# Arawai Kākāriki Wetland Restoration Programme

## Ō Tū Wharekai Outcomes Report 2007–2011

Department of Conservation
*Te Papa Atawhai*

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## Ō Tū Wharekai Outcomes Report 2007-2011

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Cover image credit: Kettleholes at Mt Guy, Lake Clearwater. Catherine Sintenie, Ō Tū Wharekai 2010 photo competition winner.



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# Executive summary

The Ō Tū Wharekai Wetland Restoration Project encompasses the Ashburton lakes complex and upper Rangitata River in the high country of mid Canterbury. It consists of 4030 ha of wetlands, 1186 ha of lakes, 12,236 ha of braided river and 26 ha of ephemeral turfs, as well as interconnecting streams.

Ō Tū Wharekai supports a diverse range of habitats, largely due to the glacial landforms that shaped the landscape. The lakes and wetlands have been designated as 'Areas of Significant Nature Conservation Value' in the Ashburton District Plan. Ō Tū Wharekai encompasses the upper Rangitata River, which contains one of two of the most important breeding sites for the threatened wrybill/ngutu pare. Ashburton lakes are also an important site for kettleholes which support rare ephemeral turf vegetation. Through the Ngāi Tahu Claims Settlement Act 1998, a Statutory Acknowledgement and Deed of Recognition is in place to formally acknowledge the association and values Ō Tū Wharekai holds for Ngāi Tahu.

The Ō Tū Wharekai Wetland Restoration Project is part of the Arawai Kākāriki Wetland Restoration Programme, which was initiated in 2007 by the Department of Conservation. Ō Tū Wharekai has three main aims: 1) increase our knowledge of the wetland values and functions of Ō Tū Wharekai to aid wetlands nationally; 2) undertake management to improve the status of species and habitats; and 3) increase awareness of wetlands through education and community input.

Key conservation outcomes to date include undertaking extensive inventories and monitoring of key species and habitats to assess status and threats to conservation values; working in partnership with iwi in developing restoration goals and prioritising work; undertaking extensive weed control programmes of willow, broom and lupin; establishing recreation facilities that reduce visitor impacts on the wetlands while increasing satisfaction and awareness of the wetlands; increased partnerships with stakeholders and community groups leading to greater conservation achievement; and developing greater education opportunities leading to increased awareness and involvement of wetland conservation values.

Continued investment in Ō Tū Wharekai is crucial to restore and manage the values and impacts in this nationally significant area. The work that Ō Tū Wharekai has done, or will do, will continue to develop tools and methodologies to help inform wetlands managers throughout New Zealand on many issues.

This report describes the conservation outcomes using data/indicators to report on the status of the site, as well as our engagement with the community. The report also provides key directives for future involvement at Ō Tū Wharekai.

# Acknowledgements

The Ō Tū Wharekai Wetland Restoration Project would not be the success it is without the help and knowledge of a great number of people, including those from the local iwi Te Rūnanga o Arowhenua, within the community, our neighbours, from other agencies, universities and schools, and DOC staff.

Public planting day at Lake Heron, September 2010. Photo: G. Iles.

# 1. Background

The Arawai Kākāriki ('Green Waterway') Wetland Restoration Programme began in July 2007 at three of New Zealand's foremost wetland sites, one of these being Ō Tū Wharekai (the upper Rangitata River and Ashburton lakes).

It is a flagship programme for the Department of Conservation aimed at protecting, restoring and understanding these ecosystems with the assistance of the community[1].

There are 10 national objectives for the Arawai Kākāriki Wetland Restoration Programme under the themes of Biodiversity, Community, and Learning (Figure 1). These objectives are utilised by Ō Tū Wharekai to prioritise on-ground management and monitoring programmes.

**FIGURE 1. OBJECTIVES OF THE ARAWAI KĀKĀRIKI WETLAND RESTORATION PROGRAMME.**

**Biodiversity**

1. Maintain the extent of wetland habitat
2. Maintain and enhance water levels and water quality
3. Protect and restore wetland habitat
4. Maintain and enhance species diversity, including threatened species

**Community**

5. Conserve historic and cultural sites
6. Promote sustainable land use
7. Improve recreation and visitor facilities
8. Maximise community awareness and involvement

**Learning**

9. Undertake research to inform wetland management
10. Develop best-practice wetland restoration tools

This Site Outcome Report summarises progress under each national objective at Ō Tū Wharekai, with reference to monitoring data and other observations that describe the current status of the ecosystems, species, and progress in working with the community.

[1] For further background on the Arawai Kākāriki Wetland Restoration Programme and implementation at Ō Tū Wharekai, refer to Robertson & Suggate (2011).

# 2. Ō Tū Wharekai site description

## 2.1 Ō Tū Wharekai vision

Our vision for Ō Tū Wharekai is that the intrinsic values of one of the best remaining high-country freshwater wetland and braided river ecosystems are protected, enhanced and appreciated.

## 2.2 Location and history of the area

Ō Tū Wharekai is located in inland mid Canterbury, 150 km south-west of Christchurch. It encompasses the Ashburton lakes complex and upper Rangitata River (Figure 2). The intensive management area sits at 624–854 m asl, and is surrounded by sub-alpine mountain ranges.

The extent of the wetlands and braided rivers within the catchment area totals 17,452 ha.

For early Māori the area was a major kaik/village and part of the seasonal mahinga kai and resource gathering trial. The area was also part of the pounamu trails and an ara/path to Poutini/West Coast. Pastoralism in the area began in the 1850s and 60s and the export of wool, tallow and meat became an important industry. High-country sheep stations were run on an annual cycle of mustering and shearing. This type of farming was low intensity, although regular burn-offs occurred to remove scrub and encourage grass growth.

The lakes, rivers and wetlands are a mixture of public conservation land (administered by the Department of Conservation (DOC)), unallocated crown land (administered by Land Information New Zealand (LINZ)), pastoral lease and freehold. Land use in the region has intensified over the last 10 years with a Nature Heritage Fund (NHF) purchase and the tenure review process allocating pastoral leases into freehold or conservation land. Farming practices have generally changed from low intensity merino sheep farming to moderate to high intensity sheep, cattle or deer farming, with greater pasture development resulting in higher use of fertilisers and over sowing. Some wetlands on freehold and leased land are still grazed and used as stock watering areas. However, tenure review, NHF purchase and covenanting has directly resulted in 226 ha of wetlands being protected in new conservation areas, and other wetlands and lakes being indirectly protected through the surrounding land becoming public conservation land.

Other land use includes recreational use of the lakes, rivers and surrounding land for fishing, boating, game bird shooting, tramping and hunting. There is a settlement of holiday homes and camping grounds at lakes Clearwater and Heron.

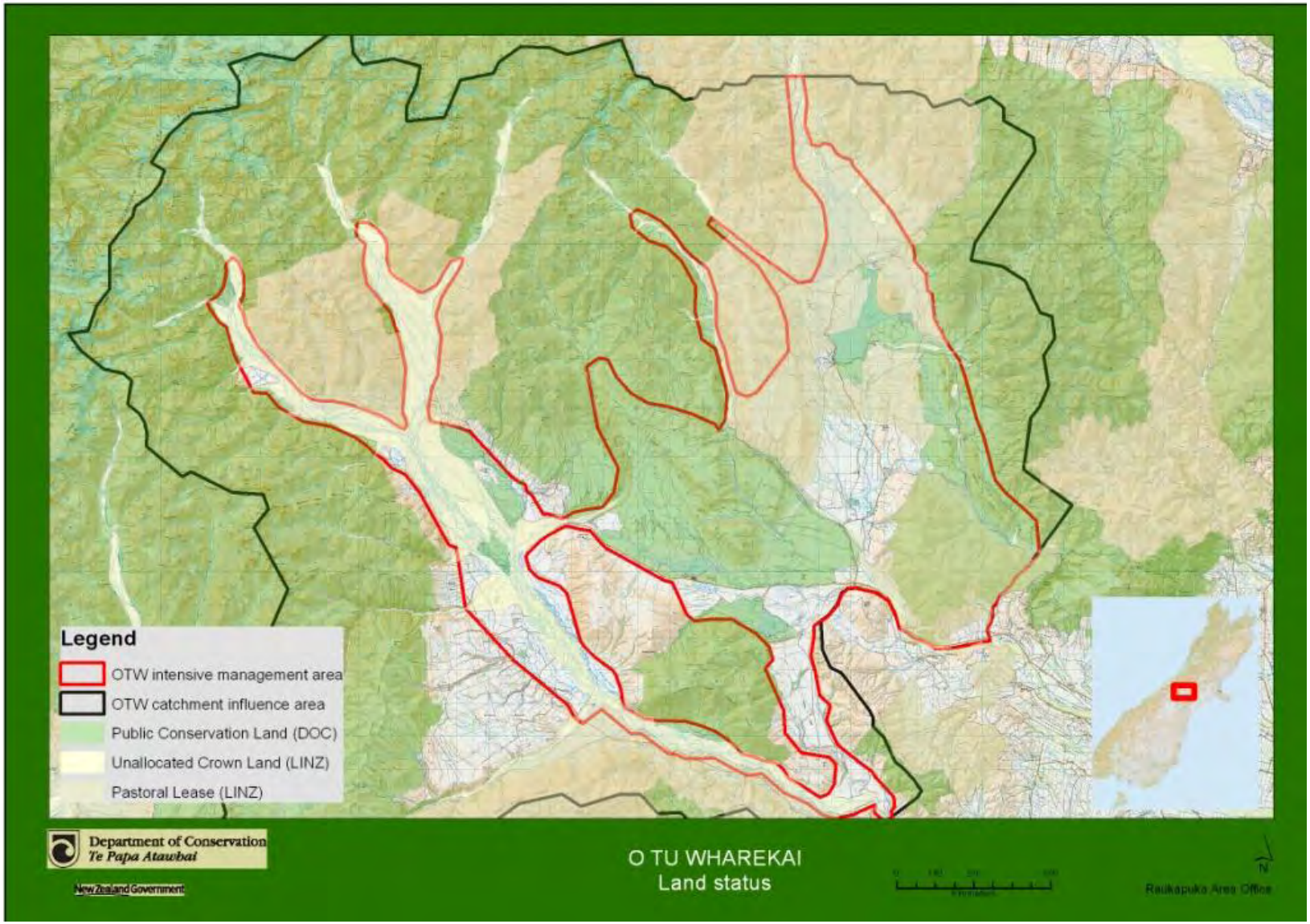



FIGURE 2. LOCATION OF Ō TŪ WHAREKAI SHOWING THE CATCHMENT AND INTENSIVE MANAGEMENT AREAS, AND LAND STATUS.

## 2.3 Wetland values

Ō Tū Wharekai is an inter-montane basin and braided river complex of over 65,000 ha with a diverse range of aquatic habitats, largely due to the glacial landforms that shaped the landscape. Freshwater lakes of varying size, kettleholes supporting a high diversity of turf species (many of which are threatened or at risk), red-tussock (*Chionochloa rubra*), sphagnum, *Schoenus pauciflorus* and *Carex secta* dominated wetlands, and relatively pristine rivers and streams make Ō Tū Wharekai a highly valued wetland system. Ō Tū Wharekai also includes two braided rivers – the upper Rangitata and upper South Ashburton.

Ō Tū Wharekai supports the threatened upland longjaw galaxid and longfin eel/tuna as well as important sports fish spawning habitat. The upper Rangitata River also supports the largest breeding colony of the endemic wrybill/ngutu pare, along with populations of black-fronted tern/tarapirohe and banded dotterel/turiwhatu. The lakes and wetlands sustain good populations of marsh crake/koitareke, low numbers of bittern/matuku, the nationally vulnerable Australasian crested grebe/kāmana and a wide range of waterfowl species, many present in large numbers. Threatened plant species include the endangered marsh arrowrush *Triglochin palustris*, pygmy forget-me-not *Myosotis pygmaea* var. *minutiflora*, pygmy clubrush *Isolepsis basilaris*, a threatened grass *Amphibromus fluitans*, and one of the largest known populations of a threatened native lily *Iphigenia novae-zelandiae*.

Through the Ngāi Tahu Claims Settlement Act 1998, a Statutory Acknowledgement and Deed of Recognition is in place to formally acknowledge the association and values Ō Tū Wharekai holds for Ngāi Tahu.

The main threats to the ecological values of Ō Tū Wharekai include the expansion of broom and Russell lupin on the braided rivers, potential water abstraction and storage for irrigation and stock water, and degraded water quality due to sediment and nutrient inputs from intensified farming. Grey and crack willows threaten the streams and swamps by increasing sedimentation and displacing native plants. Predators such as mustelids, feral cats, hedgehogs and possums threaten the areas unique bird, lizard and invertebrate communities. Increased recreational activities may increase disturbance to waterfowl.

# 3. Conservation outcomes

In all conservation projects it is essential to have clear measures of success that indicate whether the investment is achieving the desired outcomes. A key element of the Arawai Kākāriki programme was therefore developing specific indicators and measures and reporting on the programme objectives. This process of developing indicators to report on conservation achievements was initially based on the Department's Natural Heritage Management System (NHMS) biodiversity monitoring framework, and over time has expanded to incorporate freshwater environments.

A reporting framework was developed to link high-level objectives, with specific goals, management actions and monitoring (Figure 3). This established a process to report on the level of investment at each site (Implementation Report, Robertson & Suggate 2011), and for evaluating conservation outcomes (covered in this Outcomes Report).

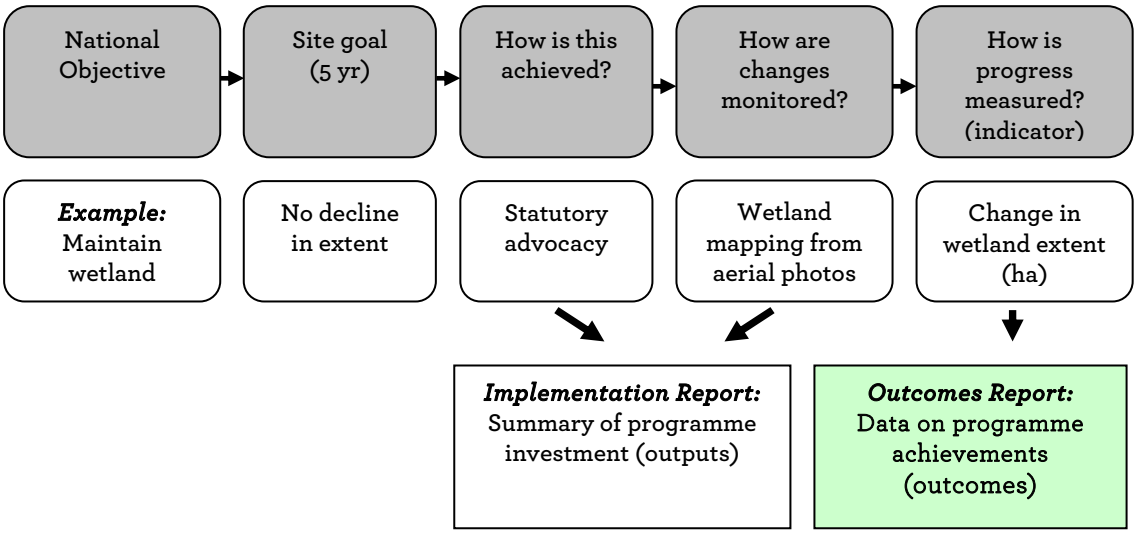



FIGURE 3. REPORTING FRAMEWORK FOR THE ARAWAI KĀKĀRIKI PROGRAMME THAT LINKS NATIONAL OBJECTIVES WITH SPECIFIC INDICATORS TO MEASURE PROGRESS.

The focus of this Outcomes Report is to describe the ecological condition of Ō Tū Wharekai as recorded from our wetland monitoring, and to detail the programme's effectiveness in promoting recreation and engaging with community.

The Outcomes Report is based on 55 specific indicators for reporting on changes in biodiversity, community involvement and the other national objectives of the Arawai Kākāriki programme (Robertson & Suggate 2011). However, not all indicators are relevant to each site, and a subset of data is presented here that is most appropriate for the Ō Tū Wharekai wetlands[2].

[2] Note: indicators not reported on for each objective are italicised.

## 3.1 Biodiversity

### Objective 1: Maintain the extent of wetland habitat

Loss of wetland habitat has been well reported across New Zealand. This is correlated with a decline in biodiversity and a reduction in the ecosystem services they provide, such as maintaining water quality.

At Ō Tū Wharekai the extent of wetlands in the management area encompasses both public conservation land, leased land and private land. The majority of wetlands are in the valleys and these are included in the intensive management area. However, due to the inter-connectedness of the mountain ranges and streams, the catchment area is also integrated in the project boundaries and is managed where relevant and possible.

Under this objective, management is focused on protecting wetlands through statutory processes via the Resources Management Act 1991 and other legislation, and through non-statutory advocacy.

#### *Outcome monitoring*

To determine changes in wetland extent over time, wetland habitat is measured using aerial photographs and satellite imagery. We mapped the extent of wetlands at Ō Tū Wharekai using high resolution colour and infrared photography. Using image analysis and mapping software this imagery will be used to generate vegetation maps of key plant communities and wetland types.

Progress is measured using the following outcome indicators:

- Extent of wetland habitat [AK 1.i, AK 1.ii]
- Extent of wetland habitat protected in covenants and reserves [AK 1.iii]

#### *Results*

Through tenure review the extent of wetland added to public conservation land increased by 74 ha or 2% from 2007 to 2011. The new wetland was primarily swamp and marsh. In addition, 75 ha of wetland habitat were protected through covenanting Deep Creek, a creek and wetland system connected to the upper Rangitata River (Table 1).

TABLE 1. EXTENT OF WETLAND HABITAT AT Ō TŪ WHAREKAI.

| Wetland habitat type | Extent of wetland habitat (ha) [2007] | | | | | Extent of wetland habitat (ha) [2011] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | PCL[1] | Other land in management area | | | Total | PCL[1] | Other land in management area | | |
| | | | Covenant | LINZ[2] | Other[3] | | | Covenant | LINZ[2] | Other[3] |
| Wetland | 4030 | 1800 (45%) | 1 | 146 | 2083 | 4030 | 1951(48%) | 76 | 146 | 1857 |
| *- Swamp* | *2491* | *874* | | *130* | *1487* | *2491* | *1025* | *75* | *130* | *1261* |
| *- Fen* | *93* | *31* | | | *62* | *93* | *31* | | | *62* |
| *- Marsh* | *1372* | *842* | | *16* | *514* | *1372* | *842* | | *16* | *514* |
| *- Seepage* | *47* | *27* | | | *20* | *47* | *27* | | | *20* |
| *- Kettleholes* | *27* | *26* | *1* | | | *27* | *26* | *1* | | |
| Lake | 1186 | 1092 (92%) | | 41 | 53 | 1186 | 1092 (92%) | | 41 | 53 |
| Braided river | 12236 | (0%) | | 12236 | | 12236 | (0%) | | 12236 | |
| **TOTAL** | 17452 | 2892 (16%) | 1 | 12423 | 2136 | 17452 | 3043 (17%) | 76 | 12423 | 1910 |

[1] Public Conservation Land, administered by the Department of Conservation
[2] Land administered by Land Information New Zealand
[3] Includes freehold land and crown pastoral lease

### *Management implications*

Tenure review has resulted in significant amount of land, previously grazed under Crown Pastoral Lease, being protected as public conservation land. Some of this land includes some important wetland habitats. There are still several properties currently going through the review process that if successful, will result in further wetland habitats being protected either as public conservation land or covenants. There is also land such as riparian margins on freehold or leased properties being protected by the landowners through fencing or controlled grazing. The Department will continue to encourage and support this where possible.

## Objective 2: Maintain and enhance water levels and water quality

Changes in hydrology and water quality can have lasting impacts on wetland ecosystems. Water levels can be altered by drainage or the diversion of surface water and groundwater. Decline in water quality, particularly from increased nutrient and sediment loads, is associated with intensification of land use.

At Ō Tū Wharekai the water quality of the wetlands and lakes is generally high; however, the lakes of the basin are primarily shallow and even the largest and deepest (37.8 m) Lake Heron has 57% of its area ≤5 metres deep. The shallow nature of the lakes increases their vulnerability to changes in land use. Strong north-west winds over the summer months mean sediments are prone to resuspension making nutrients bio-available and potentially resulting in algal bloom events.

Understanding the potential threat from altered water levels and water quality is important. Using this knowledge, on-ground management to protect the freshwater values of Ō Tū Wharekai can be implemented. Effective catchment management requires the formation of partnerships with councils, industry, local community and landowners. To date, the Department's investment has been focused on improving our knowledge of the range of freshwater habitats in Ō Tū Wharekai and the sensitivity of these systems to surrounding catchments.

### *Outcome monitoring*

Hydrological and water quality monitoring at Ō Tū Wharekai was established with the support of regional councils and research agencies. This monitoring is focused on the shallow lake catchments and kettleholes.

Progress is measured using the following outcome indicators:

- Changes in wetland/lake hydrology [AK 2.i]
- Trend in water quality of wetlands, lakes and rivers [AK 2.iii, AK 2.iv]
- *Trend in sediment accumulation* [*AK 2.vi*]
- Indices of water quality such as the Trophic Level Index (TLI) [AK 2.vii]

Hydrological change

Maori Lakes comprise a series of shallow depressions consisting principally of five main open-water bodies, the two largest being east and west Maori Lakes (Figure 4). The entire wetted area is approximately 182 ha. Surrounded by a raupō and *Carex* reedland, Maori Lakes provides habitat for Australasian crested grebe/kāmana, scaup/pāpango, marsh crake/koitareke, and paradise shelduck/pūtangitangi as well as introduced waterfowl. Development in the catchment has led to concern about the sedimentation rate of the stream-fed East Maori Lake, of which there are two main tributaries: Jacobs Stream on the eastern side and Gentleman Smith Stream to the north. On the western side there are three smaller tributaries that meander through swampy land before reaching the western lake. To improve our understanding of the hydrology of the wetland, automatic water level recorders were installed on the outlet to Maori Lakes, East Maori Lake, Jacobs Stream and Gentlemen Smith Stream, and flows and have been monitored since 2008. There are also several western tributaries; the flow in three of these was estimated visually

when the flow measurements were taken at the recorder sites. The differential between surface inflow and outflow is indicative of the groundwater component of the wetland. More recently, nutrient samples have been taken that, combined with flow, will indicate loadings to the wetland from catchment sources.

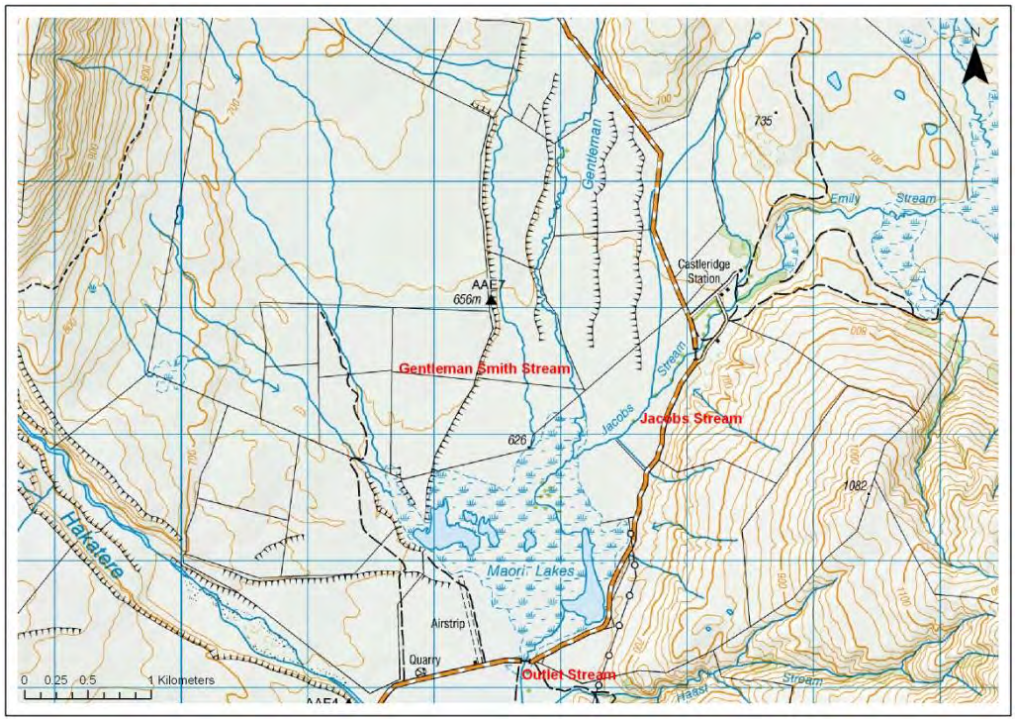



FIGURE 4: WATER FLOW OF MAORI LAKES.

Water level data is also being collected at eight kettleholes within Ō Tū Wharekai and is described under Section 3.3 Learning (Objective 9: Undertake Research to Inform Wetland Management).

Trophic Lake Index

Water quality monitoring has been regularly undertaken at Ō Tū Wharekai by the local regional council Environment Canterbury (ECan). This monitoring has focused on the shallow lakes because these waters accumulate and filter runoff and are prone to changes in trophic state reflecting surrounding land pressures. The water sampling examines nutrient levels (nitrogen and phosphorus), and other measures used in the Trophic Lake Index (TLI) are an indicator of lake condition.

Catchment nutrient load estimation

Initial hydrological and water quality investigation of the Lake Clearwater catchment was undertaken during 2010–11 to estimate nutrient concentrations and loads. This provided baseline information of nutrient levels at streams draining sub-catchments of natural tussock and streams with surrounding agricultural use. Our aim was to understand nutrient pathways, attenuation and effects on surrounding wetlands and lakes.

Hydrological change

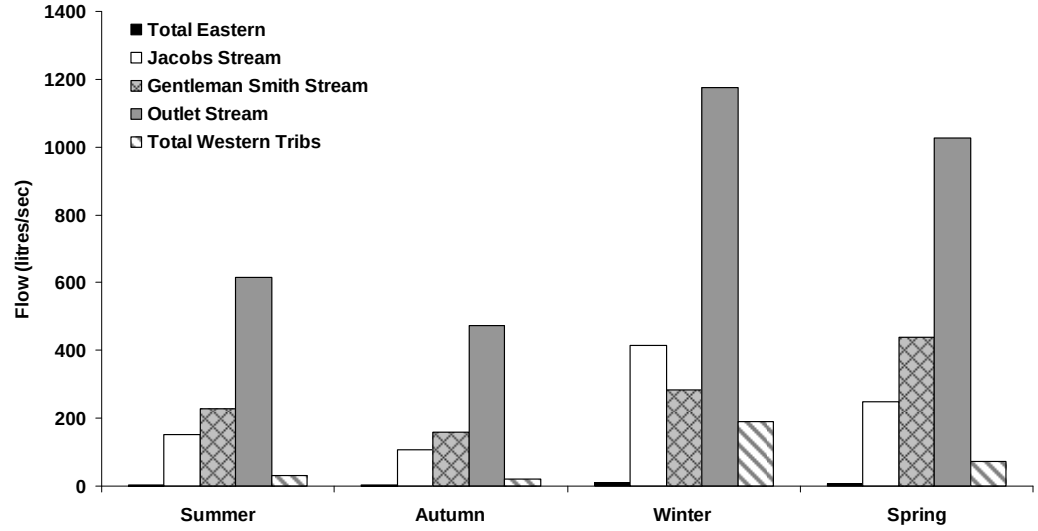



FIGURE 5. MEANS IN SEASONAL VARIATION IN STREAM FLOW FOR THE MAORI LAKES CATCHMENT (SMALL WESTERN TRIBUTARIES COMBINED) AUGUST 2008 TO MAY 2011.

Preliminary analysis of flow data for Maori Lakes demonstrates the role of the wetland in attenuating flood peaks. The outlet stream has an average flow of 918 litres per second (Boraman, 2011). Between August 2008 and May 2011 the water level of East Maori Lake varied between 255 and 1180 mm (local datum). Water attenuation by the lake and its wetland delays the effect of a fresh on flow between Jacobs Stream and the Outlet Stream by typically 10–14 hours. The filtering/sponge effect of these high-country wetlands moderates water quality and flood flows while contributing to water security over low rainfall periods. Jacobs Stream contributes more greatly to water levels during winter catching southerly flows, while Gentleman Smith Stream increases flow over spring with snow melt (Figure 5).

Trophic Lake Index

Measures of trophic state (TLI) over the last seven years demonstrate changes in lake productivity that for some lakes is cause for concern (Figure 6). Lake Emma has been the most unstable in recent years with significant blooms of cyanobacteria. An increase in TLI is indicated for Lake Clearwater and possibly Lake Heron, though at a lower rate. In their natural state the TLIs will vary due to catchment size, lake depth and area, and flushing, but in general the lakes of this region were historically low trophic state systems (oligotrophic to mesotrophic; TLI <2–3). The monitoring by ECan shows Lake Heron is the most oligotrophic, consistent with its greater size and overall depth. Lake Emma, while having spiked during the 2007–08 season, appears to be recovering, though has not yet returned to the 2004–05 levels (Figure 6).

The predicted levels of phosphorus (based on basement rock and catchment size) are exceeded by observed phosphorus levels at sites such as Lake Emma. Further, samples of phytoplankton taken over the 2010–11 summer showed composition and abundance in the Ashburton lakes also reflected levels of productivity indicated by the TLI.

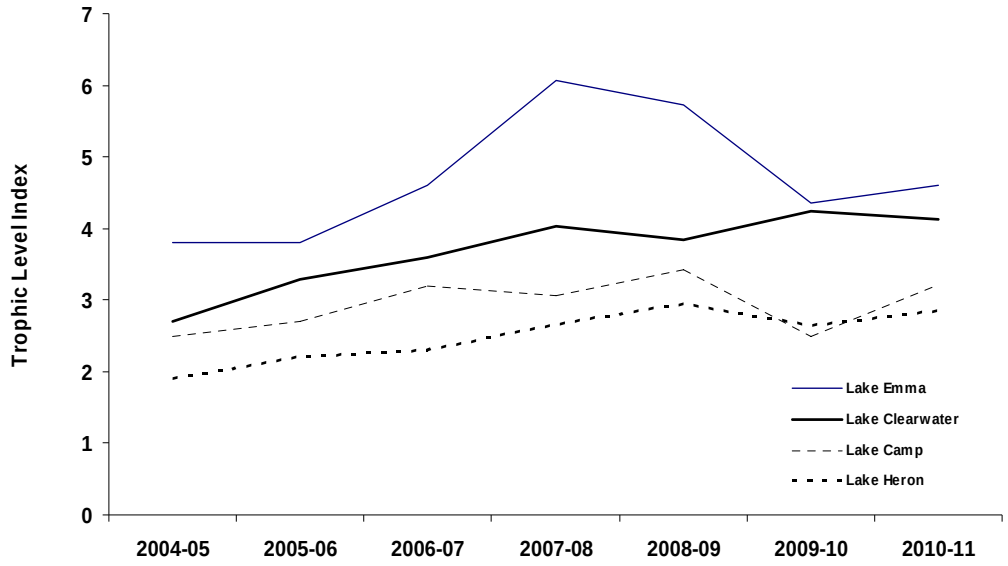



FIGURE 6. VARIATION IN THE TROPHIC LEVEL INDEX (TLI) AT FOUR ASHBURTON LAKES BETWEEN 2005 AND 2011. SOURCE: ENVIRONMENT CANTERBURY.

Catchment nutrient load estimation

The investigation of water quality dynamics of the Lake Clearwater system is ongoing, however preliminary data (54 samples across 10 sites over six occasions) is provided here (Figure 7). Nitrogen (TN) and Phosphorus (TP) loads were greatest at the lake inlet (10) and outlet (9) and at sites draining agricultural land (3, 4 and 5). The stream sites adjacent to agricultural land were the most affected though effects were seasonal. Sites 3, 4 and 5 were elevated in all nutrient species (and TSS concentrations) during late autumn and winter high-flow events in 2010 (Figures 8 and 9). The TN and TP levels exceeded the ANZECC (2000) trigger values that indicate a management response may be needed. During that winter adjacent paddocks were being converted from tussock to pasture and some intensive strip grazing had occurred. Conversion to pasture at this location is relatively recent. Information from this study will be used to develop nutrient and sediment guidelines and potential wetland treatment and restoration methods for these tussock/exotic grassland wetland systems in the future.

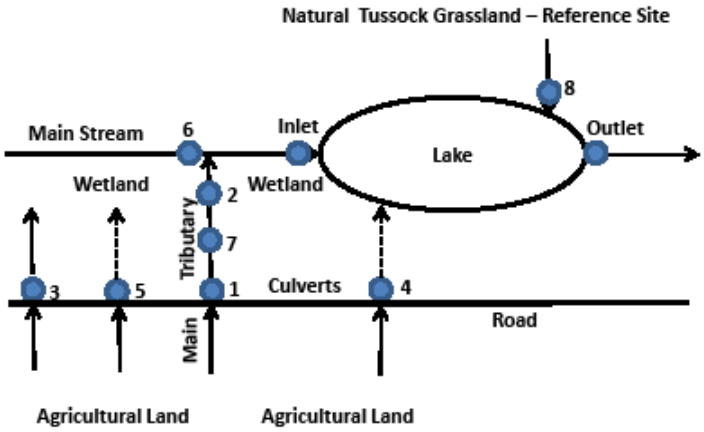



FIGURE 7. SCHEMATIC DIAGRAM OF STREAM WATER QUALITY MONITORING BETWEEN 2010 AND 2011 IN THE LAKE CLEARWATER CATCHMENT. (Note: Outlet = location 9 and Inlet = location 10 in Figures 8 and 9).

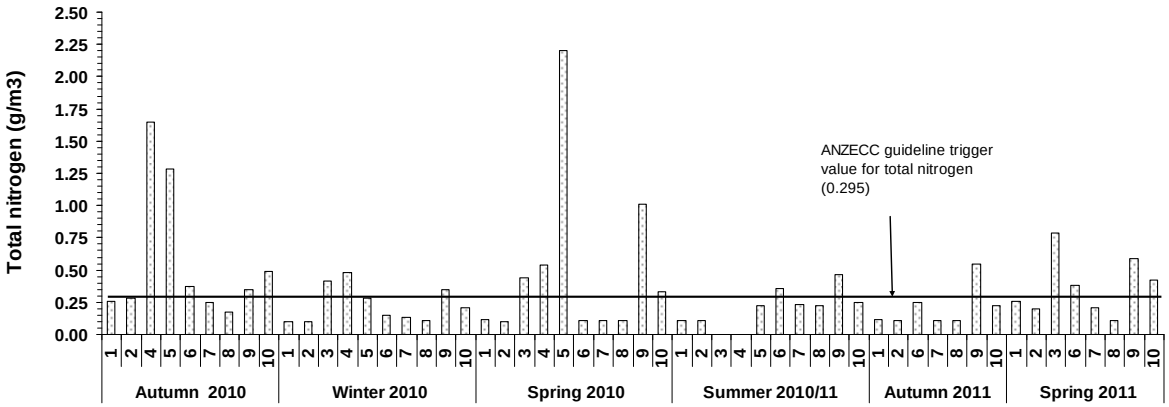



FIGURE 8. MEAN CONCENTRATIONS OF NITROGEN ($g/m^3$) AT STREAM LOCATIONS IN THE LAKE CLEARWATER CATCHMENT BETWEEN 2010 AND 2011. SOURCE: UNIVERSITY OF CANTERBURY AND DOC.

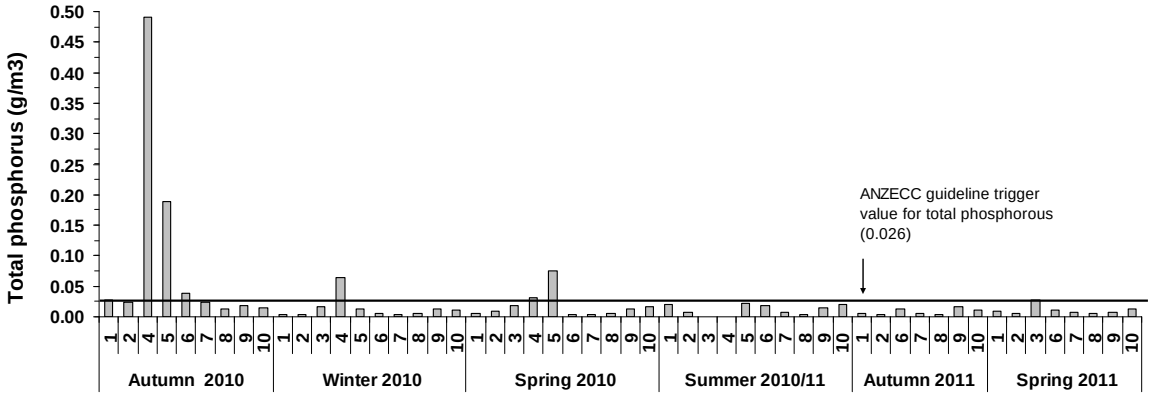



FIGURE 9. MEAN CONCENTRATIONS OF PHOSPHORUS (g/m$^3$) AT STREAM LOCATIONS IN THE LAKE CLEARWATER CATCHMENT BETWEEN 2010 AND 2011. SOURCE: UNIVERSITY OF CANTERBURY AND DOC.

### *Management implications*

Ō Tū Wharekai is an area of high biodiversity value across a range of freshwater ecosystems. Lakes are under increasing pressure due to intensification of land use in their immediate catchments. The Department, in collaboration with other agencies and research institutions, has initiated projects to assess lake vulnerability to changing land use. Research on nutrient movement across wetland gradients and in subsurface flow will better inform our management response. Changes in the trophic state of shallow lakes are difficult to reverse, so exploring a range of treatments aimed to limit these pressures is required (e.g. lowering nutrient loading via treatment wetlands, on-farm programmes, and the removal of exotic planktivorus fish).

The increased trophic status of some of the Ashburton lakes appears to be due to the cumulative effects of a range of factors such as disturbance of natural vegetation, elevated loading of nutrients, and biological interactions. Variations in macrophyte cover, for example, have been reported for Lake Emma (Champion et al. 2005; de Winton 2008). Although in the period of poor water quality (2006–07 to 2008–09) macrophyte cover was not reported as sparse, being dominated by *Elodea canadensis*. This presence of macrophyte beds will help maintain the health of the lakes and facilitate potential recovery.

The effects of waterfowl guano on lake water quality have been investigated at other locations (Manny et al. 1994; Environment Bay of Plenty 2002) but their role in nutrient loading at Ō Tū Wharekai has not been quantified. Canada geese, scaup/pāpango and black swan tend to be most abundant waterfowl, and the numbers of Canada geese in particular have led to concerns about their effect on water quality. Long term trends in waterfowl abundance and their role in the transfer of nutrients is currently being assessed.

Cyanobacteria blooms are a feature of highly eutrophic systems. Anabaena species have been recorded from lakes Emma and Roundabout, indicative of their relatively poor water quality. Further sampling across the shallow lakes of Ō Tū Wharekai will occur in the 2011–12 season to quantify the relationship between trophic status (TLI) and abiotic and biotic processes.

Maintaining original wetland surface extent is an important component of protecting wetland functionality. Reduction of wetland extent is a ubiquitous feature of lowland wetlands, and through farm intensification, the wetlands of Ō Tū Wharekai may lose buffering and margins. Maintenance of stream flows and water levels helps maintain lake water quality, and natural wetting regimes provide the natural gradients needed for wetland species to persist. The project has been contributing to a better understanding of the natural hydrology of a variety of freshwater systems. Flow and residence time (amount of time a particle spends in a particular system) of freshwater systems provides critical parameters for determining susceptibility of systems to nutrient loading and shifts in climate. Many of our freshwater environments are ephemeral systems and understanding the resilience of wetland species across a range of gradients will help to prioritise those species most at risk of decline.

Working in partnerships with landowners and the community is essential to protecting the freshwater lakes, rivers and wetlands at Ō Tū Wharekai. Designation of the project area and the values it represents in the Canterbury Water Management Strategy zone implementation plan is reassuring and will support future efforts to promote sustainable catchment management in district and regional plans.

## Objective 3: Protect and restore wetland habitat

Ō Tū Wharekai contains some of the most intact freshwater ecosystems in New Zealand. The significance of the rivers, lakes, and wetlands is directly related to the habitat condition. Both the protection and restoration of wetland habitat is a management priority. Primary causes for habitat degradation include the unrestricted access of livestock, increased abundance of invasive plants and greater fire frequency.

Management of wetland habitat at Ō Tū Wharekai has involved weed control of primarily willow in the wetland areas and broom and Russell lupin in the upper Rangitata River. Since 2007 the control areas for these species have included public conservation land, leasehold, freehold, LINZ and other private land. While most of the weed control within Ō Tū Wharekai is undertaken by the Department, weed control by landowners, community groups (such as the Rangitata Gorge Landcare Group and Forest and Bird) and Environment Canterbury also contributes. Access of livestock to wetlands has also reduced through the change in land management associated with the tenure review process. A strategic tactical fire management plan was written to assess fire hazards and formulate preventative and control measures. There is a ranging (compliance and education) programme over holiday periods to educate and enforce compliance of fire regulations.

### *Outcome monitoring*

Baseline assessments of the condition of wetland, lake and river ecosystems were undertaken using a number of complementary methods. In 2010, through the measurement of 27 wetland vegetation plots at Maori Lakes, Lambies Stream and Lake Clearwater (Bodmin and Robertson 2010), estimates of species richness and abundance, and measurements of soil and water chemistry were obtained. In addition, a further 16 plots were measured in 2009 following the 'Handbook' method (Clarkson et al. 2004). For lakes, a detailed LakeSPI (Submerged Plant Indicators) assessment was completed by NIWA in 2007 across 10 lakes (de Winton 2008). This method provides a measure of both the native character and invasive weediness of the aquatic plant community. Macrophyte abundance may also indicate long-term changes in water quality. For the streams and rivers, macroinvertebrates were sampled across 108 sites to measure species richness and abundance and calculate a macroinvertebrate index (MCI), a bio-indicator of stream health (Clucas, unpublished data).

A cultural health assessment was undertaken following State of Takiwa methodology (Te Rūnanga o Arowhenua et al. 2010). This used standard methods to identify pressures and determine the cultural harvest potential at 24 sites.

The Department also annually mapped the distribution and abundance of key weed species within Ō Tū Wharekai in order to determine the level of success of weed control programmes.

Progress is measured using the following outcome indicators:

- Extent of indigenous/weed-dominated habitat [AK 3.i, AK 3.ii]
- Biological indices of habitat condition (e.g. Lake SPI) [AK 3.iii]
- Trend in wetland soil nutrient levels and soil pH [AK 2.ii, AK 2.v]
- *Abundance of indicator plant species such as Carex secta [AK 3.iv, AK 3.v]*

- *Ratio of indigenous : exotic species [AK 3.vi, AK 3.vii]*
- Extent of wetland habitat impacted by fire [AK 3.ix]
- Distribution of weed species considered a threat [AK 3.x, AK 3.xii]
- Abundance of pest species (herbivores) considered a threat [AK 3.xi]

***Results***

Extent of weed-dominated habitat

Crack and grey willow, Russell lupin, gorse, broom, pine, rowan and elderberry are the predominant invasive woody species present within Ō Tū Wharekai. Control programmes were in place for these weeds on public conservation land prior to 2007 but have become more intensive and broader since the initiation of Ō Tū Wharekai. Mapping of the past and current distribution of woody and non-woody weeds has shown that there have been significant reductions in the overall cover of invasive plants throughout Ō Tū Wharekai regardless of land tenure (Table 2).

Mature stands of crack and grey willow were present in many of the wetland areas throughout Ō Tū Wharekai in 2007, including riverbed, stream and lake margins. Control of these stands has taken place through a mixture of aerial spraying and poisoning standing trees by hand. Areas of controlled mature trees then undergo further annual control to eliminate any regrowth or new seedling growth. Significant gains have been achieved in the control of mature willow trees within Ō Tū Wharekai (Table 2).

Broom and Russell lupins were previously abundant in large areas of braided riverbed habitat within Ō Tū Wharekai. These weeds threaten braided river ecosystems by altering the natural dynamic movement of river channels, outcompeting native plants and creating habitat for predators of braided river birds. Control of broom and lupin in braided riverbeds, through both aerial and ground spraying, has been the result of a joint effort between the Department, the Rangitata Gorge Landcare Group, LINZ and Environment Canterbury. Substantial reductions have resulted in the area of riverbed covered by mature broom and lupin (Table 2). Due to the long seed viability of these species, ongoing control of new seedlings is still required.

TABLE 2. TREATMENT AREA OF MATURE WEED SPECIES CONSIDERED A THREAT AT Ō TŪ WHAREKAI IN 2007 AND 2011.

| Weed species | | Area (ha) (2007) | | Area (ha) (2011) | | Area controlled (ha) |
|---|---|---|---|---|---|---|
| | | PCL | Other | PCL | Other | |
| *Salix spp* (crack and grey willow: wetlands, riparian margins) | *Total infested*[1] | 2412 | 58 | 9 | 22 | 2439 |
| | *High density*[2] | 117 | 39 | 9 | 13 | 134 |
| *Cytisus scoparius* (broom: riverbed, lake margins) | *Total infested* | 271 | 1240 | 15 | 12 | 1484 |
| | *High density* | 5 | 340 | 0 | 12 | 333 |
| *Lupinus polyphyllus* (Russell lupin: riverbeds, amenity sites) | *Total infested* | 2 | 60 | 0 | 22 | 40 |
| | *High density* | 2 | 38 | 0 | 1 | 39 |
| TOTAL[3] | *Total infested* | 2685 | 1358 | 24 | 56 | 3963 |
| | *High density* | 124 | 417 | 9 | 26 | 576 |

[1] Area identified is where all reproductive age invasive woody species have been controlled and ongoing surveillance and follow up will maintain control to zero density. Figure includes high density areas and scattered outliers.
[2]Area of infestation with >50% cover of target weed species
[3]As weed control buffer areas have been established to prevent re-invasion, areas controlled at some sites exceed wetland habitat areas.

Biological indices of habitat condition

1) LakeSPI

The 2007 survey across 10 lakes returned LakeSPI scores between 18–83% (Table 3). The lower scoring lakes primarily reflect the extent of the exotic macrophytes (Invasive condition 36–76%) such as the widespread *Elodea canadensis*. The lake exhibiting the best condition was Lake Donne (LakeSPI = 93%), a small lake in the Spider Lakes complex, and the only one with no *E. canadensis*. Native charophyte meadows were typically found below the depth range of *E. canadensis* at Camp, Heron, and Clearwater, and these areas supported the best native macrophyte communities. Nine of the 11 lakes surveyed contained *Ranunculus limosella,* an endemic species in gradual decline. The next LakeSPI survey is planned for 2012, which will indicate the variation in lake condition over time.

TABLE 3. BASELINE SURVEY OF AQUATIC MACROPHYTES (LAKE SPI) IN Ō TŪ WHAREKAI, NOVEMBER 2007, WHERE THE MAXIMUM PREEUROPEAN PRISTINE SCORE IS 98%..

| Lake | | LakeSPI Results (%) | | |
|---|---|---|---|---|
| | Lake Size ($km^2$) | LakeSPI score | Native Condition | Invasive Condition |
| Lake Heron | 6.95 | 42 | 45 | 60 |
| Roundabout | 0.12 | 35 | 43 | 72 |
| East Maori | 0.09 | 0 | 0 | 0 |
| West Maori | 0.10 | 39 | 60 | 69 |
| Emily | 0.19 | 29 | 27 | 76 |
| Denny | 0.05 | 26 | 18 | 74 |
| Camp | 0.44 | 58 | 59 | 36 |
| Clearwater | 1.97 | 47 | 51 | 51 |
| Emma | 1.67 | 37 | 45 | 69 |
| Donne | 0.01 | 93 | 82 | 0 |
| MEDIAN | | 38 | 45 | 64.5 |

2) Macroinvertebrate indices (MCI)

The 2008–2009 survey of 108 streams found that MCI scores were substantially lower in soft-bottom streams (n = 15, mean 2.95) than those with hard bottoms (n = 93, mean 6.23). However, the generally high scores in Ō Tū Wharekai reflect good overall ecological stream health. Based on the QMCI values (Figure 10) 67% of hard-bottom streams fall within the 'Clean' category and only 4% with 'Probable Severe Degradation'. Of the 12 sites sampled by DOC for the year 2010–11, seven fell within the Clean category (>6 QMCI). The low elevation streams (Lambies Stream, Deep Creek, Maori Outflow) had lower scores overall. Whiskey Stream registered the lowest category Probable Severe Degradation, possibly reflecting local effects of land intensification.

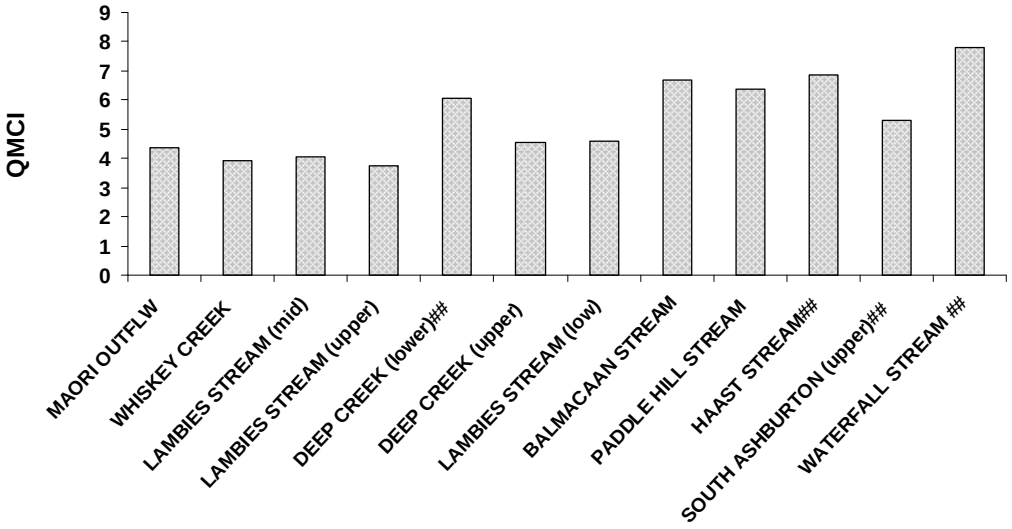



FIGURE 10. QUANTITATIVE MACROINVERTEBRATE INDEX (QMCI) FOR 15 Ō TŪ WHAREKAI SITES FOR THE YEAR 2010–11. QMCI SCORES FOLLOW STARK (1998), WHERE >6 = CLEAN WATER, 5–6 = DOUBTFUL QUALITY OF POSSIBLE MILD DEGRADATION, 5–4 = PROBABLE MODERATE DEGRADATION AND <4 = PROBABLE SEVERE DEGRADATION. (##) SITES ADDITIONAL TO THOSE ANNUALLY MONITORED.

3) Wetland vegetation

The baseline monitoring in 2010 identified both native-dominated and exotic-dominated wetland habitat at Ō Tū Wharekai. Low-growing vegetation, below the height of 1 m, is predominantly native (Table 4). This consists of native herbs, grasses, rushes and sedges. Above 1 m native vegetation is less dominant, and above 2 m native species are completely absent. This reflects the presence of willow trees (*Salix fragilis* and *S. cinerea*). Monitoring also suggested that where mature willow species are present, the ratio of native to exotic vegetation cover is lower than when there is no willow present (Table 4).

TABLE 4. COVER ABUNDANCE OF WETLAND PLANTS BY HEIGHT CLASS (N = NATIVE; E = EXOTIC). SOURCE: BODMIN & ROBERTSON 2010.

| Wetland site | Mean % cover (baseline assessment, 2010) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | < 0.3 m | | 0.3 – 1 m | | 1 – 2 m | | 2 – 5 m | | >5 m | |
| | N | E | N | E | N | E | N | E | N | E |
| Lake Clearwater | 33 | 21 | 65 | 20 | 4 | 7 | 0 | 4 | 0 | 0 |
| Lambies Stream | 20 | 37 | 29 | 20 | 1 | 11 | 0 | 22 | 0 | 10 |
| Maori Lakes | 59 | 22 | 64 | 14 | 7 | 1 | 0 | 0 | 0 | 0 |
| **TOTAL** | **37** | **27** | **53** | **18** | **4** | **5** | **0** | **6.5** | **0** | **3** |

4) Rapid assessment of wetland health

An overall score of wetland health was also recorded by Jensen (2009) using the rapid 'Handbook' method (Clarkson et al. 2004). Most of the wetlands at Ō Tū Wharekai rank

fairly highly in the wetland condition index (Table 5), as the wetland systems are still relatively natural. The pressure index is also relatively low with higher pressures mainly due to exotic weeds and stock access (Table 5).

**TABLE 5. WETLAND CONDITION ESTIMATES OF SELECTED WETLANDS IN Ō TŪ WHAREKAI USING THE HANDBOOK METHOD, 2009.**

| Wetland | No. of plots | Wetland condition index /25 | Pressure index /30 |
|---|---|---|---|
| Clearwater moraine | 3 | 24 | 6 |
| Lake Emma | 1 | 23 | 7 |
| Lake Emily | 1 | 22 | 6 |
| Lake Heron | 3 | 19 | 12 |
| Lambies Stream | 2 | 19 | 12 |
| Maori Lakes | 5 | 19 | 7 |
| Potts | 1 | 22 | 12 |
| MEAN | | 21.1 | 8.9 |

5) State of Takiwa

The State of Takiwā assessment results ranged from good to poor across the 20 sites monitored, with the majority being of moderate health (50%). A further 35% of the sites were rated as good, while the remaining 15% were poor. No sites were rated as very poor or very good. Features of high scoring sites included the degree of remnant native vegetation, and a lack of modification to, or intense pressure on, the site. Features of low scoring sites included a lack of native flora and/or fauna, high modification and/or intense pressure from farming or recreational activities. State of Takiwa results are further discussed in section 5.

Trend in wetland soil nutrient levels and soil pH

Information on the status of wetland soils was obtained in conjunction with the wetland vegetation survey across 27 sites in 2010. Changes in soil nutrient levels, pH or other indicators over time may indicate that changes in catchment land use are impacting on wetland condition. The baseline assessment of wetland soils (Table 6) indicates that the Maori Lakes site is slightly more nutrient-rich in terms of Total Nitrogen (TN) and correspondingly exhibits higher pH and conductivity levels. However, some of the variation in soil fertility is due to the wetland types sampled. For example, swamps naturally have higher nutrient levels than fens.

TABLE 6. BASELINE ASSESSMENT OF WETLAND SOIL CHEMISTRY AT Ō TŪ WHAREKAI. SOURCE: BODMIN & ROBERSTON 2010.

| Wetland site | Mean values (baseline assessment, 2011) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Soil TN (%) | Soil TP (mg/kg) | Soil TC (%) | Soil pH | Soil moisture (% dry wt) | Soil conduc-tivity (µS /cm) | Soil bulk density ($T/m^3$) |
| Lambies Stream | 1.4 | 1376 | 23.0 | 5.6 | 767 | 290 | 0.14 |
| Maori Lakes | 1.9 | 1171 | 32.8 | 5.9 | 644 | 420 | 0.12 |
| Lake Clearwater | 1.4 | 1486 | 20.1 | 5.4 | 360 | 170 | 0.26 |

Extent of wetland habitat impacted by fire

Ō Tū Wharekai has had two fires since 2007. The Lake Emma fire (March 2007) burnt 28 ha of predominantly tussock and resulted from the heat of an overturned motorbike. The Buicks Bridge fire (January 2009) was due to an upturned gas cooker and resulted in less than 1 ha of riparian margin burnt.

Distribution of weed species

The invasive algae *Didymosphenia geminata* (didymo) first appeared near Ō Tū Wharekai in the South Ashburton River at Blowing Point Bridge at the end of 2008 (Table 7). It was 15 months before it was then identified 7.7 km up river at Buicks Bridge, within Ō Tū Wharekai. At the same time it was found within Deep Creek in the upper Rangitata River, also within Ō Tū Wharekai. A recent suspect positive in Gentleman Smith may mean that that it is established within the Maori Lakes catchment.

TABLE 7. POSITIVE IDENTIFICATIONS OF DIDYMO (*DIDYMOSPHENIA GEMINATA*) AT Ō TŪ WHAREKAI 2008–2011.

| Waterway | Location GPS | First visit date | Last visit date | First positive result date | Site result |
|---|---|---|---|---|---|
| Ashburton River South Branch | E1455171 N5166693 | 14/12/2008 | 23/01/2009 | 14/12/2008 | Positive |
| Ashburton River South Branch | E1451558 N5172752 | 09/01/2009 | 11/05/2010 | 29/03/2010 | Positive |
| Rangitata River | E1439937 N5159925 | 23/09/2009 | 05/10/2010 | 23/09/2009 | Positive |
| Deep Creek | E1430061 N5176633 | 22/10/2009 | 30/03/2010 | 30/03/2010 | Positive |
| Lake Stream | E1448691 N5200926 | 17/01/2008 | 27/04/2011 | 27/04/2011 | Positive |
| Gentleman Smith Stream | E1453298 N5177869 | 09/04/2011 | 09/04/2011 | NA | Suspect positive |

Abundance of pest species (herbivores) considered a threat

Through the tenure review process and NHF purchase, many previously grazed streams and wetlands have now been fenced. Some high values sites, boundaries and marginal strips still need to be fenced.

Rabbit numbers are managed in conjunction with the Pest Management Strategy under the Biosecurity Act 1993. Ō Tū Wharekai has been compliant since April 2009, largely due to the presence of rabbit calicivirus (RCD), and some control via spotlighting.

DOC has no formal possum control program for Ō Tū Wharekai, however, possums are controlled using the trapping permit system, issued by DOC under the Wild Animal Control Act. Permits issued are dependant on demand, which often reflects possum fur prices.

### *Management implications*

Overall, the various habitat monitoring regimes indicate that most of the freshwater ecosystems of Ō Tū Wharekai are in moderate to good condition, with a low degree of modification. However, there are some degraded areas, generally through weed invasion.

Although *E. canadensis* is an exotic aquatic species and has ecologically displaced native aquatic plants in shallow lake habitats (Tanner 1985), *Elodea* is nonetheless functionally important. Elodea provides forage for grazing waterfowl, in particular black swan. It fixes nutrients coming into the lakes and its high biomass prevents re-suspension of sediments that leads to reduced water quality. So although the native characteristics of the lakes have been degraded, the exotic macrophyte presence is considered ecologically important for maintaining lake condition.

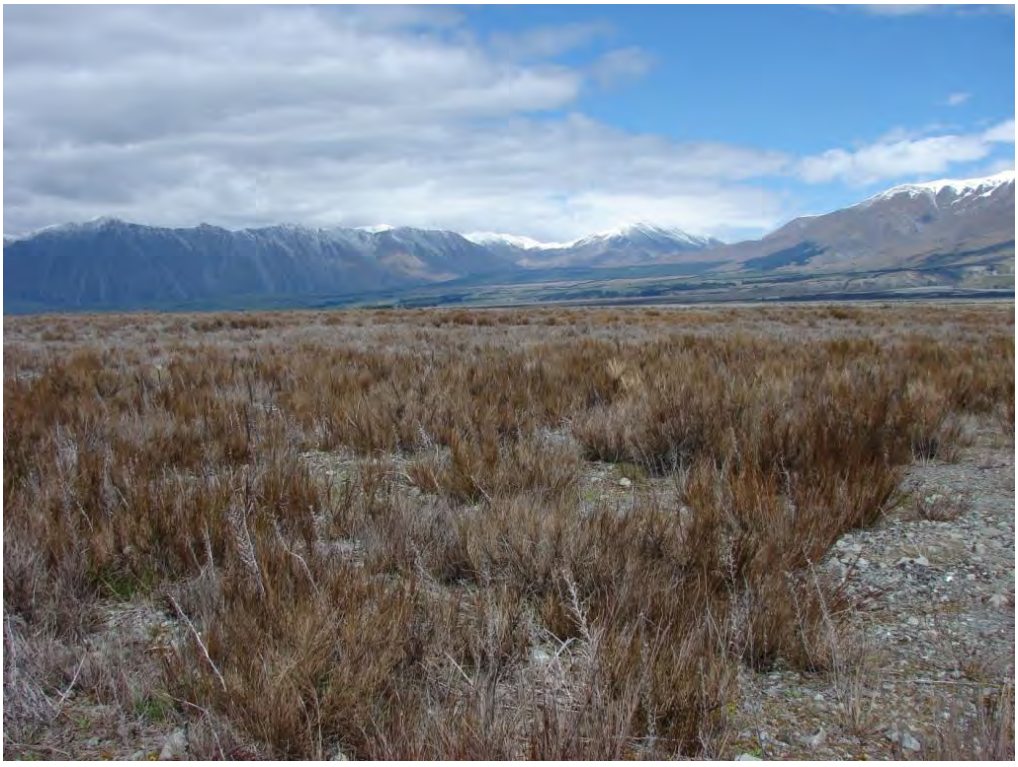
The assessment of stream condition using MCI found Balmacaan and Paddle Hill streams are almost pristine systems and demonstrate the 'Clean' standard possible in Ō Tū Wharekai. Whiskey Stream scored particularly poorly as 'Probable Severe Degradation'. Ongoing monitoring will continue at selected sites, specifically: Whiskey Stream, Deep Creek (lower), Lawrence River (spring site), Paddle Hill Stream, Balmacaan Stream, Lambies Stream (mid and lower) and Maori Lakes Outflow. Information collected will be used to assess the impact of changing land use on overall stream condition and of particular instream values (freshwater mussels and longjaw galaxid).

Native riparian and wetland vegetation is an important cultural indicator of health, providing significant habitat and breeding areas for native birds, fish and insects, and in particular mahinga kai species (Te Rūnanga o Arowhenua et al. 2010). The cultural health assessment recommended further monitoring be undertaken to inform future management of cultural values, such as restoration programmes for native vegetation, as well as measures to avoid, remedy or mitigate sedimentation, nutrient runoff and *e. coli* pollution of waterways and lakes from surrounding land use. This may include further investment in riparian fencing and planting and wetland protection.

The main causes of fire are from vehicles and machinery, out of control burn-offs on adjacent farmland, and camp fires. Because of its isolation and low population, the current risk of wildfires is relatively low. However, with increasing public use of the area, this risk is likely to increase. Managing this risk through educating and managing the public facilities is critical to prevent a large-scale fire.

Despite the significant control of invasive weed species (crack willow, grey willow, broom and Russell lupin), large infestations still remain due to continued regeneration of seedlings. It is a high priority, therefore, to undertake follow-up control of priority weed species until the seedbank is sufficiently diminished at Ō Tū Wharekai. The eradication of grey willow in particular is a key management aim for the next 5–10 years.

No new weed incursions occurred at Ō Tū Wharekai between 2007 and 2011. However, there were increased observations of didymo in some rivers and streams. The management programme for didymo has consisted of regulatory and informational signage, providing cleaning stations and communication to inform visitors. As yet didymo has not been detected in any of the lakes, though it is now in Lake Stream, which drains Lake Heron. The effect of this invasive alga on fish and invertebrate communities is so far unknown. Threatened species at potentially greatest risk are discrete remnant populations of the upland longjaw galaxid.



Sprayed broom, upper Rangitata River. Photo: G. Iles.

## Objective 4: Maintain and enhance species diversity, including threatened species

Halting the decline of native species from freshwater habitats presents a challenge. The historical loss of wetlands, increased abundance of mammalian predators and grazers, and reduced habitat connectivity have in combination reduced the diversity of native plants and animals. Ō Tū Wharekai supports a number of threatened and rare species dependent on wetlands for at least part of their life-cycle.

Management actions for protecting threatened flora and fauna have primarily focused on enhancing habitat condition (covered in Objective 3). In addition, some work has started on providing alternative breeding habitat for Australasian crested grebes/kāmana through trialling artificial breeding platforms. The Department also supports the Lake Heron Conservation Group in running a mammalian predator trapping network around Lake Heron to protect Australasian crested grebe/kāmana and other waterfowl.

### *Outcome monitoring*

A range of biodiversity monitoring programmes have been established at Ō Tū Wharekai over the past four years to monitor changes in the abundance of indicator species, and to understand the population dynamics of particular threatened species. Monitoring is focused on wrybill/ngutu pare, waterfowl (including Australasian crested grebe/kāmana), upland longjaw galaxid and threatened kettlehole turf species.

Wrybill/ngutu pare hatching success was monitored for three years, and productivity (number of chicks fledged per female) for one year. Waterfowl censuses have been undertaken annually for 26 years by Mid Canterbury Forest and Bird, and were increased by DOC to seasonally from spring 2009.

A detailed inventory of kettleholes within Ō Tū Wharekai and their turf vegetation has been undertaken, covering the Clearwater, Spider Lakes and Heron moraines.

Baseline inventory of other species such as upland longjaw galaxid and long-fin eel/tuna is also completed with the intention of setting up permanent monitoring to track long-term population trends. Inventories also were undertaken for lizard and invertebrates.

In 2009–10 a study was undertaken to describe the occurrence and abundance of predators in the wetland habitats of the Ashburton basin, and to ascertain the most effective tools at monitoring and trapping these species. This project did not include the upper Rangitata River, as this area was included in a PhD project (Pickerell, in progress). This project resulted in a more strategic design for the Lake Heron Conservation Group trapping project.

Progress is measured using the following outcome indicators:

- Diversity of indigenous species [AK 4.i, AK 4.ii, AK 4.iii]
- Number and population status of threatened species that rely on the site [AK 4.v, AK 4.vi]
- Abundance of indicator animal species such as Australasian crested grebe/kāmana [AK 4.iv]
- Distribution and abundance of predators considered a threat [AK 4.vii]

*Results*

Diversity of indigenous species

Table 8 shows that Ō Tū Wharekai has a high diversity of native species compared to introduced species for all guilds, except for mammals as we have no native mammals present. All introduced mammals have some impact on native species through predation or grazing. The very high diversity of native vascular plants is particularly notable, which is due to the high species richness of the kettlehole turf vegetation.

TABLE 8. SUMMARY OF THE DIVERSITY OF WETLAND PLANT AND ANIMAL GUILDS RECORDED AT Ō TŪ WHAREKAI SINCE 2007.

| Plant / animal guild | Diversity (no. species) | | | Source of records |
|---|---|---|---|---|
| | Native | Introduced | Total | |
| Freshwater fish | 7 | 3 | 10 | FWFDB# |
| Birds: open-water divers, deep-water waders, shallow-water waders, dappling waterfowl, torrent specialists | 12 | 3* | 15 | DOC, unpublished data |
| Birds: swamp specialists, riparian | 5 | 0 | 5 | DOC, unpublished data |
| Birds: aerial-hunting gulls, hawks, falcon and terns | 6 | 0 | 6 | DOC, unpublished data |
| Invertebrates | 98 | 6 | 104 | DOC, unpublished data |
| Vascular plants | 305 | 163 | 468 | Davis, 2011; Bodmin & Robertson, 2010 |
| Mammals | 0 | 13 | 13 | Sullivan, 2010; DOC unpublished data |
| TOTAL | 433 | 188 | 621 | |

* Black swans are classified as exotic, although were self introduced
#Freshwater Fish Database (NIWA)

Number and status of threatened species

Ō Tū Wharekai contains habitat used by a number of threatened species (six bird, three aquatic fauna, three insect and 23 known threatened plants species—see Table 9). There are also 15 relict or naturally uncommon plant species (Appendix 1). It is likely that there

are more threatened plants and insects that are yet to be recorded. Future changes in the total number of threatened species the area supports will be used as a broad indicator of ecosystem status.

TABLE 9. LIST OF THREATENED SPECIES RECORDED AT Ō TŪ WHAREKAI SINCE 2007.

| Species | Threat status | Source of record |
|---|---|---|
| **Birds** | | |
| Grey duck/pārera | Nationally critical | DOC unpubl. data |
| Bittern/matuku | Nationally endangered | DOC unpubl. data |
| Black-fronted tern/tarapirohe | Nationally endangered | DOC unpubl. data |
| Wrybill/ngutu pare | Nationally vulnerable | Sullivan 2011 |
| Banded dotterel/tuturiwhatu | Nationally vulnerable | DOC unpubl. data |
| Australasian crested grebe/kāmana | Nationally vulnerable | DOC unpubl. data |
| **Aquatic fauna** | | |
| Upland longjaw galaxid | Nationally vulnerable | DOC unpubl. data |
| Long-finned eel/tuna | Declining | |
| Freshwater mussel/kākahi | Gradual decline | DOC unpubl. data |
| **Invertebrates** | | |
| Grasshopper Brachaspis 'lowland' | Nationally endangered | Chinn 2009 |
| Grasshopper *Sigaus minutus* | Gradual decline | Chinn 2009 |
| Wolf spider *Anoteropsis arescens* | Sparse | Chinn 2011 |
| **Plants** | | |
| *Cardamine* "tarn" | Nationally critical | Davis 2011 |
| *Craspedia 'Lake Heron'* | Nationally critical | Head & Buunk 2005 |
| *Crassula multicaulis* | Nationally critical | Davis 2011 |
| *Pseudognaphalium ephemerum* | Nationally critical | Davis 2011 |
| *Triglochin palustris* | Nationally critical | Head & Buunk 2005 |
| *Amphibromus fluitans* | Nationally endangered | Davis 2011 |
| *Chaerophyllum colensoi* var. *delicatulum* | Nationally endangered | Davis 2011 |
| *Isolepis basilaris* | Nationally endangered | Davis 2011 |
| *Myosotis pygmaea* var *minutifolia* | Nationally endangered | Head & Buunk 2005 |
| *Carex cirrhosa* | Nationally vulnerable | Davis 2011 |
| *Carex rubicunda* | Nationally vulnerable | Davis 2011 |
| *Gratiola concinna* | Nationally vulnerable | Davis 2011 |
| *Iphigenia novae-zelandiae* | Nationally vulnerable | Davis 2011 |
| *Kirkianella novae-zelandiae* | Nationally vulnerable | Davis 2011 |

| | | |
|---|---|---|
| *Rytidosperma telmaticum* | Nationally vulnerable | Davis 2011 |
| *Aciphylla subflabellata* | Declining | Davis 2011 |
| *Carex tenuiculmis* | Declining | Davis 2011 |
| *Deschampsia cespitosa* | Declining | Head & Buunk 2005 |
| *Leucopogon nanum* | Declining | Davis 2011 |
| *Lobelia ionantha* | Declining | Davis 2011 |
| *Luzula celata* | Declining | Davis 2011 |
| *Ranunculus brevis* | Declining | Davis 2011 |
| *Ranunculus limosella* | Declining | Davis 2011 |
| *Raoulia monroi* | Declining | Davis 2011 |

Abundance of threatened species

Ō Tū Wharekai supports approximately 8% of the New Zealand Australasian crested grebe/kāmana population, but numbers appear to have declined since the 1980s (Figure 11) when the Ashburton lakes was once thought to hold 25% of the national population. The lakes also support between 7–27% of the population of New Zealand scaup/pāpango. *Craspedia* 'Lake Heron' is a nationally critical herb, and endemic to Ō Tū Wharekai. It only grows on the Cameron Fan.

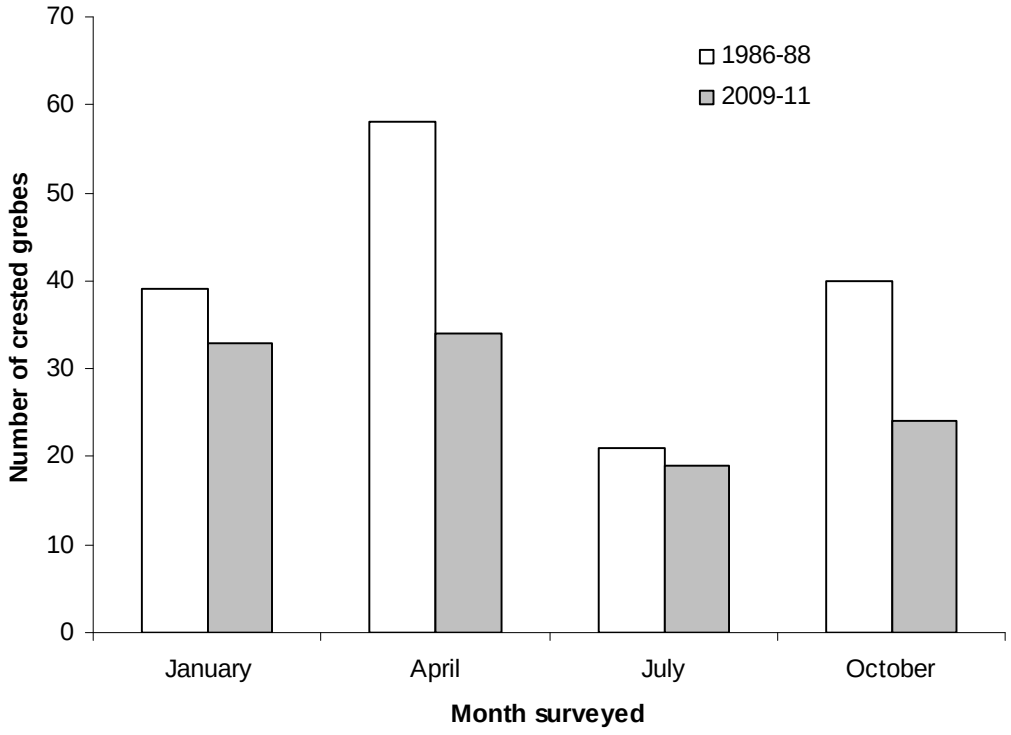



FIGURE 11. TREND (MEAN OVER TWO YEARS) IN THE ABUNDANCE OF AUSTRALASIAN CRESTED GREBE/KĀMANA AT Ō TŪ WHAREKAI BETWEEN 1986-88 and 2009–11.

The upper Rangitata River population of wrybill/ngutu pare is considered a national stronghold, although there is no current population estimate available. Wrybill/ngutu pare hatching success (percentage of nests that hatched at least one egg) varied over the three years that monitoring has occurred, ranging from 39 – 71% (Table 10). The main impacts on nests were predation and floods. The productivity in 2010 (number of fledglings produced per female) was very low and well below what is required for a population to be stable. If this figure is indicative of the overall yearly trend, it is likely that the population is in decline.

**TABLE 10. SUMMARY OF NESTING AND BREEDING SUCCESS OF WRYBILL/NGUTU PARE AT Ō TŪ WHAREKAI BETWEEN 2008 AND 2010**

| Variable | Year | | |
|---|---|---|---|
| | 2008 | 2009 | 2010 |
| Number of nests monitored | 48 | 84 | 83 |
| Number of pairs with colour bands | 0 | 10 | 37 |
| Hatching success (% nests that hatched 1-2 eggs) | 39 –55 (n=31) | 45 –79 (n=56) | 58 –71 (n=72) |
| % nests preyed on | 10 (n=31) | 14 (n=56) | 25 (n=72) |
| % nests flooded | 26 (n=31) | 3.6 (n=56) | 1.4 (n=72) |
| % nests deserted | 6.5 (n=31) | 5.4 (n=56) | 4.2 (n=72) |
| % nests where outcome unknown | 35 (n=48) | 33 (n=83) | 14 (n=84) |
| Productivity (number of fledglings per female) | - | - | 0.21 – 0.25 (n = 72) |

The upper Rangitata River population of upland longjaw galaxid may also be in decline. Work undertaken in the 1980s found a large population of upland longjaw galaxias in the Forest Creek confluence area; however, comprehensive electric fishing survey work in 2008 at this location did not find this species. The Clyde and Lawrence rivers still contain good populations and spawning areas.

Diversity of native species: kettlehole turf vegetation

The inventory of kettlehole turfs in Ō Tū Wharekai produced detailed assessments of plant species composition and abundance, with data gathered for 107 specific sites (31 in the Heron moraine, 50 in the Clearwater moraine and 26 in the Spider Lakes moraine areas) (Davis 2011). A total of 12 'threatened', 19 'at risk' and two 'data deficient' turf plant species were recorded. The Clearwater turfs contain six threatened or 'at risk' species not recorded in the other two areas. The Spider Lakes turfs provided habitat for two 'threatened' and two 'at risk' species not recorded elsewhere. Overall diversity of native kettlehole plants was very high in all three moraines. 173 native plants were recorded from Clearwater, 120 from Spider Lakes and 113 from the Heron moraine turfs.

Abundance and distribution of predators

The detection study found that the Ashburton Lakes wetlands have a wide suite of predators, with stoats and ferrets caught in high numbers. Ferrets were detected in both wet and dry habitat, but were captured in higher numbers in dry habitat. Stoats were

mainly detected in wet habitat, and it is possible that ferrets and cats out-compete stoats in drier habitats. One weasel was caught, on the dry margin of Lake Emma. Cats were only detected in dry habitat, such as beside streams or lakes. Norway rats were detected in all habitats. Hedgehogs were detected in most locations (Sullivan 2010).

The trap catch from the Lake Heron Conservation Group reflects the detection study. There appears to be high numbers of stoats, ferrets and feral cats in Ō Tū Wharekai, and in the 15 months from 2010–2011, 54 stoats, 46 ferrets, 37 cats and 61 hedgehogs were trapped. While capture rates of all predator species is seasonal, they have appeared to decline slightly for cats, ferrets and stoats since the establishment of the trapping network (Figure 12).

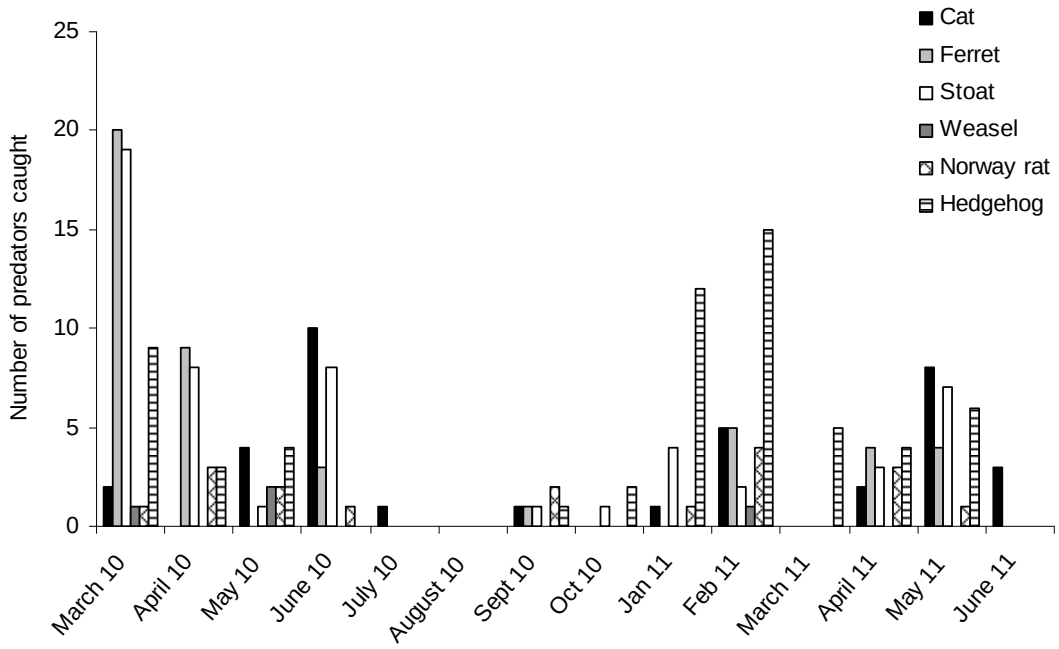



**FIGURE 12. CAPTURE RATE OF MAMMALIAN PREDATORS FROM TRAPPING AT LAKE HERON, Ō TŪ WHAREKAI, BY LAKE HERON CONSERVATION GROUP, MARCH 2010 TO JUNE 2011**

### *Management implications*

The inventory and monitoring regimes provided information on the status and, to some degree, vulnerability of native species at Ō Tū Wharekai, and are critical in identifying what steps need to be taken to protect threatened species and habitats.

Wrybills/ngutu pare do not appear to be producing enough juveniles for the population to remain stable, and are therefore likely to be in decline. Investigation into the impact of avian predators (southern black-backed gulls/karoro and swamp harriers/kāhu) is planned, and this could potentially be a cheaper and easier option than controlling mammalian predators. Broom and Russell lupin control will continue to be undertaken in the upper Rangitata River to maintain open braided river habitat. To mitigate potential effects of a future wind farm in the Waikato, Contact Wind Limited will start a trapping programme in the upper Rangitata River, after undertaking three years of breeding monitoring.

Australasian crested grebes/kāmana appear to be limited by predation and flooding of nests and possibly the extent of desirable habitat. While there appears to be sufficient native breeding habitat such as raupō beds, grebes appear to cue in to willow. Previous willow removal (e.g. Lake Heron) may have contributed to the loss of desirable habitat, and as such large mature willows in key areas are being retained for the time being. Artificial breeding platforms are also being trialled and riparian margins are being planted to provide alternative breeding habitat. Determining whether the trapping programme is making a difference on the breeding success of Australasian crested grebe/kāmana is an important long-term project. Continual management of Australasian crested grebes/kāmana will require community support, given that as a non-endemic species Australasian crested grebes/kāmana are of lower priority for funding. However, given that they are an iconic species to Ō Tū Wharekai, DOC is committed to supporting the community initiatives.

The completion of the kettlehole turf inventory greatly increased the Department's knowledge on the distribution of threatened plant species. Searching at different seasonal times is likely to enhance the chances of finding particular species, such as *Amphibromus fluitans*, *Isolepis basilaris* and *Iphigenia novae-zelandiae* (Davis, 2011). The inventory reaffirmed the importance of kettlehole turfs as supporting a very high diversity of native turf vegetation. Limiting the impacts of weeds in these habitats is a management priority.

The spring-fed streams that upland longjaw galaxid inhabit are especially vulnerable to didymo as they have highly stable flow regimes. There is no evidence of how didymo would impact on this galaxid species; however, it is likely to reduce food availability and spawning habitat. The risk of further didymo invasion is likely through the gradual incremental spread observed since 2008. Better understanding of upland longjaw galaxias habitat requirements and the river bed disturbance and flow regimes in this environment would assist in determining possible translocation sites.

The prioritisation of threatened species and ecosystem management work by the Department is currently in progress, which when complete will identify the places that will deliver the most conservation benefit for over 700 species and 200 ecosystem types. Ō Tū Wharekai has a number of species and ecosystems that are identified in this work as being important for maintaining the full range of biodiversity in New Zealand. This context is being used to optimise future work in the Ō Tū Wharekai project.

## 3.2 Community

### Objective 5: Conserve historic and cultural sites

Cultural (contemporary and traditional) and historic places of significance to tangata whenua and the local community are often found near freshwater lakes, rivers and wetlands. Protecting these sites and educating the wider community of their values is important for maintaining this heritage for future generations. Ō Tū Wharekai was a major kaik/village and part of the seasonal mahinga kai and resource gathering trail. The area was also part of the pounamu trials and an ara/pathway to Poutini/West Coast. The Ashburton high country was settled by pastoralists in the mid 1850s. The area became home to a number of large sheep stations, which contributed to the export wool industry.

To achieve this objective, the Department has worked with iwi and the community to identify the location and significance of cultural and historic sites. Once identified, appropriate management and site interpretation has or will be established.

*Outcome monitoring*

An assessment of cultural sites and values was undertaken by Te Rūnanga o Arowhenua, using State of Takiwa methodology in 2009–10. The first report produced through this project, the 'Ō Tū Wharekai Cultural Values Report' was completed in September 2009. It aimed to identify, compile and record the traditional and contemporary cultural values of tangata whenua associated with Ō Tū Wharekai, and involved a site visit and reviewing published and unpublished literature and tribal records (Te Rūnanga o Arowhenua et al. 2009). The second report, the 'Ō Tū Wharekai Cultural Health Assessment', extends the cultural values report by assessing the contemporary cultural health and state of the Ō Tū Wharekai, as well as identifying the pressures, issues, actions and existing opportunities that can guide and assist the future management, development and restoration of the area (Te Rūnanga o Arowhenua 2010).

An inventory of important historic sites at Ō Tū Wharekai was completed during 2007 (Hill 2007), and those sites considered relevant to the wetlands were incorporated into the Ō Tū Wharekai project objectives.

Progress is measured using the following outcome indicators:

- Level of protection of cultural and historic sites [AK 5.i]
- Condition of important cultural and historic sites [AK 5.ii; AK 5.iii]
- *Visitor awareness of significant historic and cultural sites [AK 5.iv]*
- Identified iwi cultural values adequately protected, restored, or enhanced [AK5.v]

*Results*

Level of protection and condition of cultural sites

The State of Takiwa cultural health assessment identified a number of management recommendations to improve the health of freshwater sites at Ō Tū Wharekai for future cultural use (Table 11).

TABLE 11. SUMMARY OF IMPORTANT CULTURAL SITES AT Ō TŪ WHAREKAI. SOURCE: TE RUNANGA O AROWHENUA ET AL. 2009, 2010.

| Site name | Protection status | Site condition | Management recommendations |
|---|---|---|---|
| Midden | To be confirmed | Unknown | Inspection planned to determine condition; location to remain undocumented to avoid vandalism |
| Mahinga kai: Hakatere/Ashburton River | LINZ | Moderate | Protection and enhancement through the development of native riparian and wetland buffer zones |
| Mahinga kai: Kirihonuhonu/Lake Emma | Government Purpose Reserve | Good | Protection and enhancement through the development of native riparian and wetland buffer zones |
| Mahinga kai: Ō Tū Roto/Lake Heron | Nature Reserve | Good – Moderate | Protection and enhancement through the development of native riparian and wetland buffer zones; investigation and control of human and agricultural pollution |
| Mahinga kai: Ō Tū Wharekai/Maori Lakes | Nature Reserve | Good – Moderate | Control sedimentation, protection and restoration of buffer and inlets; control of exotic weeds; removal of exotic fish; tuna surveys for possible cultural harvest |
| Mahinga kai: Otautari/Lake Camp | Vested with ADC | Poor | Protection and enhancement through the development of native riparian and wetland buffer zones |
| Mahinga kai: Rangitata River | LINZ | Good – Moderate | Protection and enhancement through the development of native riparian and wetland buffer zones |
| Mahinga kai: Te Puna a Taka/Lake Clearwater | Government Purpose Reserve | Good – Moderate | Protection and enhancement through the development of native riparian and wetland buffer zones; investigation and control of human and agricultural pollution |

Identified iwi cultural values adequately protected, restored, or enhanced

While most of the identified cultural values have some level of protection, such as stock fencing, many are still impacted from catchment-level threats, such as poor water quality of inflow streams, weed invasion, and occasional contamination from human waste. The Department and Te Rūnanga o Arowhenua are working to eliminate or mitigate these issues.

Level of protection and condition of historic sites

Hill (2007) identified two historic assets which relate to or support Ō Tū Wharekai – the Hakatere historic buildings and the Harper Ice Rink. The condition of these sites is identified as 'deteriorating' (Table 12).

TABLE 12. STATUS OF IMPORTANT HISTORIC SITES AT Ō TŪ WHAREKAI.

| Site name | Protection status | Site Condition | Actively conserved | Current or proposed management |
|---|---|---|---|---|
| Hakatere historic buildings | Conservation Park | Deteriorating | Yes | Restoration planned |
| Harper Ice Rink | Conservation Area | Deteriorating | Yes | Draft management plan in progress; some restoration and weed control planned |

*Management implications*

The State of Takiwa assessment was invaluable in building restoration goals for Ō Tū Wharekai and providing information on the flora and fauna present in pre-European times. It identified areas that need further management to retain or enhance their cultural and environmental values, and recommendations on how to achieve these goals. Te Rūnanga o Arowhenua and DOC are now working together on these goals.

With the proposed restoration of the historic Hakatere buildings and development into an interpretative area, visitors will gain a greater awareness of the history of both the buildings and wider landscape, and the conservation values of the wetlands. While access to the Harper Ice Rink is very difficult, protection and interpretation of this complex will give the public a greater awareness of how wetlands were used for recreation historically.

## Objective 6: Promote sustainable land use

Freshwater ecosystems are directly influenced by their surrounding catchments. Increased sediment and nutrient loads associated with the intensification of land use is linked to a decline in ecological integrity, and may lead to rapid shifts in species composition. At Ō Tū Wharekai the surrounding land use is a mixture of public conservation land, low intensity pastoral sheep and beef farming, and high intensity sheep and beef farming involving over-sowing and fertilising the land.

Working with local government, industry groups and private landholders is critical to promoting sustainable land use; for instance, to improve effluent management in agricultural areas upstream of high conservation value wetlands. This objective of the Arawai Kākāriki programme also aims to promote cultural harvest by local iwi, and facilitate sustainable concession activities on conservation land. Initially the project attempted to form a working group consisting of various stakeholders; however, public interest in this method was low. Ō Tū Wharekai instead works with individual partners and stakeholders on an individual or group basis.

### *Outcome monitoring*

Changes in land use practices at Ō Tū Wharekai were examined by collating information on the compliance of concessions, and the water quality of main tributary creeks and rivers. All concessions are assessed at the time of application and measures to mitigate or avoid impact are stipulated. Water quality from adjacent land is assessed using macro-invertebrate index and trophic level index (presented in Objective 2). Te Rūnanga o Arowhenua (2010) assessed the cultural health and state of Ō Tū Wharekai (partly presented in Objective 5).

Progress is measured using the following outcome indicators:

- Condition of conservation land managed under concession activities [AK 6.i]
- Water quality in streams draining from private land [AK 6.ii:, see Objective 2]
- Extent of indigenous wetlands on private land; covenants [AK 6.iii, AK 6.iv]
- Satisfaction of iwi on the availability and use of cultural resources [AK 6.v]

### *Results*

Concessions

There are 12 concessions granted for Ō Tū Wharekai (Table 13). There is one high impact concession: a company that undertakes 4WD guided tours over Mt Potts Conservation Area to Mt Sunday, using an existing track through the wetland and ford over Deep Creek. In 2009 a new track and ford was built to minimise impact on a salmon spawning area. As low impact concessions, guided walking tours are assessed at the time of application, and standard conditions are set in place to keep impacts on wetlands negligible. While horse trekking is classed as a high impact activity, frequency of tours for this company are kept very low, and a horse care code has been developed to avoid impacts on wetland values.

TABLE 13. SUMMARY OF THE COMPLIANCE OF CONCESSIONS AT Ō TŪ WHAREKAI BETWEEN 2007 AND 2011.

| Concession type | No. concessions | Compliance assessment |
|---|---|---|
| High impact: 4WD tours | 1 | Monitored and complying |
| Low impact: guided walking | 10 | Not scheduled to be monitored |
| Low impact: horse treks | 1 | Yet to be monitored |

Extent of indigenous wetlands on private land protected

At Deep Creek, a tributary of the Rangitata River, 75 ha of freehold land has been fenced and is in agreement to be protected as a conservation covenant under the Reserves Act. 1910 ha of wetlands are present on private or leased land; however, the proportion of these wetlands that need protecting is as yet unknown.

Satisfaction of iwi on the availability and use of cultural resources

Te Rūnanga o Arowhenua et al. (2009) confirmed Ō Tū Wharekai as an area of immense cultural significance to Ngāi Tahu Whānui as it was once an important seasonal mahinga kai area. Flora and fauna that were once harvested but are now missing or in low abundance include weka, pūkeko, fern root/aruhe, kōkopu, and cabbage tree/ti kōuka. Te Rūnanga o Arowhenua et al. (2010) described Ō Tū Wharekai as having overall moderate cultural health. The assessments highlight a significant issue with the historical loss of native flora and fauna and subsequent grazing and stock pressure on both the landscape and waterways of the area. This is balanced by the existence of important areas of remnant habitat supporting raupō and *Carex*/purei wetlands, tall tussocklands, and beech forest/tawhai, fern root/aruhe, cabbage tree/tī kouka and mountain ribbonwood/houhi patches, many of which show the benefits of protection from grazing pressure.

### *Management implications*

All concessions granted in Ō Tū Wharekai have been low impact or are managed to avoid impacting on conservation values. Opportunities for concessionaires is likely to increase with the Department's vision that "DOC has a leading role in conservation work that contributes to our prosperity: Working with tourism operators and others running businesses on public conservation areas" (www.doc.govt.nz/about-doc/role). While new concessions need to be sustainable and complement the values of Ō Tū Wharekai, these opportunities provide a forum to raise awareness and appreciation of wetlands.

With further protection and enhancement of the riparian buffers, the waterways of Ō Tū Wharekai provide potential cultural harvest opportunities. Ō Tū Wharekai provides an opportunity for DOC and Ngāi Tahu to work together on enhancing conservation values and promoting cultural use.

The Canterbury Water Management Strategy (CWMS) was developed by the CWMS Group, a directorate of Environment Canterbury, to address the issues around water in Canterbury. These issues include the declining health of both surface water and groundwater, an ongoing loss of cultural value and recreational opportunities, as well as the declining availability and reliability of water for agricultural and energy users. The CWMS Group manages the zone and regional implementation programmes (http://ecan.govt.nz/get-involved/canterburywater). This forum provides a collaborative framework for DOC to interact with other community members and partners in addressing sustainable water use. This coordinated approach is critical given some of the

trends in water quality for the Ashburton lakes previously described (Objective 2). Ō Tū Wharekai is integrated into the Ashburton Zone Implementation Plan and the Regional Zone Implementation Plan (Braided Rivers). Knowledge gained by Ō Tū Wharekai has been extended to help inform the CWMS on issues that affect not only the catchment of Ō Tū Wharekai but also the wider Canterbury region.

Ō Tū Wharekai will continue to build on our relationships with iwi, adjacent landowners, other agencies, local government and concessionaires to progress sustainable land use projects and raise awareness with the wider community.

Wetere Home, Te Rūnanga o Arowhenua, assisting with an eel survey. Photo: G. Iles.

## Objective 7: Improve recreation and visitor facilities

Public use and enjoyment of the recreation opportunities and scenic values that Ō Tū Wharekai provides is one of the key aims of the programme. The establishment of facilities for visitors such as walking trails provides a mechanism to inform the public of the issues that threaten freshwater ecosystems. The main recreational activities in Ō Tū Wharekai are sightseeing, short walks, fishing, boating and mountain biking.

At Ō Tū Wharekai an important step was developing a recreational opportunities plan that, with informal public input, identified and prioritised potential recreational opportunities (DOC 2010). Subsequently, the Department directed efforts towards developing new opportunities that allow sustainable recreation and attract visitors to public conservation land. The focus over the past four years has been providing access to land obtained via the tenure review process (i.e. Mesopotamia, Mt Potts and Barrosa); building structures that protect wetlands and create better access (i.e. Lake Clearwater boardwalk and bridges and Harrison Bight boardwalk); creating short walk opportunities (i.e. Lake Hill); and developing Te Araroa, 'the long pathway' (http://www.teararoa.org.nz).

Two vehicle exclusion fences were erected in 2009, one 4.5 km fence along the 'back' of Lake Clearwater to protect the lands beyond the lake, and one 1.55 km fence adjacent to the Lake Heron Road to protect a cluster of kettleholes.

Recreational opportunities were promoted on the DOC website, Hakatere Conservation Park brochure and signage.

### *Outcome monitoring*

The Department monitored the numbers of visitors using facilities by establishing track counters at Harrisons Bight and traffic counters at Blowing Point Bridge and Buicks Bridge. A survey of visitor behaviour and satisfaction was also undertaken in the summer of 2010–11. Off-road vehicle use was measured by establishing 34 200-m and 5 1-km transect lines throughout Ō Tū Wharekai in 2010. These transect lines were monitored annually. A study to measure the response of waterfowl to different recreation activities was also initiated and is in progress.

Progress is measured using the following outcome indicators:

- Number of visitors [AK 7.i]
- Visitor satisfaction, and visitor awareness of wetland values [AK 7.ii, AK 7.v]
- *Use of wetlands for game bird hunting and fishing [AK 7.iii]*
- Impact of recreation on wetland habitat condition [AK 7.iv]

### *Results*

Visitor numbers

The Blowing Point traffic counter estimated 9000 vehicles entered Ō Tū Wharekai via Ashburton Gorge Road during the 2010–11 year, with the highest number from November to January (Figure 13). A small proportion of these vehicles would have been from DOC staff, landowners and concessionaires. The visitor survey determined that over the holiday period vehicle occupancy was 3.2 people; based on this figure and the traffic

counters 5370 people visited Ashburton lakes from mid-December 2010 to mid-January 2011, . The number of vehicles entering Ō Tū Wharekai via the Rangitata Gorge Road was not measured.

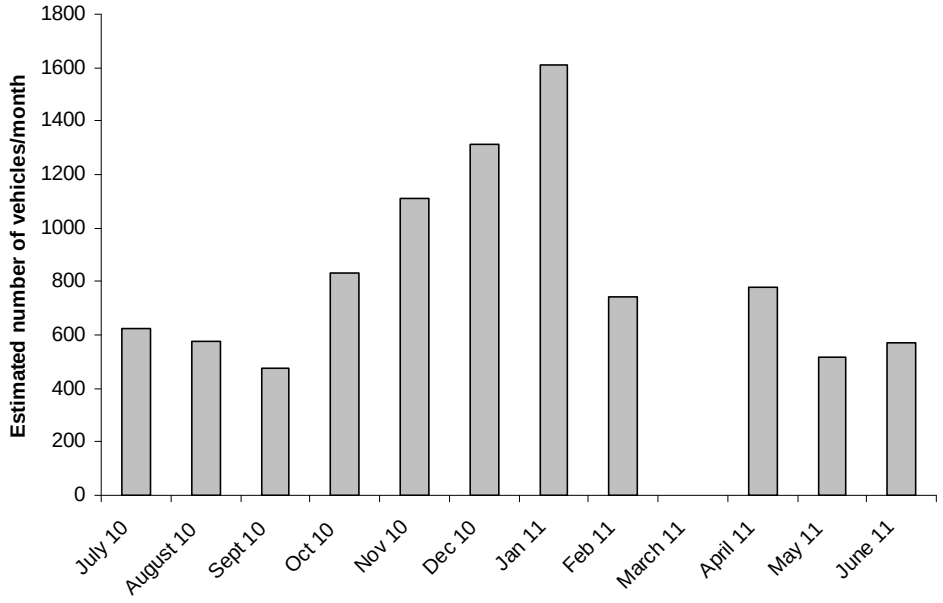



**FIGURE 13. NUMBER OF VEHICLES ENTERING ASHBURTON LAKES ESTIMATED FROM THE BLOWING POINT BRIDGE TRAFFIC COUNTER, 2010–11.**
Note: Due to a broken counter no data was recorded in March 2011.

Visitor behaviour and satisfaction

The exit survey found that over the summer holiday period, visitors were mostly from Canterbury, spent one day or less and were visiting for the first time that year. Lakes Clearwater and Camp were the most visited locations over the survey period; however, the traffic counters showed that for the rest of the year, the Heron catchment is slightly more popular. The most popular activities were sightseeing, followed by staying in a bach at Lake Clearwater, and fishing.

Just over a third of the visitors were aware of the Ō Tū Wharekai wetland project. Overall there was a high level of satisfaction experienced by the visitors (Table 14). Most visitors liked the landscape, scenery and quietness of the area, while they least liked the weather, the condition of the road and the facilities provided at lakes Camp and Clearwater and administered by the council.

**TABLE 14. SUMMARY OF VISITOR SATISFACTION AS RECORDED FROM EXIT SURVEY AT Ō TŪ WHAREKAI DURING 2010–11.**

| Year | Satisfaction | | | |
|---|---|---|---|---|
| | Very high | High | Moderate | Low |
| 2010–11 | 36 | 55 | 7 | 2 |

Impact of recreation on wetland habitat condition

Vehicle tracking decreased overall during 2011 with 125 estimated vehicle tracks compared to 218 vehicle tracks in 2010. Most of this change is attributed to the decreased use of an unauthorised motor-cross track at Lake Clearwater. The largest amount of off-road vehicle tracking continues to be at Lake Clearwater, followed by Lake Emma (Figure 14). In 2011 six transects had new incidences of minor tracking (≤5 vehicles) where there was no tracking in 2010, and three transects had an increase in vehicle numbers: two at Lake Heron and one at Lake Emma. The largest increase in off-road use was at the start of the Heron 2WD road, as vehicles leave the road to access the lake (transect 1).

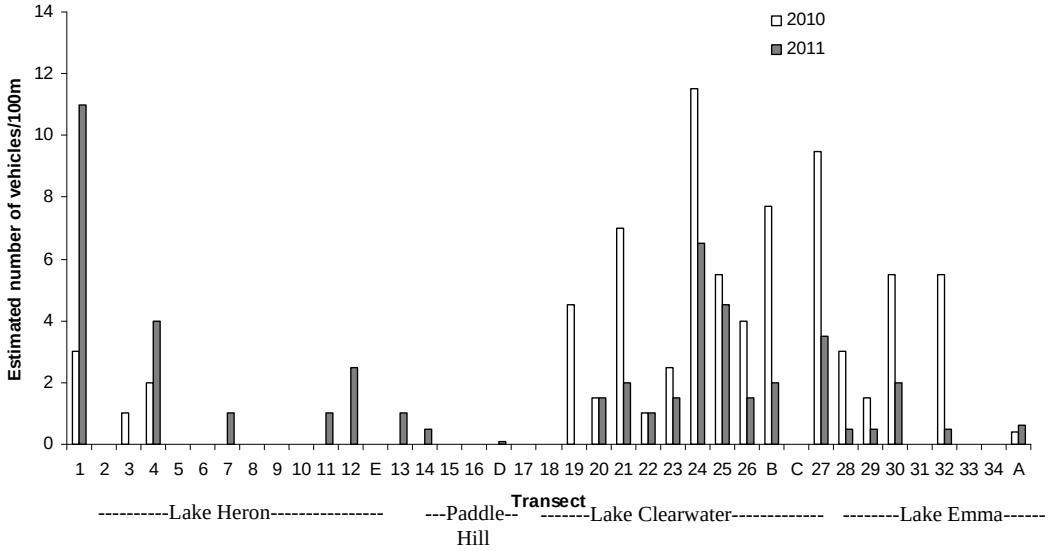



FIGURE 14: NUMBER OF VEHICLES ESTIMATED VIA VEHICLE MONITORING TRANSECTS PER 100 m.

### *Management implications*

The visitor survey showed that sightseeing and short walks are a popular recreational use that is also likely to be undertaken by first-time visitors. The fact that short walks and other 'front-country' activities are highly popular, and that most people visit for one day or less, suggest that we could provide further facilities for these users. At the time of this report, new structures were built to aid access to Mt Sunday, and plans being prepared to develop a short interpretative walk to a kettlehole. In early 2012 the Hakatere Historic buildings were being developed to provide a gateway for visitors, with interpretation on wetlands, cultural values and history, as well as information on facilities and access. Some interpretation on wetland values will also be in situ. These new facilities and interpretation aim to increase use, awareness and satisfaction.

While vehicle tracking monitoring does not measure a direct impact on wetlands, it does measure the degree or potential impact from off-track vehicle movements around the basin. With targeted signage and education of visitors via ranging, tracking may be managed. Overall, off-track driving has reduced, with only a few areas needing focused management. The issue of motor-cross riders creating and using circuits also needs addressing.

More targeted collaboration with user groups such as Fish and Game and 4WD clubs is recommended to collect information on visitor numbers and to raise awareness.

## Objective 8: Maximise community involvement and awareness

Without the support of the local community it is often difficult to achieve the goals for biodiversity conservation and improved recreation opportunities. Successful engagement requires an understanding of community values and the interest of individuals in contributing to wetland management. Promoting awareness of the unique features and vulnerability of wetlands to a wider audience through media and other communication tools is equally important. At Ō Tū Wharekai community involvement has increased steadily over the four years as a result of greater awareness of the project and the opportunities that it provides. The development of new groups, school projects and the involvement of individuals has lead to a significant contribution from volunteers.

The key aim of this objective is to increase local community and general public awareness and engagement in management of the Ō Tū Wharekai restoration programme. This is achieved through providing information via email updates, hosting working bees, education initiatives and supporting students and community groups.

### *Outcome monitoring*

The changes in the perceptions and involvement of community were evaluated by measuring the increase in volunteer hours and level of engagement from stakeholders.

Progress is measured using the following outcome indicators:

- *Proportion of the community, iwi and stakeholders with improved awareness of the Arawai Kākāriki programme [AK 8.i, AK 8.iii]*
- Level of external interest (website hits) [AK 8.ii]
- Level of engagement of stakeholders with conservation at the site [AK 8.v]
- Number of partnerships that involve tangata whenua [AK 8.vi]
- Number of volunteers who participate in conservation projects [AK 8.vii]

### *Results*

Level of external interest

The Ō Tū Wharekai website gets on average 100 visits per month (Figure 15). The increased visits to the website in May 2010 can be attributed to the results of the photo competition displayed.

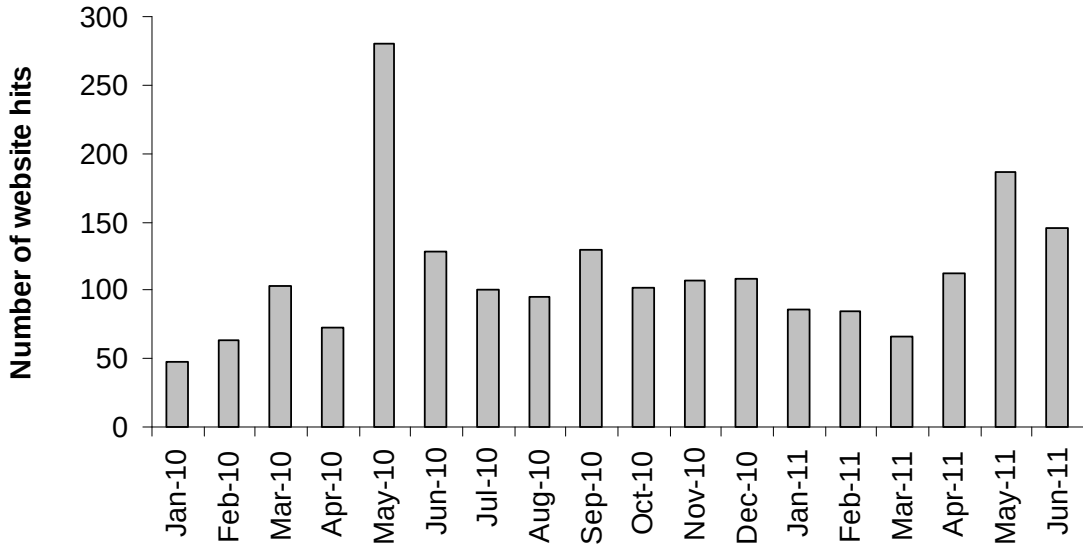



**FIGURE 15. VISITS TO THE Ō TŪ WHAREKAI WEBSITE, JANUARY 2010 TO JUN 2011.**

Community involvement and awareness

Since January 2009 a monthly email update has been sent to over 120 stakeholders, groups and interested people. This forum is an up-to-date and interactive way of providing information and engaging with community members.

Ō Tū Wharekai holds 1–2 working bees, such as planting days, each year,. In summer 2010–11 a summer programme was piloted, which successfully attracted 83 people to three events. Information was presented at a number of A&P shows but was considered an ineffective way of engaging with the community.

The Lake Heron Community Group was formed by local landowners and community members, and they run a trapping programme around Lake Heron to protect waterfowl. Mid Canterbury Forest and Bird runs the winter waterfowl count, undertakes regular wilding pine control days and assists with other bird counts. The Lake Clearwater Hut Holders Association established a wetland restoration area adjacent to the village to filter pollutants entering the lake. The Hakatere Heritage Committee is raising funds and promoting the restoration of the historic Hakatere buildings.

Providing education opportunities at Ō Tū Wharekai can be difficult due to its isolation and lack of facilities. DOC staff overcame this by becoming involved in LEARNZ. This is a virtual learning programme that involves a week-long intensive interactive programme via the internet. LEARNZ has been run three times, with a combined total of 6215 students being involved. Ō Tū Wharekai became involved in Aoraki Polytechnic's Outdoor Recreation course, where second and third year students undertake projects and learn about conservation. Ō Tū Wharekai has also hosted interns and summer students, which has significantly contributed to the amount of work achieved.

Number of volunteers who participate in conservation projects

Volunteer hours increased almost tenfold since the projects inception (Table 15). Improved resources and connections with the community have lead to the formation of regular groups or events, which results in more sustained volunteer opportunities.

**TABLE 15. SUMMARY OF VOLUNTEER HOURS FROM VOLUNTEERS WHO PARTICIPATED IN CONSERVATION PROJECTS AT Ō TŪ WHAREKAI .**

| Volunteer group | Year | | | | Total |
|---|---|---|---|---|---|
| | 2007–08 | 2008–09 | 2009–10 | 2010–11 | |
| Forest and Bird/Kids Conservation Club | 230* | 230* | 260* | 300* | 1220 |
| Lake Heron Conservation Group | 0 | 0 | 400* | 420* | 820 |
| Aoraki Polytechnic (tertiary) | 0 | 0 | 392 | 357 | 749 |
| Internships/supervised students# | 0 | 0 | 0 | 1050 | 1050 |
| Mt Hutt College (primary) | 0 | 0 | 60 | 60 | 120 |
| Other/individuals | 70* | 90* | 306* | 186* | 372 |
| **Total** | **300** | **340** | **1418** | **2373** | **3581** |

* Some hours estimated

# Only students that require direct supervision from DOC staff are recorded

Partnerships with tangata whenua

Through the State of Takiwa programme, DOC and Te Rūnanga o Arowhenua have improved their partnership through increased collaboration in identifying cultural values and setting management objectives (refer to Objective 3 and 5).

### *Management implications*

Community partnerships and volunteer input have become an integral part of Ō Tū Wharekai's programme. In our conservation work an important role for DOC is: "sharing information and partnering with others including iwi, communities, non-government organisations, businesses, conservation boards, and central and local government" (www.doc.govt.nz/about-doc/role). Ō Tū Wharekai is a good example of how conservation outcomes can be increased through involving iwi, the community, and other stakeholders. This creates a feeling of greater ownership from the community, and then raises awareness of the plight of wetlands.

In education programmes, Ō Tū Wharekai has concentrated most of our effort into building ongoing, repeatable programmes such as LEARNZ, which tend to become better structured and more time and resource efficient than spontaneous one-off events. We plan to continue with these programmes and maintain our connection with schools and polytechnics.

## 3.3 Learning

### Objective 9: Undertake research to inform wetland management

Understanding how wetlands function, testing approaches to protect their values, and sharing this information with other wetland managers is an important part of the Arawai Kākāriki Programme. A large number of research projects have been implemented under the Ō Tū Wharekai project since 2007 and are being used to guide conservation. Some of these were led by the Department and others in partnership with agencies and universities.

A synopsis of the each research project is provided below.

A hydrological and nutrient transport balance for the Lake Clearwater catchment. *In progress* . [H. Wadworth-Watts, B. Caruso (University of Canterbury)]

Agricultural use of land can cause diffuse runoff of nutrients and sediments, and diffuse pollution from agricultural activities is a leading cause of water degradation. To investigate possible diffuse runoff from changes in land use in Ō Tū Wharekai, and subsequent risks to Lake Clearwater, a range of monitoring activities will be used to attempt to resolve the hydrology of the catchment, as well as the transport, attenuation and fate of diffuse runoff. It is hoped that the nutrient balance will be a useful tool for use in land management in the area and for similar high-country farmed areas.

The diversity of algae in streams and lakes of Ō Tū Wharekai. 2011. C. Kilroy (NIWA), R. Clucas (DOC) and C. Woods (Royal Society Fellow). ]

A periphyton survey contracted to NIWA and undertaken in the summer of 2010–11 to investigate the relationship between algal communities and habitat condition (Kilroy et al. 2011). High species richness was observed with 131 taxa identified, 77 of these diatoms. The Trophic Diatom Index (TDI) was utilised to determine the potential for algae to indicate stream condition, the first time the TDI has been used in New Zealand. The relatively high biodiversity of periphyton demonstrates a wide range of habitat and generally good ecosystem health. The results suggest lower richness in glacier-mountain streams and decreasing richness as stream order (i.e. river size) increases. The periphyton survey provided comprehensive information on the algal biodiversity in the Ashburton Basin, and is the only survey of its type for an inland high-country basin.

Ignition thresholds for grassland fuels and implications for activity controls and public conservation land in Canterbury. Heather Wakelin (University of Canterbury). 2010.[ H. Wakelin (University of Canterbury)]

Fire prevention is the primary objective for Department of Conservation's fire management regime, and requires knowledge of conditions that contribute to the greatest fire risk. The primary object of this research was to determine threshold conditions for fire ignition in grasslands and to provide a scientific basis for DOC to mitigate against wildfires. The findings suggest that hot metal parts from off-road vehicles, such as quad bikes and two-wheel trail bikes, have the potential to ignite cured grass at almost any moisture content level. Carbon emissions from open vehicle exhausts, metal sparks from maintenance activities and open flames from lighters and gas cookers are also dangerous ignition sources.

Valuation of ecosystem services of freshwater ecosystems, Phase I: Description of ecosystem services and development of Choice Experiment questionnaire: 2010 [A. Giorgetti (Enveco), H. Robertson (DOC)]

This research project involving Enveco, Scion and DOC focused on gaining a better understanding of the value of the ecosystem services provided by Ō Tū Wharekai. Choice Experiment (CE), an economic valuation method, shows how individuals make trade-offs between different ecosystem services of a particular resource. The willingness-to-pay (WTP) of individuals or groups is estimated for a specified change in an ecosystem service. In Phase I of this project we undertook an extensive review of existing valuation studies and the specific issues pertaining to Ō Tū Wharekai. This produced a list of the key ecosystem services for Ō Tū Wharekai that would be suitable for economic valuation using CE. Ecosystem services were made up of both use and non-use values. Use values consist of fishing, hunting and hiking, whereas non-use values refer to the services that are unrelated to their current or planned use, such as scenic values. Phase II of this project, to be undertaken in 2012, will involve conducting the detailed economic survey. From examining the economic benefits from changes in specific ecosystem services, this will enable an estimate of the net economic benefit of different management options at Ō Tū Wharekai in a cost benefit framework.

Paleoecological research project in Ō Tū Wharekai, Ashburton basin wetlands and lakes. *In progress.* [J. Shulmeister, A. Staniland (University of Queensland]

The aim for this research is to provide a detailed historical description of the terrestrial and aquatic ecosystems at Ō Tū Wharekai, which subsequently informs the identification of restoration targets. Analysis of deep sediment cores removed from Ō Tū Wharekai lakes and wetlands are used to assess the changes in vegetation, fires, hydrology and trophic status over the past 10,000 years. The work addresses vegetation succession and climate history, and the frequency of natural and human-induced fires.

Interaction between water flow and predation risk by introduced mammalian predators on the Rangitata. *In progress.* [G. Pickerell (Otago University)]

It is assumed that by breeding on islands in braided rivers, threatened river-bird species are afforded some level of protection from mammalian predation, but it is unknown how this may be affected by a reduction in water flow around islands. The basic aims of the PhD are to investigate the importance of the 'Safe Island' concept for braided river birds. In particular, it aims to describe the mammalian predator guild of the Rangitata River and to consider what characteristics of braided-river islands best explain the presence of mammalian predators, whether this is related to the breeding success of birds, and to predict how this may be affected by changes in water flow.

Native vegetation recovery after willow control. *In progress.* [H. Robertson (DOC), K. Bodmin (NIWA)]

A study commenced in 2010 on the impact of willow control on native wetland vegetation. An array of permanent vegetation monitoring plots will help determine the effect of aerial willow spraying on native vegetation alongside and underneath mature willows. This research will examine the survival rates of native vegetation immediately after aerial herbicide spraying and the subsequent regeneration rates, with links to similar projects at other wetlands in New Zealand.

Determining the impacts of hydrological processes and weed invasion on kettlehole turf vegetation. *In progress*. [K. Lange, N. Head (DOC), M. Davis (Freelance Ecologist)]

Kettleholes are a geomorphologic feature of fluvio-glacial landscapes that occur within Ō Tū Wharekai. They form ephemeral wetlands during late winter and spring and have a diverse associated turf flora that is uniquely adapted to survive annual inundation of water and ice. Water depth and duration of inundation are thought to be critical factors influencing species assemblages. The details of how this process works, however, are largely unknown. Weed invasion is the primary threat to the turfs and is facilitated by disturbance created through, for example, animals (pugging and grazing), vehicles and motorbikes. It is not fully understood, however, what effect various weed species will have on kettlehole turfs within Ō Tū Wharekai in the absence of disturbance from cattle and sheep.

Monitoring was implemented in 2009 at eight kettlehole sites within Ō Tū Wharekai (four in the Clearwater moraines and four in the Heron moraines). This comprises annual vegetation monitoring and water level monitoring. Over time, this monitoring will provide important information about the extent of weed colonisation in the absence of stock grazing and provide information on changes in threatened and at risk plant populations. Vegetation data will also be able to be correlated with the seasonal variation in water levels.

Global change and the persistence of invertebrates in Canterbury high-country wetlands. *In progress*. [M. Galatowitsch (University of Canterbury)]

Glacial lakes, ponds and tarns dot the alpine tussock regions of the South Island high country. These habitats are known to have complex hydrology with many having unpredictable seasonal or periodic drying, many being exacerbated by global change processes (e.g. climate alterations, invasive species spread) that can influence population dynamics. This PhD research project seeks to understand the life-cycles and functional traits of invertebrate species in ephemeral wetlands and the potential impacts of climate change on these ecological communities.

## Future research

Future research priorities at Ō Tū Wharekai include:

- Investigate the impact of avian predators on wrybill and the subsequent effectiveness of control in isolation from mammalian control
- Continue to evaluate the drivers of lake trophic status, the primary threats (such as nutrient sources, perch) and identify feasible management options
- Investigate the impacts of herbivores and hydrology on kettlehole turf vegetation
- Investigate long-finned eel recruitment into the Ashburton lakes
- Quantify the impact and rate of change of sediment accumulation in the Ashburton Lakes and potential methods to reduce sediment inputs
- Continue to investigate the efficacy of selective herbicides for plant pest control
- Continue identification of high-value freshwater biodiversity sites, including the distribution and abundance of freshwater mussel populations

## Objective 10: Develop best-practice wetland restoration tools

Ō Tū Wharekai has undertaken or contributed to a number of projects to develop national tools, protocols and methodologies for wetland management. These are outlined below.

Wetland condition monitoring

The wetland vegetation and soil monitoring methods used at Ō Tū Wharekai were developed specifically for monitoring the outcome of wetland restoration actions. The methods build on the Handbook for Wetland Monitoring (Clarkson et al. 2004) and the Recce vegetation plot methodology (Hurst & Allen 2007). These methods were trialled at Ō Tū Wharekai (Bodwin and Robertson 2010) where they provided a comprehensive dataset to assess the biotic and abiotic status of the palustrine wetlands. The methods are being applied at the other sites and will be developed as national protocols by the Department.

Cryptic bird monitoring protocols

Many wetland bird species exhibit cryptic behaviour and are therefore difficult to observe or systematically survey using existing bird monitoring techniques. Species such as marsh crake can be used as an indicator to monitor wetland health and integrity, including determining whether populations of interest are stable, increasing, or decreasing and when and where management intervention is necessary. Research undertaken at Ō Tū Wharekai contributed to the development and trialling of national protocols for monitoring marsh crake (O'Donnell 2010).

Wetland mapping guidelines

Under the Arawai Kākāriki Programme a guideline for mapping wetland extent and dominant vegetation types was developed (McNutt et al. 2009). The draft guidelines were utilised as a resource to map the extent of wetlands at Ō Tū Wharekai. Experience from the wetland mapping exercise, which used aerial photos and GIS software, will inform the revision of the national guidelines.

Monitoring framework

All three Arawai Kākāriki sites are utilising a national outcome monitoring framework developed specifically for reporting on changes in wetland condition and for community involvement. The indicators used in this report represent the first comprehensive application of the NHMS-based monitoring system, and provides the foundation for monitoring the effectiveness of wetland conservation projects implemented by the Department.

# 4. Summary of conservation outcomes

An essential first step for Ō Tū Wharekai was to establish the conservation values of the lakes, rivers and wetlands of the Ashburton basin and upper Rangitata River. Extensive inventories have been undertaken on birds, fish, lizards, ephemeral turf vegetation and invertebrates. Habitat condition has been assessed using a number of methodologies. Our increased knowledge of conservation values subsequently led to focused monitoring on threatened and indicator species and habitats, and a number of permanent monitoring regimes are now established. The increase in ecosystem understanding has resulted in targeted management to protect and restore Ō Tū Wharekai.

Key highlights of the work to date include the following:

- Tenure review, land purchase and covenanting have resulted in a significant increase in the extent of wetlands protected.
- In 2011, an inventory and survey of all known kettleholes present within Ō Tū Wharekai and their associated turf communities was completed. This information has contributed greatly to our appreciation of the diversity of kettleholes and threatened flora that exists. Annual vegetation and water level monitoring that was established in a selection of kettleholes has begun to develop our functional understanding of kettleholes, which will, in turn, significantly aid management decisions.
- Our understanding of the condition of Ō Tū Wharekai streams and lakes has also substantially improved with the completion of a comprehensive periphyton survey, water quality (nutrient levels), freshwater mussel and macro-invertebrate sampling in streams and the instigation of research projects with the University of Canterbury on the vulnerability of lakes to eutrophication from changes in land use. This work will compliment efforts of the CWMS to achieve sustainable catchment management and improved management of freshwaters.
- Ō Tū Wharekai funding enabled key invasive weed species of wetlands and braided rivers, such as willow and broom, to be controlled to extremely low levels within the intensive management area. The area infested with mature weeds in 2011 reduced to <30 ha from an estimated >2500 ha in 2007. This reduction will have a substantial positive impact on the recovery and restoration potential of wetlands.
- With increased land acquired through the tenure review process, there is greater awareness of the area as well as recreational opportunities. We recorded over 5000 visitors entering Ō Tū Wharekai during December 2010 – January 2011 alone. To manage the impact of visitors, Ō Tū Wharekai produced a Recreational Plan to identify and prioritise the development of tracks and structures. An opportunity for public input provided information on community values and desires resulting in a considerable improvement of visitor facilities, while protecting the conservation values. Incidences of off-road vehicle use also decreased substantially between 2010 and 2011 through efforts to fence off important areas and educate users.

- A critical component of the project was to work in partnership with iwi in developing restoration goals and prioritising work. The first step in this process was to undertake an inventory of cultural values. This work was done by Te Rūnanga o Arowhenua with Ngāi Tahu consultants. Following this work, an assessment of environmental health was completed focusing on the potential for cultural harvest opportunities using State of Takiwa methodology. DOC and Te Rūnanga o Arowhenua are now working towards progressing the recommendations.
- Increased partnerships with stakeholders and community groups have led to greater conservation achievement. Initially, volunteer involvement tended to be limited to a few keen individuals, but over the four years of the project a significant increase in volunteer participation was recorded, leading to better awareness of the area and wetland values. Volunteer output is now equivalent to 30% of a full time equivalent (FTE) staff member.
- The education programme has been developed and the project is included in the curriculum for one local primary school and one tertiary institution. Through establishing LEARNZ, education opportunities have been made available to over 6000 students from around the country. Greater integration with universities has led to more research opportunities being achieved, leading to increased understanding of systems and better conservation outcomes from management.
- Ō Tū Wharekai produced a tactical fire management plan, which is a directive to guide fire prevention and control strategies. Developing fire plans is a national goal and the Ō Tū Wharekai plan was the first of its kind. This plan piloted the methodology and information required for such a plan.
- There has been considerable development of site infrastructure to aid research and management in the area. A building within the Hakatere Historic building complex was converted to a staff house, a weather station was installed at the head of Lake Heron and water level recorders have been installed in many kettleholes and streams.

Lake Heron Conservation Group and Aoraki Polytechnic students clearing and rebaiting traps. Photo: G. Iles.

# Future directions

The last four years of work in Ō Tū Wharekai has resulted in detailed understanding of the ecosystems, species and cultural and social values the area supports, and the threats to these values without further management intervention. While the weed control and visitor programmes have achieved notable results, more effort is needed to conserve other internationally significant features at Ō Tū Wharekai. Future work is needed to build on the achievements to date and further the success of this project, while informing other wetland projects on and off public conservation land.

Key directives for future work at Ō Tū Wharekai are:

- The prioritisation of ecosystem and species conservation by the Department is establishing a set of management sites across New Zealand that will form the basis for much of DOC's natural heritage delivery in future years. This process has identified key habitats within Ō Tū Wharekai as priority ecosystems for wetland/freshwater conservation. Ō Tū Wharekai will be working on building these prescriptions into the work plan. The following species and ecosystems have been identified as high priority:
    - Wrybill/ngutu pare: To protect wrybill, Ō Tū Wharekai needs to continue to advocate for sustainable river flows, and maintain adequate habitat by ongoing weed control; investigate management tools such as aerial predator control; and support proposed or existing trapping programmes, i.e. Contact Wind Ltd (upper Rangitata River) and ECan (upper South Ashburton River).
    - Australasian bittern/matuku: Ō Tū Wharekai needs to establish an estimate of the local bittern population. Work such as fencing wetlands from stock, revegetation of riparian margins and wetlands and improving/maintaining water quality will benefit bittern.
    - Upland longjaw galaxid: Ō Tū Wharekai needs to continue to determine the extent of this population, the rate of decline and identify options to reduce threats. Advocating for prevention of the spread of didymo is crucial.
    - Ephemeral turfs containing a number of high priority threatened plants: While many ephemeral turfs are situated on public conservation land, they are still at risk from lagomorphs and weed invasion. Ō Tū Wharekai needs to continue to investigate methods of reducing these impacts.
    - Inter-montane lakes and wetlands: Ō Tū Wharekai needs to continue to apply management such as weed control and fencing where required; monitor water quality; and establish tools to prevent or reduce sediment and nutrient inputs.
- Ō Tū Wharekai has significantly invested in controlling weeds such as grey and crack willow, broom and Russell lupin. With continued investment, there is a good chance of eradicating grey willow from Ashburton lakes and Russell lupin from the headwaters of the upper Rangitata River. Broom and crack willow will continue to persist and establish, but with ongoing surveillance and control, these weeds can be maintained to levels low enough have minimal impact on wetland and river ecosystems. If control was to cease, it is probable that these weeds would quickly reach original extent and invade new habitats.

- Ō Tū Wharekai is the source catchment of both the Rangitata and Ashburton rivers and to some extent the Rakaia River. These waterbodies are key regional economic drivers—valued in the community for economic, recreational and conservation values. As braided river systems they are internationally significant for their geo-morphological and conservation characteristics. Water quality in the lower Ashburton River catchment has been shown to be under threat from over allocation and high rates of diffuse run-off from agri-farming activities. The Ashburton Zone Implementation Plan (ZIP) identifies Ō Tū Wharekai as an area of high priority for maintaining water quality into the upper catchment. Working in partnership with regional council and landowners to implement innovative freshwater management projects at Ō Tū Wharekai is seen as critical to achieving sustainable land use practices that maintain the freshwater values.
- Maintenance of relatively intact freshwater systems is also essential for ensuring the ongoing protection of aquatic species at Ō Tū Wharekai, such as longfin eel/tuna. The ecological integrity of the Ashburton River system supports the migration of eel/tuna, among other species (e.g. kōaro, torrent fish) to and from Ō Tū Wharekai. We will continue to inform regional planning processes by sharing our understanding of the catchment processes that influence the lake, river and wetland ecosystems.
- Community input has been crucial to the success to the project to date and will continue to be important in the future. It is recognised that conservation of some local iconic species such as Australasian crested grebe/kāmana may become more reliant on community groups. Further, there is potential for community support to restore the historic Hakatere Buildings, by assisting with building recreational facilities, planting and weed removal. There may also be opportunities for business input. A key aim for Ō Tū Wharekai, therefore, is to continue to build on raising awareness and increasing support from the community.
- The State of Takiwa projects have been instrumental in identifying restoration and management goals, as well as building the relationship between the Department and Te Rūnanga o Arowhenua. A high priority is to progress the recommendations from this work. This may include the Department helping to raise the capacity of the rūnanga members through training, work experience and job opportunities, achieving the goals of both partners.
- To aid visitor experiences and promote the conservation, historic and cultural values of the area, Ō Tū Wharekai is currently developing an interpretation and signage package in situ, and comprehensive information based at the historic Hakatere buildings, which are being developed as a gateway to the Ashburton lakes. This work is due to be completed early 2012.
- The LEARNZ virtual learning programme, Aoraki Polytechnic Outdoor Recreation course and other education opportunities were recognised for their ability to raise awareness of freshwater conservation values. Ō Tū Wharekai aims to continue to invest in these initiatives that reach over 5000 students.

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# Appendices

## Appendix 1: Rare plants of Ō Tū Wharekai

| Species | Status | Survey |
|---|---|---|
| *Coprosma intertexta* | Relict | Davis, 2011 |
| *Agrostis subulata* | Naturally uncommon | Davis, 2011 |
| *Botrychium australe* | Naturally uncommon | Davis, 2011 |
| *Carex berggrenii* | Naturally uncommon | Davis, 2011 |
| *Carex decurtata* | Naturally uncommon | Davis, 2011 |
| *Centrolepis minima* | Naturally uncommon | Davis, 2011 |
| *Juncus pusillus* | Naturally uncommon | Davis, 2011 |
| *Lobelia perpusilla* | Naturally uncommon | Davis, 2011 |
| *Montia angustifolia* | Naturally uncommon | Davis, 2011 |
| *Pilularia novae-hollandiae* | Naturally uncommon | Davis, 2011 |
| *Ranunculus maculatus* | Naturally uncommon | Davis, 2011 |
| *Eleocharis pusilla* | Data deficient | Davis, 2011 |
| *Leptinella maniototo* | Data deficient | Davis, 2011 |
| *Ranunculus macropus** | Data deficient | Davis, 2011 |
| *Rytidosperma thomsonii* | Data deficient | Davis, 2011 |

* Record requires confirmation