp nettle (*Urtica linearifolia*). Most areas periodically flooded; mostly accessible to stock, although some areas are fenced off.
- R** Raupo dominant: forming dense stands right around the shore of the lake; also forming "islands" in open water. Rushes and sedges are present and form patches in places (e.g. *Juncus effusus*, *J. amabilis*, *Carex secta*, *C. geminata*, *Bolboschoenus fluviatilis*, *Eleocharis acuta* and *Schoenoplectus validus*). Appears to be spreading into the lake, probably because lake water levels have been artificially lowered. Regularly cleared in places for access, views and duck hunting.
- H** Harakeke (lowland flax) dominant. Typically associated with cabbage trees. A few areas on the western shore.
- P** Pasture. Surrounding the lake. In constantly wet grazed turf are primarily glaucous sweetgrass (*Glyceria declinata*), creeping bent (*Agrostis stolonifera*), and Mercer grass (*Paspalum distichum*), along with various rushes and sedges. In dry grazed pasture, Indian doab (*Cydonon dactylon*) and perennial ryegrass (*Lolium perenne*) are particularly prevalent. In areas fenced from stock, rank tall grasses (tall fescue, *Festuca arundinacea*, Yorkshire fog, *Holcus lanatus*, and perennial ryegrass) are dominant.
- O** Open water. In the south-western broad embayment are expansive beds of macrophytes (submerged bottom-rooted aquatic plants, mainly *Potamogeton*

*crispus* and *P. pectinatus*), visible at times as a different texture on the water surface.

Whilst little is left of the vegetation present in pre-human times, these types mimic the natural patterns to a certain extent. In the past, the lake would naturally have been surrounded by dense forest, dominated by totara, ngaio, kowhai and kanuka on the hills and by tall kahikatea on the rich wet soils near the shore. Fringing that on the lake shore would have been cabbage trees, harakeke (lowland flax) and purei (tussock sedges). Further into the water still would have been areas of tall rushes and sedges, including raupo. Very wet peaty flats may have contained shrub communities that included manuka. A small amount of manuka still persists in a swampy flat behind a bay on the western side of the lake.

Willows have been introduced to provide a replacement tree element in the system. Although this has created valuable habitat for fauna and flora, it has brought with it a significant problem. The willows are more tolerant of prolonged inundation than any native tree or shrub, and as a consequence are invading the entire shore area. This is exacerbated by fluctuating and artificially lowered water levels. It also makes the prospect of restoring natural shore vegetation a challenge. Monitoring is required to assess the rate and ecological consequences of willow spread now that stock are being fenced off from the lake margins. The vegetation map, photopoints and transects are designed to do that job, and to follow the processes in the rest of the vegetation around the lake.

*Next monitoring:*

In two years' time (late 2008).

### **1.1.2 Photopoints**

*Method:*

13 photopoints were set up the length and breadth of the wetland in December 2001. Each was marked with an aluminium label attached to a post, either an existing fence post or a new one driven in for the purpose. The photopoints were chosen to represent the spectrum of terrestrial vegetation types and situations around the lake. They were also selected to be readily relocated. Photos were taken from the standing position at each photopoint: mostly panoramas of the vegetation; some more localised and specific. A SLR camera with a 50mm lens was used. Film was Kodak colour print, 200asa. In November 2004 the method was repeated. In 2006 the photopoints were repeated using a six mega pixel digital camera. The photos, in order, are in the album that accompanies this document.

The location of each photopoint is marked on the map (Appendix 1). It is also described on the photopoint recording sheet, with an accompanying GPS grid reference (one for each photopoint, Appendix 2). Also on each sheet is a description of the vegetation and the ecological patterns and processes occurring there.

*Observations:*

#### **Photopoint 1:**

Sited on the hillside quite high above the eastern side of the lake. A splendid vantage point, chosen to follow the processes within the patterns of raupo, willows, harakeke and cabbage trees around the small bay below, and also on the other side of the lake. In 2004, quite a lot of change in 3 years was evident. The lake water level was noticeably higher than in 2001 (as a result of work done at the outlet by landowners for this purpose). The weed bed of macrophytes on the opposite shore was no longer visible as a consequence. Raupo had been aerial herbicided on various outer edges, so was substantially knocked back there, but had been allowed to regenerate in places. A raupo "island" had arrived in the bay, having floated across from the opposite shore in windy conditions. Young willows had grown noticeably.

In 2006 the "raupo island" has rejoined the edge of the lake. The effects of spraying on the raupo have been negated by regrowth of the main body of raupo. Young willows have established on the new raupo edge. The water is very turbid and macrophyte beds previously noted are no longer in evidence. The azolla patches are no longer in evidence as well but this could be a function of the prevailing wind which has driven floating plants up onto dry land where they have become desiccated or decomposed.

**Photopoint 2:**

Sited down on the shore below Photopoint 1. Chosen to track the fate of the harakeke and cabbage trees that look to be being swamped by grey willows, and of the raupo patterns where regular control is done. In 2004, the biggest changes were in the water level (considerably higher) and in the raupo fringe (had grown/regenerated in places and had been removed elsewhere). The rapidity with which raupo could expand in a shallow lake and also the effects of management were well demonstrated.

In 2006, Cabbage trees and Harakeke on the point have become less evident as the raupo extends, and the willows grow in stature. Those flax plants that are now being increasingly shaded by the willow canopy are becoming increasingly sparse. The mature cabbage tree on the hill in the background has since fallen.

**Photopoint 3:**

Sited on a fenceline on the hillside a little south of the first two photopoints, and chosen to complement them and provide more detail. Raupo appears to be advancing and willows appear to be spreading. There are some artificially bared areas of wet muddy flats, favoured by dotterels, herons, stilts, ducks and geese. In 2004, the water level was higher, young willows had grown noticeably and raupo had been herbicided around its outer margins and had diminished in bulk except towards the bay to the north. The raupo was being prevented from expanding landwards by deliberate grazing. Fencing is therefore not required here, especially since the water level is likely to be raised further, allowing the raupo to expand landwards a little.

No roosting shags were noted during the 2006 survey at this site but they can be seen in other areas of the lake on drying perches so their absence could be attributed to time of day. Only isolated plantlets of azolla and lemma minor are evident. Willows on are showing excellent recovery following spraying as is the Raupo. There has been some reduction in the raupo levels to landward due to grazing and spot spraying. Generally

the raupo is of the same extent but slightly reduced in stature.. No wading birds were noted but being a very windy day this is to be expected somewhat.

**Photopoint 4:**

Similar site to Photopoint 3, but to the north of the first two photopoints. Chosen to follow the same processes and patterns. In 2004, the changes evident were as for Photopoints 1-3. Young willows had grown, and had colonised in places. Where not controlled, raupo had expanded or thickened. Substantial raupo control had been done on the western and NW side of the lake, the large expanses having been knocked back in a major way. Plenty of raupo habitat (valuable for wetland birds, fish and invertebrates) remained though.

In 2006, Raupo are absent from the bay at the foot of the spur the photopoint is located upon . Raupo appears to be spreading slightly out into the main body of the lake but is completely absent from the edge of the small embayment where stock have access. This bay appears to be shallow enough for cattle to wade some distance out into the water and prevent raupo establishment. Due to the reduced exposure to the prevailing wind in this arm this site is being used as a refuge for large numbers of water fowl. Black swan, and mallard duck populations are in excess of 500 individuals each at this site and a gaggle of over 100 feral geese are also present.

**Photopoint 5:**

Sited on a fenceline quite high on the hillside overlooking the south (outlet) end of the lake. Commands a good view of the expansive willow forest and the raupo fringing it. In 2004, the willow forest was essentially as in 2001 (though cabbage trees were more visible as they were in flower). Young willows had grown noticeably and had spread somewhat. Raupo had expanded where not controlled, and with the elevated water level had broken up in places, floating chunks having been blown away from the main mass. Localised recent aerial control of the raupo had been done. The former great mass of macrophytes (weed bed) on the other side of the lake was not now visible.

In 2006, the previously sprayed willows are showing signs of a full recovery. The raupo and cabbage trees at this site are in excellent health with some expansion of the raupo margin. There is no evidence of the effects of spraying on the raupo. This site would be suitable for an under planting trial for Kahikatea amongst the willow forest.

**Photopoint 6:**

Sited high on the hillside opposite Photopoint 5, and chosen to provide a complementary view for monitoring the vegetation processes. Photos were also taken of the same scene but closer to the lake, in order to provide more detail. In 2004, changes were as for Photopoint 5. The lake level was higher. Raupo had expanded where not controlled, especially near the lake outlet. It had also broken up in places due to the higher water and wind. Young willows had invaded and grown noticeably.

In 2006, the water level appears a little lower with no spray damage evident. Willows are either fully recovered or nearly so. The raupo fringe has extended outward into the lake with an island of raupo evident in 2004 now attached to the main body of raupo.

**Photopoint 7:**

Sited on a fenceline above the south-western shore of the lake. There is a clump of planted silver poplar, within the willow fringe, considered to be a potentially serious weed. In 2004, the largest visible change was where raupo had been killed. Otherwise, willows had continued to grow. The macrophyte bed was no longer visible (due to the elevated water level). Many shags were using the silver poplar clump for roosting, suggesting that its value for them might outweigh its weed potential. Stock were being kept out of the lake thereabouts by electric fencing.

In 2006, The macrophyte bed is still absent whilst the willow and raupo have continued to extend outwards into the lake. The electric fencing is no longer in place and as such the raupo edge has been grazed. Sprayed raupo has recovered to its original extent but is of slightly lower stature. 16 dabchick were counted from this site.

**Photopoint 8:**

Sited on a low knoll at the NE end of the lake. Chosen for its view of willow forest and raupo expanses. In 2004, in the main panorama, some willows had been controlled. Raupo had probably continued to advance into the lake except where controlled. Willows were showing some advance into the raupo. To the N, the edge of the willows had been cleared, cabbage trees had been left and new ponds had been created. This recent management is likely to enhance the conditions for native wetland fauna and flora.

The willow forest and raupo are showing no signs of damage from spraying and some regrowth of willows is occurring in recently cleared pond areas. Cabbage trees with these cleared areas are in good health and are no doubt benefiting from the reduction in competition with willows.

**Photopoint 9:**

Sited high on the hilltop not far from Photopoint 8. A magnificent vantage point for the whole northern end of the lake. In 2004, willows were invading the raupo; the raupo was advancing into the lake (except where controlled). Raupo control had been major on the opposite shore, but willows there had not been controlled. There had been some willow control on the near shore, and the elevated water now showed behind the fringing vegetation.

Inn 2006 the situation is similar to other sites that have received some spraying. Willows and Raupo have recovered to their pre-spraying extent with the raupo possibly reduced in stature only.

**Photopoint 10:**

Sited high on the hillside on a fenceline to the south of Photopoint 9, and chosen as a complement to it, particularly to check on the apparent expansion of raupo as an island. In 2004, changes were as for Photopoints 8 & 9. Young willows were starting to proliferate in places.

In 2006 willow species are showing no signs of dieback and are at a similar extent to their 2004 coverage. Raupo has re-established to at least the 2004 levels on the island with patchy recovery of raupo on the point to the north. Clumps of raupo have

established ad outliers based on the 2004 extent. These are expected to thicken to form a continuous band mirroring the 2004 edge. No azolla was recorded but this is probably due to the effects of strong winds.

Many birds have congregated in this more sheltered portion of the lake, possibly reflecting the importance of these narrow areas as shelter from winds.

**Photopoint 11:**

Sited at the end of a headland between two bays on the NW side of the lake. Chosen to follow the patterns of willows, raupo and cabbage trees on the shore. In 2004, major changes were evident: elevated water level; major raupo control had been done from the air (in future it will be done by boat, keeping the edges pinned back); there was continued growth in willows. But willow control had been done nearby, with the intention of steadily replacing them with native plants (for birds, aesthetics, etc).

In 2006 the pattern is essentially the same as 2004. Raupo has recovered from spray works to a similar extent but is of lower stature. Willows continue to invade the raupo, and establish new seedlings. These will need control if improvements are going to be maintained.

**Photopoint 12:**

Sited on the spur that leads to the headland of Photopoint 11. Chosen to follow the fate of remnant shrubs of manuka on the swampy flat to the south, and the raupo and willows on the swampy flat to the north. In 2004, the manuka still existed, as did the raupo areas. Some willow control and pond development had been done either side of the spur. Pied stilts were using the new ponds. To the N, things were much as previously. It is fenced there and has potential formal protection as a QEII Open Space Covenant, though occasional cattle and horses were using the area in 2004.

In 2006, some planting has taken place with a mix of native and exotic species eg silver birch. Raupo has recovered a little with no obvious signs of spray damage evident. The Manuka stand remains but is in a state of reduced health with no new recruits evident. Some stump removal has recently taken place and the land is awaiting recontouring

**Photopoint 13:**

Sited east of Photopoint 12, on a small spur that gives good views of areas of harakeke and cabbage trees at risk from willow spread. In 2004, to the NE the young willows had grown up markedly, raupo had been controlled and the harakeke looked okay. The aerial control of raupo had knocked back some willows and tussock sedges. To the S, things were as for Photopoint 11. To the SW, both raupo and willows had been controlled and there had been some careful earthworks done (formation of boat access and tracks, well-designed and practical for management).

There has been a substantial recovery in the raupo. In both lakeward and landward directions with the removal of grazing pressure. Carex species and Cyperus ustulatus persist in good health but the Harakeke remains in small pockets only amongst the Raupo on the southern edge. Cabbage trees are in good condition but are facing increasing competition from canopy closure of the willows.

*Next monitoring:*

November-December 2008; thence every second year. Photos to be repeated; recording sheets to be used.

**1.2 Aquatic vegetation***Method:*

The composition of the aquatic vegetation was assessed at three sites, chosen to represent the main parts of the lakeshore. Macroinvertebrate sampling and fish survey was done at these sites too. The site locations are marked on the map (Appendix 1) and described on the combined aquatic vegetation and macroinvertebrate recording sheets (one for each site, Appendix 3).

Sampling at each site was done by hand-pulling aquatic vegetation and "washing" it in white plastic trays for examination. The aquatic macrophytes present were identified, and their relative abundance was recorded. Macroinvertebrates were searched for in each sample (see 2.4), and their standard sensitivity scores recorded to give a measure of water quality.

*Observations:*

In 2004, the lake water level was appreciably higher than in 2001 but in 2006 it was once again slightly lower due to the prevailing dry weather conditions. That affected the way sampling could be done. Samples were generally very low in both abundance and diversity in both terms of macrophytes and macroinvertebrates. The lake was highly turbid, buffeted by very strong winds, and contained large numbers of waterfowl. All these factors are thought to have led to the reduced diversity and volume of species.

In 2001, the aquatic macrophytes were dominated by the exotic species curly pondweed (*Potamogeton crispus*), with lesser amounts of its native relatives fennel-leaved pondweed (*P. pectinatus*) and red pondweed (*P. cheesemanii*). Curly pondweed was thought to be the dominant plant in the big weed beds at the SW side of the lake. Mercer grass (*Paspalum distichum*) was prevalent on the edge of standing water. Floating plants were all natives: duckweed (*Lemna minor*), Pacific azolla (*Azolla filiculoides*), watermeal (*Wolffia australiana*) and the rare floating liverwort *Ricciocarpus natans* (see 1.4). Overall, the native submerged macrophytes had largely been displaced by the exotic species, but were still present. The floating native species were still common.

In 2004, the same suite of aquatic plants was present, but the changed water levels had affected their patterns of local abundance. All three pondweeds (*Potamogeton* spp.) were less apparent at the sampling sites. Perhaps like the large beds in the SW corner of the lake they had become submerged. The floating plants were somewhat more abundant at the sampling sites than before.

In 2006, a reduced array of species were found and those that were present were generally represented by a few individuals only. Large rafts of desiccated and decomposing aquatic vegetation were found in the embayments of the eastern shore reflecting the effect of the prevailing wind. These climatic conditions as well high

numbers of swans on the lake have potentially caused the reduction in the aquatic vegetation component. Emergent shore species have fared a little better and during the period of the survey made up the bulk of the visible aquatic plant biomass.

*Next monitoring:*

November-December 2008; thence every second year. Sampling to be repeated; recording sheets to be used.

## 1.1 Weeds

*Method:*

Weeds were searched for during the survey and monitoring of both the terrestrial and aquatic vegetation (1.1, 1.2). Their presence and impact were noted.

*Observations:*

The following terrestrial weeds are regarded in 2001 as requiring surveillance. Nothing much had changed in 2004 or 2006, and no new weeds were found.

**Crack willow (*Salix fragilis*)** and **grey or pussy willow (*Salix cinerea*)**, well established and capable of dominating the riparian vegetation right around the lakeshores; also considered aquatic weeds; should be prevented from spreading and controlled where encroaching on open water, streams and traditional access ways, but provide the only forest habitat around the lake, vital to the continued survival of several native birds (including the rare Australasian Bittern) and the only rare native plant (swamp nettle, *Urtica linearifolia*).

**Silver poplar (*Populus alba*)**, a single clump on the SW shore of the lake; capable of spreading far and wide very quickly; should be either eradicated or well contained. In 2004, providing roosts for many shags.

**Montbretia (*Crocoshia x crocosmiiflora*)**, a small patch with the silver poplar, obviously planted; capable of spreading right around the shore; should be eradicated.

**Papyrus (*Cyperus papyrus*)**, a small patch with the silver poplar and montbretia, obviously planted; possibly capable of spreading around the shore; should be eradicated.

**Blackberry (*Rubus fruticosus* agg.)**, forming patches on the margins of willow forest in various places. Not really an ecological problem; more of a nuisance.

The following aquatic weeds are regarded as requiring surveillance:

**Curly pondweed (*Potamogeton crispus*)**, common around the lake shores, forming dense beds in the SW. Has already displaced most of the native macrophytes. This was only a minor component of the system in 2006

**Hornwort (*Ceratophyllum demersum*)**, present in smallish quantities, capable of forming very dense beds.

**Purple-backed duckweed (*Spirodela punctata*)**, not detected during the surveys but could be present. Could displace the native floating species.

**Canadian pondweed (*Elodea canadensis*)**, present in the outlet channel, capable of forming very dense beds.

**Water buttercup (*Ranunculus trichophyllus*)**, present in the outlet channel, capable of forming very dense beds.

**Raupo** (*Typha orientalis*) is not considered an ecological problem at present, in fact precisely the opposite: it provides vital habitat for wetland birds, including the rare Australasian Bittern, Spotless Crake and NZ dabchick. It should be subject to limited control at traditional access ways and around the fringes.

*Next monitoring:*

November-December 2006, along with other vegetation monitoring; thence every second year.

## 1.2 Notable flora

*Method:*

Plants of note were searched for during baseline survey and subsequent monitoring.

*Observations:*

To date, two rare plants have been recorded from the wetland. The first is swamp nettle (*Urtica linearifolia*), which is present in the willow forests right around the lake. It is reasonably common, and will be informally monitored through general observation as it does not appear to be currently at risk. Photographs of swamp nettle are in the 2001 photo album.

The other rare plant is a floating liverwort, *Ricciocarpus natans*. This uncommon species is "found in swamps with a high dissolved organic content in the water" (Coffey and Clayton 1988). It has previously been recorded from Horseshoe Lake in central Hawke's Bay. In Runanga Lake at the time of baseline survey it was quite abundant in shallow water around the shoreline. Photos of it amongst duckweed and Pacific azolla are in the photo album that accompanies this report. In 2006 this plant was not noted but this reflects the general reduction in the aquatic vegetation biomass.

Should any other notable plants be detected or introduced in future, extra monitoring will be needed.

*Next monitoring:*

November-December 2008, along with other monitoring; thence every second year.

## 2. FAUNA

### 2.1 Waterbirds

#### *Method:*

Two methods were used:

1. **Directed searches**, whereby a number of sites around the lake were visited to listen and look for crakes, rails and bitterns.
2. **General fauna survey**, whereby waterbirds were searched for during other survey and monitoring activities.

#### *Observations:*

During the baseline survey in December 2001, twenty-three species of waterbirds were recorded from Runanga Lake. All except Black-fronted Dotterel were present in November 2004. The list includes NZ Dabchick (an uncommon endemic) and Australasian Bittern (a rare native). Both are listed as threatened by the Department of Conservation (Hitchmough 2002). Dabchicks were seen right around the lake, both pairs and juveniles, indicating that there is a strong resident breeding population. Bitterns were seen and heard right around the lake also, similarly indicating a strong resident breeding population. For these two species, Runanga Lake is clearly a Hawke's Bay stronghold, perhaps in conjunction with nearby Oingo Lake and an array of smaller wetlands. Two other birds listed as nationally threatened use the lake in small numbers: Little Black Shag and Black-billed Gull. Spotless Crake, a regionally rare wetland bird and hard to detect, could also be present. The dense raupo, backed by willow forest, whilst not good for recreational hunters, seems to suit these rare birds well.

The other wetland birds included swans, ducks (including NZ Shoveler and NZ Scaup), shelducks, shags, herons, Pukeko, Australasian Harrier, Welcome Swallow, Spur-winged Plover, Pied Stilt, Black-fronted Dotterel and gulls. The swans, ducks, shelducks and Pukeko are seasonally hunted in the wetland. Although it is the nature of waterbirds to be somewhat shy, they are quite wary, suggesting that hunting is making it difficult for them to feed, roost and breed in safety.

The full list of birds detected in November 2006 and their estimated numbers is in Appendix 4. Of the native species, there were fewer shags and ducks in 2004, perhaps reflecting the seasonal difference of a month between the two monitoring visits. There were far more swans though ("too many" according to a couple of landowners spoken to) and more domestic geese. Canada Goose had made a solitary appearance. In 2006 the swan numbers appear to be still on the increase and are by far the most abundant bird species on the lake. Duck numbers are also very high and feral geese numbers are over 50.

#### *Next monitoring:*

November-December 2008; thence every second year.

## 2.2 Other birds

### *Method:*

General fauna survey, whereby birds other than waterbirds were searched for during other survey and monitoring activities.

### *Observations:*

In 2001, twenty-one other species of birds were recorded at the lake. Five are common natives and include Shining Cuckoo, which was not detected in 2004. The remainder are common introduced species typical of the Hawke's Bay rural scene. The full list of birds detected in November 2006 and their estimated numbers is in Appendix 4. Bird names are according to Heather and Robertson (1996). Recorded bird numbers are artificially low in the 2006 sampling season due to the extremely windy weather resulting in less bird movement and calling.

### *Next monitoring:*

November-December 2008; thence every second year.

## 2.3 Fish

### *Method:*

Runanga Lake is regionally significant for native freshwater fish, and is a traditional harvesting site for eels at least. At the time of the baseline survey, Longfin Eel, Shortfin Eel and Common Bully, all natives, had been previously recorded from the lake. Common names are according to McDowall (2000). In 2001 fish were surveyed largely using netting and trapping. Fyke nets, hinaki and minnow traps were set overnight at the three aquatic sampling sites (for locations, see map, Appendix 1, and aquatic vegetation and macroinvertebrate recording sheets, Appendix 3). Meat was used as bait in the fyke nets and hinaki; vegemite in perforated film canisters was used as bait in the minnow traps. Fish were also observed in open water sites and caught for identification using a scoop net. In 2004, minnow traps were set only. This was because Alan Gregory, a commercial eel fisherman, was operating in the lake during the monitoring visit. From him I gained tremendous insight into the freshwater fish of the lake, particularly the eels. It was a thrill to spend time with someone so knowledgeable and passionate about eels, and a rare treat to encounter a fisherman not intent on strip-mining the resource.

Due to the extreme turbidity of the Lake in 2006 the monitoring of fish was limited to setting of nets with some limited success using spotlighting. Large numbers of the common bully *Gobiomorphus cotidianus* were caught using minnow traps and Long and short finned eels were noted during spotlighting searches on the lake.

### *Observations:*

The fish detected during the baseline survey and subsequent monitoring were:

- Shortfin eel (*Anguilla australis*). Only small eels (less than 60cm long) caught in 2001; in 2004 numerous eels of a great range of size classes shown to me by the commercial fisherman. For the last few years he has assiduously worked at increasing both the population and the size structure by deliberately releasing or not catching larger eels and not taking the little ones at all. He has also

systematically caught large Goldfish (see below), because they are a threat to young eels. He told me that small eels burrow into soft material if possible and can even get into bird plumage and be transported from wetland to wetland!

- Common bully (*Gobiomorphus cotidianus*). Very common, seen and caught at various places, mostly 2-5cm long but plenty of juveniles. In 2004 jet-black males were seen around rocks, splendid in their territorial breeding colouration.
- Goldfish (*Carassius auratus*). Erroneously known as carp (McDowall 2000); introduced to New Zealand. A large population in the lake, with big fat adults (see photos in the 2004 album that accompanies this report) and shoals of juveniles in the shallows. The adults apparently out-compete and predate upon eels if uncontrolled, but the juveniles are good eel food.

Not recorded during the survey were:

- Longfin eel (*Anguilla dieffenbachii*). Reported as present in the lake in 2004 by Alan Gregory (commercial eeler), but in fairly low numbers as this species prefers cooler water. Known to be in serious decline in the North Island because of uncontrolled commercial harvesting.
- Spotted eel (*Anguilla reinhardtii*). Mostly occurs in Australia, but present in low numbers in New Zealand. Alan Gregory has caught a few in the lake.
- Koi carp (*Cyprinus carpio*). Introduced to New Zealand; anecdotal reports from the lake; probably not present but mistaken for Goldfish.

*Next monitoring:*

November-December 2006; thence every second year.

## 2.4 Aquatic invertebrates

*Method:*

Macroinvertebrates (invertebrates big enough to see with the naked eye) were sampled along with aquatic vegetation at three representative sites (see 1.2 and 2.3; locations marked on the map, Appendix 1, and described in the aquatic vegetation and macroinvertebrate recording sheets, Appendix 3). Aquatic vegetation samples were gathered by hand, and "washed" into trays to dislodge invertebrates. Water and substrate (mud, etc.) samples were also gathered and examined with the use of trays and a hand lens. Invertebrates were identified using the Taranaki Regional Council guidebook (1997) and Parkinson and Cox (1990). Sensitivity scores, indicative of water quality, were assigned from the Taranaki Regional Council guidebook (1997) and subsequent updates. Species found and their scores are listed in the aquatic vegetation and macroinvertebrate recording sheets (Appendix 3).

*Observations:*

In all three sites, the invertebrates found had sensitivity scores ranging from 1 (very low water quality) to 5 (moderate water quality; 10 is very high water quality). The ranges and averages of the scores are tabulated below. They show that at none of the sites was the water of particularly good quality, although it should be pointed out that the scores are primarily for streams rather than still bodies of water such as lakes. The

number of species found was similar to that of 2004 with a slight reduction in site 1 being balanced with an increase at site 3.

	Number of species found		Range of sensitivity scores	
	2004	2006	2004	2006
Site 1	11	10	1-5	1-5
Site 2	9	9	1-5	1-5
Site 3	8	9	1-5	1-5

Kakahi or freshwater mussels (*Hyridella*) were formerly present on the eastern side of the lake (Dick Thompson, pers. com.). They may still be present. In the outlet stream above the road bridge koura (freshwater crayfish, *Paranephrops*) were caught during the baseline survey, and in the stream just to the SW of the lake both koura and freshwater shrimps (*Paratya*) were caught.

*Next monitoring:*

November-December 2006; thence every second year. Sampling to be repeated; recording sheets to be used.

## 2.5 Mammalian pests

*Method:*

General fauna survey, whereby signs of mammalian pests were searched for during other survey and monitoring activities.

*Observations:*

Nine mammals that can be regarded as pests in the wetland were detected during baseline survey and monitoring set-up (see below). They were all confirmed as still present in 2006.

- Domestic goats: at the NE end.
- Domestic red deer, cattle and sheep: largely fenced out of the lake now, but still unimpeded in places.
- Rabbit: present around the margins in low numbers.
- Hare: present around the margins in moderate numbers.
- Possum: present around the lake margins, in moderate numbers especially in the willow forests
- Hedgehog: present around the lake margins.
- Feral cat: present around the lake margins; being actively controlled in places.

Other mammalian pests probably present but not detected include:

- Ship rat and Norway rat: known predators of birds, lizards and invertebrates.
- Mouse: known predator of invertebrates.
- Stoat, ferret and weasel: known predators of birds, lizards and invertebrates; good swimmers. Ferrets were reported as being present by landowner Dick Thompson.

*Next monitoring:*

November-December 2006; thence every second year.

## **2.6 Terrestrial invertebrates**

Not deliberately surveyed or included in the monitoring plan, but worthy of attention during general survey. No noteworthy species were detected in December 2001 or November 2004.

## **2.7 Reptiles and amphibians**

Also not deliberately surveyed or included in the monitoring plan, but worthy of attention during general survey. However, frogs were heard croaking and were seen fleetingly at various points around the lake in December 2001. They were probably the southern bell frog (*Litoria raniformis*), native to Australia and reasonably widespread in New Zealand. They were not detected in November 2004. Frogs have rapidly declined recently world-wide (and in New Zealand) through fungal disease. The frogs are not regarded as having a significant adverse impact on the natural ecology of the lake.

*Next monitoring:*

General observation, November-December 2006; thence every second year.

## CONCLUSIONS AND RECOMMENDATIONS

The monitoring regime has allowed a series of conclusions to be drawn about various aspects of the ecological condition and trend of Runanga Lake, and the efficacy of management. Out of these conclusions flow a consequent series of recommendations. They build on those from the 2002 baseline survey but are essentially similar.

### 1. Fencing and native vegetation restoration

The fencing that has been carried out so far by individual landowners has been successful in excluding domestic stock from various parts of the lake. The result has been improvement in the condition and much regeneration of the native wetland vegetation around the lake margins there, especially raupo, sedges and rushes. There has also been a proliferation of exotic (introduced) vegetation that was otherwise controlled, to varying degrees, by stock. Willows are among the chief beneficiaries, exacerbating problems for restoration of the native vegetation. Exotic wetland grasses, particularly creeping bent, swamp millet and Mercer grass, have also proliferated.

The rest of the lake (about two-thirds of its shoreline) is not fenced from stock, or is managed with a grazing regime. Several properties make up this portion. Managing the lake margins in such complex ownership is not straightforward. The involvement of the Regional Council seems not to be looked on particularly favourably by the landowners at present, but the Council could offer coordination and active assistance if asked.

Because the native vegetation has become so depleted around the lake and in the surrounding landscape, deliberate planting will be necessary to create a dominant and self-perpetuating cover of native vegetation for the future. The Regional Council could usefully provide guidance and assistance in this restoration initiative as well if asked.

*Recommendation: That the Regional Council assists in maintaining existing fences in stock-proof condition and that assistance to fence other parts of the lake margin be offered to owners if requested.*

*Recommendation: That the Regional Council encourages the planting of native plants in the areas of former pasture from which stock are excluded if asked, and that willows be controlled to allow this (see below).*

### 2. Willow control

Without control, grey (pussy) and crack willows will quite rapidly come to dominate the entire lake surrounds. However, the old forest of willows at each end of the lake is vital in providing habitat for swamp nettle and a number of native birds, and mimics the function of the former native forests that would have fringed the lake in the past. Those willows therefore should not be cleared before native forest vegetation is ready to replace them. With that in mind, control of the willows but not eradication is preferable at this stage. Prevention of their spread is the greatest priority.

Willows are rapidly proliferating in places. Control is desirable before the task becomes great. The Regional Council could provide useful assistance in that regard. Aerial herbicide application is not necessary or desirable at Runanga Lake. It would be too crude and ecologically rough for such a wetland, and there would be consequent loss of much of the

raupo beds and tree cover that are so valuable as habitat for birds. Ground-based and boat-based control (cutting and poisoning) should achieve the desired ecological outcomes without the same costs.

*Recommendation: That willow control be confined at present to the younger growth spreading out from the old stands, and that if the older willows are cleared, that is done in modest stages with the ground they vacate being replanted in appropriate native trees and other wetland margin plants.*

*Recommendation: That ground and boat-based control methods be used to kill existing young willows and prevent their reinvasion.*

### **3. Water levels, flows and aquatic vegetation**

The water level of the lake has been lowered in the past by artificially channelling the outlet channel, much against the wishes of the tangata whenua and other owners. This lake is now more shallow than it was naturally, rendering it vulnerable as an ecologically healthy wetland. In 2001 it was suggested that restoration of higher water levels, even by a modest amount, would substantially improve the ecological status of the lake. The topic was subsequently discussed between the landowners and Regional Council, but the Council's advice was that raising the level would be too costly. In frustration, the landowners decided to do it themselves, and in 2004 the water level in the lake had been raised about 50cm by simple blockage of the outlet drain. As a consequence, the lake was significantly healthier ecologically. The landowners state that the lake used to be about a metre higher still and they would like to see the water level restored.

*Recommendation: That the issue of restored lake water levels be kept on the agenda for discussion between the Regional Council and the Runanga landowners.*

### **4. Weeds**

There are some terrestrial weeds present, and a few aquatic ones. Of greatest concern are grey and crack willows (see 2. above), and hornwort (which would be difficult to control). Water net poses a serious potential threat to this shallow lake, and could easily arrive. Commercial eel fishing is the most likely potential source of introducing it to the lake. Potentially troublesome terrestrial arrivals could be vines such as Japanese honeysuckle. They should be controlled as soon as they are detected.

*Recommendation: That great care be taken with commercial eeling activities to ensure that water net and other aquatic weeds are not transported to Runanga Lake.*

*Recommendation: That Japanese honeysuckle and other such newly arrived weeds be controlled wherever found in the wetland.*

### **5. Notable flora**

Swamp nettle (*Urtica linearifolia*) is the only known rare terrestrial plant in the wetland. It is currently flourishing and is fairly widespread on the western side of the lake. Willow forests seem to provide the habitat this plant requires currently, mimicking the role played by the native forest fringe in the past. The rare floating liverwort *Ricciocarpus natans* is currently quite common around the lake shores. It does not seem to require management, just monitoring.

*Recommendation: That swamp nettle continues to be monitored, and that the older willow forest be retained for the interim to ensure there is habitat for the nettle.*

*Recommendation: That the floating liverwort Ricciocarpus natans continues to be monitored, via the aquatic sampling sites.*

## **6. Water birds**

The variety and numbers of water birds appear to be holding their own at present. Two nationally threatened species - Australasian Bittern and NZ Dabchick – are resident at the lake in good numbers. In fact, Runanga Lake holds possibly the best breeding populations of them in Hawke's Bay, and it is one of the most accessible sites to listen or watch for this bird. Two other nationally threatened species – Little Black Shag and Black-billed Gull – use the lake in low numbers. It is not known whether spotless crane, banded rail or marsh crane might still persist; they are notoriously hard to detect, especially after the breeding season. A specific search by experts in spring might reveal these birds. The continued hunting of waterfowl seems somewhat at odds with the restoration of a natural wetland. However, since the hunters are the prime users, managers and observers of the wetland at present it would be better to incorporate their energies and insights into restoration management rather than alienating them.

*Recommendation: That the populations of Australasian Bittern, NZ Dabchick, Little Black Shag and Black-billed Gull be regularly monitored.*

*Recommendation: That a specific search be mounted in spring for Spotless Crane, Banded Rail and Marsh Crane, using local Department of Conservation and Ornithological Society expertise.*

## **7. Land birds**

Land birds use the wetland in considerable numbers. Most are exotic (introduced) species, but a few are natives.

*Recommendation: That land birds continue to be monitored routinely.*

## **8. Fish**

The wetland has clearly been depleted in terms of its native fish fauna in the past. Common bullies are still abundant, but no galaxiid (whitebait) fish species appear to be currently present. Eels were until recently in fairly low numbers and there appeared to be few large ones left. It is therefore tremendously gratifying to observe at first hand the restoration of the Shortfin Eel population through the conscientious efforts of a commercial eel fisherman, working in collaboration with the main landowner. Part of the restoration of this native fish population has been brought about through control of exotic Goldfish.

*Recommendation: That the practice of commercial eeling in Runanga Lake be held up as an example of excellent management for the restoration of a wild eel population whilst providing for a sustainable harvest.*

## **9. Aquatic invertebrates and water quality**

Aquatic macroinvertebrates provide a useful measure of water quality and habitat condition. They indicate that the lake can support a considerable diversity of small animal life, but that the water quality is compromised by shallowness of water and by artificial nutrient input. There are limitations to the technique though, because it was primarily developed for stream systems, and other measures of water quality are necessary for comprehensive monitoring of condition and trend. The Ecological Monitoring Plan for Runanga Lake (Walls 2002a) proposes regular (monthly or quarterly) sampling of standard parameters. These included pH, conductivity, turbidity, colour absorbances, biochemical oxygen demand, dissolved reactive phosphorus, ammoniacal-nitrogen, nitrate-nitrogen, total phosphorus and total nitrogen. The draft management plan commissioned by the Council (Lake Runanga Draft Management Plan 2001-2006) also suggests such monitoring.

*Recommendation: That aquatic macroinvertebrate monitoring continues.*

*Recommendation: That monitoring of other standard water quality parameters be seriously considered.*

### **10. Mammal pests**

Herbivorous mammal pests are not now much of a problem in the wetland, but they are a limitation on restoration of native vegetation. Domestic stock have been partly excluded by fencing, but are present elsewhere. The main mammal threats otherwise are from possums and predators (cats, ferrets, stoats, weasels and rats). Particularly in view of the presence of a resident population of Australasian Bittern and NZ Dabchick, restoration management plans should include active on-going control of these pests. The readily accessible nature of the wetland lends itself to the maintenance of a system of traps and bait stations. Some landowners are actively controlling possums and feral cats. The Regional Council could possibly help with advice and resources.

*Recommendation: That the landowners be encouraged to run an active on-going programme of possum and mammal predator control for the wetland, with assistance from the Regional Council.*

### **11. Frogs**

Southern bell frogs were conspicuous in the wetland in 2001 but not so in 2004. Whilst this species is native to Australia, not New Zealand, its presence is welcome in the light of major frog declines world-wide. Until proven otherwise, this frog is not considered an ecological threat to the wetland.

*Recommendation: That the presence and relative abundance of frogs be monitored in the wetland.*

### **12. State of the Environment (SOE) monitoring and reporting**

Parameters used in this monitoring regime are directly applicable to State of the Environment (SOE) monitoring and reporting. Using a basic assessment of status (or condition) and trend for each parameter, they can be used as environmental indicators, and an overall condition and trend rating for the wetland as at November 2004 can be arrived at. It is demonstrated in the table below.

The conclusion is that the wetland is in a moderately natural state and is stable-to-improving overall at this stage. Some facets have significantly improved since 2001, notably water levels and native fish. It is expected that restoration management will produce continued improvement in status/condition in future.

Indicator	Status/Condition (High, Medium, Low)	Trend (Improving, Stable, Deteriorating)
Native vegetation	L	S
Native flora	L-M	S
Native birds	M-H	S
Native fish	M	I
Native macroinvertebrates	M	S
Water levels	M	I
Water flows	L-M	S
Water quality parameters	?	?
<b>Overall ecology</b>	<b>M</b>	<b>S-I</b>

*Recommendation: That a similar tabulation of ecological condition and trend be used as part of the regular monitoring reporting for the wetland.*

### 13. Monitoring techniques and frequency

In the light of seven years' experience in Pekapeka Swamp and other wetlands in Hawke's Bay, the suite of techniques being used to monitor the ecological condition and trend of Runanga Lake appears to be appropriate and valuable. The only issues are the difficulty of detecting rare water birds (see 6.) and the lack of monitoring of water quality parameters (see 4 and 9 above). In view of the relative stability of the wetland but some pressing management needs, monitoring at two-yearly intervals seems sensible. The interval of three years between baseline survey and the subsequent monitoring has been just a little long to be able to interpret some of the changes.

*Recommendation: That the current ecological monitoring programme be continued, repeated at two-yearly intervals.*

### 14. Information for and relationship with landowners

In November 2004, the landowners contacted were very helpful and interested in the ecological monitoring. More than one expressed the wish to obtain personal copies of the 2002 monitoring plan, the 2002 baseline survey and monitoring report and the 2004 monitoring report. This seems both appropriate and reasonable, given that the lake is entirely privately owned. The Regional Council would engender much goodwill by supplying the landowners with the reports.

*Recommendation: That the Regional Council sends copies of the monitoring reports to the landowners.*

## **ACKNOWLEDGEMENTS**

For their help, interest and support in the 2004 monitoring work, my particular thanks go to:

Landowners Bruce Carswell, Alan, Sue and Bernie Gunn, Dudley Hammond, Stuart Harper and Dick Thompson; Alan Gregory (commercial eel fisherman); Anna Madarasz, Sara Gerard, Graham Sevicke-Jones and Garth Eyles of Hawke's Bay Regional Council, Napier; Hans Rook, Alan Lee and John Adams of the Department of Conservation, Napier; Taranaki Regional Council (freshwater invertebrates guide); Marie Taylor and Richard Croad, Bay View; Sue Scheele and Finn Scheele, Christchurch.

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## **APPENDIX 1: Vegetation map of Runanga Lake; Vegetation types and monitoring site locations, November 2004**

### **Vegetation types**

- W** Willows dominant
- R** Raupo dominant
- H** Harakeke dominant
- P** Pasture (both grazed and rank)
- O** Open water

### **Monitoring sites**

- Photopoints
- Aquatic sampling sites

**APPENDIX 2: Photopoint recording sheets, November 2004**

- Photopoint no. 1
- Photopoint no. 2
- Photopoint no. 3
- Photopoint no. 4
- Photopoint no. 5
- Photopoint no. 6
- Photopoint no. 7
- Photopoint no. 8
- Photopoint no. 9
- Photopoint no. 10
- Photopoint no. 11
- Photopoint no. 12
- Photopoint no. 13

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 1
<b>Establishment date:</b> 11/12/01		<b>Grid reference:</b> V21/E2828875;N6173541
		<b>Observer/Photographer:</b> Geoff Walls
<b>Photopoint relocation notes:</b>		
Access road to lake edge, then straight up hill behind to near top. Close to rocks. Tag on deer fence to N.		
<b>Direction from marker/post (magnetic bearing):</b> 5-photo panorama, S-W-N		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b>		
Chosen because of a splendid vantage point from which to follow changes in patterns of raupo, willows and sedges around the lake shore. Also, there are cabbage trees and harakeke on the N side of the small bay here.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	Quite a lot of change in 3 years. Water level noticeably higher than in 2001. Weed bed (macrophytes) on opposite shore no longer visible. Raupo has been aerial herbicided on various outer edges, so substantially knocked back there, but has been allowed to regenerate in places. A raupo "island" has arrived in the bay, having floated across from the opposite shore in windy conditions. Young willows have grown noticeably.
18/11/06	Andrew Lamason	No Macrophytes can be seen, The raupo island has joined the main body of reeds. Young willows are establishing on the new Raupo edge, whilst others have thickened noticeably. Cabbage trees and harakeke on the point are less distinct as they are becoming consumed by the willow growth. The water is a very sickly green, possibly in a state of bloom. No azolla or other floating aquatics are present. The raupo has largely recovered from spraying with young willows establishing in the old spray zones.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 2
<b>Establishment date:</b> 11/12/01		<b>Grid reference:</b> V21/E2828744;N6173584
<b>Photopoint relocation notes:</b> Access road to lake edge, where meets lake. A small turning bay here, and a tag on a small post. Also Aquatic Sample Site 1.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 3 photos taken		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen to follow the fate of the cabbage trees and harakeke on the N side of the small bay here, being swamped by grey willows. Also to follow the raupo patterns here, where it is kept at bay deliberately. Some artificially bared wet muddy flats favoured by waders and waterfowl.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	Biggest changes are in the water level (considerably higher now) and in the raupo fringe (has grown/regenerated in places and has been removed elsewhere). Demonstrates the rapidity with which raupo can expand in a shallow lake and also the effects of management.
18/11/06	Andrew Lamason	Raupo continues to thicken except at the photopoint position where it is manually cleared and grazed. Willows continue to increase in size and cover. The cabbage trees on the peninsula are in good health. The cabbage tree on the spur behind the photopoint has died and fallen

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 3
<b>Establishment date:</b> 11/12/01		<b>Grid reference:</b> V21/E2828824;N6173232
<b>Photopoint relocation notes:</b> On S boundary of Alan Gunn's land, 7 <sup>th</sup> post uphill from bottom strainer on fenceline. Tag on post.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 5-photo panorama, S-W-N		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen to complement Photopoints 1 & 2 and to provide more detail on the processes of raupo advance, willow invasion (taking place within the raupo) and results of willow and raupo control hereabouts. Some artificially bared wet muddy flats favoured by waders and waterfowl.		
<b>REPHTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	Water level higher. Young willows have grown noticeably. Raupo has been herbicided around outer margins and has diminished in bulk except towards the bay to the north. It is being prevented from expanding landwards by deliberate grazing. Fencing is not required here, especially since the water level is likely to be raised further, allowing the raupo to expand landwards a little. Shags roosting in silver poplar opposite.
18/11/06	Andrew Lamason	No shags were present in silver poplar, no azolla and little lemma minor were noted either. Willow on the edges is very healthy and there is no raupo die back is evident. There has been some spraying of the lakeward edge of the raupo. The water appears to be only slightly lower than previous. No wading birds present.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 4
<b>Establishment date:</b> 11/12/01		<b>Grid reference:</b> V21/E2828558;N6174293
<b>Photopoint relocation notes:</b>		
On a small spur near Alan Gunn's N boundary fence, c. 30m S of the fence. Tag on 9 <sup>th</sup> fencepost uphill from the big bottom strainer.		
<b>Direction from marker/post (magnetic bearing):</b> 6-photo panorama, S-W-N		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b>		
Chosen to follow the same processes as in the 3 previous photopoints, but to the N of them. Willows expected to be invading raupo; raupo spreading into lake; raupo expected to thicken and spread landwards if fenced from stock; sedges and rushes expected to also increase.		
<b>REPHTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	As for Photopoints 1-3. Young willows have grown, and have colonised in places. Where not controlled, raupo has expanded or thickened. Substantial raupo control has been done on the western and NW side of the lake, the large expanses having been knocked back in a major way. Still plenty of raupo habitat remaining though.
18/11/06	Andrew Lamason	No raupo in small bay between the toe of the spur and the willows to the south. elsewhere the raupo has regrown a little after being knocked back by spraying Young willows are showing signs of grazing pressure. Pasture continues to the lakes edge as cattle grazing has removed all sedges etc.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 5
<b>Establishment date:</b> 11/12/01		<b>Grid reference:</b> V21/E2828828;N6172865
<b>Photopoint relocation notes:</b> On N boundary of S. Harper's property, atop the 'peneplain' (the top of the rise). Tag on fencepost.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 6-photo panorama, S-W-N		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen to follow the patterns and processes involving the expansive willow forest and big raupo beds at the S end of the lake. Raupo possibly moving out into lake; willows possibly invading raupo. Control of both in some form is planned.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	Willow forest essentially as in 2001 (though cabbage trees more visible as in flower). Young willows have grown noticeably and have spread somewhat. Raupo has expanded where not controlled, and with the elevated water level has broken up in places, floating chunks having been blown away from the main mass. Localised recent aerial control of the raupo. The former great mass of macrophytes (weed bed) on the other side not now visible.
18/11/06	Andrew Lamason	Cabbage trees are healthy but are becoming indistinct amongst the willow forest. The raupo continues to expand lakeward, with no evidence of previously sprayed zones. The willow forest is in good health with those previously defoliated trees showing signs of complete recovery. Macrophyte beds are no longer visible.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 6, 6a
		<b>Grid reference:</b> 6 V21/E2828280;N6172373 6a V21/E2828468;N6172432
<b>Establishment date:</b> 12/12/01		<b>Observer/Photographer:</b> Geoff Walls
<b>Photopoint relocation notes:</b> 6: high on the spur that runs into the SW corner of the lake, at the fenceline that crosses it. Tag on fencepost. 6a: on the 1 <sup>st</sup> knoll at the bottom of the spur, 35m uphill from the bend in the access road. No post or tag. <b>Direction from marker/post (magnetic bearing):</b> 6: 6-photo pan, N-E-S; 6a: 7-photo pan <b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Another perspective on the S end of the lake. Willows apparently invading raupo; raupo apparently advancing into lake a bit each year. Willows may be controlled in future. Many cabbage trees and much <i>Carex secta</i> beneath willows; some harakeke in SW corner. 6a is a closer view; 6 is more extensive.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	As Photopoint 5. Lake level higher now. Raupo has expanded where not controlled, especially near the lake outlet. It has also broken up in places due to the higher water and wind. Young willows have invaded and grown noticeably.
18/11/06	Andrew Lamason	As above. Water level appears a little lower. No spray damage is evident amongst raupo and willows are largely recovered. Raupo is extending into the lake with the island of 2004 now incorporated into the main mass of raupo.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 7
<b>Establishment date:</b> 12/12/01		<b>Grid reference:</b> V21/E2828399;N6173362
<b>Photopoint relocation notes:</b> On fenceline just past end of access track; 14 <sup>th</sup> post past galvanised gate.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 7-photo panorama, NE-E-S-SW		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Usual combination of willows and raupo. On near shore, a narrow fringe of raupo; on the far shore, little willow. A big clump of silver poplar at an old maimai site in 6 <sup>th</sup> photo, a potentially serious weed problem. Papyrus and montbretia planted at same site.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
15/11/04	Geoff Walls	The largest visible change is where raupo has been killed. Otherwise, willows have continued to grow. The macrophyte bed is no longer visible (elevated water level). Many shags using the silver poplar clump for roosting, so maybe not such a problem! Stock are currently kept out of the lake hereabouts by electric fencing.
18/11/06	Andrew Lamason	No shags were noted in the Silver Poplar clump at present. No macrophytes are visible in the lake whilst the raupo continues to expand into the lake. Areas that have ben sprayed have nearly fully recovered, but at a slightly lower stature. The site is no longer protected by electric fencing and as such is being lightly grazed.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 8
<b>Establishment date:</b> 13/12/01		<b>Grid reference:</b> V21/E2828970;N6175226
<b>Photopoint relocation notes:</b>		<b>Observer/Photographer:</b> Geoff Walls
<p>Access track through Dick Thompson's land, past hayshed and around towards lake (E flank). Tag on 10<sup>th</sup> post towards lake from gate in fence; photopoint is on small promontory c. 20m to the south.</p> <p><b>Direction from marker/post (magnetic bearing):</b> 4-photo panorama, S-W-NW</p> <p><b>Camera info (lens, film, etc):</b> 50mm, 200asa colour</p>		
<p><b>Vegetation (composition, structure, patterns, processes):</b>          Chosen to examine willow forest and raupo expanses. Willows appear to be invading raupo and raupo appears to be advancing into lake.</p>		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
16/11/04	Geoff Walls	5 photos taken: an extra one to the N, where the edge of willows has been cleared, cabbage trees left and ponds created. In the main panorama, some willows have been controlled. Raupo has probably continued to advance into the lake except where controlled. Willows are showing some advance into the raupo.
18/11/06	Andrew Lamason	Willows and Raupo are not showing any signs of spraying operations. The small ponds where willows have been removed are being re-colonised by willows re-sprouting from amongst the remaining slash. Floating aquatic weeds are present in greater numbers in this area than in the main body of the Lake.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 9
<b>Establishment date:</b> 13/12/01		<b>Grid reference:</b> V21/E2829119;N6175121
		<b>Observer/Photographer:</b> Geoff Walls
<b>Photopoint relocation notes:</b> Top of hill to E of Photopoint 8 (ie top of 1st hill through gate at fence). No tag.		
<b>Direction from marker/post (magnetic bearing):</b> 4-photo panorama @50mm; 3-photo pan @28mm, S-NW		
Camera info (lens, film, etc): 50mm, 28mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen to examine willow forest and raupo expanses. Willows appear to be invading raupo and raupo appears to be advancing into lake.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
16/11/04	Geoff Walls	Only the 28mm panorama taken. Willows invading raupo; raupo advancing into the lake (except where controlled). Raupo control has been major on the opposite shore, but willows have not been controlled there. There has been some willow control on the near shore, and now the elevated water shows behind the fringing vegetation.
18/11/06	Andrew Lamason	Willows and raupo have generally expanded to their pre-spray extent. Raupo is possibly a little lower in stature but is otherwise in good health.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 10
<b>Establishment date:</b> 13/12/01		<b>Grid reference:</b> V21/E2829065;N6174700
<b>Photopoint relocation notes:</b> High on knoll near boundary fence. Tag on fence post. Similar site to Photopoint 9, but not quite so high.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 4-photo panorama, SW-N Camera info (lens, film, etc): 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen as a complement to Photopoints 8 & 9, to examine willow forest and raupo expanses. Willows appear to be invading raupo and raupo appears to be advancing into lake.		
<b>REPHTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
16/11/04	Geoff Walls	As for Photopoints 8 & 9. Young willows starting to proliferate in places.
18/11/06	Andrew Lamason	Willows are similar to their 2004 extent with no signs of dieback. Raupo has re-established too at least the 2004 levels on the island in the inflow delta, but has only had a patchy recovery on the point to the north. Clumps have re-sprouted from remnants of the 2004 extent in the main body of the lake. No floating aquatics are present. Many birds are congregating in this portion of the lake to escape the worst of the prevailing winds and chop.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 11
<b>Establishment date:</b> 13/12/01		<b>Grid reference:</b> V21/E2827957;N6174252
<b>Photopoint relocation notes:</b> Access via Hammond's road and down spur to the house, then beyond down to the lake edge alongside the deep bay. No post or tag at site; spreading macrocarpa tree c. 20m to SW.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 5-photo panorama of bay and main S arm of lake; 2 more photos taken from 10m to N, looking N		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Dense beds of raupo all around shore, also some raupo islands. Willow patch in head of bay and scattered willows elsewhere. Some cabbage trees. Willows undoubtedly invading raupo; raupo expanding.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
16/11/04	Geoff Walls	Major changes: elevated water level; major raupo control from the air (in future it will be done by boat, keeping the edges pinned back); continued growth in willows. But willow control has been done nearby, with the intention of steadily replacing them with native plants (for birds, aesthetics, etc).
18/11/06	Andrew Lamason	As above. Willows continue to advance into the lake amongst the raupo. Raupo has been pinned back to a small degree from the water. Some replanting of exotic and introduced shrubs has taken place but they appear to be struggling.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 12
<b>Establishment date:</b> 13/12/01		<b>Grid reference:</b> V21/E2827654;N6174510
<b>Photopoint relocation notes:</b> Access via Hammond's road and down towards the house. Photopoint is c.200m W of house, from the spur just on the lake side of a small knoll. No post or tag at site.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 3-photo pan to S; 2-photo pan to NE		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour (80mm for one manuka photo)		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen to follow fate of manuka (remnant shrubs) amongst raupo and rank pasture on swampy flat behind bay. Stock fenced out of manuka. Also to follow raupo thickening and willow spread on both swampy flats where stock is now fenced out. Willow may be controlled hereabouts, and a QEII Covenant is in prospect.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
16/11/04	Geoff Walls	The manuka still exists, as does the raupo. Some willow control and pond development has been done either side of the spur. Pied stilts using the ponds. To the N, much as previously. It is fenced there and has potential formal protection as a QEII Open Space Covenant, though occasional cattle and horses use the area.
18/11/06	Andrew Lamason	No waders present. Less than 10 manuka are evident amongst the raupo. Some earthworks/stump removal has taken place. Silver birch ahs been planted in recently cleared areas near the small pond. Several pheasants were seen in the area adjacent to the stump clearance.

## PHOTOPOINT RECORDING SHEET

<b>Location/Area:</b> Runanga Lake		<b>Photopoint no:</b> 13
<b>Establishment date:</b> 13/12/01		<b>Grid reference:</b> V21/E2828036;N6174585
<b>Photopoint relocation notes:</b> N of Photopoint 11, in Bruce Carswell's land. Atop a distinct knoll just on N side of fairly deep bay.		<b>Observer/Photographer:</b> Geoff Walls
<b>Direction from marker/post (magnetic bearing):</b> 4 photos; 2 to NE (pan), 2 to S,SW		
<b>Camera info (lens, film, etc):</b> 50mm, 200asa colour		
<b>Vegetation (composition, structure, patterns, processes):</b> Chosen to follow fate of harakeke especially, also cabbage trees, in the face of willow advance. Raupo will probably thicken if not grazed. Many sedges ( <i>Carex secta</i> , etc.). Swamp nettle is present here.		
<b>REPHOTOGRAPHY DETAILS:</b>		
<b>Date</b>	<b>Observer/ Photographer</b>	<b>Comments (changes, processes, etc)</b>
16/11/04	Geoff Walls	To the NE, young willows have grown up markedly, raupo has been controlled and the harakeke looks okay. The aerial control of raupo has knocked some willows and some tussock sedges back. To the S, as for Photopoint 11. To the SW, both raupo and willows have been controlled and there have been some earthworks (formation of boat access and tracks, well-designed and practical for management).
18/11/06	Andrew Lamason	Substantial recovery of the raupo in both lakeward and landward directions. Willows are recovering following spraying. <i>Carex</i> spp and umbrella sedges are all in good health with no signs of grazing pressure. The Harakeke is being reduced in extent and health by encroaching willows and will soon be shaded out without intervention. Raupo and willow on the southern edge are both in good health but are facing severe competition from invading willows.

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### **APPENDIX 3: Aquatic vegetation and macroinvertebrate recording sheets, November 2004**

- Site no. 1
- Site no. 2
- Site no. 3

AQUATIC VEGETATION AND MACROINVERTEBRATE  
RECORDING SHEET

<b>Location/Area:</b> Runanga Lake	<b>Site no:</b> 1
<b>Establishment date:</b> 11/12/01	<b>Grid reference:</b> V21/E2828744;N6173584
<b>Observer:</b> Geoff Walls	
<b>Site notes (location details, vegetation, etc):</b> E side of lake in small bay at end of access road. Also Photopoint 2. Fringe of raupo and willows, with some harakeke, cabbage trees and <i>Carex secta</i> in the vicinity. Tag on small post on water's edge.	
<b>SAMPLING DETAILS</b>	
Date: 15/11/06	Observer: Andrew Lamason
<b>Sampling methods/notes:</b> <b>Tray and handlens; samples taken from water's edge</b>	
<b>AQUATIC VEGETATION PRESENT</b>	
<b>Species</b>	<b>Relative abundance*</b>
	2004      2006
Potamogeton crispus	M      S
Potamogeton cheesemanii	S      -
Potamogeton pectinatus	S      -
Lemna minor	M      S
Azolla filiculoides	M      S
Mercer grass	S      S
Water forget-me-not	S      -
Raupo	S      M
Ricciocarpus natans	S      -
Myriophyllum triphyllum	S      -
Water pepper	S      S
<b>* estimated % or: a = absent u = uncommon/rare s = some m = much</b>	

MACROINVERTEBRATES PRESENT		COMMENTS		
Species	SENSITIVITY SCORE (1-10)	2004	2006	
Copepod	5	P	P	
Xanthocnemis damselfly larva	5	P	P	
Dytiscid beetle	5	P	P	
Potamopyrgus snail	4	P	P	
Gyraulus snail	3	P	P	
Physa snail	3	P	P	
Anisops backswimmer	3	P	P	
Water boatman	3	P	P	
Hirudinea leech	3	P	A	Not found in 2006
Microvelia bug	3	P	P	
Chironomid midge larva	1	P	P	

AQUATIC VEGETATION AND MACROINVERTEBRATE  
RECORDING SHEET

<b>Location/Area: Runanga Lake</b>		<b>Site no: 2</b>	
<b>Establishment date: 11/12/01</b>		<b>Grid reference: V21/E2828121;N6172773</b>	
<b>Observer: Geoff Walls, Erna Zimmermann</b>			
Site notes (location details, vegetation, etc): Maimai on lake edge. Tag placed on old fence post erected on landward side of willows at E2828153 N6172763, c. 150m N of pipe gate by limestone rocks.			
<b>SAMPLING DETAILS</b>			
Date: 15/11/04		Observer Andrew Lamason	
<b>Sampling methods/notes:</b>			
Tray and handlens; not possible to reach the lake edge (water too deep), so samples taken from the standing water behind the willow fringe.			
<b>AQUATIC VEGETATION PRESENT</b>			<b>COMMENTS</b>
<b>Species</b>	<b>Relative abundance*</b>		
	2004	2006	
Lemna minor	M	S	
Azolla filiculoides	M	S	
Wolffia australiana	U	-	Not recorded in 2006
Raupo	M	M	
Juncus articulatus	M	M	
<b>* estimated % or: a = absent u = uncommon/rare s = some m = much</b>			

<b>MACROINVERTEBRATES PRESENT</b>		<b>COMMENTS</b>		
<b>Species</b>	<b>SENSITIVITY SCORE (1-10)</b>	<b>2004</b>	<b>2006</b>	
Copepod	5	P	P	
Dytiscid beetle	5	P	P	
Potamopyrgus snail	4	P	P	
Physa snail	3	P	P	
Hirudinea leech	3	P	A	Not found in 2006
Microvelia bug	3	P	P	
Flatworm	3	P	P	
Mosquito larva	3	P	P	
Oligochaete worm	1	P	A	Not found in 2006

**\* estimated % or: u = uncommon/rare s = some m = much**

AQUATIC VEGETATION AND MACROINVERTEBRATE  
RECORDING SHEET

<b>Location/Area: Runanga Lake</b>		<b>Site no: 3</b>	
		<b>Grid reference: V21/E2828910;N6175175</b>	
<b>Establishment date: 11/12/01</b>		<b>Observer: Geoff Walls</b>	
<b>Site notes (location details, vegetation, etc):</b> Maimai on NE edge of lake amongst willows and harakeke. Access via farm track and across paddock, thence along boardwalk. Tag on fence at boardwalk entrance.			
<b>SAMPLING DETAILS</b>			
Date: 16/11/06		Observer: Andrew Lamason	
<b>Sampling methods/notes:</b> <b>Tray and handlens; samples taken from water's edge</b>			
<b>AQUATIC VEGETATION PRESENT</b>			<b>COMMENTS</b>
<b>Species</b>	<b>Relative abundance*</b>		
	2004	2006	
Azolla	M	S	
Lemna	M	S	
Raupo	M	M	
Ricciocarpus natans	S	-	Not recorded in 2006
Sedges	S	S	
Swamp nettle	U	U	
<b>* estimated % or: a = absent u = uncommon/rare s = some m = much</b>			

<b>MACROINVERTEBRATES PRESENT</b>		<b>COMMENTS</b>		
<b>Species</b>	<b>SENSITIVITY SCORE (1-10)</b>	<b>2004</b>	<b>2006</b>	
Dytiscid beetle	5	P	P	Not found in 2006
Copepod	5	P	P	
Gyraulus snail	3	P	P	
Anisops backswimmer	3	P	P	
Water boatman	3	P	P	
Stonefly larva	3	P	A	
Microvelia bug	3	P	P	
Chironomid midge larva	1	P	P	

### APPENDIX 4: Bird lists, Runanga Lake, November 2004

Water birds			Other birds		
Species	Est. Nos.	Breeding (yes/no)	Species	Est. Nos.	Breeding (yes/no)
<b><u>Native species</u></b>			<b><u>Native species</u></b>		
Black shag	20	n	Fantail	20	?
Little shag	30	n	Silvereye	30	?
Little black shag	10	n	Riroriro	20	?
Pied stilt	12	y	Pipit	10	?
Spur-winged plover	16	y	<b><u>Introduced species</u></b>		
Black-backed gull	20	n	Skylark	30	y
Black-billed gull	0	n	Starling	100+	y
Pukeko	50	y	Blackbird	20	y
Welcome swallow	50+	y	Thrush	20	y
NZ kingfisher	10	?	Redpoll	20	?
Australasian harrier	15	?	Greenfinch	20	?
Australasian bittern	6+	?	Goldfinch	50	?
NZ dabchick	15+	y	Chaffinch	20	?
NZ shoveler	4	?	Yellowhammer	20	?
NZ scaup (Black teal)	8	?	Pheasant	2+	?
Grey teal	20	?	Magpie	15	y
Paradise shelduck	40	y	Myna	15	y
White-faced heron	10	?	Dunnock	20	y
<b><u>Introduced species</u></b>			Californian quail	30	y
Mallard	100	y			
Black swan	500+	y			
Canada goose	0	?			
Domestic goose	50+	y			

## APPENDIX 5: Other animal lists, Runanga Lake, November 2004

Species	Est. Nos.	Breeding (yes/no)	Species	Est. Nos.	Breeding (yes/no)
<b><u>Introduced mammals (detected)</u></b>			<b><u>Native reptiles</u></b>		
Rabbit		y			
Hare		y	<b><u>Introduced frogs</u></b>		
Domestic deer		y			
Domestic cattle		y			
Domestic sheep		y			
Domestic goat		y			
Cat		y			
Hedgehog		y			
Possum		y			
<b><u>Introduced mammals (probably present)</u></b>					
Stoat		y			
Ferret		y			
Weasel		y			
Ship rat		y			
Norway rat		y			
Mouse		y			