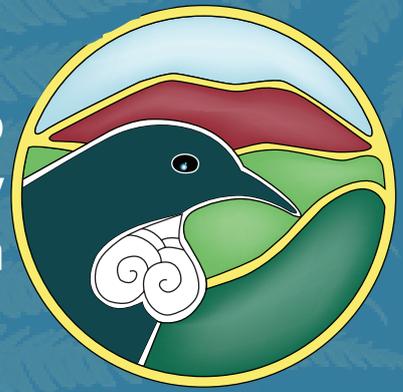


Waikato  
Biodiversity  
Forum



**Restoring**  
**Waikato's**  
**Indigenous**  
**Biodiversity:**  
**Ecological Priorities and Actions**





# THE WAIKATO BIODIVERSITY FORUM

Concern for the Region's biodiversity loss led to the establishment of the Waikato Biodiversity Forum in 2002.

The Forum is made up of representatives from research and management agencies, iwi groups, private landowners and community groups who are interested in enhancing native biodiversity in the Waikato Region. It provides a link for biodiversity work across the Waikato region and is an independent, non-statutory body that shares a common philosophy of working together to improve biodiversity.

The Forum's region of interest extends down to the northern slopes of the Tongariro National Park, across to Mōkau on the west coast and up to just north of Port Waikato and includes the Coromandel Peninsula and land west of the Kaimais.

Two part-time coordinators manage the Forum's projects in liaison with a focus group. The focus group has a broad membership, with representatives drawn from the research and management agencies and community groups who belong to the Forum. Actions the Forum takes to reach its vision include:

- encouraging agencies and groups to network, share ideas and work together to protect and enhance biodiversity
- advocating for the development of sound policy to enhance biodiversity protection at national, regional and local levels
- organising forums to discuss biodiversity issues and offer support and recommendations in relation to local projects
- organising workshops for community groups on a variety of topics such as pest control
- raising awareness of the importance of biodiversity through the media, the Forum's website and presentations to groups
- acting as a referral agency for biodiversity information such as pest management
- providing funding advice to community groups and organisations
- maintaining a database of community biodiversity projects.

To join the Waikato  
Biodiversity Forum, visit  
[www.waikatobiodiversity.org.nz](http://www.waikatobiodiversity.org.nz)

## WHAKATAUKI

*Poipoia te mauri  
poipoia te wairua  
poipoia te tapu  
poipoia te hā  
o te Wao tapu nui o Io*

*Nurture the life-force  
nurture the spirit  
nurture the sacredness  
nurture the heartbeat  
of the gifts of the  
creator*

## Joe Harawira

*Director-Strategic Partnerships/Treaty Te Putahitanga, Kahui  
Kaupapa Atawhai*



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QEII

University of Waikato-Biological Sciences



# **SECTION 1:** introduction



# BACKGROUND

The Waikato region's natural environment is made up of diverse ecosystems, plants and animals. However, much has changed since people have settled here. The Waikato is one of the regions with the greatest indigenous biodiversity loss in New Zealand. While indigenous vegetation still covers 25 per cent of its former area in the region, it is concentrated in large patches gracing prominent peaks or fringing ranges. Indigenous forests, scrub and wetlands on the extensive lowlands have been almost completely removed or drained over time, leaving vast expanses without indigenous character. Along the coast, very few of our region's beaches are undeveloped. Promoting any indigenous vegetation or ecosystem establishment in these areas will mean a positive improvement in biodiversity.

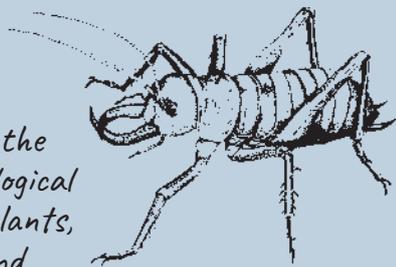
## PURPOSE OF THE DOCUMENT

This document is a project of the Waikato Biodiversity Forum. At the first Forum meeting in May 2002 one of the major recommendations was for the Forum to develop a biodiversity restoration 'opportunities' document to provide a framework for identifying key priorities for biodiversity restoration across the Waikato Region. The priorities and actions highlighted in this document are viewed as the ultimate collaboration of Forum members.

The purpose of this document is to:

- raise awareness of the need to restore rare and depleted indigenous ecosystems across the Waikato Region.
- support and empower communities to undertake ecosystem restoration and contribute to biodiversity protection and enhancement in the Region.
- guide local groups and management agencies who want to prioritise restoration activities and projects across the Region.
- provide an overall context for the many restoration projects already completed or underway and for new restoration projects that may be undertaken in the future.
- provide options for securing a better representation of all ecosystem types across the region.

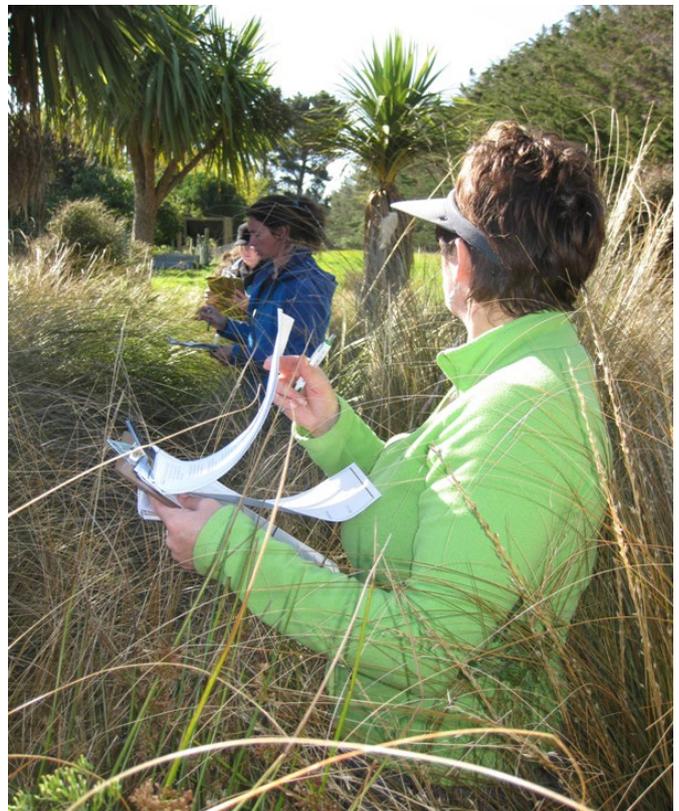
*Biological diversity, or "biodiversity" for short, describes the variety of all biological life - species of plants, animals, fungi and micro-organisms - the genes they contain and the ecosystems on land or in water where they live. It is the diversity of life on earth.*



*From "The New Zealand Biodiversity Strategy",  
Department of Conservation, 2000*

## HOW TO USE THIS DOCUMENT

This document highlights priorities and actions for restoring depleted ecosystems across the Waikato region. It also identifies ecosystems that are in most need of restoration. More importantly, it provides a context of indigenous ecosystem restoration in the Waikato, so that people who want to be involved in restoration projects can see where they fit into the bigger picture.



*Citizen Science - monitoring a wetland - Monica Peters*

This document can be used alongside organisational plans (such as iwi management and local authority plans) to help organisations in their ecological restoration work. The focus is on the ecological perspective, but it is written with the understanding that cultural and community goals and aspirations are a vital part of restoration work.

If you are planning a restoration project, use the diagram on **page 9** to find the most relevant sections of this report for your project.

## CHOOSING A RESTORATION SITE

This diagram will help you use the sections in the document which best suit your needs in choosing and undertaking a restoration project.

Which of the following best describes your situation?

You already have a site in mind, whether it's on your own property or a local reserve

Go to the page in **section 4** for your particular type of ecosystem and use the **Choosing Actions table** to decide what to do in what order to restore your site.

You have several sites of the same type (e.g. several bush blocks on your land) you would like to improve, but can only do one at a time and are unsure where to start

Use **Table 1** on **pages 11 and 12** to score each of your sites to help you decide which site to choose first. Then use the **Choosing Actions table** in **section 4** for your ecosystem type to decide what to do in your site

You would like to undertake a restoration project in a particular ecosystem type (for instance wetlands), but have no specific location in mind

Go to the page in **section 4** for your particular type of ecosystem. Read the section on which type of your ecosystem is most depleted or at risk.

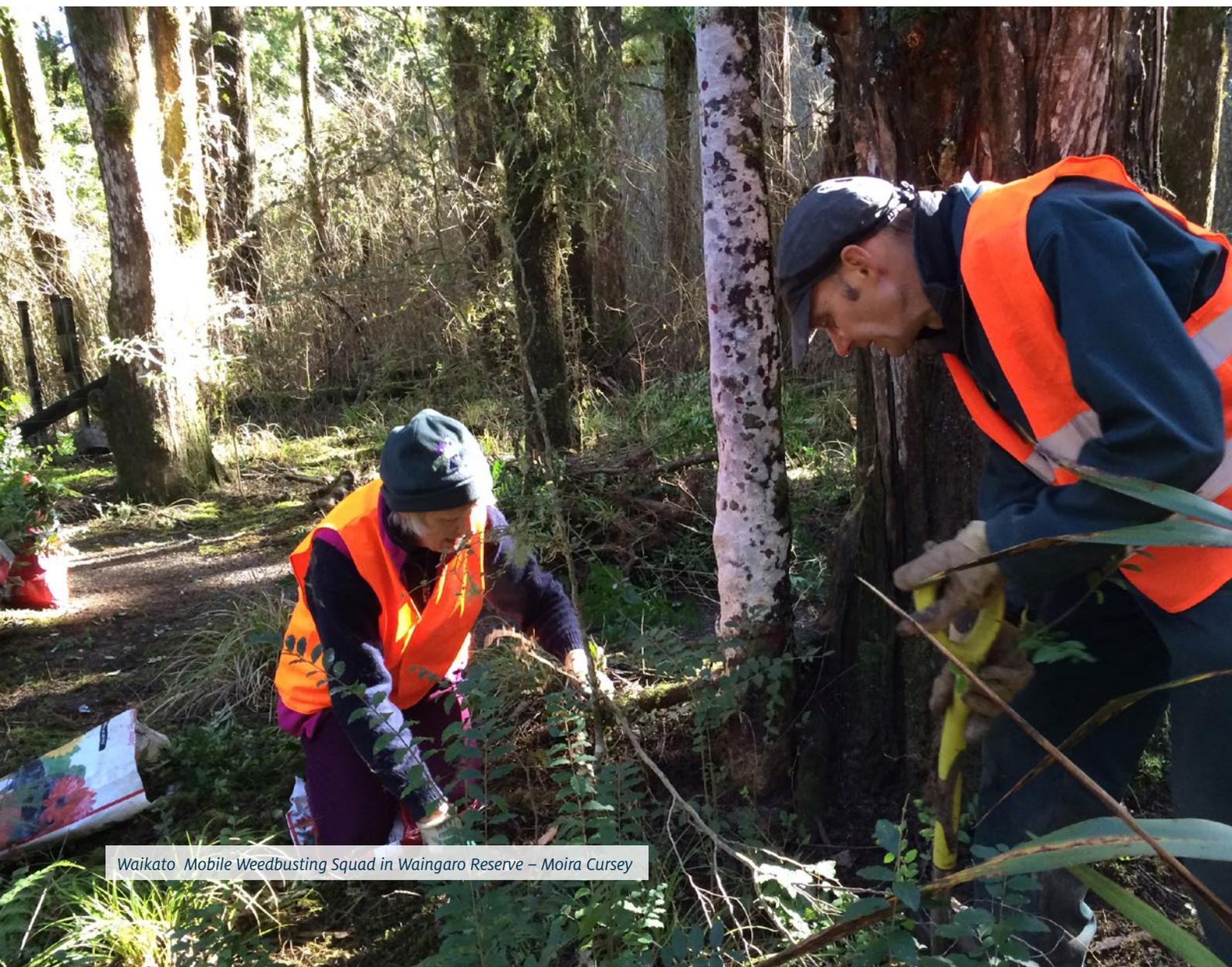
Make a shortlist of sites and use **Table 1** on **pages 11 and 12** to score each to determine your priority

You would like to undertake a restoration project, but have a wide range of options, and you are unsure which are priorities

Read through the restoration priorities in **sections 2 and 3** to learn more about the threats that each faces and the types of ecosystem at greatest risk to help you decide which ecosystem type to tackle.

You might be a local council or a conservation-minded organisation with a wide geographic area of interest and interested in a wide range of ecosystems

Use **Table 1** on **pages 11 and 12** to choose between similar sites, and the **Choosing Actions table** in **section 4** to decide what to do. Seek professional advice on selecting priority ecosystems. The Waikato Biodiversity Forum has many members with appropriate expertise.



Waikato Mobile Weedbusting Squad in Waingaro Reserve – Moira Cursey

The table on the next two or three pages has been designed to help you choose the best site to start on if you have a range to choose from. Start at the top of the table and systematically consider each of the features in turn and score them individually. Do this exercise separately for each of the sites under consideration.

Do not follow the scoring results slavishly but use them as a guide for making your decision. Remember, there may be certain factors that are not easily quantified and which may be important in your final decision. Some factors may be more important than others, depending on each situation. Compare your results with someone else to see that there is consistency and comparability of the results.

Once you have completed this exercise, or even as part of completing this exercise, you will need to consider more specifically

the information provided on each of the eight major ecosystems within the Waikato. For each one a brief description of the distribution, pattern and past history of the type is given, followed by an identification of the key threats and the future priorities for restoration. A template follows this, to assist you in deciding on which restoration actions need to be undertaken and to determine their priority. Again, you need to systematically consider each of the action points listed and compare and discuss your results with others in your project team.

Before undertaking any restoration project it is necessary to consult with tangata whenua and locals as to the cultural and recreational value of the site.

**Table - 1. Choosing a priority restoration site**

Score each of the sites you have in mind to find out which is the highest priority. The higher the score the more significant the site is for restoration as a general rule. Use the one page blank template (Appendix 1) to help you with this process.

FEATURE	COMMENTS	SCORE	
<b>SIZE</b>	Generally larger sites are able to support more species, a variety of habitats and larger populations. However, if the site is extremely large you may find it too difficult to manage adequately - only include sites you feel you can manage in this assessment.	Largest site	5
		Medium site	3
		Smallest site	1
		<b>SCORE</b>	
<b>SHAPE</b>	The 'rounder' or 'squarer' a site is, the less 'edge' it has. This is important for practical reasons if the site needs fencing, but also to minimise 'edge effects' such as damage from wind, grazing animals and pests and weeds.  However, many natural areas are naturally long and skinny, such as riparian zones and gully wetlands as they follow waterways. Only compare similar types of site (for example, don't compare a square peat bog with a skinny gully wetland). When comparing naturally skinny areas, still look for sites with wide zones. Note also that open water bodies with irregular shapes are better than round ponds with no bays.	Round/square	5
		Irregular	3
		Linear (skinny)	1
		<b>SCORE</b>	
<b>VULNERABILITY</b>	The vulnerability of an ecosystem relates to its susceptibility to modification and especially to any weakness in an ecosystem that allows for attack from disease and pests. An ecosystem that is highly vulnerable has a greater likelihood of deteriorating in condition compared to one of low vulnerability. Ecosystems which have a high vulnerability to deteriorating in the short term could include a coastal kohekohe forest which has a high population of possums. An ecosystem with a medium vulnerability could include a wetland with weeds on the margin which have the potential to spread further into the site. Sites of low vulnerability are frequently of either very low or very high quality. High quality sites with low vulnerability include natural areas which are largely unmodified, have low levels of introduced plants and animals, and are either large in size or well buffered by adjacent natural areas.	High	5
		Medium	3
		Low	1
		<b>SCORE</b>	
<b>CONNECTIONS TO OTHER NATURAL AREAS (E.G. FOREST, SCRUB, DUNES)</b>	Natural areas that are within or next to another area of forest or scrub, or other natural feature, enable you to manage several habitats at one location. Habitat mosaics are beneficial for wildlife that use several habitats. Natural areas can buffer each other, e.g. wetlands next to forests are already well buffered from run-off and 'edge effects'.  Natural areas that are connected to other natural areas allow movement of species so for instance animals can access a greater source of food and can find a suitable mate.	Touch	5
		Close to	3
		Far away from	1
		<b>SCORE</b>	
<b>HABITAT COMPLEXITY (DIVERSITY)</b>	Sites that have a range of habitats, such as wetlands with open water, dense vegetation, islands, and different vegetation types such as kahikatea forest, manuka scrub, sedges and reeds, will enable a greater variety of plants and animals to live there. Bandy rivers without stopbanks offer greater variety of habitat than straight controlled rivers.	Touch	5
		Close to	3
		Far away from	1
		<b>SCORE</b>	

FEATURE	COMMENTS	SCORE	
<b>SPECIAL FEATURES</b>	Does the site have any rare plants or special population of native animals that you know of? Is it a particularly rare or at risk ecosystem type or does it support an unusual community type even if there are few species? The Department of Conservation (DOC) or local council staff can help you with information. Also consider cultural values (features of special significance to iwi) and special landforms (such as limestone outcrops).	Many features	5
		Some	3
		None	1
		<b>SCORE</b>	
<b>IDENTIFIED AS A SIGNIFICANT NATURAL AREA (SNAS)</b>	These are sites (generally above 0.5hectares in size) which have been identified as SNAs by the Waikato Regional Council and by District Councils (Hamilton, Matamata Piako, Taupo and Rotorua district councils). The councils have identified SNAs as areas that meet one or more criteria for significance in the Waikato Regional Policy Statement. Contact local councils for the most up to date SNA ranking information.  Please note:do not include the SNA scoring if your site is already covered by connections to other natural areas, habitat diversity or special features.	High	5
		<b>SCORE</b>	
<b>ACCESS</b>	You will need to visit the site regularly and carry equipment to it. You will find more eager volunteers if the site is easy to reach, especially by car. If the site is virtually inaccessible it may not be a good candidate for a community management project. Note that wetlands can be hard to access during rainy periods and geothermal areas can be highly dangerous at any time.	Good access	5
		Moderate	3
		Poor	1
		<b>SCORE</b>	
<b>MANAGEMENT NEED</b>	If the site does not have any management needs, or is being looked after already, then it is not a high priority for action. Check that each site is legally protected, secure from stock, weed/pest-free. Check with DOC and your local council to find out if they are doing any pest control.  If the site has huge and expensive management needs, and an uncertain future, it may not be worth including in this assessment.	Low	5
		Moderate	3
		High	1
		<b>SCORE</b>	
<b>COMMUNITY/ CULTURAL ENTHUSIASM</b>	Some sites may be seen as a potential project by a community group or iwi. These sites may include school forest restoration in school grounds or planting an urupa site.	High	5
		Moderate	3
		Low	1
		<b>SCORE</b>	
<b>OWNERSHIP</b>	This is a difficult issue to score, so use your intuition. In general if the site is a public reserve more people will be able to enjoy the fruits of your labour and more people may be willing to help out. If the site is a covenant (such as a QEII open space covenant) or in some similar form of legal protection your hard work is more secure - a future landowner can't destroy the site and ruin your efforts.  Also consider the number of owners. It may be more difficult to get a large number of people to agree to look after the wetland - but then if you are successful you have a lot more potential helpers! Information on ownership can be obtained from the district council.	Public reserve	5
		Private covenant	3
		Unprotected	1
		<b>SCORE</b>	
<b>TOTAL SCORE</b>	Look at your total scores, but use your intuition as some features may turn out to be more important than others. A site with 838-0031 a high score with poor access may not be your best bet. A site with a low score may have some very important special features that you wish to protect. The scores are to guide your decision making, not make the decision for you.		

## Significant Natural Areas

The Waikato region has a large number of Significant Natural Areas (SNAs). These are areas of natural habitat that meet one or more criteria for significance in the Waikato Regional Policy Statement. Some of these areas contain threatened species or rare types of habitat that make them more important relative to other natural areas without these features. Identification of SNA is an important step in managing the region's natural heritage, protecting threatened species from the risk of extinction, reconnecting fragmented ecosystems, and meeting the requirements of the Resource Management Act 1991. Significant natural areas provide us with a wide range of ecosystem services, including habitat for native plant and animal species, flood or erosion control, providing oxygen, helping to regulate climate, and scenic appeal. Identification of SNA is carried out by the Waikato Regional Council and involves a comprehensive assessment of the region by ecosystem type in collaboration with each district council: terrestrial, wetlands, lakes, marine and coastal, geothermal, rivers and streams, and karst. These areas are then assigned a level of significance (international, national, regional, local) to enable prioritisation of resources when assisting in the protection of these areas. The regional council and district councils then decide how to protect or better manage SNA in consultation with relevant landowners. This may include the use of rules in district or regional plans as well as funding and assistance by way of rates relief, pest and weed control or fencing.

For information on Significant Natural Areas in your district go to the following websites

[www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Biodiversity-Significant-Natural-Areas/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Biodiversity-Significant-Natural-Areas/)

Datasets can be downloaded from the following website (look for "Significant Natural Areas" in the list):

[www.waikatoregion.govt.nz/Environment/Environmental-information/REDI/Land/](http://www.waikatoregion.govt.nz/Environment/Environmental-information/REDI/Land/)

## Community participation

The restoration of Waikato ecosystems would not be possible without the contribution and support from community groups and interested individuals. There is an amazing amount of energy going into many different sites across the region.

The Nature Space website contains information about the community groups in the Waikato region. [www.naturespace.org.nz](http://www.naturespace.org.nz). The website holds information on the groups, their contact details and a marker flag over their project/s location.

The variety of projects are great examples of what can be achieved by community groups and private landowners and management agencies across the region to restore ecosystems. If one group or individual can make this difference, imagine what the Waikato region would look like if lots of people were planting stream banks, fencing bush and protecting sand dunes.



Future generation lending a helping hand – Blair Dickie

## Restored ecosystems - before and after

Below are photos of ecological restoration projects that show what community groups and private landowners and management agencies across the Waikato region can achieve to restore ecosystems.



*Mangaiti Gully Hamilton planting 2012 – Rex Bushell*



*Mangaiti Gully Hamilton planting 2013 – Rex Bushell*



*Mangakotukutuku Stream Hamilton 2011*



*Mangakotukutuku Stream Hamilton 2015*



*Mokau Beach planting*



*Mokau Beach after planting*



*Pauanui Beach before restoration*



*Pauanui Beach after restoration*

# **SECTION 2: BIODIVERSITY**

New Zealand's  
unique biodiversity



New Zealand's plants and animals have developed during 80 million years of isolation. Our islands are fragments from the super-continent of Gondwana. Our species are the products of evolution on our isolated islands, and are so distinctive that scientists have described New Zealand as the closest one can get to studying life on another planet.

High percentages of New Zealand's indigenous species are endemic (they are found nowhere else on earth)<sup>1</sup>. Other species are referred to as indigenous species as they occur naturally in New Zealand but may be found in other countries.

According to the Environment Aotearoa 2015 report published in October 2015, New Zealand has the second-highest level of endemism for vertebrates including birds, mammals and amphibian species in the world, only exceeded in the Madagascar and Indian Ocean Islands region.

Over 90 per cent of New Zealand's insects, 84% of freshwater fish, 82 per cent of ferns, conifers and flowering plants, 32 per cent of bird species, all 60 reptiles, four remaining frogs and two species of bat are endemic<sup>2</sup> (see Figure 1: Made in New Zealand).

The uniqueness of much of New Zealand's biodiversity means the responsibility for its continued existence is entirely up to New Zealanders; it cannot be conserved in nature anywhere else. New Zealand has lost a significant proportion of its indigenous biodiversity and is still losing species. Many indigenous species face extinction including 81 per cent of bird species that breed in New Zealand (known as resident species), 72 per cent of freshwater fish, 88 per cent of reptiles, 100 per cent of frogs and 27 per cent of our resident marine mammal species<sup>3</sup>. Since 2005 the threat increased for 7 per cent of our threatened freshwater, land and marine species.

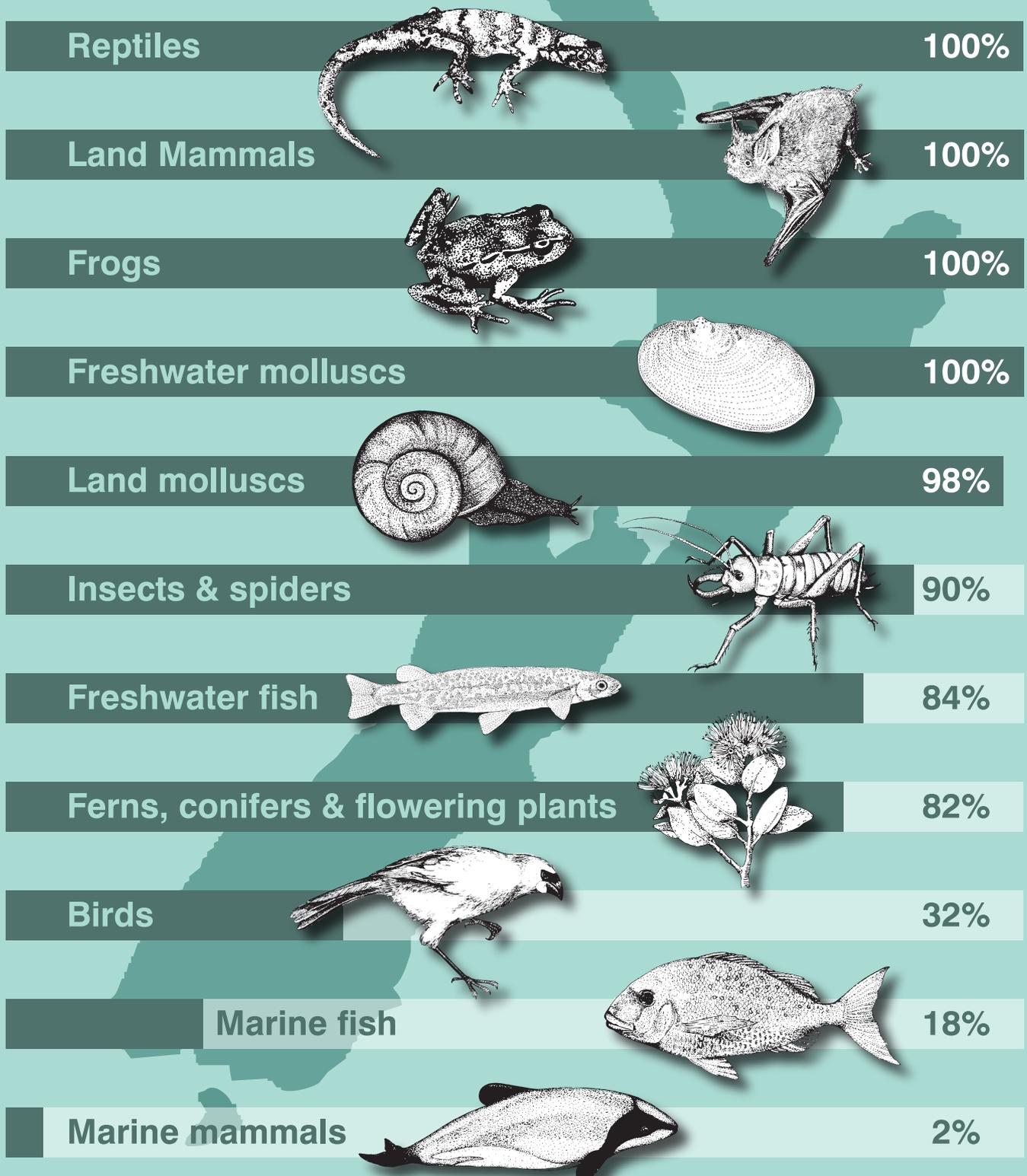


New Zealand Falcon – Neil Fitzgerald

1 This includes New Zealand's endemic birds that breed only in New Zealand but which may disperse to other countries in the non-breeding season or as sub-adults.  
2 Environment Aotearoa, Ministry of the Environment and Statistics New Zealand, 2015.

# Made in NZ

## Percentage of native species unique to New Zealand



Data sourced from Department of Conservation, New Zealand Threat Classification System. Illustration copyright: Sonia Frimmel (What's the Story?)

Figure - 1. Made in New Zealand

# MAJOR LANDSCAPES OF THE WAIKATO REGION

The Waikato region, New Zealand's fourth largest, covers about 2.5 million hectares and has 1,195 km of coastline. There are four distinct landscapes: the Taupo volcanic zone, the Waikato and Hauraki lowlands, the western hill country and the eastern Coromandel ranges (see Map 2: Major landscapes of the Waikato region).

The landscapes of the Waikato reflect a long and turbulent history of change. Active volcanoes feature in the south (Tongariro National Park) and reach higher altitudes than anywhere else in the North Island. Fumaroles and heated soils signal the geothermal activity closely tied to the edge of the Pacific Plate.

An extensive wetland area covering the lower Waikato began forming 17,000 years ago when a volcanic eruption changed the course of the Waikato River from the Hauraki Plains to the Waikato Basin. Blocked by ash, the river spread out into a huge fan across the flat Waikato landscape, gradually forming channels in the newly

formed surface. Eventually the river consolidated in its present channel, leaving a complex of lakes and swamps on either side. Lake Taupo and its massive caldera mark the site of some of the world's most devastating eruptions that only 1800 years ago mantled most of the landscape with volcanic ash and pumice and started another phase of wetland development.

Dormant and long extinct volcanoes are found in central and northern parts of the region, especially in the Coromandel. Wild windswept black sand beaches characterise the west coast, while white sand and sheltered estuaries and bays characterise the east. Numerous small offshore islands are a feature of the Coromandel Peninsula. Uplifted ranges of greywacke, interspersed by alluvium and peat filled basins and incised by the mighty Waikato, Waipa and Waihou rivers cover much of the central area. In the west, ancient uplifted blocks of limestone feature in the Waitomo and Limestone Downs district south of Port Waikato.

*Tongariro National Park landscape – Moira Cursey*





Map - 1. Major landscapes in the Waikato region

Elevation data derived from National Topographic Database, Land Information New Zealand; copyright reserved. Relief image supplied by Terralink NZ Limited; copyright reserved.

# Indigenous Ecosystems of the W

Figure - 2. Figure Indigenous Ecosystems of the Waikato Region 2016



# Waikato Region

An illustration of the Waikato Region landscape. It shows a winding river flowing through a lush green valley. In the foreground, there are tall grasses and a blue bird with a red beak. The middle ground features a dense forest of various trees and plants. In the background, there are rolling hills and snow-capped mountains under a blue sky with a white cloud. Three numbered circles (1, 2, 3) are placed on the landscape to indicate different ecosystem types.

## 1 Native Forest and Scrub

Once heavily forested, today only 26% of the Waikato Region (around 620,833 ha) remains in native vegetation (mostly forest and scrub), fragmented into thousands of patches. Most of these remnants are in hill country; only 18% of pre-European vegetation is left in the vast lowland area, and only 5% in the coastal zone. Most areas of scrub on hillsides are regenerating back into native forest. Forests are home to many species of native birds, reptiles, frogs and bats.

## 2 Swamps and Bogs

Wetlands once covered 5% of the Waikato Region (108,000 hectares) but agricultural drainage reduced this to 1%. Waikato freshwater wetlands include peat domes, moderately fertile wetlands (with kahikatea, manuka, or sedges) and raupo / harakeke (flax) swamps. They are home to many unique and threatened plants and animals including the giant cane rush, Australasian bitterns, and giant kokopu.

## 3 Streams, Rivers and Lakes

The Waikato hosts several freshwater icons, including our longest river and largest lake. Lake Taupo provides valuable habitat for indigenous fish and invertebrates. Nearby streams and rivers support endangered species such as the blue duck. The Waikato River (425 km long) and its associated wetlands, streams and lakes, supports a diverse range of indigenous fish.

## 4 Beaches and Dunes

Only a few beaches in the Waikato Region are undeveloped and coastal subdivision puts pressure on the coastline's natural character. The removal of dune plants such as pingao and spinifex has led to the loss of the protective buffer dunes provide against erosion and flooding, and valuable habitat for dune birds, lizards and invertebrates.

## 5 Marine and Estuarine Ecosystems

The 1195 km Waikato coastline includes the exposed west coast, the Firth of Thames and the sandy beaches and inlets of the Coromandel Peninsula. It is home to a diverse range of species including the endangered Maui dolphin. Some 35 estuaries, comprising seagrass beds; mangroves; saltmarshes; sand and mud flats; rocky reefs and shallow open water, provide feeding, spawning and nursery habitats for many fish, shellfish and birds.

## 6 Coastal Islands

Many small islands and rocky stacks stand offshore from the Coromandel Peninsula, including Cuvier, and the Mercury and the Aldermen Islands. Some of these are refuges for animals and plants that are now extinct on the mainland, including tuatara and North Island saddleback. Gannet Island off the coast of Aotea Harbour is an important breeding ground for NZ fur seals and Australasian gannets.

## 7 Geothermal Ecosystems

The Waikato Region contains almost 80 percent of New Zealand's geothermal systems, comprising springs, seeps and streams, geysers, sinter terraces, colourful lakes, superheated fumaroles and hydrothermal eruption craters. Geothermal areas are home to unique plants, animals and bacteria with many primitive and ancient species.

## 8 Karst (limestone) Ecosystems

Karst habitats and landscapes are found in the western hill country from Port Waikato to Mokau. Rainwater dissolves limestone creating karst features such as caves, fluted rock outcrops, natural bridges, disappearing streams, and blind valleys and springs. This geodiversity creates habitat for some unique species, including cave weta, limestone ferns and a hebe shrub found only in the Waikato.

## 9 Mountain Ecosystems

A significant area of alpine habitat clothes the upper slopes of our highest mountains in Tongariro National Park and the Kaimanawa Ranges. Here the vegetation is dominated by red, snow and bristle tussocks, alpine shrubland, prostrate herbfields and alpine wetlands. There is a high diversity of insects, along with pipits, harriers, falcons and the occasional banded dotterel.

This diversity of landscapes is matched by corresponding diversity in the indigenous ecosystems and communities of native plants and animals. The Waikato region contains nine major ecosystems (see Figure 2: Major ecosystem types of the Waikato region). Eight of these ecosystems are presented later in this document with associated restoration information. They include:

- native forest and scrub
- swamps and bogs
- streams, rivers and lakes
- beaches and dunes
- marine and estuarine ecosystems
- coastal islands
- geothermal ecosystems
- karst ecosystems
- mountain ecosystems

These nine ecosystems support a richness and diversity of native plants and animals. This richness includes more than 900 native plants, 124 native bird species, 19 reptiles (geckos, skinks, tuatara), two species of native frogs, about 20 native freshwater fish, two species of native bats, Māui dolphin and New Zealand fur seals.

Some special features of the Waikato region's biodiversity include:

- three of New Zealand's five internationally important wetlands (Kopuatai, Whangamarino and Firth of Thames). These sites are classified as RAMAR sites under the Ramsar Convention which is an international treaty for the conservation and sustainable use of wetlands
- 70 per cent of New Zealand's geothermal areas
- the only place in the world with natural populations of:
- Archey's frog (in the Whareorino Forest and in the Coromandel Ranges)
- Te Aroha and Moehau stag beetles
- Mahoenui giant wētā and Mercury Island tusked wētā
- the shrub *Hebe scopulorum*, the giant cane rush *Sporadanthus ferrugineus*, and the swamp helmet orchid *Anzybas carsei*
- one of the largest areas of karst landscape in New Zealand
- one of the largest populations of kōkako in New Zealand
- one of New Zealand's three most important coastal stretches for shorebirds
- New Zealand's longest river (the Waikato) and largest lake (Taupo)
- the largest eel fishery and one of the largest whitebait fisheries in New Zealand.



Archey's frog – Auckland ZOO

## WHAT SPECIES ARE SPECIAL IN YOUR AREA?

Restoration of biodiversity includes helping to protect and restore threatened plant and animal species to the places they once lived. There are threatened plant and animal species that are characteristic of your area that you may wish to learn about and help with their recovery. Appendices 4 (What's special in your area?) show key locations and strongholds of some of the 100 threatened animal and plant species respectively in the Waikato region. The species shown on the maps are not a complete list of all species in your area.

*To help save one or more of the endangered species on the maps you may like to organise an "adoption".*





*Mahoenui Giant wētā – Department of Conservation*

**Adoption could mean taking one or more of the following actions:**

- Your community could highlight and promote an endangered plant or animal species as a local icon/tourist symbol.
- Schools could get behind an adopted species, study it and take part in activities to protect the species.
- Local councils could plant an adopted plant species in municipal places such as roundabouts, public gardens, and promote it for growing in home gardens.
- Your community could raise funds locally to protect natural populations of a threatened species.
- You could get together with others and work with Department of Conservation to save a threatened species.
- You could find out more about threatened plant species on these websites: [www.nzpcn.org.nz](http://www.nzpcn.org.nz) and [www.doc.govt.nz](http://www.doc.govt.nz)
- You can find out more about threatened animal species on this website: [www.doc.govt.nz](http://www.doc.govt.nz)

**Examples of adoption:**

- The Mahoenui Giant wētā has been adopted in Te Kuiti, with the erection of a large bronze replica to help save this endangered species.
- The Whaingaroa Environment Centre in Raglan has adopted Māui dolphin and has held a Māui Dolphin Day to raise awareness of this endangered species.

The North Island brown kiwi has been adopted by community groups based on the Coromandel Peninsula. They are controlling pests and heightening public awareness of this threatened species by running holiday programmes for the public and placing display panels around the Coromandel highlighting threats to kiwi.

# BIODIVERSITY DECLINE IN THE WAIKATO REGION

Before human settlement, most of the Waikato region was covered in extensive areas of native vegetation. Higher, wetter or less accessible areas were covered in mature kauri, beech or podocarp (mainly rimu, tōtara and kahikatea) forest. Native dune vegetation (pingao and spinifex) was found on the coast, especially at harbour mouths and river deltas. There were vast freshwater wetlands near the lower Waikato River and Hauraki Plains. The region also supported many unique plant and animal species including bats, birds, reptiles, frogs, insects and snails.

Human settlement has resulted in significant changes (see Map 2: Remaining natural areas of the Waikato region). Maori modified vegetation patterns through burning and clearing forests, particularly in coastal and lowland areas. The arrival of Europeans led to large-scale changes, particularly the replacement of forest and wetlands with exotic pasture. While these changes brought economic prosperity, they also brought environmental costs. Now the Waikato region has over 223 species threatened with extinction<sup>3</sup>.

## ECOSYSTEM LOSS

Ecosystem loss has occurred most severely in the Waikato region's coastal and lowland areas. Only 28 per cent of coastal, 18 per cent of lowland and 34 per cent of submontane zones have indigenous ecosystems remaining. By contrast, the extent of indigenous ecosystems in the montane, subalpine and alpine areas is largely unchanged.

Pōhutukawa fringed coastal forests were once common on the lowland, cliffed and rocky coasts of the Waikato. Today, less than five per cent remains, mostly on islands off the Coromandel Peninsula. Excluding these islands, original forest now makes up only half a per cent of the coastal zone. The coastal flax and pōhutukawa that remain provide nectar for birds (such as tui and bellbirds) and lizards (skinks and geckos). Large trees provide roosts and nesting sites for shags. Streamside grasses near the coast provide spawning areas for native fish, such as inunga. Areas of regenerating forest and scrub make up about 20 per cent of the coastal zone (see Map 3: Remaining natural areas of the Waikato region).



*North Island brown kiwi – Department of Conservation*

Wetlands covered five per cent of the Waikato region (108,000 hectares) in 1840. Now approximately 28,226 hectares remain which equates to about seven per cent of the original coverage. The loss of large areas of the Waikato region's wetland habitat has threatened the survival of many plants and animals, with 24 species of freshwater wetland plants and animals threatened with extinction (11 animal species and 13 plants).

Approximately 70 per cent of total dune areas have been modified for coastal subdivisions, forestry, agriculture and sand mining. The removal of dunes and plants such as pingao and spinifex has led to the loss of the protective buffer that dunes provide against erosion and flooding. The loss of dunes means reduced habitat for small animals including insects, spiders, butterflies, moths and lizards.

## FRAGMENTATION

The indigenous vegetation cover (mostly forest and scrub) is fragmented into thousands of patches, ranging in size from less than one hectare to a 94,000 hectare tract of forest in the Coromandel Ranges. The vast majority are smaller than 25 hectares, separated from each other by pasture, plantation forests and towns.

Fragmentation of our forests and other ecosystems has had significant implications for our native animals. Some species, such as tui and kākā, are highly mobile and capable of moving over open country between the remaining patches of forest. Others, such as Archey's frogs, snails and lizards, are probably unable to leave their forest patch. If their patch becomes unsuitable, they will not be able to move to a better site. If their populations die out, no new animals will be able to move in to recolonise their patch.



*Coromandel striped gecko- Rob Chappell*

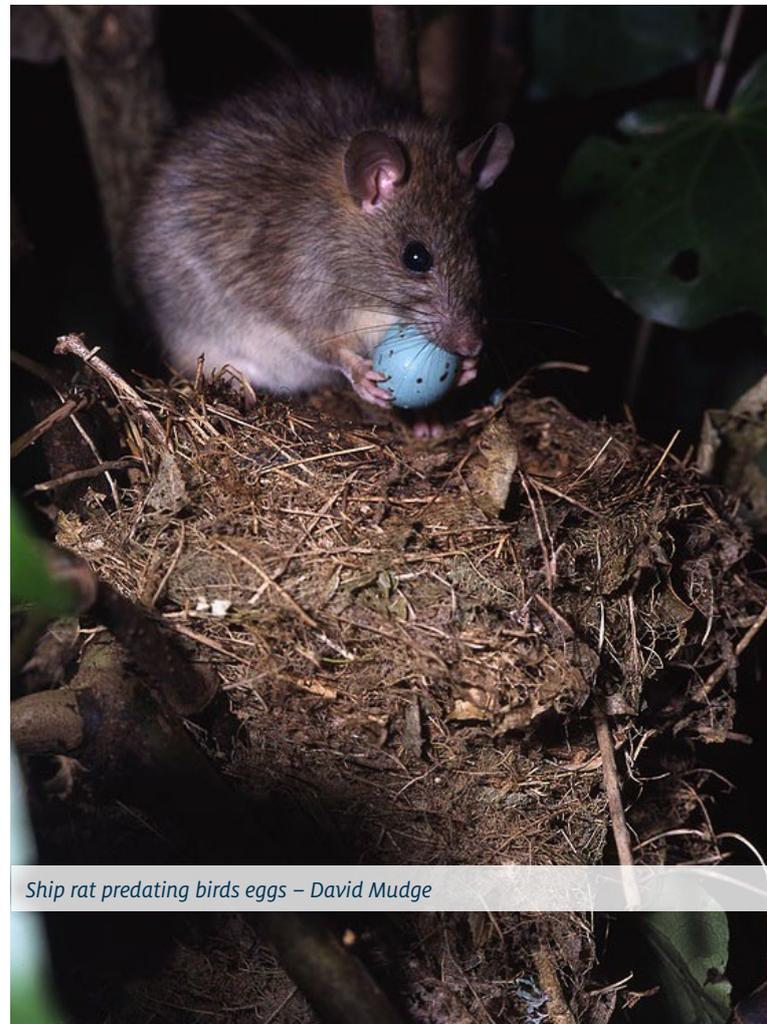
Our waterways, too, were once connected from small tributary streams to the ocean. The only barriers to fish were large or fast-flowing waterfalls. Most of our native fish rely on open pathways to feed in stream reaches and breed in estuaries, but many waterways are now blocked by perched culverts, dams or areas of polluted water.

In restoring our biodiversity, we need to learn more about 'wildlife corridors', and consider re-connecting natural areas. This means removing barriers to allow fish to once again travel from the sea, up the rivers, to the wetlands or headwaters. It might also mean planting native forest 'stepping stones' or continuous streamside, roadside or rai-side vegetation, to allow birds and other animals to move between larger forest patches. Priority places for connections include sites where intensive pest control or removal will allow wildlife to flourish to bursting point, so surplus young animals can spillover to new habitats.

## DEGRADATION

Introduced pests have become established in almost all of our ecosystems and threaten to destroy many of our native plants and animals. Often a range of introduced plants and animals are found in the same area, with their combined effects causing a lot of damage. Weeds, such as wild ginger and willow, smother native vegetation. Introduced animals such as rats, possums and koi carp eat native animals or kill them indirectly by eating their food or degrading their habitat. Some animal pests kill trees by eating leaves and bark or by compacting soils with their hooves. Animal pests also interfere with plant breeding by killing the animals that pollinate flowers and spread seeds or by eating and trampling the flowers, fruits and seeds.

Other forms of degradation include pollution, such as excess nutrients and sediments in our waterways and marine area, loss of shade over small streams and over-harvest of native plants and animals. Farm stock in natural areas can compact soil and cause erosion, trample or eat plants and cause pollution through their urine and dung.



*Ship rat predated birds eggs – David Mudge*



*Koi carp eat juvenile native fish*

Most of the shallow riverine lakes in the region are now murky and unable to support as much submerged plants, meaning there are lower numbers of native fish species inhabiting these lakes. The peat lakes, that naturally support specialised plants and animals, have also been substantially altered and riparian and instream habitats of most lowland and hill country streams and rivers are degraded.

The marine ecosystems of the Waikato region include subtidal eel grass beds, mangroves, saltmarshes, sand and mud flats, rocky reefs and shallow open water. These ecosystems are at risk of degradation from sedimentation and pollution especially the subtidal eel grass beds. Pollution and sedimentation can also adversely impact shellfish beds. The degradation of the deeper water marine ecosystem through the activities such as trawl fishing is reducing marine species, such as the Māui dolphin.

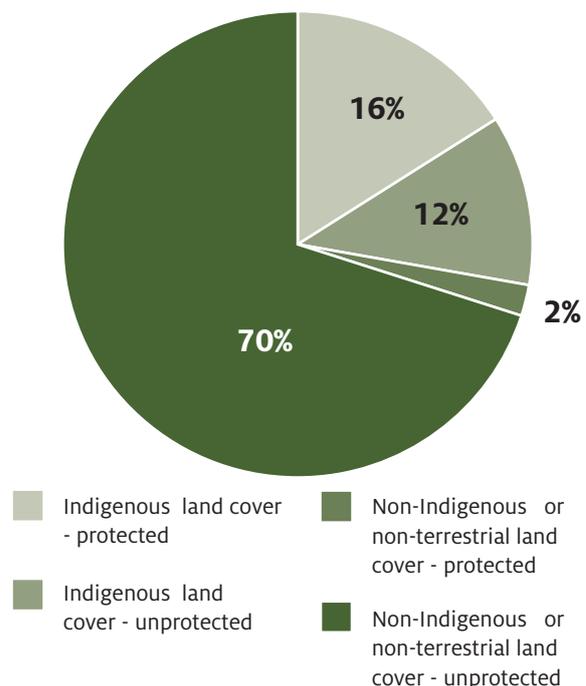
Vegetation clearance has had a huge impact on karst ecosystems. Very few of the major karst systems in the Waikato have intact forest overlying the caves. Vegetation removal leads to increased sediment loads entering the caves, reducing water quality and smothering the delicate limestone features. It also alters the cave micro-climate, increasing light and decreasing humidity, which impacts the growth of stalactites and stalagmites, and the food chain of cave fauna.

Extensive areas of geothermal ecosystems have been lost by damming of rivers in the Waikato region for electricity supply. Geothermal ecosystems occupy only about 0.002 per cent of New Zealand's land surface so they are naturally rare. Almost all geothermal ecosystems have been degraded to some extent by human induced factors such as trampling by people, weed invasion, rubbish dumping, stock grazing and trampling and clearance of vegetation for land development.

## WAIKATO'S RESERVE NETWORK

One of the major goals of New Zealand's Biodiversity Strategy is to protect the full range of New Zealand's biodiversity. Like many other parts of New Zealand, Waikato's reserve network is unrepresentative of the original diversity of ecosystems, plants and animals of the region.

As of March 2014 only 28 per cent of the region's land area has indigenous vegetation cover. Eighteen per cent of this area (386,477) is legally protected for conservation and biodiversity protection purposes. Protected areas of indigenous cover are mainly in montane and upland area with continuous large areas covered. These protected areas are small and scattered in the lowland areas.



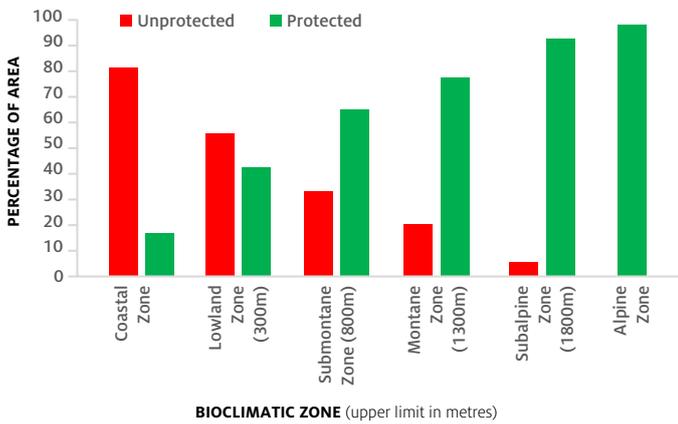
**Figure - 3.** Land cover and protection status in the Waikato region.



Relief image supplied by Terralink NZ Limited; copyright reserved. Textured landcover derived by Waikato Regional Council.

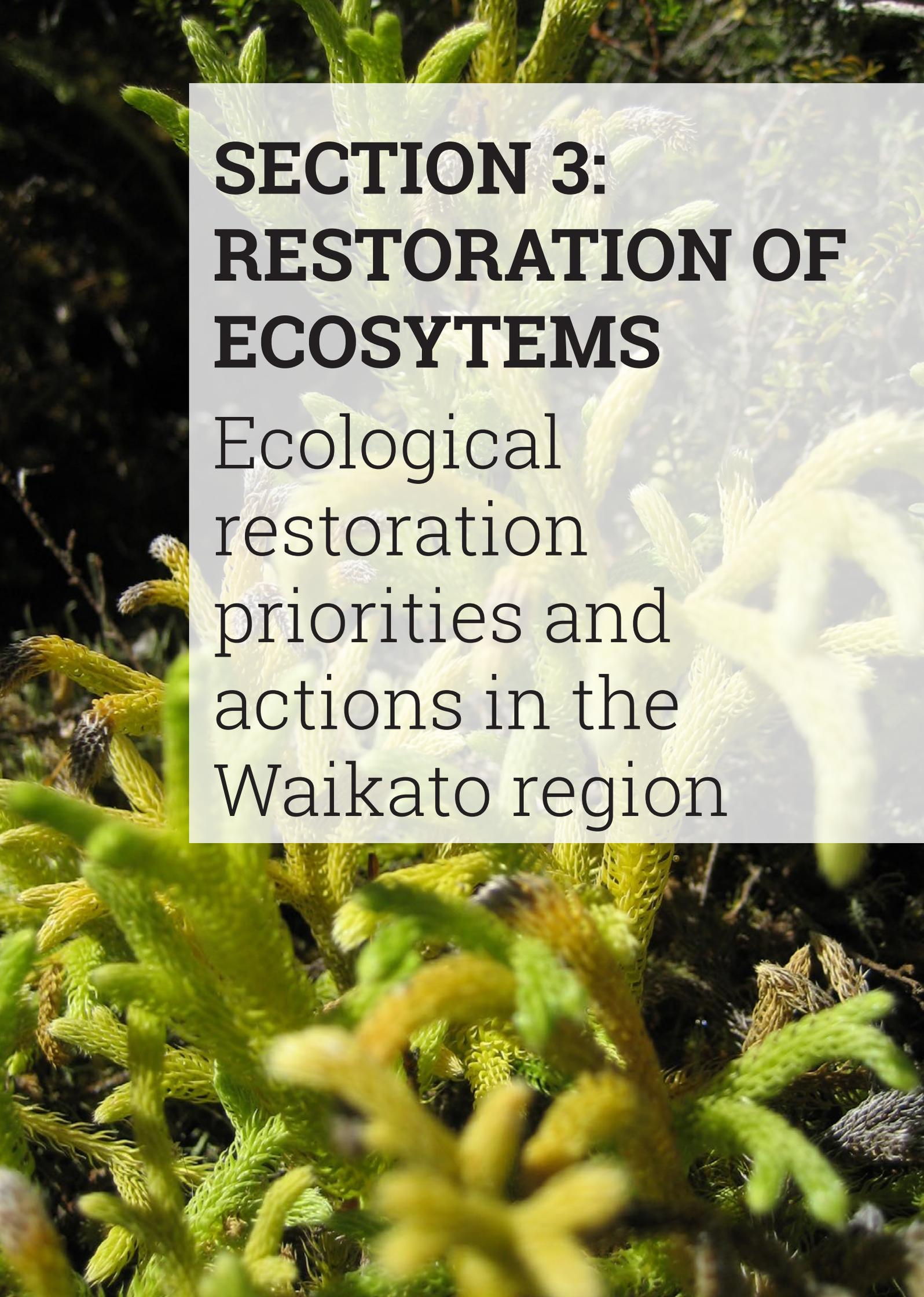
Map - 2. Remaining natural areas in the Waikato region

Currently an even smaller percentage of the Waikato’s coastal indigenous vegetation is under some form of legal protection (such as marine reserves), and those areas that are protected are not fully representative of the range of habitats. As human pressure on the coastal environment and surrounding catchments grows, the fragmentation, degradation and loss of these habitats is likely to continue unless proactive steps are taken to avoid these effects. Both coastal and lowland areas are most in need of urgent protection and restoration



**Figure - 4.** Bioclimatic Zones- Protected and unprotected.

A representative reserve network would require protection of adequate amounts of indigenous ecosystem in each of the bioclimatic zones. This information can guide us in considering what the priorities and actions are for future protection, enhancement and restoration. Indigenous ecosystems in the montane, subalpine, and alpine bioclimatic zones are well catered for with protection levels of 70 per cent or more in each case. The coastal and lowland bioclimatic zones by contrast are severely under-represented and as well opportunities for protection are limited.

A close-up photograph of moss plants, showing their intricate, feathery structure in shades of green and yellow. A semi-transparent white rectangular box is overlaid on the upper portion of the image, containing the title and subtitle text.

# **SECTION 3: RESTORATION OF ECOSYSTEMS**

Ecological  
restoration  
priorities and  
actions in the  
Waikato region



Dabchick – Phil Brown

The restoration priorities for the region are to protect, enhance and restore a representative range of biodiversity across the region to a level in which they are self sustaining, for instance:

- establish mountains to the sea corridors of both terrestrial and aquatic ecosystems
- reconnect fragmented ecosystems (on land and via waterways)
- return species that have been lost from the area such as kiwi
- buffer the edges of wetlands, rivers, lakes, geothermal areas, springs, coastal cliffs, dunelands, estuaries, and fragmented forest
- establish pest-free areas on islands and on the mainland to act as refuges and nurseries for native species
- reconstruct ecosystems currently removed from or now rare in the region.

## WHAT IS AN ECOSYSTEM?

The focus of this document is the restoration of ecosystems. Ecosystems are communities of living things (animals, plants, fungi, bacteria and other micro-organisms) that interact with each other and their physical environment (soil, rock, minerals, air, water, temperature, salinity).

The roles of the animals and plants, and their abundance, are inseparably bound up with the numbers of other organisms and the amounts of materials available, and with the kinds of physical forces acting at any time. There are ceaseless exchanges of materials, and of energy between living things and their environment, following cyclic pathways which are perpetually repeated, for example the carbon and nitrogen cycles. These cycling systems are characteristic of ecological systems or ecosystems for short.

The system cannot continue functioning without a constant input of energy from the outside. Energy is input mainly in the form of light and almost all forms of life obtain their high-energy organic nutrients either directly or indirectly from plant photosynthesis.

Just as the human body relies on the circulation of blood and oxygen and the conversion of food to energy, an 'ecosystem' relies on the circulation or transfer of water, gases (such as oxygen, carbon dioxide), nutrients (such as nitrogen, phosphorus) and energy (sunlight, heat, food). However, ecosystems are even more complex than the human body and to restore or manage them requires good knowledge of their characteristics and processes.

Natural ecosystems are dynamic. They are constantly changing within their inherent range of natural variability as a result of internal and external processes such as:

plant and animal population processes like mating, birth, growth, maturation, death and

decay changes in plant or animal population size through birth, death, immigration, and

emigration loss and gain of species through extinction (local or global) and evolution or

emigration catastrophes such as volcanic activity, fire, landslide, earthquakes or disease

epidemics gradual or rapid change in species make-up over time as the environment

changes (Succession, see box).

Ecosystem Services New information below

Ecosystem services are the benefits that humans receive from nature. These benefits are as diverse as clear air to breathe, pollination of our food crops, and appealing landscapes in which to spend our time

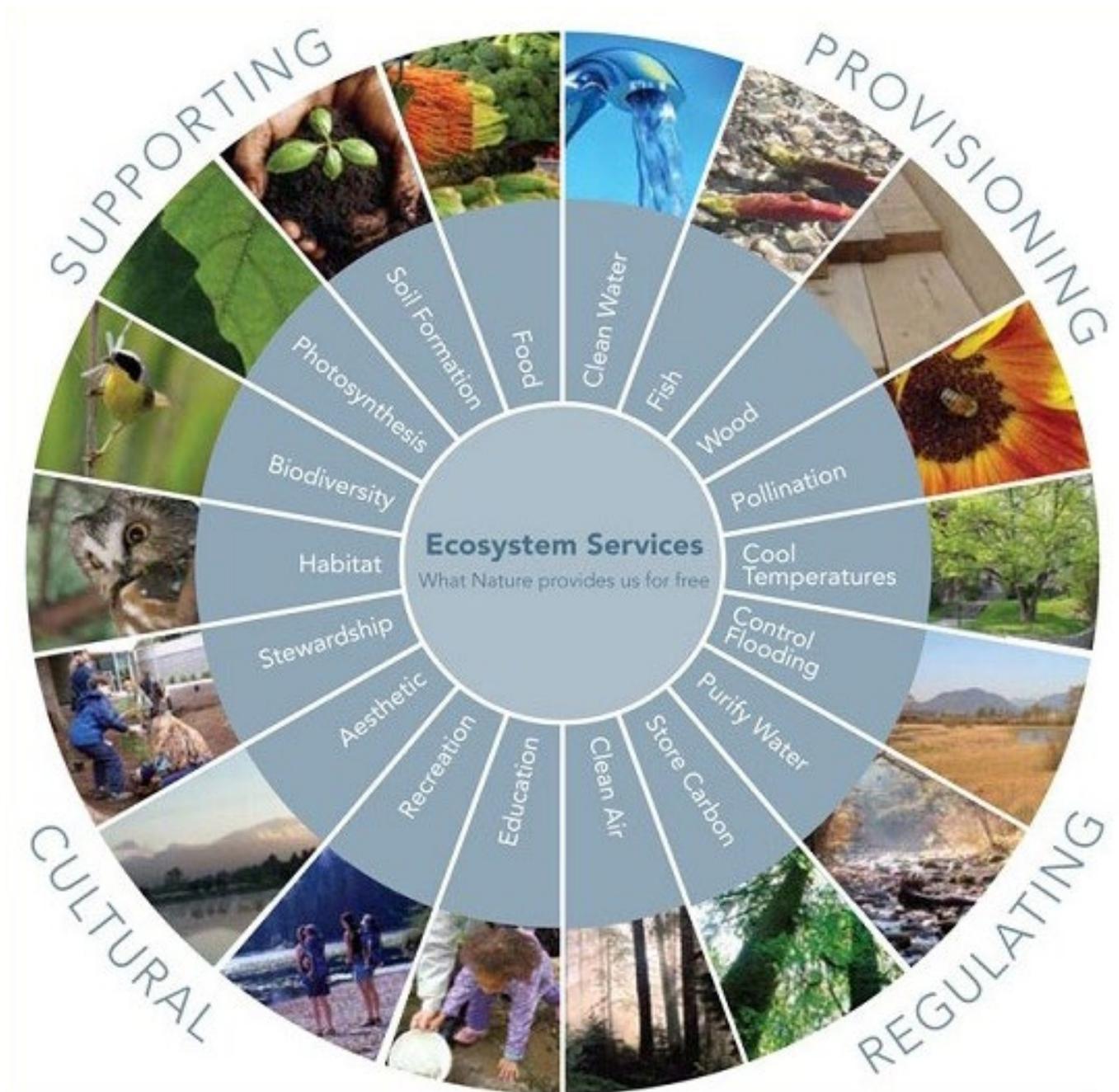


Figure - 5. Ecosystem services

[www.metrovancouver.org](http://www.metrovancouver.org)

### Succession

Many ecosystems typically change in composition and structure from one form to another. This is called "succession". An example is the development of scrub into forest, or the infilling of shallow lakes with sediment to form a swamp.

Often human activities alter the rate of succession, for instance clearance of hillside vegetation may speed up the rate of infilling of swamps or repeated burning may stall or prevent the return of forest. Understanding succession can also help us to restore ecosystems on land, for instance, if we plant appropriate scrub species, over time this will develop into forest if there is a nearby seed source.

## WHAT IS A HEALTHY ECOSYSTEM?

A healthy ecosystem has the following features (see box):

- a typical structure (e.g. height, density, layers, zonation patterns), and
- a typical composition (mix) of species occurring in a relatively predictable proportion or abundance.

A healthy ecosystem also functions (works) correctly, for instance:

- **the water, food, and gas cycles are working 'normally'**  
e.g. a wetland is receiving sufficient water to support the species there, a peat bog is storing carbon in accumulating peat
- **animals can move between them**  
e.g. there are no unnatural barriers to stop fish moving between the headwaters and the sea plants are able to regenerate

e.g. there are birds, lizards, bats, or insects around to pollinate the flowers (their flowers, fruit and seed is not all getting eaten by possums and rats)

- native animals are able to reproduce  
e.g. there are enough mature animals of both sexes for each to find a mate, they have enough food at the right time of year to breed, their eggs and chicks are not all eaten by pests
- species food chains and relationships are intact  
e.g. snapper are preying on kina, lizards are pollinating rātā, bitterns are dispersing sedge seeds
- the system has the ability to withstand or recover from stress or damage  
e.g. periodic drought, storms, or localised fires.

Ecosystem functions can be disrupted by things like:

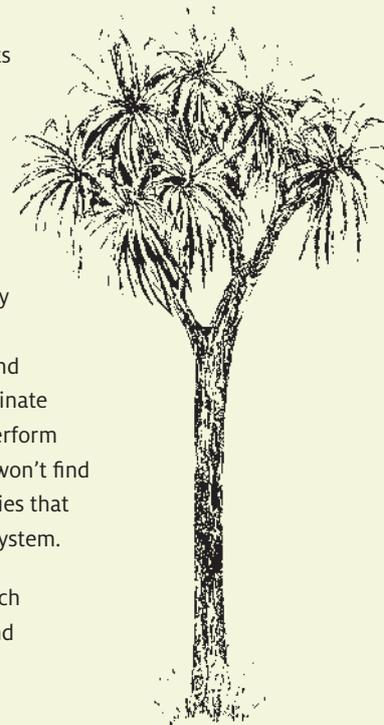
- removal of habitat (such as clearance of vegetation, draining wetlands)
- removal of species (such as over-harvesting certain species of fish)
- grazing on plants by stock or animal pests
- degradation of habitat by animal and plant pests
- predation of native animals by introduced pests
- barriers to migration (such as dams and culverts in waterways, cleared areas between forest)
- introduction of pollutants such as sediment, excess nutrients, or toxic substances
- introduced plant and animal species.

## WHAT IS ECOSYSTEM STRUCTURE AND COMPOSITION?

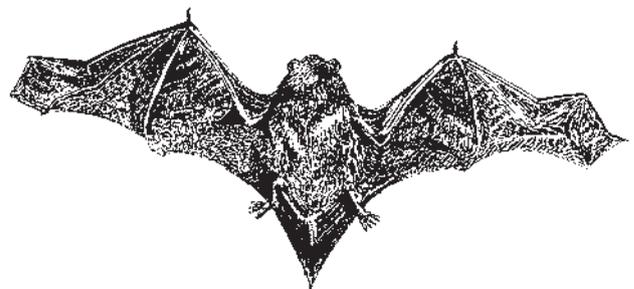
A healthy lowland forest ecosystem, for instance, will have the typical forest structure, which means it will have a canopy, a few tall emergent trees, a dense shrub and treefern layer, and a dense ground cover. If the ground cover has been trampled and all been eaten out by stock, then the structure is not typical of lowland forest, and the forest is not healthy.

If the lowland forest is healthy, the plants will comprise native species, eg. mostly tawa and rimu trees with other tree species such as mangeao, northern rata, and rewarewa in the canopy, and shrubs such as kawakawa in the understorey, and a ground cover of ferns such as hen and chicken fern. It will also typically contain animal species such as tui, grey warbler, insects, and bats and animals and micro-organisms that are needed to pollinate plants, decompose dead material and perform other functions. In a healthy forest you won't find many non-native species, or native species that don't typically occur in that type of ecosystem.

Ecosystem integrity is the degree to which an ecosystem has its typical structure and



composition, is dominated by native species, and functions well. Ecosystem viability is the ability of the ecosystem to maintain itself into the future, in other words, the likelihood that it will still be there in reasonably good condition for our children and grandchildren to enjoy. An ecosystem might be currently of typical structure, composition and functioning, but it might not be viable. For instance, a peat bog may remain healthy for some time after its water table has been lowered by drainage, but without a permanently high water table it will eventually dry out and degrade.





Tui – Kemble Pudney

## WHAT IS RESTORATION?

“Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.” Society for Restoration International Science and Policy Working Group, 2004. The SER international primer on ecological restoration, Arizona, USA.

To restore biodiversity in the Waikato region we need to do three things:

1. Retain the ecosystems we still have - stop further loss through clearance, drainage, etc.
2. Restore degraded ecosystems - get rid of pests, stop pollution, harvest plants and animals sustainably, replant or return species that have been lost from the ecosystem, reinstate key natural processes, such as shade over small streams.
3. Reconstruct lost ecosystems - start from scratch to rebuild natural areas.

Ecological restoration is any activity that kicks off or speeds up the recovery of ecosystem health, integrity and viability. Frequently, an ecosystem that requires restoration has been degraded, damaged, transformed or entirely destroyed through direct or indirect human activities such as forest clearance or wetland drainage.

In its broad sense, ecological restoration covers the full spectrum of repair and enhancement of ecosystems but it can be useful to distinguish different types of “restoration”. Restoration in a strict sense is a process of repairing the composition, structure, function and dynamics of pre-existing ecosystems. Just as someone tries to undertake an authentic restoration of a classic car or an old house, the target is an original condition, however the “spare parts” may not always be available.

Ecological restoration has been defined as ‘the return of an ecosystem to a close approximation of its condition prior to disturbance’. However, it is not always possible to achieve this because we don’t always know what the original condition was, some of the original species have become extinct or because of potentially enormous costs involved. The potential to restore ecosystems varies over space and time and is dictated by the degree of degradation and the practicality of repairing that degradation.

However, ecosystem restoration is much more than this because we are trying to ensure that the restored ecosystems are not static museum type examples, but that they can continue to change and the species they support are able to continue to evolve at the same rates as before. Many of the current community led projects in the Waikato region are restorations in the strict sense because they are attempting to return ecosystems to as close as possible to their original condition. Restoration can also incorporate rehabilitation of existing ecosystems or total reconstruction of lost ecosystems.

## WHAT IS REHABILITATION?

Rehabilitation is like fixing up an old house without trying to stay true to its original state. Rehabilitation involves enhancing the ecological functioning of the system on a recovery pathway toward an improved target condition. The recovery pathway in rehabilitation will be on a similar trend to that of restoration but with a different end point that is likely to feature an altered species composition. For example, many riparian plantings on streams and rivers in the Waikato are undertaken to reduce nutrient inputs and improve water quality but the species composition may be different to the original composition.

## WHAT IS RECONSTRUCTION?

Reconstruction is like building a new house after the original one has been removed or destroyed. Reconstruction involves recreating ecosystems from scratch by assembling the plant and animal components of the system using a target “original” composition and structure but recognising the goal of establishing dynamic, functioning systems. For example, converting exotic pasture back to ecosystems comprising indigenous plant and animal communities similar to those that originally occurred there. This might be through planting a nurse crop of hardy shrubs, with later planting of tree species to encourage the return of wildlife. This document focuses on restoring existing ecosystems. For more on ecosystem reconstruction see the hot tips boxes in the ecosystem description pages. A great example of reconstruction is the development of Waiwhakareke Natural Heritage Park in Hamilton.



Green gecko – Neil Fitzgerald

## THE PRINCIPLES OF RESTORATION

The overall objective of our document is to help communities to achieve their goals of improving biodiversity in the region by restoring and reconstructing ecosystems across the region. Ecosystems are dependent on one another and do not exist in isolation, so restoration activities undertaken in one part of our region have the potential to influence, interact with, connect to or buffer those being undertaken elsewhere. Every small bit that you do contributes to a much greater whole. We want to encourage and assist the restoration of the whole of the Waikato region, regardless of whether the land and water is publicly or privately owned.

When undertaking restoration, it is important to thoroughly investigate your proposed site, to understand what biodiversity resources you have and what problems you need to address. You need to know the types of ecosystems that were formerly present, their likely composition and whether the fundamental ecological processes are still operating and what potential there is to restore indigenous biodiversity. It is highly desirable that this understanding leads to the development of a restoration plan. Information on how to go about restoration and production of restoration plans can be found on the International Society for Ecological Restoration's website: [www.ser.org](http://www.ser.org)

## NINE KEY PRINCIPLES OF RESTORATION

A core set of key principles that ensure successful restoration is explained below.

1	Identify the key processes leading to degradation or decline	➤	e.g. are stock browsing the understorey, is the wetland drying out?
2	Develop methods to reverse or lessen the degradation or decline	➤	e.g. fence stock out, reinstate the water table.
3	Determine realistic restoration goals, and understand timeframes for achieving success by recognising there may be ecological and economic limits or social barriers to your plans	➤	e.g. ensure the actions identified in 1 and 2 above are realistic and that the community shares your goals for restoration.
4	Start small with achievable and measurable targets before attempting large-scale restoration	➤	e.g. reduce possum numbers over five hectares to two per cent residual trap catch within three years.
5	Develop easily observable measures of success	➤	e.g. increased understorey plant density, or flowering success of key species.
6	Develop practical techniques for implementing these restoration goals at a scale relevant to the problem	➤	e.g. controlling weeds in the catchment rather than in individual sites.
7	Keep good records and tell others about successful techniques so that they can be used more widely	➤	e.g. record the dates and numbers of trees planted, the spray and concentration used, assess survival or levels of control achieved.
8	Monitor important ecosystem trends and assess progress against the project goals	➤	e.g. forest canopy health and regeneration trends.
9	Modify or change procedures depending on the rate and degree of success	➤	e.g. change the pest bait, timing to improve rates of pest control, trial different tree species or check on planting technique if planting success has been poor.

## MONITORING

Monitoring of the restoration site is very important so that success can be tracked. This can be quite an important motivator for you as you can see the benefit of your work and be encouraged by your successes. It is important to monitor and show other people and organisations what changes have occurred as result of your work. These people could include organisations that help to fund your project.

Photographs are a great way of showing the results over time of your activities. Keep written records of, for example, the reduction in possum and rat numbers in the restoration area after poisoning operations, the changes to understorey and forest floor once stock are removed or the increase in bird numbers at the site when canopy and understorey vegetation has recovered. The monitoring may vary from twice a year to annually or every two years depending on the type of work being carried out.

### Citizen science

Citizen science has become a valuable way of monitoring conservation projects. In New Zealand, the term 'citizen science' has only recently entered the vocabulary in the environmental management, community conservation and science sectors (e.g., Brumby et al. 2015; Spurr 2012). Citizen science describes scientific investigations in which volunteers collect biodiversity and environmental data, in order to enhance our knowledge of the natural world. One way to understand the scope and nature of citizen science is to look at how volunteers participate. In some investigations, the role of the volunteer is mainly to collect data (sometimes known as 'crowdsourcing'). Their data may take the form of records /observations along with information on when and where the data were collected. Physical samples (e.g., of flora, fauna, fungi), may also be collected, while some investigations may be based on the analysis and classification of information contained in images, video or sound recordings. In other studies, volunteers' role may be broader, and they may fully design the research or partner with science and land management professionals to do so, and then analyse the data and report on findings.

Another way to understand citizen science is by project type:

**Timeframe unspecified:** Volunteers collect data which can be submitted any time for projects that have no specified end date e.g., the Department of Conservation's Marine Mammal Sightings database and ongoing flora, fauna and fungi observations submitted to NatureWatch.org.nz

**Timeframe specified, activities repeated:** Volunteers collecting data over a specified time frame currently form the most numerous type of citizen science project in New Zealand. Examples include community-led predator control monitoring and bird counts, where data are collected within set time frames (e.g. seasonally), with monitoring activities repeated over the years. Iwi-led cultural health monitoring may also fall into this project type.



*Citizen Science -recording species in a vegetation plot – Monica Peters*

**One-off events:** Data are collected by volunteers in response to events such as major floods, or for baseline flora, fauna and fungi studies as occurs in a BioBlitz.

Citizen science projects in New Zealand will continue to grow with investigations into water quality, habitat and ecological condition, and biosecurity threats all possible areas for expansion. In order to build a greater cohesion and maximise the potential of citizen science in New Zealand, key needs include improving access to citizen science programmes, projects and data, and establishing sources of long-term funding. For community groups, greater support is required for their environmental monitoring activities, toolkit and protocol selection as well as improving their capacity to monitor their restoration project outcomes. Lastly, a strategy is needed that enhances the use of citizen science data and considers data quality as well as legal and ethical factors.

Monitoring of the restoration site is very important so that success can be tracked. Photographs are a great way of showing the results over time of your activities.



Monitoring a wetlands – Monica Peters

## PRACTICAL CONSIDERATIONS OF RESTORATION

Keeping the key principles in mind, there are also some basic practical considerations that should be addressed at the outset of a restoration project. See Appendix 3 for resources to help with restoration.

Find like-minded people to help you refine and achieve the goals. Talk to locals and involve as many people as possible at the beginning of the project	➤	Locals, management agency staff such as DOC, other community restoration groups, tangata whenua.
▼		
Determine ownership of any sites of interest (private or public land?)	➤	Public, private, other.
▼		
Assess potential sites	➤	See choosing a priority restoration site (page 11).
▼		
Learn more about your selected ecosystem type	➤	Read section 4 for information on ecosystem types.
▼		
Identify values present	➤	Native species, cultural values, recreation values, landscape values.
▼		
Identify problems and prioritise	➤	Weeds, animal pests, drainage, pollution, other.
▼		
Use the Choosing Actions table in section 4 for your ecosystem type	➤	Prioritise your management actions.
▼		
Develop a restoration management plan	➤	Check with other groups in the area to ask them about their management plan. This is valuable for funding purposes and to keep you on track.

## ORGANISATIONAL ROLES IN ECOLOGICAL RESTORATION

There are many groups and agencies who can help you plan your restoration project. See Appendix 3 for agency contact details.

### Community groups, hapū groups

- Provide support and advice to other community groups.

### Iwi

- Provide support to hapū groups undertaking restoration.
- Prepare environmental plans to give guidance for iwi in biodiversity protection.
- Collaborate and coordinate with community restoration groups.

### District councils

- May provide funding for community group restoration projects.
- Include criteria for identifying significant areas and prepare schedules of significant sites.
- Include rules in district plans to reduce biodiversity loss.
- May prepare a biodiversity strategy specific for district.
- Provide non-regulatory mechanisms for biodiversity protection in district plans such as education and advice, rates relief, covenants.
- Provide information on council owned and managed land, such as riparian areas and esplanade reserves.

### Waikato Regional Council

- Provide funding to community groups for restoration projects.
- Provide technical information and assistance to community groups.
- Motivate community groups to become involved in ecological restoration.

### Department of Conservation

- Provides technical information and assistance to groups.
- Provides funding to community groups for restoration projects.
- Motivates community groups to become involved in ecological restoration.

### Crown Research Institutes

- Provide technical information on ecological restoration.
- Provide research into biodiversity and ecological restoration.

### University of Waikato

- Provides technical information and courses on ecological restoration.
- Researches ecological restoration.
- Provides students to assist with restoration projects and monitoring.



Talking weeds with Waikato Regional Council – Moira Cursey

### Non-governmental organisations (NGOs)

- Provide funding to community groups for restoration projects.
- Provide technical information and assistance to community groups.
- Motivate community groups to become involved in ecological restoration.
- Lobby government to provide biodiversity funding to carry out ecological restoration work.

## CONCLUSION

The Waikato Biodiversity Forum hopes that this document will be widely used by management agencies and community groups, helping them focus on maintaining and enhancing native biodiversity in the Waikato region.

We hope it will provide an overall context for restoration and protection projects already underway, and for new projects being planned for the future.

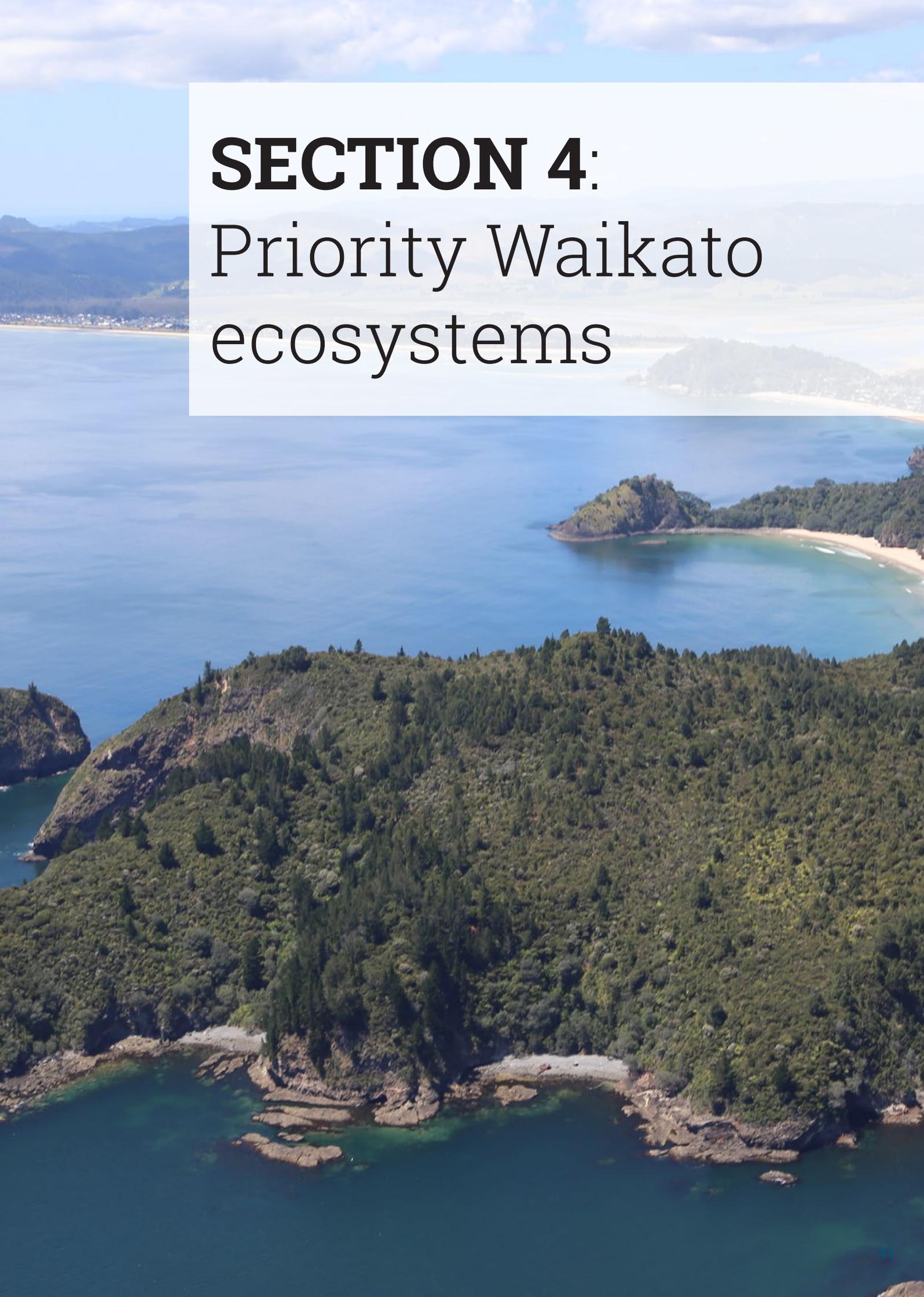
It is also intended that this document informs community groups and management agencies' decisions when prioritising activities.

Finally, the document gives an outline of the many actions that can be taken to improve biodiversity in eight major ecosystem types in the Waikato region. If we all work together to restore the ecosystems in our local areas, it will be possible to achieve regional restoration of our precious indigenous natural heritage.



Hebe scorpiolorum grows on limestone bluffs – Bruce Clarkson



An aerial photograph of a coastal landscape. In the foreground, a large, rugged headland is covered in dense, dark green forest. The headland curves around a bay. In the middle ground, a small, forested island sits in the center of the bay, with a sandy beach on its right side. The water in the bay is a clear, light blue-green, while the water further out is a deeper blue. In the background, a coastal town is visible on the left, and more forested hills are on the right. The sky is bright blue with some light clouds.

# **SECTION 4:** Priority Waikato ecosystems



*Wrights Bush*

## NATIVE FOREST AND SCRUB

Tall evergreen rainforest clothed more than 70 per cent of the Waikato region prior to human settlement. Forest composition varied mainly with altitude, topography and latitude. Coastal forests were dominated by pohutukawa and had other frost intolerant trees such as karaka, pūriri and kohekohe. Lowlands were mainly covered in conifer - broadleaved forest with rimu and tawa most prominent. Within this zone, dense mixed conifer forests were a feature of some areas affected by recent volcanic eruption or on periodically flooded river flats. Poorly drained sites had swamp and semi-swamp forests with abundant kahikatea, pukatea and/or swamp maire.

The uplands including ranges and dormant volcanic cones were more variable and comprised various combinations of conifers, broadleaved and beech forest, with the major species including hardy trees such as kamahi, Hall's tōtara, tāwheowheo, tāwari and silver beech. Northern forests were significantly different to those of the central and southern areas because of the abundant presence of kauri, tānekaha, hard beech and taraire north of the so called "kauri line" at approximately 38 degrees south latitude (approximately Kawhia through Te Awamutu to Tirau).

These patterns of forest composition are still evident on the landscape but the remaining forests (20 per cent of the Waikato region) are largely confined to the uplands with a patchwork of remnants and second growth characterizing the coastal and lowland zones.

Forest and Scrub are main components of the terrestrial ecosystems. They provide critical ecological services and sustain the indigenous biodiversity of the region: providing habitats for indigenous flora and fauna; acting as fundamental buffer zones for other ecosystems in the region; regulating atmospheric carbon levels and temperature; reducing erosion and stream sedimentation; storing, filtering and recycling of nutrients; breaking down and absorption of pollutants; and providing buffers for recovery from unpredictable natural events.

### THREATS TO NATIVE FOREST AND SCRUB

- Forest/scrub clearance, where the clearance of scrub in particular removes opportunities to regenerate young forest. While the main phase of forest clearance is long over in our region, there are continuing problems associated with land use changes such as establishment of exotic plantation forests or new pasture and horticulture.
- Grazers (such as cattle) and browsers (like possums and goats) cause the most destruction of forest and scrub. Where domestic stock has too frequent access or grazing intensity is too great, forest can be severely degraded. With continuing grazing, the forest eventually collapses, as the canopy trees are unable to effectively regenerate. Browsing by goats, deer and possums leads first to compositional change as the most palatable species are targeted first, but eventually canopy collapse occurs if browser numbers are not controlled

- For the fauna dependent on forest habitat the main problem is predation by introduced animals such as possums, rodents, and mustelids (stoats, ferrets and weasels).
- Invasive weeds prevent regeneration of native trees by smothering the ground layer or tree crowns, by outcompeting the regenerating young trees. The smaller forest patches close to human activities are the most susceptible to invasion by a range of introduced weeds.
- Climate change: this is a new and emerging pressure on biodiversity of the forest and scrub. The climate change will change the forest and scrub ecosystem structure, and functioning. Some forest and scrub species along the coast line are at risk from this change.
- Disease-causing pathogens such as kauri dieback, This disease is attacking and killing kauri trees with no known "cure" at present.

## WHICH TYPES OF FOREST ARE MOST DEPLETED IN OUR REGION?

- Coastal and semi-coastal forest, e.g. Coromandel Peninsula.
- Conifer (e.g. kahikatea, tōtara) broadleaved forests of alluvial terraces and other high fertility soils, e.g. the Waikato Basin.
- Dense mixed conifer forests, e.g. Pureora Forest Park.
- Swamp forests, e.g. Hauraki Plains.

## HOW DO I KNOW WHAT TO DO, AND WHEN?

Use the table overleaf to help you prioritise your management actions. The actions are listed roughly in priority order, though each site is different and will require its own assessment.

Future priorities will be to:

- restore, regenerate and recreate forest habitat to enlarge and protect scattered remnants of bush
- recreate mountain to the coast forests establishing corridors to each forest type
- achieve a healthy understorey of native vegetation within each forest type
- restore appropriate species of conifers to a sustainable level of self pollination
- re-connect lowland forest to coastal forest and lowland forest to sub-montane forest
- increase the numbers of birds, insects and other native animals that remain and return native fauna that have been lost from natural areas.
- manage the habitat which are threatened by climate change.

## Native forest and scrub hot tips

- Visit Waikato Regional Council's website for forest management fact sheets and information on weeds and animal pests: [www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz)
- Read Waikato Regional Council 's booklet "Planting Natives in the Waikato region" for information on planting native trees and shrubs.
- Call 0800 BIODIV for ecological district planting guides.
- Go to [www.doc.govt.nz/get-involved/run-a-project/restoration-advice/bush-restoration/start-the-project/](http://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/bush-restoration/start-the-project/) for information on starting your own bush restoration project
- Go to [www.doc.govt.nz/get-involved/run-a-project/restoration-advice/native-plant-restoration/local-planting-guides/ecological-restoration-in-the-waikato/](http://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/native-plant-restoration/local-planting-guides/ecological-restoration-in-the-waikato/) for Waikato ecological planting guides
- Visit the Weedbusters website - [www.weedbusters.org.nz](http://www.weedbusters.org.nz)
- Visit the New Zealand Landcare Trust website for the Biodiversity Restoring the Balance self-help kit and for information and resources for community groups - [www.landcare.org.nz](http://www.landcare.org.nz)
- Read "Native Forest Restoration - A Practical Guide for Landowners" by Tim Porteous.
- For the Forest Monitoring and Assessment Kit (FORMAK) visit - [www.formak.co.nz/default.aspx](http://www.formak.co.nz/default.aspx)
- Learn more about native plants on the Native Plant Conservation Network website - [www.nzpcn.org.nz](http://www.nzpcn.org.nz)
- Visit [www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Biodiversity-Significant-Natural-Areas/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Biodiversity-Significant-Natural-Areas/)
- For Significant natural Areas visit - [www.waikatoregion.govt.nz/Environment/Environmental-information/REDI/Data-download/](http://www.waikatoregion.govt.nz/Environment/Environmental-information/REDI/Data-download/)
- For the SNA data visit - [www.waikatoregion.govt.nz/tr201036](http://www.waikatoregion.govt.nz/tr201036)
- Visit [www.kauridieback.co.nz](http://www.kauridieback.co.nz) to find out how to prevent the spread of kauri dieback disease.



# CHOOSING ACTIONS:

## NATIVE FOREST AND SCRUB

### ASSESS NEEDS/PLAN

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Write up a plan of action. Get help. Phone 0800 BIODIV (246348) for advice and referral. .

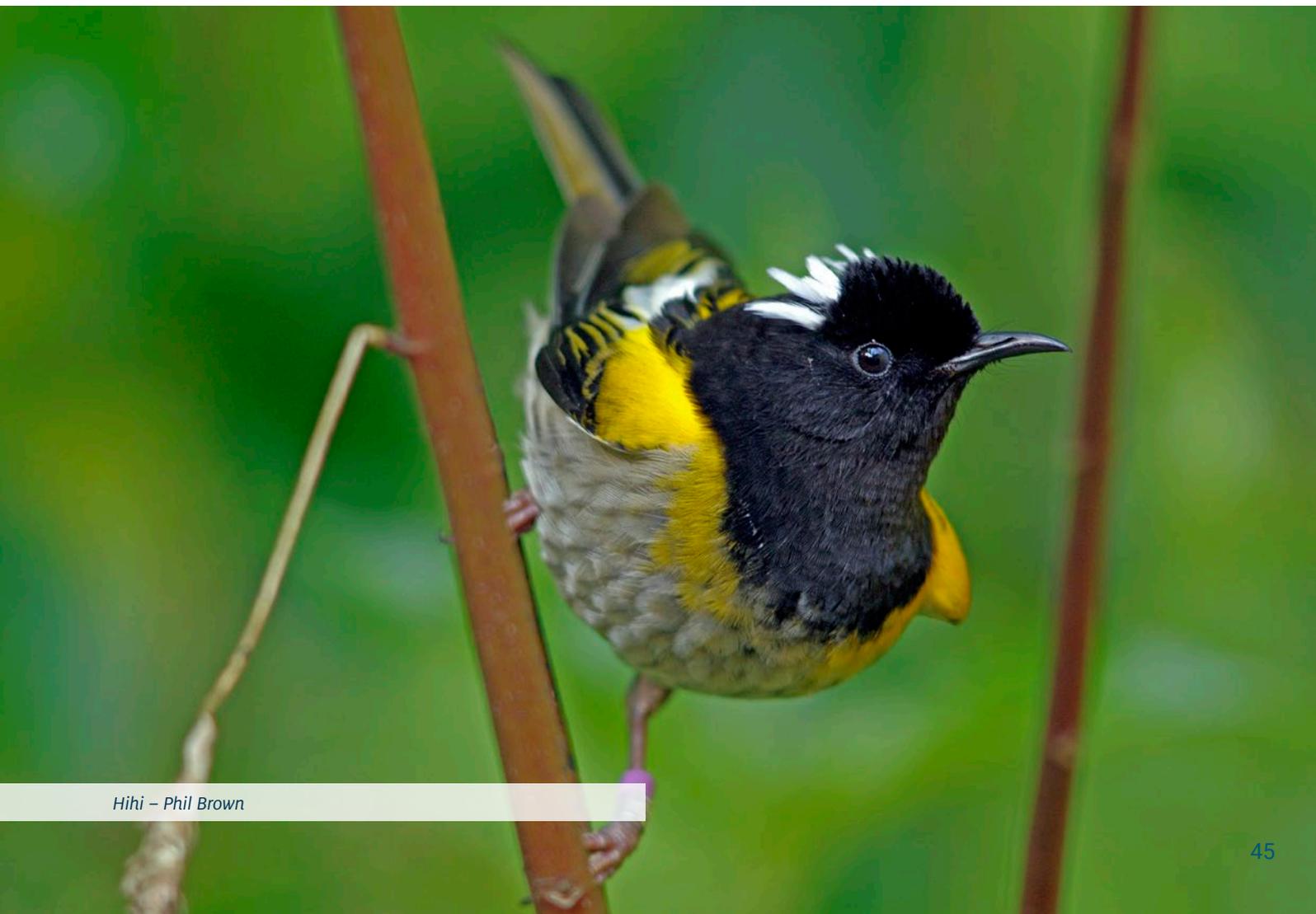
### SEEK FUNDING

Complete this table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you can start on the work. Call 0800 BIODIV for funding advice.

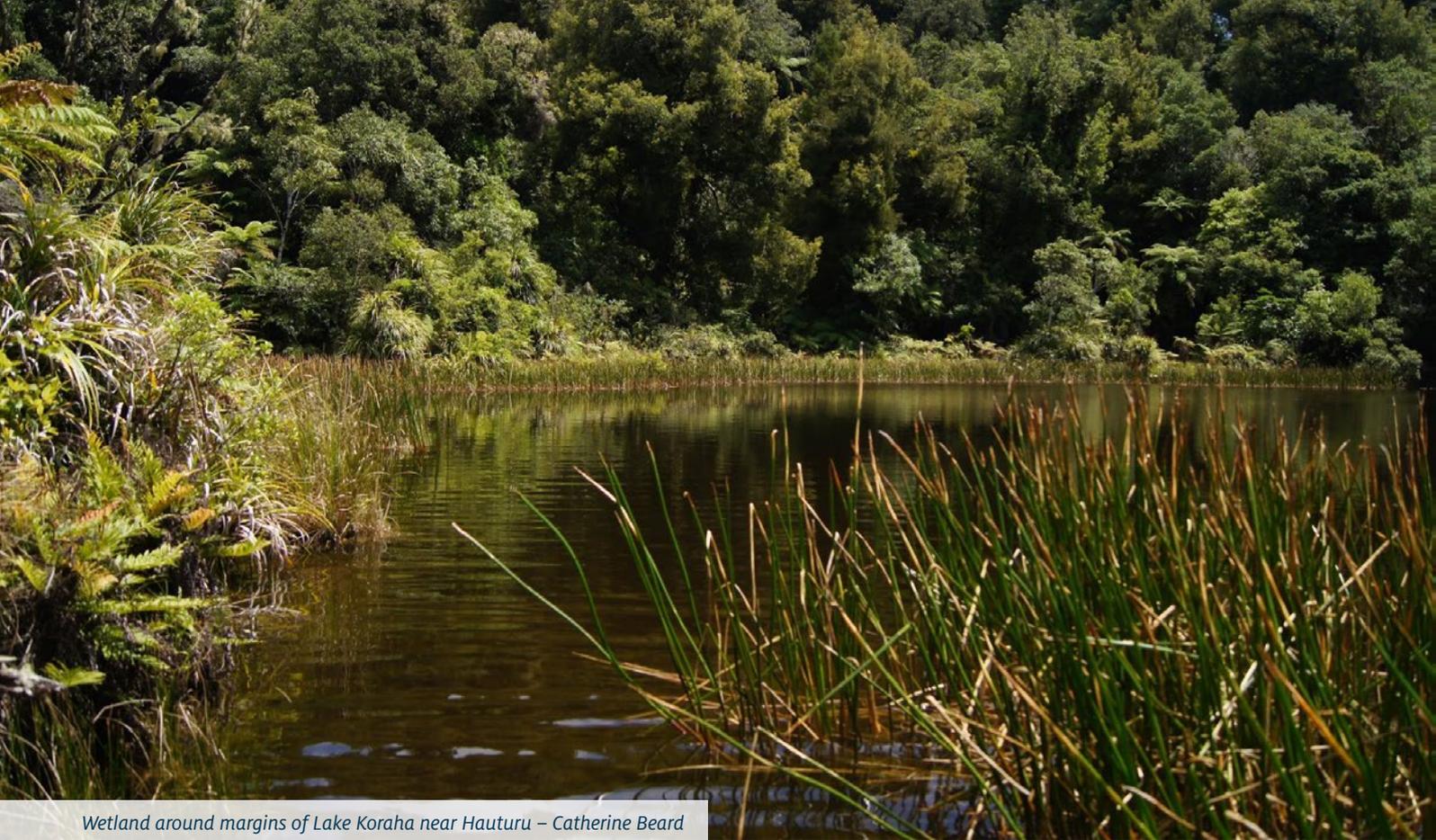
However, if you are planning to protect the site and you need to fence it, it pays to contact QEII National Trust first, as they usually pay a share of the fencing costs.

ACTION AND PRIORITY		COMMENTS
<b>Fencing</b>	Control animals that adversely affect forest	<ul style="list-style-type: none"> <li>If grazing animals can enter your site they will trample the soil and eat the plants, and their dung and urine will pollute the site. Heavier animals, such as cattle, are generally more damaging. Even a hot wire will be a good start to keep cattle out. A more robust type of fence will be required to keep out deer, pigs and goats.</li> <li>Be ready to tackle weeds as soon as the last stock are out, you may find the weeds 'take off' when grazing stops.</li> </ul>
<b>Control weeds</b>	Regional plant pests Woody plants Ground covers Others	<ul style="list-style-type: none"> <li>Deal with weeds you are legally obliged to. See the plant and animal pests section in the Waikato Regional Council's website <a href="http://www.waiktoregion.govt.nz">www.waiktoregion.govt.nz</a></li> <li>Be vigilant for weeds in nearby sites that are not in your native forest - yet! Note also that getting rid of some weeds can just encourage others! Get good advice on weed management. Visit <a href="http://www.weedbusters.org.nz">www.weedbusters.org.nz</a></li> </ul>
<b>Control pests</b>	Hoofed animal Rabbits/hares (if planting) Possums, rodents, mustelids, cats	<ul style="list-style-type: none"> <li>Pests in native forest can include deer, pigs, goats, rodents, possums, mustelids (stoats, ferrets, weasels), rabbits/hares and feral cats.</li> <li>Target the large animals first, as they will be easier to find and if the site is well fenced may be able to be eliminated. Use a trained hunter to shoot deer, goats and pigs. Other pests will need ongoing control.</li> <li>Contact your local Department of Conservation office or Waikato Regional Council for advice. Note that in some situations other pests will be more important, for instance dogs in kiwi zones.</li> </ul>
<b>Planting</b>	Buffer Enhance Connections Maintain	<ul style="list-style-type: none"> <li>First you should consider planting the edges of the native forest.</li> <li>If the site is of unnaturally low diversity, and isolated from natural seed sources, consider enhancement plantings (plants that should be in the area)Make sure they are appropriate to the site - get advice. If you have to remove a lot of weeds consider enhancement planting of natives as soon as possible to reduce the chance of another weed filling the space.</li> <li>If your site is isolated from other natural areas, consider planting corridors of vegetation to encourage birds to move between them.</li> <li>Keep your plantings weed free until the plants are well established. Small plants can be smothered by the weeds in grass. Protect from rabbits, hares and stock.</li> <li>Plant ecosourced plants which are characteristic of the area you are planting (natural plant populations are placed back in their natural range). Check nearby areas for clues to the appropriate vegetation of the area.</li> </ul>
<b>Site ecological information checking</b>		Check if there are any inventories which have been done for the sites or has your land been identified as Significant Natural Areas? The SNA information can be obtained from the District Councils.

ACTION AND PRIORITY		COMMENTS
<b>Encourage native animals</b>		If the site is very depleted of native animals, monitor the situation for a few years to see what turns up naturally. If you want to re-introduce wildlife you will need a permit from the Department of Conservation.
<b>Monitoring</b>	Watch for new weeds!	Take photos of your site before you start and at regular intervals during your work. Keep records of which plants you planted survived so you can learn for next time. Keep records of for example annual possum capture rates. Use the forest monitoring and assessment kit (FORMAK). If the project is large and needs a lot of funding get a professional monitoring programme in place, to justify your application for the next round of grants.
<b>Legal protection</b>		If a site is not legally protected as a reserve or private covenant, it's generally best to seek legal protection when the site is in good condition. However, if you are planning to protect the site and you need to fence it, it pays to contact QEII National Trust first, as they usually pay a share of the fencing costs.



Hihi – Phil Brown



*Wetland around margins of Lake Koraha near Hauturu – Catherine Beard*

# SWAMPS AND BOGS

Swamps and bogs are different types of wetlands that provide habitat for plants and animals that are specially adapted to living in permanently or temporarily wet conditions

Water is a defining feature of wetlands. The types of plants and animals living in these habitats depends on how much water is in the system, how frequently inundation occurs, how long the wetland stays wet, where the water comes from (groundwater, surface water, rainwater or a combination of all three), how deep the water is, and other factors such as temperature and the chemicals and nutrients that are in it.

Swamp and bog plants typically grow close together forming dense communities. Plants adapted to extremely wet conditions grow in, or emergent from surface water. Others prefer wet soil or peat where the ground water levels are high but where water is not visible at the surface. Different types of plants grow in different types of wetlands. In the Waikato Region there are:

- Peat bogs with jointed rushes, tangle ferns, orchids, sundews and sphagnum moss
- Sedgeland with purei (Carex) and reedlike Baumea and Juncus
- Swamp shrublands with manuka, ferns and sedges
- Swamp forests with kahikatea, cabbage tree and swamp maire
- Fertile swamps with raupo and harakeke (flax).

Between 80 to 92 per cent of the Waikato's bogs and swamps have been drained since people settled in New Zealand, leaving only 26,400 hectares of these types of wetlands in the Region. The loss and degradation of large areas of wetlands has not only caused a significant decline in the environmental services that these habitats provide (such as improving water quality, absorbing contaminants and nutrients, controlling floodwaters etc), but has also threatened the survival of many native species, including the giant cane rush, the swamp helmet orchid, giant kōkopu, Australasian bittern, North Island fernbird, banded rail, marsh and spotless crakes.

## THREATS TO SWAMPS AND BOGS

Drainage remains a real threat to many swamps and bogs, although it is illegal to drain wetlands without a resource consent from Waikato Regional Council. Most of the remaining swamps and bogs are threatened by:

- poor water quality (increased sediment and nutrient loading)
- weed invasion including willow, reed sweet grass, alder, alligator weed and yellow flag iris
- animal pests including stoats, rats, possums, cats, rabbits, hedgehogs, koi carp, deer and pigs
- grazing and trampling by farm animals
- loss of connections to streams, other wetlands and estuaries
- fire.

## WHICH TYPE OF SWAMPS AND BOGS ARE THE MOST DEPLETED IN OUR REGION?

<b>Swamp forests</b>	swamp maire, kahikatea forest.
<b>Peat bogs</b>	giant cane rush habitats
<b>Sedgeland</b>	Carex wetlands.

## HOW DO I KNOW WHAT TO DO AND WHEN?

Use the table overleaf to help you prioritise your management actions. The actions are listed in a rough order of priority, though each site is different and will require its own assessment.

Seek professional advice to help you identify the management issues for your site, then write up a plan of action using a copy of the wetland management template (available from [www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz))

# CHOOSING ACTIONS: SWAMPS AND BOGS

## ASSESS NEEDS/PLAN

Do this before anything else. Seek professional advice to help you identify the management issues for your site, then write up a plan of action using a copy of the wetland management template (available from [www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz))

## SEEK FUNDING

Complete the table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you start work. Call 0800BIODIV for advice.

ACTION AND PRIORITY		COMMENTS
<b>Manage water</b>	Monitor/assess Restore water levels if necessary	Wetlands need water, but not necessarily all year round. Water levels naturally drop in many wetlands during summer. To find out what happens in your wetland, monitor water levels for a year (put pegs in the ground after floods/heavy rains to show the high levels).  Check with Waikato Regional Council if you need to divert or dam water to restore your wetland - you will probably require a resource consent to undertake those types of activities.
<b>Reduce pollution</b>	Inflowing water Paddock run-off	If your wetland has a stream flowing into it consider a silt trap and a planted swale to absorb excess nutrients out of the water. See the section on "planting" below for how to deal with run-off.
<b>Control stock</b>	Cattle/horses/deer Sheep/calves	If grazing animals can enter your site they will trample and eat the plants, and their dung and urine will pollute the site. Heavier animals such as adult cattle or horses generally create more damage than lightweight animals such as sheep and calves. Even a hot wire will be a good start in keeping livestock out of your wetland. Be ready to tackle weeds as soon as grazing stops, as you may find the weeds 'take off' when they are no longer being eaten.
<b>Control weeds</b>	Regional plant pests Woody plants Ground cover Others	<ul style="list-style-type: none"> <li>Deal with pest plants. See the plant and animal pests section in the Waikato Regional Council website for information on which ones you are legally obliged to control <a href="http://www.waikatoregion.govt.nz">www.waikatoregion.govt.nz</a></li> <li>In many types of wetlands in New Zealand the native plants are short in stature and need a lot of light to stay healthy. These types of wetlands are easily invaded by woody non-native plants such as willow or alder that shade out native plants over summer. Visit the Waikato Regional Council website to find out how to control these types of weeds <a href="http://www.waikatoregion.govt.nz">www.waikatoregion.govt.nz</a></li> <li>Dense ground cover weeds such as reed sweet grass and flag iris should also be a priority for control as they can smother seedlings and prevent regeneration of native species,</li> <li>Be vigilant for weeds in nearby sites that are not in your wetland - yet!</li> <li>Note that if you intend to change the water levels this may have an effect (good or bad) on weeds. If you change water levels, wait a couple of years to see what happens to the weeds - higher water levels may kill some of the problem plants. Note also that getting rid of some weeds can just encourage others! Seek advice on weed management and subsequent planting.</li> </ul>

ACTION AND PRIORITY		COMMENTS
<b>Control pests</b>	Hoofed animals Rabbits/hares (if planting) Possums, cats, mustelids and rodents Pest fish	<ul style="list-style-type: none"> <li>Pests in wetlands can include deer, pigs, goats, rodents, possums, mustelids (stoats, ferrets, weasels), rabbits, hares and feral cats.</li> <li>Target the large animals first, as they will be easier to find and if the site is well-fenced may be able to be eliminated. Use a trained and licensed hunter to shoot deer, goats and pigs. Other pests will need on-going control.</li> <li>Pest fish may also be present. Care should be taken not to transfer eggs/adults on equipment to other areas or waterways. If pest fish are present, please note that they are often difficult to control - specialist advice is required to identify methods to control pest fish. Contact your local Department of Conservation office or Waikato Regional Council for advice.</li> </ul>
<b>Planting</b>	Buffer Enhance Connections Maintain	<ul style="list-style-type: none"> <li>First consider planting the edges of the wetland to trap sediment and run-off.</li> <li>If the site has unnaturally low diversity and is isolated from natural seed sources, consider enhancement plantings. Seek advice to ensure these are appropriate to the site. - and that plantings are planned for an appropriate time of year. If you have to remove a lot of weeds, plant natives as soon as possible to stop another weed filling the space. If you have used herbicide wait the stated number of days before replanting.</li> <li>If your site is isolated from other natural areas consider planting corridors of vegetation to encourage birds to move between them.</li> <li>Keep your plantings weed free until the plants are well-established. Small plants can be smothered by rank grass. Protect from rabbits, hares and stock.</li> <li>Plant ecosourced plants which are characteristic of the area you are planting (natural plant populations are placed back in their natural range). Check nearby areas for clues to the appropriate vegetation of the area.</li> </ul>
<b>Encourage native animals</b>		If the site is depleted of native animals, monitor the situation for a few years to see what turns up naturally. If you want to re-introduce wildlife you will probably need a permit from the Department of Conservation and/or the Fish and Game Council.
<b>Provide fish access</b>	Downstream Upstream	If the waterway connections between your wetland and the sea are broken by poorly designed culverts, dams without fish passes or other barriers, talk to your council. Focus on downstream barriers first, so your fish can get to the sea and back to your wetland. Upstream connections help other wetland owners share your fish. Note that these actions may also provide access for pest fish species if not already present - see Pests above.
<b>Monitoring</b>	Watch for new weeds!	Take photos of your site. Keep records of which of the plants you planted survived so you can learn what works best for future plantings. Check for an increase in bird numbers and health of plants. If your project is large and needs a lot of funding, then getting a professional monitoring programme designed and implemented will be useful in supporting funding applications. Use the WETmak Wetlands Monitoring and Assessment Kit <a href="http://www.landcare.org.nz/wetmak">www.landcare.org.nz/wetmak</a>
<b>Legal protection</b>		If a site is not legally protected, it is generally best to seek legal protection after it has been restored. However, if you are planning to protect the site to begin with and you want to fence it, contact QEII National Trust, as they may agree to pay a share of the fencing costs.

## Swamps and bogs hot tips

- Visit the Waikato Regional Council website for information on "Restoring a Wetland" A free copy of the wetland management plan template is available for download
- Call 0800 BIODIV (246348) or the Waikato Regional Council on 0800 800 401 for free wetland management factsheets or visit - [www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/)
- Visit the Weedbusters website - [www.weedbusters.org.nz](http://www.weedbusters.org.nz)
- Visit the Landcare Research website and read their factsheet on how to prioritise weed control - [www.landcareresearch.co.nz/\\_\\_data/assets/pdf\\_file/0018/39042/weed\\_management\\_handout.pdf](http://www.landcareresearch.co.nz/__data/assets/pdf_file/0018/39042/weed_management_handout.pdf)
- Visit the Waikato Catchment Ecological Enhancement Trust website for information on funding to enhance the sustainable management of Waikato and Waipa River catchment's [www.wceet.org.nz](http://www.wceet.org.nz)
- Visit the New Zealand Landcare Trust website for the Biodiversity Restoring the Balance self-help kit and for community group information and resources - [www.landcare.org.nz](http://www.landcare.org.nz)
- Read a copy of Wetland Restoration A Handbook for New Zealand's Freshwater Systems at - [www.landcareresearch.co.nz/\\_\\_data/assets/pdf\\_file/0018/41409/Cover\\_Contents\\_2012.pdf](http://www.landcareresearch.co.nz/__data/assets/pdf_file/0018/41409/Cover_Contents_2012.pdf)
- Read Understanding the "wet" in Wetlands A guide to the Management of freshwater wetland hydrology at - [www.gw.govt.nz/assets/council-publications/wetland\\_hydrology.pdf](http://www.gw.govt.nz/assets/council-publications/wetland_hydrology.pdf)



Waiwhakareke peat lake – Hamilton City

# STREAMS, RIVERS AND LAKES

Streams, rivers and lakes are an integral part of the Waikato landscape and help form part of the region's identity with several iconic waterbodies. Four major types of naturally-formed lakes are recognised in the Waikato region - peat, riverine, volcanic and sand dune. The region's 14 riverine lakes are part of an extensive wetland system that includes lakes Whangape, Waahi, Waikare and the internationally important Whangamarino Wetland. There are 31 peat lakes in the Waikato including Lake Rotoroa (Hamilton Lake), Lake Ngaroto and Lake Kainui (Lake D).

These lakes form the largest collection of this ecosystem type in New Zealand, whereas volcanic Lake Taupo is the largest lake in New Zealand. The freshwater ecosystems are inhabited by a range of aquatic life, from tiny zooplankton and phytoplankton, to crayfish and mussels, fish such as eels and galaxiids, and birds that rely on freshwater for all or part of their lives.

Most of the region's waterway length is made up by smaller streams, and these in turn are fed by small springs and seepages that support important components of aquatic biodiversity. Headwater streams drain a wide range of geologies and rise at various altitudes and from a variety of sources, providing a highly diverse range of stream habitats throughout the region.

Most shallow riverine lakes in the region are now murky and unable to support submerged plants. The hydrology and chemistry of peat lakes, that naturally support specialised plants and animals, have been substantially altered, and riparian and instream habitats of most lowland streams and rivers are degraded. The region is fortunate in having scattered areas of protected mountains and hill country which support relatively pristine headwater streams.'

## THREATS TO STREAMS, RIVERS AND LAKES

Forest clearance and drainage along with subsequent land use intensification and the spread of pest species have substantially altered the condition of most lowland waterbodies in the Waikato. These ecosystems are adversely affected by:

- high nutrient levels and turbid waters
- weed invasion including willow, oxygen weed and hornwort
- animal pests including koi carp and catfish
- bank erosion and sedimentation by farm animals
- loss of connections to streams, other wetlands, and estuaries for migratory fish, shrimps and wetland birds
- drainage of associated wetlands and channelisation
- abstraction and damming.

## WHICH TYPE OF STREAMS, RIVERS AND LAKES ARE THE MOST DEGRADED IN OUR REGION?

Lowland waterways in the Waikato catchment and the Hauraki area.

Riverine lakes such as Waikare and Kimihia in the Waikato district and peat lakes such as Lake Ngarotoiti in the Waipa district.

## HOW DO I KNOW WHAT TO DO, AND WHEN?

Use the table overleaf to help you prioritise your management actions. The actions are listed in roughly the priority order, though each site is different and will require its own assessment.

# CHOOSING ACTIONS: STREAMS, RIVERS AND LAKES

## ASSESS NEEDS/PLAN

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Write up a plan of action.

## SEEK FUNDING

Complete this table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you can start on the work. Call 0800 BIODIV for advice.

ACTION AND PRIORITY		COMMENTS
<b>Reduce pollution</b>	Point sources Diffuse run-off	If your lake or stream has a point source (e.g. pipe) discharge flowing into it, contact your local council for advice. Diffuse run-off is harder to control but suitable riparian management such as fencing and dense planting can help. See your local council for advice and funding opportunities.
<b>Water levels and flow</b>	Maintain levels Reduce variability	Aquatic life needs water, all year round for most species. Fluctuating water levels beyond the natural range of variation can adversely affect aquatic life, and minimum flows need to be sustained. Note intermittent flowing streams have value too. Check with Waikato Regional Council if you need to divert or dam water - you will probably need resource consent.
<b>Control stock</b>	Fence margins Install troughs Bridge stock crossings	If grazing animals can enter your site they may trample and erode banks, and their dung and urine will pollute the site when they enter the water. Heavier animals like adult cattle and horses are generally more damaging than lightweight animals such as sheep and calves. Even a hot wire will be a good start to keep cattle out. If the water body is used by stock for drinking, provide an alternative stock water supply. Build stock crossings using bridges or appropriate culverts (not perched) to keep stock out of water at crossing points. Fence off springs.
<b>Control weeds</b>	Regional plant pests Riparian plants Macrophytes	<ul style="list-style-type: none"> <li>Deal with weeds you are legally obliged to. See the plant and animal pests section on Waikato Regional council's website.</li> <li>Be vigilant for weeds in nearby sites that are not in your stream or lake - yet! Riparian willows may invade streams and lake edges and cause clogging of the channel and bed; restored riparian sites may initially be invaded by weeds that need control. Replace riparian weeds with suitable native plants to stop the weeds coming back.</li> <li>Shade can reduce troublesome growths of macrophytes (large aquatic plants) - plant appropriate shading vegetation</li> <li>Limit spread of troublesome aquatic plants around lakes and waterways (e.g. on boat propellers).</li> <li>If water weeds are present they are difficult to control, specialist advice is required to identify methods to control water weeds. Contact your local Department of Conservation (DOC) office or Waikato Regional Council for advice.</li> </ul>

ACTION AND PRIORITY		COMMENTS
<b>Control pest fish</b>	Limit spread Seek help to control pest fish	<ul style="list-style-type: none"> <li>• Pest fish such as koi carp, catfish, rudd and Gambusia can cause water turbidity leading to collapse of macrophyte communities, erosion of banks and margins by their feeding activities and eat native life.</li> <li>• Don't transfer eggs/adults on equipment to other areas or waterways. Make sure you thoroughly clean boats, trailers and any fishing gear before you leave any waterbody. Refer <a href="http://www.biosecurity.govt.nz/pests/didymo">www.biosecurity.govt.nz/pests/didymo</a></li> <li>• If pest fish are present they are difficult to control, specialist advice is required to identify methods to control pest fish. Contact your local DOC office or Waikato Regional Council for advice.</li> </ul>
<b>Riparian planting</b>	Buffer Enhance Connections Maintain	<ul style="list-style-type: none"> <li>• First you should consider planting the edges of streams to provide shade. This is not so effective for larger rivers but riparian planting can still help with bank stability and have other ecological benefits. For riparian zones around lakes, divide into three plant zones: moist soils that flood often, wet soils that flood sometimes and standing, open water. Next, identify the appropriate plants for your site (planting guides can be obtained from Waikato Regional Council, the Department of Conservation or call 0800 BIODIV).</li> <li>• Even narrow riparian zone widths (around 5-10 metres) can deliver many benefits to adjacent waterbodies by providing shade, bank stability, organic matter and filtering overland flows.</li> <li>• If your site is isolated from other natural areas, riparian zones may provide additional opportunities as corridors of vegetation to encourage animals to move between them.</li> <li>• Keep your plantings pest free until the plants are well established. Small plants can be smothered by rank grass. Protect from rabbits, hares and stock.</li> <li>• Plant ecosourced plants which are characteristic of the area you are planting (natural plant populations are placed back in their natural range). Check nearby areas for clues to the appropriate vegetation of the area.</li> </ul>
<b>Increase habitat diversity</b>	Meander Floodplains Retain wood Reduce sediments	<ul style="list-style-type: none"> <li>• Channelisation and stopbanking limit the natural interaction of rivers with their floodplains and reduce habitat diversity. Where possible, retain an area adjacent to rivers where natural floodplain interactions can occur and that allows floodflows to move through quickly without channelisation. Bends in streams and rivers increase the area and diversity of habitat for aquatic life.</li> <li>• Large pieces of wood that fall into streams, rivers or lakes and remain stable there can provide important cover for fish, roosts for birds, and habitat for invertebrates - don't remove stable wood pieces. Consider putting some in where you can be sure it will remain stable without choking the waterway.</li> <li>• Deposition of sediment onto stream and lake beds can reduce habitat for bottom-dwelling species. Prevent sediment inputs by using sediment traps and stabilise severely eroding banks, preferably with appropriate plantings. Not all undercut banks are bad - some provide cover for fish and crayfish.</li> </ul>
<b>Fish access</b>	Downstream Upstream	If the waterway connections to the sea are broken by poorly designed culverts, dams without fish passes or other barriers, talk to your council. Focus on downstream barriers first, so your fish can get to the sea and back to your stream or lake. Upstream connections help other waterway neighbours share your fish. These actions may also provide access for pest fish species if not already present.-
<b>Monitoring</b>	Watch for new pests Monitor stream health	<ul style="list-style-type: none"> <li>• Watch out for pest species such as Salvinia, water hyacinth, and the new invasive algae Didymosphenia - report outbreaks to the Ministry of Agriculture and Forestry (MAF) and get good advice on management. See <a href="http://www.biosecurity.govt.nz">www.biosecurity.govt.nz</a> for more information (use the search box to find factsheets on these plants).</li> <li>• Check for stream health by, for example, identifying and counting fish on annual basis and checking clarity of the water.</li> <li>• Use the Stream monitoring kit from NIWA <a href="http://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit">www.niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit</a></li> </ul>

## Streams, rivers and lakes hot tips

- Call Waikato Regional Council's Freephone 0800 800 401 or visit their website for information on Clean Streams and streamcare groups: [www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz)
- Visit NIWA's website for more information identifying freshwater plants and animals and read "Restoring streams for freshwater fish" by R. Richardson and I. Jowett: <http://docs.niwa.co.nz/library/public/NIWAsts53.pdf> Visit the NIWA website for information on stream monitoring: [www.niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit](http://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit)
- Visit the Landcare Research website, read their factsheet on how to prioritise weeds and do a search for "stability" for information on riparian planting: [www.landcareresearch.co.nz](http://www.landcareresearch.co.nz)
- Visit the Waikato Catchment Ecological Enhancement Trust for information on funding to enhance the sustainable management of the ecological resources in the Lake Taupo and Waikato River catchments: [www.wceet.org.nz](http://www.wceet.org.nz)
- Visit the Wai Care website for information and guidance about water care: [www.waicare.org.nz](http://www.waicare.org.nz)
- Visit the Weedbusters website: [www.weedbusters.org.nz](http://www.weedbusters.org.nz)
- Visit the New Zealand Landcare Trust for a list of publications guides and kits [www.landcare.org.nz](http://www.landcare.org.nz)
- Visit the New Zealand Landcare Trust [www.landcare.org.nz/News-Features/News/Freshwater-Invertebrate-Guide](http://www.landcare.org.nz/News-Features/News/Freshwater-Invertebrate-Guide)
- Visit Landcare Research for useful guides [www.landcare.org.nz/Publications/Reports-Kits](http://www.landcare.org.nz/Publications/Reports-Kits).

# BEACHES AND DUNES

Most of the region's western coasts consist of high-energy black sand beaches and dunes. The east coast of the region is more sheltered and beaches and dunes are mostly made of white sand.

Our beaches are inhabited by a variety of species, including shellfish such as tuatua and biscuit shells, and a variety of crustaceans such as sandhoppers and paddle crabs. The dunes provide homes and food for small animals including insects, spiders, butterflies, moths and lizards, which in turn provide habitats for shorebirds.

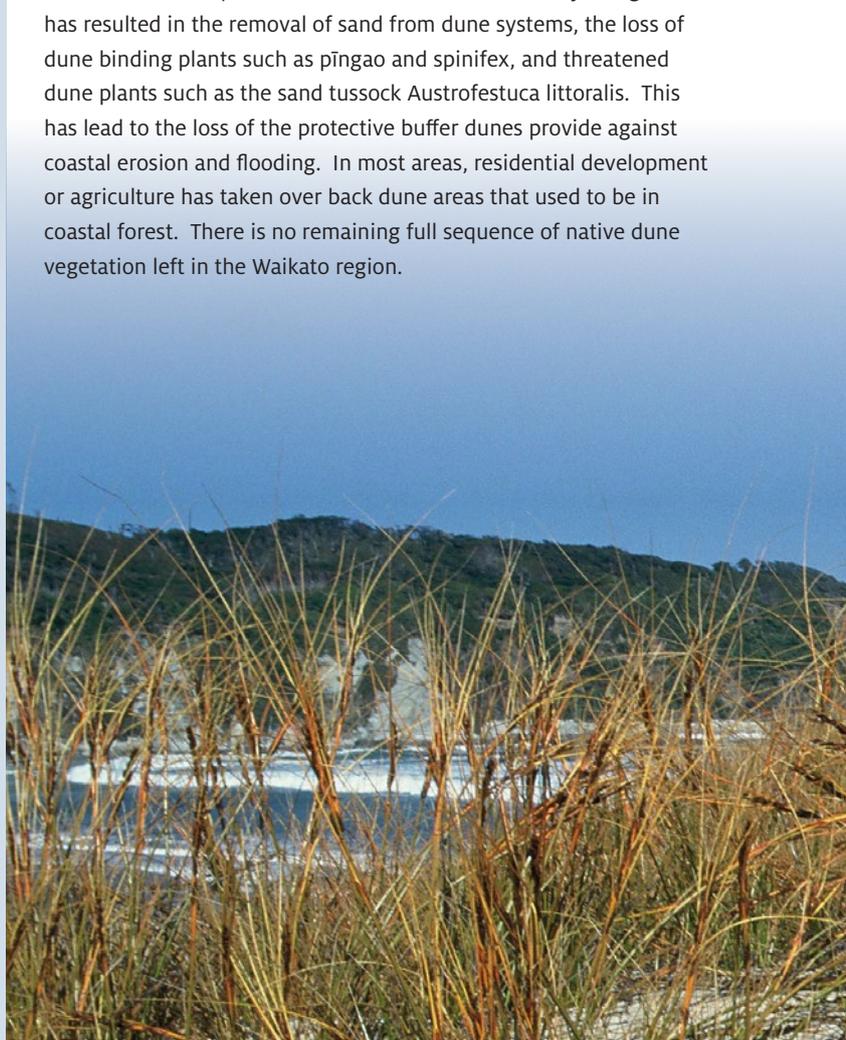
Endemic species of shorebirds are found along the Waikato shorelines, such as:

- New Zealand dotterel
- variable oystercatcher
- wrybill.

## THREATS TO BEACHES AND DUNES

Human activities are the main threat to beaches and dunes. Coastal subdivision and other land use activities have had a huge impact on coastal dunes since the 1950s, particularly along the eastern Coromandel. At least 70 per cent of the region's dune areas have been modified for coastal subdivisions, forestry, agriculture and sand mining.

Residential development and associated human activity along dunes has resulted in the removal of sand from dune systems, the loss of dune binding plants such as pīngao and spinifex, and threatened dune plants such as the sand tussock *Austrofestuca littoralis*. This has led to the loss of the protective buffer dunes provide against coastal erosion and flooding. In most areas, residential development or agriculture has taken over back dune areas that used to be in coastal forest. There is no remaining full sequence of native dune vegetation left in the Waikato region.



Some threats to dunes:

- Introduced exotic plants that reduce natural character and affect natural dune building and repair include marram, boneseed, wild ginger, coastal wattle, bushy asparagus, kikuyu, agapanthus, silver/white poplar, box thorn, sweet pea shrubs, yuccas, Agave americana, blue morning glory and pampas.
- Grazing of dune vegetation by stock, rabbits and hares.
- Sand mining and extraction for iron sands.
- Discharge of stormwater from coastal subdivisions that accelerate beach and dune erosion and degrade amenity and natural character.
- Damage to sand binding grasses by off-road vehicles and pedestrian trampling, leading to serious wind erosion and disruption of natural dune building.
- Predation of ground nesting shore birds by introduced predators (including feral cats, rats, mustelids, dogs and hedgehogs).
- Loss of shore bird habitat due to introduced plants.
- Disturbance to nesting shorebirds by humans, dogs and vehicles.
- Dumping of garden waste on sand dunes.

In the future, sea level rise and other changes likely from predicted global warming could drive further dune erosion.

Existing development on the back dunes means that in a lot of cases, natural shoreward movement of dunes cannot occur, and they will be “pinched out”.

## WHICH TYPES OF BEACHES AND DUNES ARE MOST DEPLETED IN OUR REGION?

Natural dunes are depleted on both coasts of the Waikato region.

The east coast (Coromandel Peninsula) beaches and dunes are the most depleted. Many of the natural dunes have been flattened and built on, so both the original structure and vegetation have been severely altered. There are just a few sites where natural dunes remain, but none have a complete sequence of natural vegetation from sand binding grasses through to coastal forest.

The west coast has seen less development on the dunes, but the vegetation has been altered considerably through changing land use. Many dunes (such as those at Kawhia) are covered in exotic forestry, and native sand binding grasses have been replaced by introduced marram grass.

## HOW DO I KNOW WHAT TO DO, AND WHEN?

To carry out restoration work on beaches and dunes you will need to work in conjunction with a beachcare group. To find out if there is one already operating at your beach, or to organise a new one, phone Waikato Regional Council and talk to the Beachcare coordinators for your area

The table overleaf can help your beachcare group to prioritise actions that can help to protect and restore these environments. The actions are listed in roughly priority order, though each site is different and will require its own assessment. It is important to both protect and enhance what small areas of dune still exist. New development needs to be set back far enough from the sea to allow for natural changes in the shoreline, as well as possible future erosion caused by climate change and sea level rise.



# CHOOSING ACTIONS:

## BEACHES AND DUNES

### ASSESS NEEDS/PLAN

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Check with Waikato Regional Council to find out if there is a Beachcare group for your area. You can also get advice from other agencies such as DOC, local councils, local iwi and community groups to find out about similar or related projects planned or underway nearby. Write up a plan of action.

### SEEK FUNDING

Complete this table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you can start on the work. Call 0800 BIODIV for advice. Remember that dunes and beaches are generally public property. Seek permission from the authorities to erect structures, remove weeds or undertake any planting.

ACTION AND PRIORITY		COMMENTS
<b>Protect shorebirds</b>	Research Education Signs/ fences	<ul style="list-style-type: none"> <li>Contact the New Zealand Ornithological Society or the Department of Conservation to find out if your area is an important nesting or roosting site for shorebirds. They may also have historical information. If the site is very depleted of shore birds, monitor the situation for a few years to see what changes occur.</li> <li>Encourage the local community to protect shorebirds. Use meetings, presentations, newspaper articles, brochures and posters to highlight the plight of local species.</li> <li>Seek permission and community support to place fencing and signs around shorebird nesting sites during the breeding season. This will encourage people to keep a respectful distance and prevent dogs, pedestrians and vehicles from trampling eggs and disturbing birds.</li> <li>Control pests (see below).</li> </ul>
<b>Minimise human damage</b>	Exclude vehicles Exclude pedestrians from sensitive areas Education	<ul style="list-style-type: none"> <li>Talk to your local District Council about options for excluding vehicles from dune areas.</li> <li>Erect signs to educate people about the value of and need to keep off fragile dunes. Build wooden access ways and negotiate fenced off areas to encourage people to keep off fragile dunes and protect sand grasses and back dune vegetation. Plan access ways that will have minimal effect on the dune vegetation.</li> <li>Place signs near access ways to inform people of re-vegetation activities and the importance of leaving dunes undisturbed.</li> </ul>
<b>Control weeds</b>	Plant pests Other weeds Replace with native plants	<ul style="list-style-type: none"> <li>Deal with regional plant pests first, including boneseed, pampas, gorse and broom. See <a href="http://www.waikatoregion.govt.nz">www.waikatoregion.govt.nz</a>.</li> <li>Remove other exotic plants and weeds such as marram grass and wilding pines from the dune and beach area and replant in native vegetation. It is particularly important to replace marram to ensure the dune remains stable.</li> <li>Note also that getting rid of some weeds can just encourage others! Get good advice on weed management. Replace weeds with native plants to reduce weed re-invasion.</li> </ul>
<b>Planting</b>	Stabilise the seaward dune face Stabilise loose migrating sand Restore the back dunes	<ul style="list-style-type: none"> <li>If the fore dunes are bare, plant native sand grasses such as spinifex and pīngao on the seaward dune face to bind the sand. Use ecosourced plants. Don't plant trees or shrubs in the sand grass area seaward of the dune crest, as these species will be subject to salt burn or erosion.</li> <li>Plant sand binders on loose sand close to the beach.</li> <li>Plant ground covers, shrubs and trees on the back dunes. These native species can include knobby club-rush, sand coprosma, pōhuehue, flax, toetoe, taupata, tauhinu, karo, ngaio, akeake and pohutukawa. Consider the impact planted tree's may have on views once they are of a mature size. See Auckland Council's website for more planting ideas.</li> <li>Apply slow release fertilizer at the time of planting. Use water retention crystals and weed releasing in early stages of planting where practical.</li> </ul>



Beachcare on the West Coast – Moniqua Nelson-Tunley

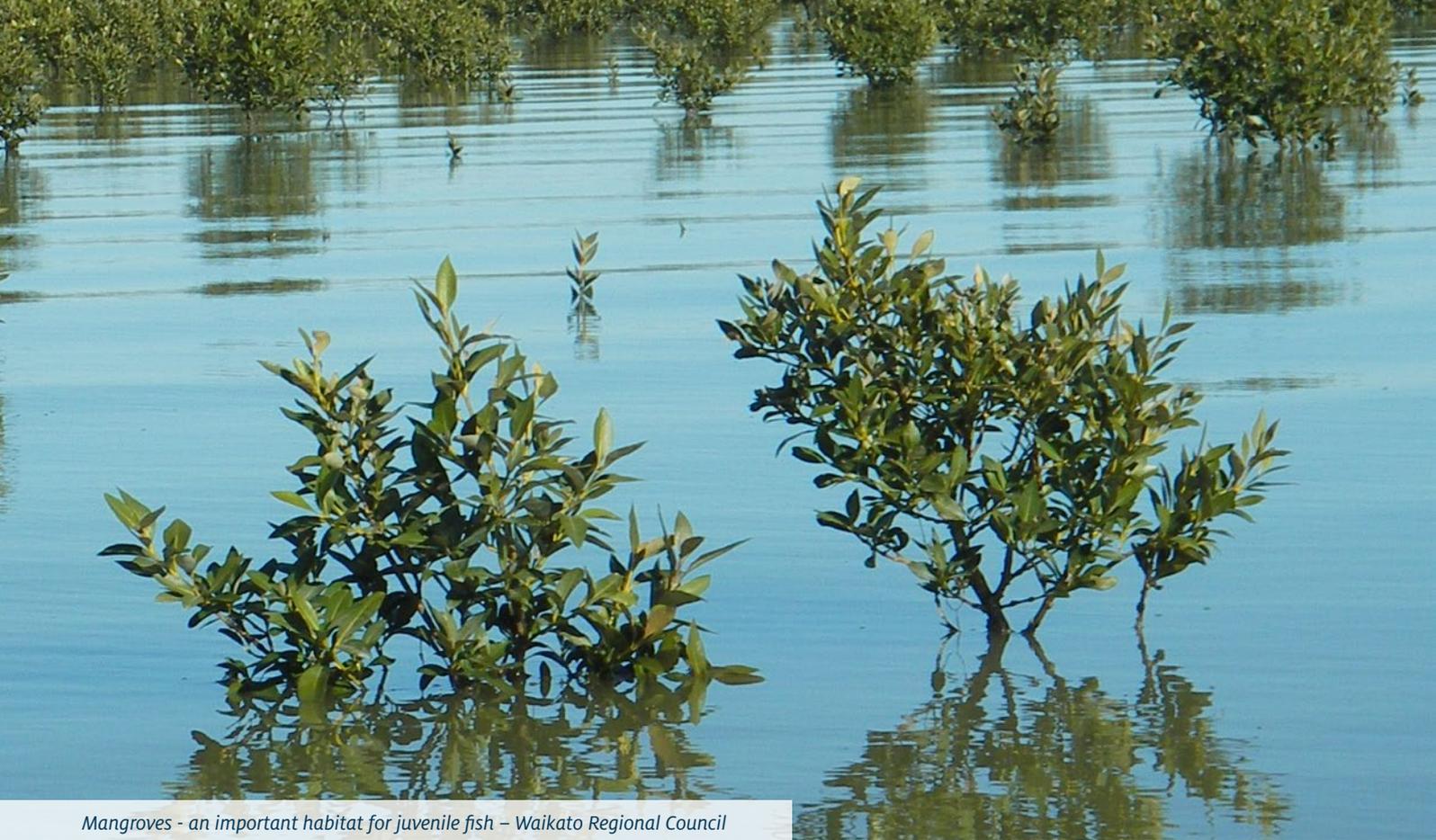
ACTION AND PRIORITY		COMMENTS
<b>Control pests and stock</b>	Exclude stock  Control predators  Control herbivores	<ul style="list-style-type: none"> <li>Prevent stock from grazing on dunes and trampling on beaches.</li> <li>Hedgehogs, cats, rats and mustelids destroy the breeding attempts of ground nesting birds such as dotterels. Talk to Waikato Regional Council’s for advice on pest control, particularly in areas where public safety is important.</li> <li>Back dune plantings are subject to rabbit and hare browsing. Control these pests if possible to avoid loss of plantings. If it is not appropriate to use poisons or other control methods in public places, try painting the plants with rabbit deterrent. See the plant and animal pest section on Waikato Regional Council’s website for repellent recipes.</li> </ul>
<b>Monitoring</b>	Monitor success of actions	Take photos of your site. Keep records of which plants you have planted survived so you can learn for next time. Monitor the number of insects and other wildlife on the beach and dunes. If the project is large and needs a lot of funding get a professional monitoring programme in place, to show results to community and funding agencies. Seek advice from the Department of Conservation or the New Zealand Ornithological Society for monitoring shorebirds and animal pests.

## Beaches and dunes hot tips

- Call Waikato Regional Council on 0800 800 401 or visit [www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz) for information on beaches, dunes, beachcare groups and plant and animal pests.
- Visit the Dune Restoration Trust of New Zealand’s website - [www.dunestrust.org.nz](http://www.dunestrust.org.nz)
- Visit the Weedbusters website - [www.weedbusters.org.nz](http://www.weedbusters.org.nz)
- Read Waikato Regional Council’s “Fragile: A Guide to Waikato Dunes”.

- Read “Which Coastal Plant” by Andrew Crowe, an informative and simple guide to the identification of New Zealand’s most common coastal plants. Read “Plants of the NZ Coast” by L B Moore and N Adam.





*Mangroves - an important habitat for juvenile fish – Waikato Regional Council*

# MARINE AND ESTUARINE ECOSYSTEMS

The coastline of the Waikato region covers approximately 1195 kilometres, and includes the exposed west coast, the Firth of Thames and the Coromandel Peninsula. Estuaries are among our most sensitive coastal places. They are home to a wide range of birds, fish and shellfish, and are of enormous environmental and economic importance. There are around 30 estuaries in the Waikato region.

A number of different aquatic ecosystems are recognised within estuaries: seagrass beds, mangroves, saltmarshes, sand and mud flats, rocky reefs and shallow open water areas. Seagrass beds and mangroves provide shelter and food for a wide range of coastal and estuarine animals. Seagrass also binds land sediments and acts as a wave break. Saltmarshes are often nurseries for juvenile fish, and are important breeding and feeding areas for birds. Intertidal sand and mud flats are home to marine worms, shellfish and crabs. These are important food sources for many fish and birds, and they also play a vital function in recycling nutrients.

The inner Firth of Thames is a productive habitat for cockles, pipi and fish, particularly benthic soft-sediment feeders such as yellowbelly flounder, dab flounder and short finned eel. Snapper and yellow-eyed mullet, pilchard, āhuru and grey mullet are also found within the inner Firth of Thames. Several species of shark feed in the area, most notably rig. In spring the females of several species including rig, hammerhead, bronze whalers and schools of shark

utilize the upper Firth of Thames for birthing. Orca are occasional visitors to the shallows and common dolphins, including nursery groups, are observed regularly in the upper Firth. The Firth is also an important feeding ground for whales. Thousands of arctic nesting shorebirds, including the bar-tailed godwit, lesser or red knot, ruddy turnstone, eastern curlew and sharp-tailed sandpiper use the Firth as a wintering ground.

Subtidal environments include rocky reefs with associated macroalgae (seaweed) and fauna, and soft sediment habitats. Maui dolphin (around 55 in the wild) are found only on the west coast of the North Island of New Zealand. New Zealand fur seals are also found off the west coast. Currently there is only one marine reserve within the Waikato region, at Te Whanganui a Hei (Hahei), established in 1992. The entire west coast of the Waikato region lies within the West Coast North Island marine mammal sanctuary. The sanctuary was established in 2008 and particular activities, such as seismic surveying and mining, are restricted within its boundaries.

## THREATS TO MARINE LIFE

Main potential threats to coastal and marine life:

- Coastal margin development - population growth and coastal settlement.
- Increased demands for recreational uses - such as boating and fishing.
- Habitat destruction from excavation and dredging for example for boat ramps and boat channels.
- Sedimentation from catchment and forestry development.
- Contaminants, such as nutrients and heavy metals, resulting from sewage, agricultural and stormwater runoff and discharge.
- Development in estuaries - such as marine farms and marinas.
- Over fishing.
- Introduction of invasive species such as Spartina.
- Rubbish from boats and antifoulants used on boats.
- Stock grazing down the estuarine waters edge.
- Long term climate changes including sea level rise.

Sedimentation and pollution pose threats to seagrass beds. Seagrass beds are important nursery habitats for juvenile invertebrates, fish and shellfish. Pollution, sedimentation and over-harvesting can also adversely impact shellfish beds. Other specific threats related to marine organisms, especially the Maui's dolphin, include trawl fishing, boat strikes, entanglement in marine litter (especially plastics, nets and fishing lines) and persistent organic pollutants and heavy metals.

## WHICH TYPES OF MARINE ECOSYSTEMS ARE MOST AT RISK IN OUR REGION?

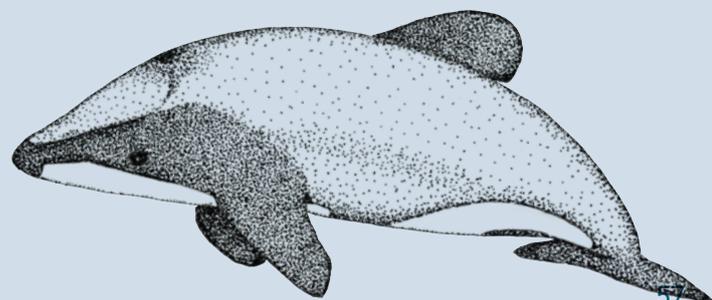
- Subtidal seagrass beds.
- Intertidal seagrass beds.
- Salt marshes and saline wetlands.

## HOW DO I KNOW WHAT TO DO, AND WHEN?

It's important to practice good land management in our estuaries' catchments. This reduces run-off and leaching of nutrients and minimises erosion, leading to less sediment and infilling in our estuaries. For information on what you can do, see the table overleaf.

## Marine and estuarine ecosystems hot tips

- Visit the Department of Conservation website to find out more about marine ecosystems and species - [www.doc.govt.nz](http://www.doc.govt.nz)
- Read "Marine Reserves - A Guide for Prospective Applicants" to find out about supporting an application for a marine reserve in your area - [www.doc.govt.nz](http://www.doc.govt.nz)
- Visit Waikato Regional Council's website for information on marine and estuarine ecosystems, harbour and coastal wetland care groups and animal and plant pests - [www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz)
- Visit NIWA's website to find out more about marine and estuarine ecosystems - [www.niwa.co.nz](http://www.niwa.co.nz)
- To find out more about Maui's dolphin visit - [www.hectorsdolphins.com](http://www.hectorsdolphins.com)
- Visit the Weedbusters website - [www.weedbusters.org.nz](http://www.weedbusters.org.nz)
- Visit the Miranda Shorebird Centre on the Firth of Thames to learn more about shorebirds - [www.miranda-shorebird.org.nz](http://www.miranda-shorebird.org.nz)



# CHOOSING ACTIONS:

## MARINE AND ESTUARINE ECOSYSTEMS

### ASSESS NEEDS/PLAN

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Write up a plan of action. Find out from Waikato Regional Council whether there is a harbourcare group in your area.

### SEEK FUNDING

Complete this table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you can start on the work. Call 0800 BIODIV for advice. Remember that marine ecosystems are generally public property. Seek permission from the authorities to undertake any works such as weed control or planting in estuaries.

ACTION AND PRIORITY		COMMENTS
<b>Reduce pollution</b>	Keep contaminants out of stormwater Exclude stock from waterways Dispose of rubbish wisely	<ul style="list-style-type: none"> <li>Prevent pollutants getting into stormwater drains and flowing into estuaries and coastal areas. Wash your car, boat keels, motors and trailers on the grass, not on paved surfaces. Fix oil leaks. Don't put petrol, paints, solvents, and garden chemicals down stormwater drains. Have septic tanks pumped out regularly to prevent seepage into the coastal marine area. Follow Waikato Regional Council's on-site sewage rules for septic tank design.</li> <li>Fence off estuaries to prevent stock access. Prevent stock from polluting the streams and rivers which flow into the coastal marine area by fencing and planting waterways.</li> <li>Dispose of boat rubbish (especially plastic) and sewage on-shore, and maintain bilge pumps to reduce oil leaks. Don't dump rubbish in estuaries (including garden rubbish, which may include invasive weeds).</li> </ul>
<b>Reduce sediment delivery to waterways</b>	Fence and plant stream banks and steep slopes Minimise erosion Control pests	<ul style="list-style-type: none"> <li>Plant or leave a buffer strip of plants along streams and at the edge of estuaries to help stabilise the banks and trap nutrients. Fence gullies and waterways to prevent stock access. Retire unproductive land and allow it to regenerate into native bush. Don't cultivate steep land.</li> <li>Minimise earthworks on steep slopes and close to water, and use appropriate land management practices such as keeping stock off steep pasture when it is wet. Plant cover crops when land is left fallow.</li> <li>Remove wild goats and rabbits (they eat the vegetation that stabilises slopes).</li> </ul>
<b>Fish responsibly</b>	Report strandings Don't harass sea mammals Report sightings of distressed sea mammals	<ul style="list-style-type: none"> <li>Report dead or stranded whales or dolphins immediately to the Department of Conservation on 0800 DOCHOT (0800 362 468). Do not move the dolphin or any nets found in the area.</li> <li>Report sighting of distressed sea mammals to Department of Conservation.</li> <li>Use a 'no wake' speed for boats within 300 metres of dolphins and whales. Don't try to swim with or feed any dolphins, seals or whales.</li> <li>Report sightings of Maui dolphins to the World Wildlife Fund sightings network on 0800 4 MAUIS (0800 462 847) or submit a report at <a href="http://www.wwf.org.nz">http://www.wwf.org.nz</a>. Report the location, number of dolphins and date/time of sighting. If possible, take a photo with the shore in the background.</li> </ul>
<b>Control weeds</b>	Plant only natives Limit spread of weeds Remove weeds	<ul style="list-style-type: none"> <li>Don't plant exotic species in estuaries.</li> <li>Remove exotic plants and weeds from the motor and hull of boats and wash down to prevent invading weeds being transferred to the marine area.</li> <li>Talk to the Department of Conservation about options for removing aquatic weeds such as spartina and saltwater paspalum. Control terrestrial weeds such as wilding pines and gorse at the edge of estuaries. Getting rid of some weeds can just encourage others! Get good advice on weed management.</li> </ul>

ACTION AND PRIORITY		COMMENTS
<b>Protect sensitive areas</b>	Avoid sensitive habitats	Avoid trampling across saltmarshes, mangroves and seagrass beds. They are sensitive to trampling and can take a long time to recover.
<b>Marine reserves</b>	Support proposals for marine reserves	People in communities where there are potentially important marine areas and values can support a proposal for a marine reserve through organisations such Forest and Bird.
<b>Monitoring</b>	Weeds Water quality	<ul style="list-style-type: none"> <li>• Take before and after photos of estuarine areas.</li> <li>• Monitor intertidal areas for weeds such as saltwater paspalum and spartina.</li> <li>• Check for any improvement in water quality and record. Contact Waikato Regional Council for advice about monitoring.</li> </ul>



Whangamata estuary



Great Mercury Island, Mercury group and Aldermen Islands – Rob Chappell

## COASTAL ISLANDS

Islands are essentially hilltops that are above current sea level. They have not always been as they are, as sea levels have varied drastically through the past 100,000 years. This means that many near-shore islands (those on the continental shelf) have, at various times, been connected with the mainland or submerged beneath the sea. Human alteration of islands has often been as devastating as on the mainland, through a combination of:

- cultivation, occupation, and harvesting of sites
- lighthouse stations
- introduction, both accidental and deliberate, of plant and animal pests
- repeated fires, both accidental and deliberate.

Many native species have survived because they found refuge on islands that were inaccessible, isolated or happened through good fortune to be uninhabited by mammal pests brought by humans. For example, the Aldermen Islands (off the coast of Tairua) have probably been visited by humans since the arrival of Maori in New Zealand. Yet only one of the six islands in the group has ever had an established population of rats.

There are a large number of islands, islets, and rock stacks close to the Coromandel Peninsula, including Cuvier Island, the Mercury Islands, and the Aldermen Islands. Some of these islands have limited access to the public. They provide refuges for animals and plants that have become extinct on the mainland because of rats, cats, mustelids and other mammal predators. The west coast of

the region has only one island, Gannet Rock, which is a wildlife sanctuary. It is located off the coast of Aotea Harbour, and is a haul out and breeding site for the New Zealand fur seal and a breeding site for the Australasian gannet.

Many of these islands provide important wildlife refuges, helping to protect threatened native species, such as storm petrels, shearwaters, tuatara, giant centipedes, lizards, tree wētā, Mercury Island tusked wētā, various lizards, saddleback and little spotted kiwi. There are very few areas on the mainland used for seabird breeding. The Coromandel islands house tens of thousands of seabirds, and Red Mercury Island is the national stronghold of Pycroft's petrel.

Plant species found on offshore islands are typical of what was once present around the mainland coastline. On the Coromandel islands, the vegetation is dominated by species like pohutukawa, milk tree, karo, whau, wharangi, and wharareke. These islands also tend to house a range of threatened plants that have become extinct or very rare on the mainland, such as Cook's scurvy grass, shore spurge and milk tree.

Because Repanga/Cuvier Island was permanently inhabited for the longest period, it has a much longer history of pest habitation and eradication. By the late 1880s, kiore were well established, and the 1888 commissioning of the lighthouse station saw the introduction of cattle, sheep, goats, and cats. Goats and cats in particular had a

major impact on the island, and restoration began in 1961 with the eradication of goats, with feral cattle and sheep in 1963, feral cats by 1964, and kiore in 1993.

The Mercury Islands were used as a test bed for the development of modern aerial toxin methods to eradicate rodents with the following eradications:

- Korapuki Island: Rabbits in 1988, and rats in 1989
- Moturehu/Double Island: Rats in 1989
- Kawhitu/Stanley Island: Rabbits and rats in 1992
- Whakau/Red Mercury Island: rats in 1993

Later, the other islands in this wider group that had mammalian pests were targeted, including:

- Ohinau Island: mice, kiore, and rabbits in 2005-06
- Ahuahu/Great Mercury Island: rats and cats in 2016

In the Motukawao/Happy Jack group on the western coast of the Coromandel:

- Motuoruhi/Goat Island: Pigs in 1970, and goats and stoats in 2003
- Waimate Island: Stoats in 2005
- Whanganui Island: Possums in 1995
- Motutapere Island: Possums, rats, and mice in 1996, and mice again in 2005 after reinvasion

## THREATS TO ISLANDS

The major threats to coastal islands are:

- introduction of pests that could destroy internationally important populations of rare species such as Mercury Island tusked wētā, little spotted kiwi and saddleback fire.

Pests or fire could wipe out decades of work by DOC and tangata whenua.

### Which types of coastal island ecosystems are most at risk in our region?

Islands that are close to shore are most at risk of invasion by weeds or pests.

### How do I know what to do, and when?

For information on what you can do, see the table overleaf. If you'd like to visit a predator free island, see the hot tips box below.

# CHOOSING ACTIONS:

## COASTAL ISLANDS

Most of the coastal islands are administered by the Department of Conservation. All the islands in the Cuvier-Mercury and Aldermen Island groups are “no-landing islands” to keep them free from animal pests and fires. Contact your closest Department of Conservation office to find out how you can become involved and help with coastal island restoration work.

If you own a coastal island with native forest and/or a wetland, use the native forest and scrub table or the swamps and bogs ecosystems template to assist you in deciding on which restoration actions need to be undertaken and to determine their priority. You can also learn about restoring a coastal island by joining an island restoration group through the Department of Conservation.

ACTION AND PRIORITY		COMMENTS
<b>Contain animal pests</b>	Prevent transfer of pests Keep pets off islands	<ul style="list-style-type: none"> <li>Make sure no animal pests such as rats are transferred to islands. Be particularly careful with food and keep it in sealed plastic containers. Use rat bait on board your boat.</li> <li>Don't use islands to exercise pets.</li> </ul>
<b>Prevent weed spread</b>	Remove weeds from your boat	Remove exotic plants and weeds from the motor and hull of boats and wash down away from a waterway to prevent transfer of invading weeds to the marine area.
<b>Visit islands responsibly</b>	Respect no-landing bans Visit islands with permission or 'open sanctuaries' Help restore islands	<ul style="list-style-type: none"> <li>Don't land on islands that have no-landing rules to protect them from fire and pests. Don't let your pets land either. Keep dogs under control within swimming distance of islands.</li> <li>The Moehau Environment Group (supported by the Department of Conservation) runs several one-day trips each year to Repanga/Cuvier Island. Cuvier has one of the longest histories of restoration in New Zealand, with goats, cats, and rats all having been removed.</li> <li>Tiritiri Matangi is an open sanctuary run by the Department of Conservation and the Supporters of Tiritiri Matangi. The island is being re-vegetated with community help, and threatened species once present are being re-introduced. Contact Fullers Ferry service for information.</li> </ul>
<b>Volunteer</b>	Join an island restoration group	The Department of Conservation maintains staff on Raoul Island (in the Kermadec Group), approximately 900 kilometres north-northeast of Cape Reinga. This team is supplemented by up to eight volunteers once a year, who stay for four months. The main management aim for Raoul is weed control.

### Coastal islands hot tips

- Visit the Department of Conservation's website and search for "islands": [www.doc.govt.nz](http://www.doc.govt.nz)
- Visit a pest-free island to learn about species recovery programmes:
  - Tiritiri Matangi Island (via 360 Discovery Tours Ferry from Gulf Harbour, Whangaparaoa Peninsula) or downtown Auckland.
  - Cuvier Island via Moehau Environment Group's Summer Holiday Programme - [www.meg.org.nz](http://www.meg.org.nz)
  - Visit Motutapere Island Scenic Reserve (off Coromandel Harbour), or Mahurangi Island
  - Recreation Reserve (in Te Whanganui-a-Hei/Cathedral Cove Marine Reserve at Hahei).





*Soda fountain spring Orakei Korako*

# GEOTHERMAL ECOSYSTEMS

Geothermal features include steaming ground, boiling mud pools, fumaroles and hot springs. Not all geothermal features are hot. Some contain cooled geothermal water with a high mineral content. Some contain no water at all and are comprised of altered or heated ground. Geothermal features support rare ecosystems with high soil, water or air temperatures, unusual and often extreme chemical environments (such as high acidity or alkalinity, high concentrations of toxic chemicals such as arsenic, mercury, and boron) and a range of potentially lethal gases (for example, hydrogen sulphide).

About 70 per cent of New Zealand's geothermal resources occur within the Waikato region, yet the region's geothermal vegetation still only covers a total area of 635.8 hectares excluding geothermal water and bare ground. See Table 2 [www.waikatoregion.govt.nz/tr201507/](http://www.waikatoregion.govt.nz/tr201507/). Although the area of geothermal vegetation is low, there are many more hectares of features such as lakes and sinter terraces.

The special types of vegetation or biota that occupy geothermal ecosystems include:

- prostrate kānuka shrubland over a turf of unusual mosses, liverworts, and lichens
- low fertility shrubland of mingimingi, mānuka, and monoao
- ferns, fern allies, and orchids rare in New Zealand but more common in the tropics
- thermophilic (heat-loving) microorganisms such as stunningly coloured blue green algae

- subtropical fungi attached to plant roots that assist plant survival
- species of invertebrates and algae that occur only in thermal pools and springs
- coastal plants found around geothermal sites (such as arrow grass and *Triglochin striata*).

## THREATS TO GEOTHERMAL ECOSYSTEMS

The damming of the Waikato River to form Lake Ohakuri in 1961 drowned an extensive area of geothermal features. Geothermal electricity development at Wairakei-Tauhara and Ohaaki has led to the loss of geothermal flowing features with high biodiversity.

Almost all geothermal ecosystems elsewhere have also been degraded to some extent by human-induced factors, including:

- trampling by tourists and other visitors. Both soils and vegetation are easily destroyed by repeated pedestrian traffic with extremely slow recovery times
- weed invasion of areas of low to moderate geothermal influence, particularly by pines and blackberry
- rubbish dumping
- stock grazing and trampling
- clearance of vegetation for land development.

Geothermal habitats occupy only about 0.002 per cent of New Zealand's land surface, so they are naturally rare. The majority of geothermal areas are legally protected within Department of Conservation reserves or other types of conservation covenants, with about 30 per cent by area in various forms of private ownership in the Waikato region.

## WHICH TYPES OF GEOTHERMAL ECOSYSTEMS ARE THE MOST THREATENED IN OUR REGION?

Because geothermal ecosystems only occupy a very small area naturally, they are all considered important. Many geothermal terrestrial ecosystems have populations of rare ferns, fern allies, orchids or other plants that increase the need for careful management.

Geothermal aquatic ecosystems are even more vulnerable to change than terrestrial ecosystems, because large-scale geothermal extraction is more likely to destroy such features, some of which may hold organisms or ecosystems unique to a particular pool with a unique chemical composition.

## How do I know what to do, and when?

Use the table overleaf to help you prioritise your management actions. The actions are listed in roughly the priority order, though each site is different and will require its own assessment.

# CHOOSING ACTIONS: GEOTHERMAL ECOSYSTEMS

## ASSESS NEEDS/PLAN

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Write up a plan of action.

## SEEK FUNDING

Complete this table to determine what actions are needed. Geothermal sites can be extremely dangerous because of extreme heat, boiling waters and toxic fumes!



Tahunaatapu pool Whangairoroheia

ACTION AND PRIORITY		COMMENTS
<b>Fence</b>	Keep to tracks Control stock	<ul style="list-style-type: none"> <li>Preventing or controlling public access will reduce degradation of geothermal areas by trampling and limit the possibility of accidents. Keep to tracks and boardwalks.</li> <li>If grazing animals can enter your site, they will trample and eat the plants and damage fragile sinter terraces. Heavier animals such as adult cattle and horses are generally more damaging than lightweight stock such as sheep and calves. Even a hot wire will be a good start to keep cattle out. Geothermal areas are also extremely dangerous for stock. Fencing will protect them and fragile ecosystems.</li> </ul>
<b>Reduce rubbish</b>	Don't dump Remove unsightly or dangerous rubbish	<ul style="list-style-type: none"> <li>Don't use geothermal areas for dumping rubbish, including offal.</li> <li>Allow geothermal ecosystems to thrive by removing unsightly and dangerous rubbish left in fumaroles. Be extremely careful, you may need to use specialist contractors.</li> </ul>
<b>Control weeds</b>	Remove plant pests Deal with pines and blackberry	<ul style="list-style-type: none"> <li>Deal with weeds you are legally obliged to. See the plant and animal pests section in Waikato Regional Council's website.</li> <li>Remove shallow-rooting pines near warm ground if they are likely to fall into geothermal features. Otherwise, poisoning pines is better than cutting them down, although sometimes leaving them is best depending on the site. After cutting pines down the open site is a perfect place for new seedlings to establish but if there is a dense scrub canopy pines are less likely to re-establish.</li> <li>Poison blackberry, but make sure there are no rare ferns mixed in with a blackberry thicket.</li> </ul>
<b>Planting</b>	Buffer	Plant in the cool ground around geothermal areas to enhance their natural character and protect them from runoff. Geothermal ecosystems are dangerous and highly specialised areas where plants must cope with rapid changes in soil heat and chemistry over very short distances. It will be difficult to plant successfully into such areas, so leave nature to 'plant' into hot areas or seek expert advice.
<b>Monitoring</b>	Assess changes in the entire site and/or focal plant populations	Take photos of your site. Count the number or cover of rare plants you see and follow their progress.
<b>Legal protection</b>	Seek protection	If a site is not legally protected as a reserve or private covenant, it's generally best to seek legal protection when the site is in good condition. However, if you are planning to protect the site and you need to fence it, it pays to contact QEII National Trust first, as they usually pay a share of the fencing costs.

## Geothermal ecosystems hot tips

**WARNING:** Geothermal areas are extremely dangerous and care must be taken at all times. If you have any doubts about the stability of geothermal crusts or the temperature of water or soils, don't expose yourself to the risk. The surface may give the appearance of solid ground but is often a thin layer of weak ground over hot water.

In addition geothermal areas can be prone to hydrothermal eruptions. This can happen almost anywhere in a geothermal area. Assume all geothermal areas are unsafe to walk on.

Hydrogen sulphide and carbon dioxide gases are lethal in high concentrations and being heavier than air, will collect in sheltered hollows and enclosed spaces.

- Visit Waikato Regional Council's website for more information on geothermal ecosystems - [www.waikatoregion.govt.nz/Environment/Natural-resources/Geothermal-resources/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Geothermal-resources/)
- Read the latest inventory of geothermal ecosystems in the Waikato Region - [www.waikatoregion.govt.nz/tr201507/](http://www.waikatoregion.govt.nz/tr201507/)



# KARST ECOSYSTEMS

The hill country of the western Waikato is home to many karst ecosystems and landscapes. These karst landscapes are formed when water dissolves carbonate containing rocks such as limestone. They are scattered from Port Waikato to Mokau, and include the Waitomo Glowworm Cave and a variety of sculpted pools, caves, arches, gorges, disappearing streams, springs and unusual rock formations. This geodiversity creates some unique ecosystems and species.

There are particular plant species found only on limestone outcrops or in tomos or cave entrances, such as *Hebe scopulorum* which is confined to exposed limestone bluffs south of Kawhia Harbour and *Asplenium cimmericum* which is found in cave entrances. Many other plants have strongholds on the limestone, such as the spleenwort fern *Asplenium lyallii* and the climbing rata *Metrosideros colensoi*.

Eyeless cave beetles and other species are found deep in the caves while cave wētā prefer the cave entrances. Glowworms need a steady supply of flying food to get caught in their sticky 'fishing lines', a humid habitat (hence they prefer living in moist caves, along stream banks and in tunnels) and a still atmosphere so their lines don't get tangled. Bats seem to favour the karst landscapes which provide a range of roosting and breeding sites. Even native fish have been found in cave streams and a few years ago several new species of snails with very limited distribution have been found in Waikato karst areas.

## THREATS TO KARST ECOSYSTEMS

Over the last century vegetation clearance has had the greatest impact on karst ecosystems. Introduced predators and browsers and exotic weeds continue to degrade these ecosystems. Forest cover over karst is important for a range of processes such as:

- controlling the amount of sediment entering caves
- influencing the food chain for cave species
- affecting the micro-climate of cave entrances and the whole cave system
- affecting the growth rate of speleothems\*
- maintaining cave hydrology.

### Other threats to karst features:

- Human use, for example through stalactite breakage and souvenir collection.
- Human activity in some high use caves increases the carbon dioxide content of the air. The acid in carbon dioxide will start to dissolve the limestone especially in the tourist caves. The oil in human skin will discolour limestone.
- Changes to the regional water table and increased sedimentation.

\* Speleothems are cave formations which are formed by the chemical precipitation of compounds previously dissolved in ground waters. The most common examples are stalactites and stalagmites.

- Changes to the water quality entering the caves. High nutrient content which may encourage “undesirables” to establish in the area.
- Animal and plant pests.
- use as holes for rubbish disposal.
- Rooding, quarrying and other such surface activities.
- Recreational use, particularly by groups with little knowledge of cave conservation.
- Changes to the volume and variability of flows entering the cave system.

## HOW DO I KNOW WHAT TO DO, AND WHEN?

Use the table overleaf to help you prioritise your management actions. Managing threats to karst systems must take into account both the significance and vulnerability of a feature or process. Each site is different and will require its own assessment.

## WHICH TYPE OF KARST ARE THE MOST DEPLETED IN OUR REGION?

Very few of the major karst systems in the Waikato have intact forest overlying the caves. Because this ecosystem is so rare and special we need to protect as much as possible. Many significant karst features remain on unprotected private land. Where caves lie underneath farmland, fencing and planting the entrances and overlying tomos will still help the rest of the cave.



# CHOOSING ACTIONS:

## KARST ECOSYSTEMS

### ASSESS NEEDS/PLAN

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Write up a plan of action. Get a copy of the bush restoration plan template from the Department of Conservation <http://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/bush-restoration/start-the-project/> or phone 0800 BIODIV (246 348).

### SEEK FUNDING

Complete this table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you can start on the work. Call 0800 BIODIV for advice.

ACTION AND PRIORITY		COMMENTS
<b>Protect water table</b>	Avoid damming/diverting water	Karst ecosystems are created by the erosive effects of water. Changes in water supply can damage cave systems. Major dams, in-cave dams and major water takes could create an issue. Talk to Waikato Regional Council if you are concerned about possible damming or diverting.
<b>Reduce pollution</b>	Sediment Nutrient run-off	If your cave system has a stream flowing into it, consider retiring the riparian margin and providing a planted swale to absorb excess nutrients out of the water. See planting below to deal with run-off.
<b>Reduce human damage</b>	Don't take 'trophies' Limit trampling Take all rubbish from cave	<ul style="list-style-type: none"> <li>Cave formations can be damaged by touching. Leave some caves 'untouched' and use well visited caves to reduce the number damaged by humans.</li> <li>Never touch, break off or damage cave formations. Leave them for others to enjoy. Take only photos. Even broken bits of stalactite should always be left in the cave.</li> <li>Use designated tracks where marked to reduce trampling damage in caves. Avoid bone deposits and untrampled cave floor surfaces.</li> <li>Take out all rubbish and human waste and dispose appropriately.</li> <li>Go caving with a leader who understands cave conservation and cave safety.</li> </ul>
<b>Control stock</b>		If grazing animals can enter your site they will trample the soil and eat the plants, and their dung and urine will pollute the site. Heavier animals, such as cattle are generally more damaging. Even a hot wire will be a good start to keep cattle out. A more robust type of fence will be required to keep out deer, pigs and goats. Priorities for fencing include bush margins, stream margins, spring heads and cave entrances. Be ready to tackle weeds as soon as the last stock are out, you may find the weeds 'take off' when grazing stops.
<b>Control weeds</b>	Regional plant pests Limestone specialists Other weeds	<ul style="list-style-type: none"> <li>While weeds won't grow in the dark of underground karst ecosystems, they can reduce the natural value of the landscape on the surface and around cave entrances.</li> <li>Deal with weeds you are legally obliged to. See the plant and animal pests section in Waikato Regional Council's website. Be vigilant for weeds in nearby sites that are not in your site - yet!</li> <li>Weed control may need to be targeted in relation to karst-reliant native plants. A particular weed of karstscapes is <i>Geranium robertianum</i> - the common herb robert - which grows in limestone rock cracks that could be habitat to rare ferns.</li> <li>Note also that getting rid of some weeds can just encourage others! Get good advice on weed management.</li> </ul>

ACTION AND PRIORITY		COMMENTS
<b>Control pests</b>	Hoofed animals Possums, rodents, mustelids, cats Rabbits/hares (if planting)	<ul style="list-style-type: none"> <li>• Pests cause damage to the special forest systems that grow on the surface in karst landscapes. Pests include deer, pigs, goats, rodents, possums, mustelids, rabbits, hares and feral cats. It is also likely that rats impact on cave ecosystems.</li> <li>• Target the large animals first - they will be easier to find and if the site is well fenced may be able to be eliminated. Use a trained hunter to shoot deer, goats and pigs. Other pests will need ongoing control using traps or poisons. Seek advice from the Department of Conservation regarding control methods and best practice.</li> </ul>
<b>Planting</b>	Buffer Enhance Connections Maintain	<ul style="list-style-type: none"> <li>• Firstly, you should consider planting the edges of streams, springs, tomos and cave entrances to trap sediment and run-off. Also consider planting to buffer existing native bush remnants.</li> <li>• If the site is of unnaturally low diversity and isolated from natural seed sources, consider enhancement plantings. Make sure they are appropriate to the site - get advice. If you have to remove a lot of weeds, consider enhancement planting of natives as soon as possible to reduce the chance of another weed filling the space</li> <li>• If your site is isolated from other natural areas, consider planting corridors of vegetation to encourage birds to move between them. Retirement and planting of streams will provide for this.</li> <li>• Keep your plantings weed free until the plants are well established. Small plants can be smothered by rank grass. Protect from rabbits, hares, and stock.</li> <li>• Retiring areas around cave entrances, including shaft entrances, will help the caves.</li> </ul>
<b>Enhance native fauna</b>	Cave species Surface fauna	<ul style="list-style-type: none"> <li>• Cave fauna are often present in low numbers and are vulnerable to impacts. Help protect them by reducing pollution and human damage (see previous page).</li> <li>• Surface fauna such as forest birds and/or bats will benefit from the actions noted above (particularly pest control and fencing).</li> </ul>
<b>Monitoring</b>	Measure change	It is important to be able to measure the effect of any management activities on karst features. Having baseline data is important. Take photos of your site prior to any action. Undertake photo monitoring at set intervals. Visual inspections and biological surveys may also be useful. In terms of any restoration planting, keep records of which plants survived and those that didn't so you can learn for next time. If the project is large and needs a lot of funding get a professional monitoring programme in place, to justify the next round of grants.
<b>Legal protection</b>		If a site is not legally protected as a reserve or private covenant, it's generally best to seek legal protection when the site is in good condition. However, if you are planning to protect the site and you need to fence it, it pays to contact QEII National Trust first, as they usually pay a share of the fencing costs. Talk to the Department of Conservation about other options for protecting karst and cave features.

## Karst ecosystems hot tips

- Visit the New Zealand Speleological Society web site: [www.caves.org.nz](http://www.caves.org.nz)
- Visit the Waitomo Caves Discovery Centre for information, or for educational visits, contact the Museum's education service, phone 07 878 7640 or email [info@waitomodiscovery.org](mailto:info@waitomodiscovery.org). Visit their website - [www.waitomocaves.com](http://www.waitomocaves.com)
- Local cavers can probably help if you want to know about caves that lie under your land and where entrances are. Try Hamilton Tomo Group [info@htg.org.nz](mailto:info@htg.org.nz)
- Visit the Weedbusters website - [www.weedbusters.org.nz](http://www.weedbusters.org.nz)

- Visit the New Zealand Landcare Trust website for the Biodiversity Restoring the Balance self-help kit and for community group information and resources - [www.landcare.org.nz](http://www.landcare.org.nz)
- For information on the Maniapoto Karst Plan contact the Department of Conservation Te Kuiti. Phone: 07 878 1050 or email [tekuiti@doc.govt.nz](mailto:tekuiti@doc.govt.nz)
- Visit Department of Conservation website for information on karst ecosystems - [www.doc.govt.nz](http://www.doc.govt.nz)





*Ngāuruhoe's mountain vegetation – Moira Cursey*

## MOUNTAIN ECOSYSTEMS

Mountain ecosystems in the Waikato Region are found in the Tongariro National Park and the Kaimanawa Ranges. Tongariro was the first national park formed in New Zealand, and the fourth in the world. It was also the first national park in the world to be gifted by a country's indigenous people. In 1887 Te Heuheu Tūkino IV (Horonuku), then the paramount chief of Ngāti Tūwharetoa, gifted the sacred peaks of Tongariro, Ngāuruhoe, and part of Ruapehu, to the people of New Zealand. This prevented the land being divided up and preserved the mana (prestige) of the Tūwharetoa people. When established the original size of Tongariro National Park was 2,640 hectares. It has gradually increased to its present size of 79,596 hectares.

In 1993 Tongariro National Park became the first park in New Zealand to be inscribed on UNESCO World Heritage Status List under the revised criteria describing cultural landscapes. The mountains at the heart of the park have cultural and religious significance for the Maori people and symbolize the spiritual links between this community and its environment. The park has active and extinct volcanoes, a diverse range of ecosystems and some spectacular landscapes.

The area is dominated by beech forest with some mountain celery pine and Hall's tōtara. The Hall's tōtara grows especially on the northern slopes of Tongariro where volcanic eruptions have destroyed or prevented the growth of beech. The lower slopes of the mountains are covered in alpine shrub, tussock, herbs, flax, and plants such as mosses, ferns, spider orchids and fungi. These plants

have special adaptations to survive below freezing temperatures and snow cover. For example, the New Zealand edelweiss is woolly which provides insulation from the cold temperatures experienced in winter. The shrubby olearia is found on many of the stream banks and is adapted to withstand frost conditions. The ground cover vegetable sheep (*Raoulia*) forms a dense mat of tightly packed leaves close to the ground to escape wind and retain the sun's heat.

Wetland bog areas occur around the lower slopes of the mountains. These bogs have developed where ash has accumulated and formed into an impermeable substance creating pools. Plants such as sundew which is insectivorous grow in these bogs.

A number of threatened plant species are found in the Tongariro National Park, including woodrose (*Dactylanthus taylorii*) and two wetland orchids. Mistletoe can occasionally be found in the beech canopy although it is becoming increasingly rare as it is a favourite food of possums.

The mountainous lands of Tongariro National Park are the home of threatened animal species, such as, the North Island brown kiwi, kaka, falcon, North Island robin, blue duck (whio), parakeet, kereru and both long and short-tailed bats. Common skinks are also present plus two gecko species -the forest gecko and the common gecko. They are adapted for spending winter sheltering in rocky holes and the common gecko hibernates.

## THREATS TO HIGH MOUNTAIN ECOSYSTEMS

The major threats to mountain ecosystems are:

- the spread of fire
- the spread of weeds such as, wilding pines, heather and broom
- the damage done by deer, pigs, goats, rabbits, possums, rats and mustelids
- the damage done by Kaimanawa horses
- volcanic eruptions
- the spread of didymo into the waterways (although there is now evidence to strongly suggest that didymo only blooms in low phosphate rivers and the Central North Island has high phosphate rivers).

## HOW DO I KNOW WHAT TO DO, AND WHEN?

For information on what you can do see the table below.

ACTION AND PRIORITY	COMMENTS
<b>Prevent weed spread</b>	Remove exotic plants and weeds from the motor and hull of boats and wash down away from a waterway to prevent transfer of invading weeds and didymo from waterways.
<b>Animal pest control</b>	Join Project Tongariro <a href="http://www.tongariro.org.nz">www.tongariro.org.nz</a> and find out how you can help with animal pest control.
<b>Volunteer</b>	Project Tongariro <a href="http://www.tongariro.org.nz">www.tongariro.org.nz</a> can tell you about volunteering on different projects in and around the mountains. They manage a number of projects and run a Mahi Aroha Summer Programme. Department of Conservation may have volunteer opportunities available.

# CHOOSING ACTIONS: HIGH MOUNTAIN ECOSYSTEMS

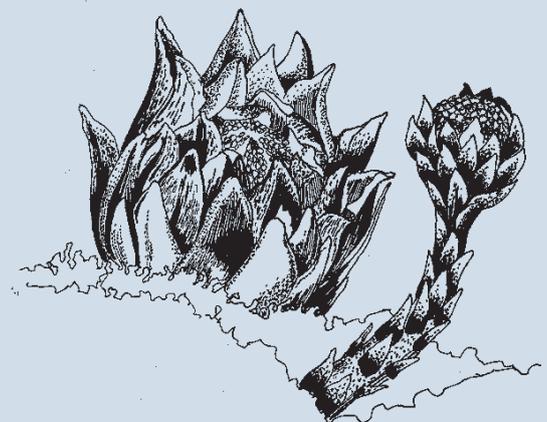
Mountain ecosystems of the Waikato Region are mainly administered by the Department of Conservation. Link in with Department of Conservation or Project Tongariro if you want to be involved in restoration work around the Park



Lake Surprise Tongariro National Park – Yanbin Deng

### Mountain ecosystems hot tips

- Visit Tongariro National Park and explore the area.
- Attend one of Project Tongariro's Summer Holiday programme events [www.tongariro.org.nz](http://www.tongariro.org.nz)
- Contact Project Tongariro to find out about their projects in and around the mountains.





# APPENDIX 1:

## RESTORATION PRIORITY TABLE

Score each of the sites you have in mind to find out which is the highest priority. The higher the score the more significant the site is for restoration as a general rule. See page 11 for more information.

FEATURE	SCORE	
<b>Size</b>	Largest site	5
	Medium	3
	Smallest site	1
	<b>SCORE</b>	
<b>Shape</b>	Round/square	5
	Irregular	3
	Linear (skinny)	1
	<b>SCORE</b>	
<b>Vulnerability</b>	High	5
	Medium	3
	Low	1
	<b>SCORE</b>	
<b>Connections to other natural areas (e.g. forest, scrub, dunes)</b>	Touch	5
	close to	3
	Far away from	1
	<b>SCORE</b>	
<b>Habitat complexity (diversity)</b>	Complex	5
	Some Variety	3
	All the same	1
	<b>SCORE</b>	
<b>Special features</b>	Many features	5
	Some	3
	None	1
	<b>SCORE</b>	
<b>Identified as a Significant Natural Area</b>	High	5
	<b>SCORE</b>	
<b>Access</b>	Good access	5
	Moderate	3
	Poor	1
	<b>SCORE</b>	
<b>Management need</b>	Low	5
	Moderate	3
	High	1
	<b>SCORE</b>	
<b>Community/cultural enthusiasm</b>	High	5
	Moderate	3
	Low	1
	<b>SCORE</b>	
<b>Ownership</b>	Public reserve	5
	Private covenant	3
	Unprotected	1
	<b>SCORE</b>	
<b>Total score</b>		

# APPENDIX 2: RESOURCES

## WEBSITES

### **Centre for Biodiversity and Ecology Research, University of Waikato**

[www.cber.bio.waikato.ac.nz](http://www.cber.bio.waikato.ac.nz)

### **Citizen Science**

An inventory of Citizen Science in New Zealand, 2016 prepared by Monica Peters

[www.landcare.org.nz/Regional-Focus/Manawatu-Whanganui-Office/Citizen-Science-Meets-Environmental-Restoration](http://www.landcare.org.nz/Regional-Focus/Manawatu-Whanganui-Office/Citizen-Science-Meets-Environmental-Restoration)

### **Department of Conservation**

Department of Conservation guide for establishing, maintaining and improving community conservation projects. This is also a toolkit providing a range of useful information, such as facilitating meetings, group planning and reviewing events and group progress.

[www.doc.govt.nz](http://www.doc.govt.nz)

[www.doc.govt.nz/get-involved/run-a-project/community-project-guidelines/](http://www.doc.govt.nz/get-involved/run-a-project/community-project-guidelines/)

### **Ducks Unlimited New Zealand wetland and waterfowl conservation group.**

[www.ducks.org.nz](http://www.ducks.org.nz)

### **Forest Monitoring and Assessment Kit (FORMAK)**

[www.formak.co.nz](http://www.formak.co.nz)

### **Landcare Research**

[www.landcareresearch.co.nz](http://www.landcareresearch.co.nz)

### **Maui dolphin**

[www.mauisdolphin.com](http://www.mauisdolphin.com)

### **Ministry for the Environment**

[www.mfe.govt.nz](http://www.mfe.govt.nz)

### **National Wetland Trust**

[www.wetlandtrust.org.nz](http://www.wetlandtrust.org.nz)

### **Nature Space**

Nature Space is a website for groups, individuals and landowners undertaking ecological restoration in New Zealand. There is information about groups and their location marked on a map of New Zealand plus newsletters and notifications of events and associated ecological restoration information.

[www.naturespace.org.nz](http://www.naturespace.org.nz)

### **Nature Watch**

Nature Watch is a website where you can record what you see in nature, meet other nature watchers, and learn about the natural world.

[www.naturewatch.org.nz](http://www.naturewatch.org.nz)

### **New Zealand Biodiversity**

[www.biodiversity.govt.nz](http://www.biodiversity.govt.nz)

### **New Zealand Ecological Society**

[www.nzes.org.nz](http://www.nzes.org.nz)

### **New Zealand Nature Services – Landcare Research**

This website details plants for particular locations across New Zealand

[natureservices.landcareresearch.co.nz/app/](http://natureservices.landcareresearch.co.nz/app/)

### **New Zealand Plant Conservation Network**

[www.nzpcn.org.nz](http://www.nzpcn.org.nz)

### **New Zealand Landcare Trust**

[www.landcare.org.nz](http://www.landcare.org.nz)

### **New Zealand Speleological Society**

[www.caves.org.nz](http://www.caves.org.nz)

### **NIWA**

[www.niwa.co.nz/ncabb/tools](http://www.niwa.co.nz/ncabb/tools)

### **Predator Free New Zealand**

[www.predatorfreenz.org/](http://www.predatorfreenz.org/)

### **QEII National Trust**

[www.openspace.org.nz](http://www.openspace.org.nz)

**Tane's Tree Trust** (indigenous forestry promotion)

[www.tanestrees.org.nz](http://www.tanestrees.org.nz)

**Waikato Biodiversity Forum**

[www.waikatobiodiversity.org.nz](http://www.waikatobiodiversity.org.nz)

**Waikato Catchment Ecological Enhancement Trust**

[www.wceet.org.nz](http://www.wceet.org.nz)

**Waikato River Authority**

[www.waikatoriver.org.nz](http://www.waikatoriver.org.nz)

**Waitomo Caves**

[www.waitomocaves.co.nz](http://www.waitomocaves.co.nz)

**Weedbusters**

[www.weedbusters.org.nz](http://www.weedbusters.org.nz)

**WETMAK monitoring kit**

<http://www.landcare.org.nz/wetmak>

## PUBLICATIONS

Crowe, Andrew, 1995: Which Coastal Plant?, Viking.

Department of Conservation,

Threatened Plants of Waikato Conservancy 2004, DOC Science Publishing, Science and Research Unit.

New Zealand Coastal Policy Statement 2010

[www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/new-zealand-coastal-policy-statement/new-zealand-coastal-policy-statement-2010/](http://www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/new-zealand-coastal-policy-statement/new-zealand-coastal-policy-statement-2010/)

Environmental Defence Society publications

[www.eds.org.nz/our-work/publications/](http://www.eds.org.nz/our-work/publications/)

Treasuring Our Biodiversity 2013

Caring for Our Coast 2013

Managing Freshwater 2010

Managing the Marine Environment 2010

Vanishing Nature: Facing New Zealand's biodiversity crisis 2015

Janssen, Helmut, 2004: Bush Vitality- A Visual Assessment Kit, Rainbow Print Ltd, Christchurch, New Zealand.

Landcare Research

Wetland Restoration: A Handbook for New Zealand Freshwater Systems 2012 edited by Beverley Clarkson and Monica Peters

[www.landcareresearch.co.nz/publications/books/wetlands-handbook](http://www.landcareresearch.co.nz/publications/books/wetlands-handbook)

Ministry for the Environment

[www.mfe.govt.nz](http://www.mfe.govt.nz)

National Policy for Freshwater Management 2014

Environment Aotearoa 2015

Statement on National Priorities for Biodiversity

Moore, L. B. and N. Adam, 1963: Plants of the NZ Coast, Pauls Book Arcade.

Northland Biodiversity Enhancement Group 2004

Restoring the Balance -Biodiversity self-help kit published by

[www.landcare.org.nz/files/file/57/1215-restoring-the-balance.pdf](http://www.landcare.org.nz/files/file/57/1215-restoring-the-balance.pdf)

Porteous, Tim, 1993: Native Forest Restoration - A Practical Guide for Landowners, QEII, Wellington, New Zealand.

Robertson, Gretchen and Peters, Monica 2006 Turning the Tide: An estuaries toolkit for New Zealand communities.

Waikato Botanical Society Inc, 2002: Botany of the Waikato, Bankwood Publications, Hamilton, New Zealand.

Waikato Regional Council

Fragile: A Guide to Waikato Dunes.

Managing Wetlands and Managing Forest Fragments factsheet series.

Waikato Regional Policy Statement 2016

Weedbusters New Zealand, The Weed Control Handbook

How to Identify and Manage Invasive Plants in New Zealand

New Holland Publishers (NZ) Ltd, 2011

## OTHER RESOURCES

Waikato Biodiversity Forum – Advice and Referral

**0800 BIODIV (246348)**

# APPENDIX 3: AGENCIES AND ORGANISATIONS CONTACTS

## **Auckland/Waikato Fish and Game Council**

Manages New Zealand's freshwater sport fisheries and gamebird hunting.

Phone 07 849 1666

[www.fishandgame.org.nz](http://www.fishandgame.org.nz)

## **AgResearch**

Phone 07 856 2836

[www.agresearch.co.nz](http://www.agresearch.co.nz)

## **Centre for Biodiversity and Ecology Research, University of Waikato**

Phone 07 838 4022 or 07 838 4149

[www.cber.bio.waikato.ac.nz](http://www.cber.bio.waikato.ac.nz)

## **Department of Conservation**

Hauraki -Waikato- Taranaki Region

Hamilton Email [waikato@doc.govt.nz](mailto:waikato@doc.govt.nz)

Hauraki Email [thames@doc.govt.nz](mailto:thames@doc.govt.nz)

Te Kuiti Email [tekuiti@doc.govt.nz](mailto:tekuiti@doc.govt.nz)

[www.doc.govt.nz](http://www.doc.govt.nz)

## **Central North Island**

Taupo Email [taupo@doc.govt.nz](mailto:taupo@doc.govt.nz)

Turangi Email [turangi@doc.govt.nz](mailto:turangi@doc.govt.nz)

## **Environmental Defence Society**

The Environmental Defence Society is a not-for-profit environmental organisation comprised of resource management professionals who are committed to improving environmental outcomes.

[www.eds.org.nz](http://www.eds.org.nz)

## **Federated Farmers**

Phone 07 838 2589

[www.fedfarm.org.nz](http://www.fedfarm.org.nz)

## **Landcare Research**

Phone 07 858 3700

[www.landcareresearch.co.nz](http://www.landcareresearch.co.nz)

## **National Institute of Water and Atmospheric Research (NIWA)**

Phone 07 856 7026

[www.niwa.co.nz](http://www.niwa.co.nz)

## **National Wetland Trust of New Zealand**

Increase public knowledge and appreciation of wetland values, increase understanding of wetland functions and processes, ensure landowners and government agencies commit to wetland and protect, enhance and restore wetlands.

[www.wetlandtrust.org.nz](http://www.wetlandtrust.org.nz)

## **New Zealand Landcare Trust**

Provides facilitation to empower groups, brokers information exchange, supports and encourages community landcare and streamcare groups, develops networks, partnerships and collaboration. Provides assistance with funding options and has contestable funds available.

Phone 07 858 3725

[www.landcare.org.nz](http://www.landcare.org.nz)

## **Nga Whenua Rahui**

System of formal protection of Maori owned indigenous ecosystems by which the owners retain tino rangatiratanga (ownership and control). Can provide funding.

Phone 04 471 0726

[www.doc.govt.nz](http://www.doc.govt.nz)

## **Predator Free New Zealand**

We are committed to dramatically reducing NZ's predator populations, including rats, stoats, possums, weasels and ferrets. We want to protect our native species and see their populations increase in our lifetime. It's one of the most ambitious conservation projects undertaken in NZ – ambitious, but achievable

[www.predatorfreenz.org](http://www.predatorfreenz.org)

## **Queen Elizabeth II National Trust New Zealand**

Helps landowners protect important features on their land while retaining ownership.

Can provide funding.

Phone 0508 QE2 TRUST (732 878)

[www.openspace.org.nz](http://www.openspace.org.nz)

**Royal New Zealand Forest and Bird Society Waikato Branch**

Aims to preserve and protect native animals and natural features.  
Can provide funding.

[www.forestandbird.org.nz](http://www.forestandbird.org.nz)

**Waikato Regional Council**

Freephone 0800 800 401

[www.waikatoregion.govt.nz](http://www.waikatoregion.govt.nz)

**Iwi management agencies**

Iwi management agencies work to support the whanau and hapu of their rohe by working with communities in for example health, fisheries, treaty claims, education, housing, social services and environment.

**Hauraki Maori Trust Board**

Phone 07 862 7521

[www.haurakimaori.co.nz](http://www.haurakimaori.co.nz)

**Maniapoto Maori Trust Board**

Phone 07 878 6234

[www.maniapoto.iwi.nz](http://www.maniapoto.iwi.nz)

**Raukawa Charitable Trust**

Phone 07 885 0206

[www.raukawa.org.nz](http://www.raukawa.org.nz)

**Tūwharetoa Maori Trust Board**

Phone 07 386 8832

[www.tuwharetoa.co.nz](http://www.tuwharetoa.co.nz)

**Waikato Raupatu Lands Trust (Tainui)**

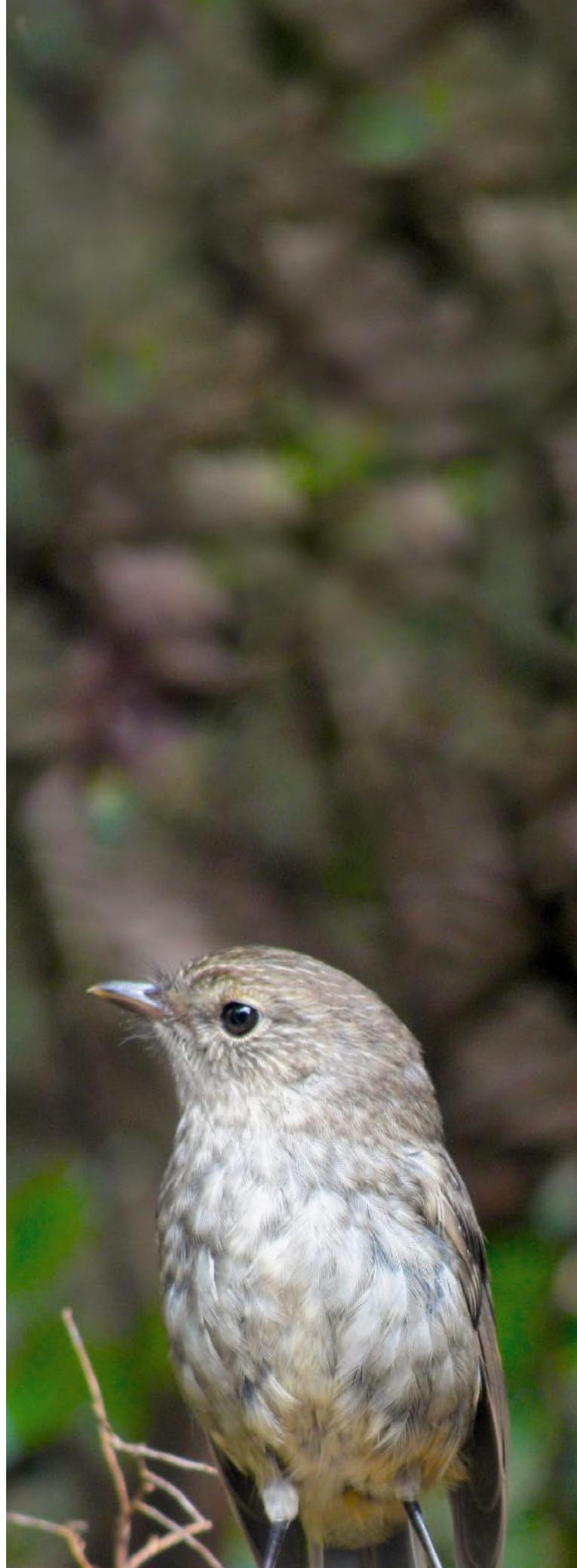
Phone 07 824 8689

[www.wrrt.co.nz](http://www.wrrt.co.nz)

**Waikato River Authority**

Phone 07 839 7966

[www.waikatoriver.org.nz](http://www.waikatoriver.org.nz)



North Island robin – Moira Cursesey

# What's special in your area?

Key locations of some threatened animal species in the Waikato region 2016. Check out [www.doc.govt.nz](http://www.doc.govt.nz) for more information on these species.



## Legend

### Nationally critical



1 Maui's dolphin  
*Popoto*

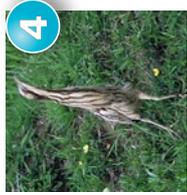


2 Mercury Island tusked weta

### Nationally endangered



3 Moehau stag beetle



4 Australasian bittern  
*Matuku*



5 Kākā



6 Black billed gull  
*Tarāpunga*



7 Mahoenui giant weta

## APPENDIX 4.



15 Short-tailed bat  
*Pekapeka*



16 New Zealand dabchick  
*Weweia*



17 North Island brown kiwi

### Declining



18 Fernbird  
*Mātātā*



19 Hochstetter's frog  
*Pepeketua*



20 Giant kōkopu  
*Taiwharu*



21 Black mudfish  
*Waikato*

# Nationally vulnerable



Kōkako



Wrybill  
Ngutu-parore



Blue duck  
Whio



New Zealand dotterel  
Tūturiwhatu



Archey's frog  
Pepeketua



New Zealand Falcon  
Kārearea



Long-tailed bat  
Pekapeka



22 Short jawed Kōkopu



23 Dwarf galaxias  
Kāraha

# Recovering



24 Brown teal  
Pāteke



25 Saddleback  
Teike

# Relict

(remnant populations - not unduly threatened)



26 Tuatara



27 Red crowned parakeet  
Kākāriki



28 Te Aroha stag beetle



Photographs courtesy of Department of Conservation, Nick Ling, Bob McDowell, Darren Le Roux, Kerry Borkin and Paul Schilov.

# What's special in your area?

Key locations of some threatened plant species in the Waikato region 2016. Check out [www.doc.govt.nz](http://www.doc.govt.nz) and [www.nzpcn.org.nz](http://www.nzpcn.org.nz) for more information on threatened plant species.



## Legend

### Nationally critical

1



*Anzybas carsei*  
Swamp helmet orchid

2



*Pomaderris apetala*  
subsp. *maritima*  
Tainui

### Relict

(remnant populations – not unduly threatened)

13



*Desmoschoenus spiralis*  
Pingao

14



*Sporadanthus ferrugineus*  
Giant cane rush

### Nationally vulnerable

3



*Hebe speciosa*

4



*Pittosporum turneri*  
Turner's kohuhu

5



*Dactyloctenium taylorii*  
Wood rose

6



*Pimelea tomentosa*

### Nationally uncommon

15



*Epacris sinclairii*

16



*Hebe scopulorum*  
Awaroa koromiko

17

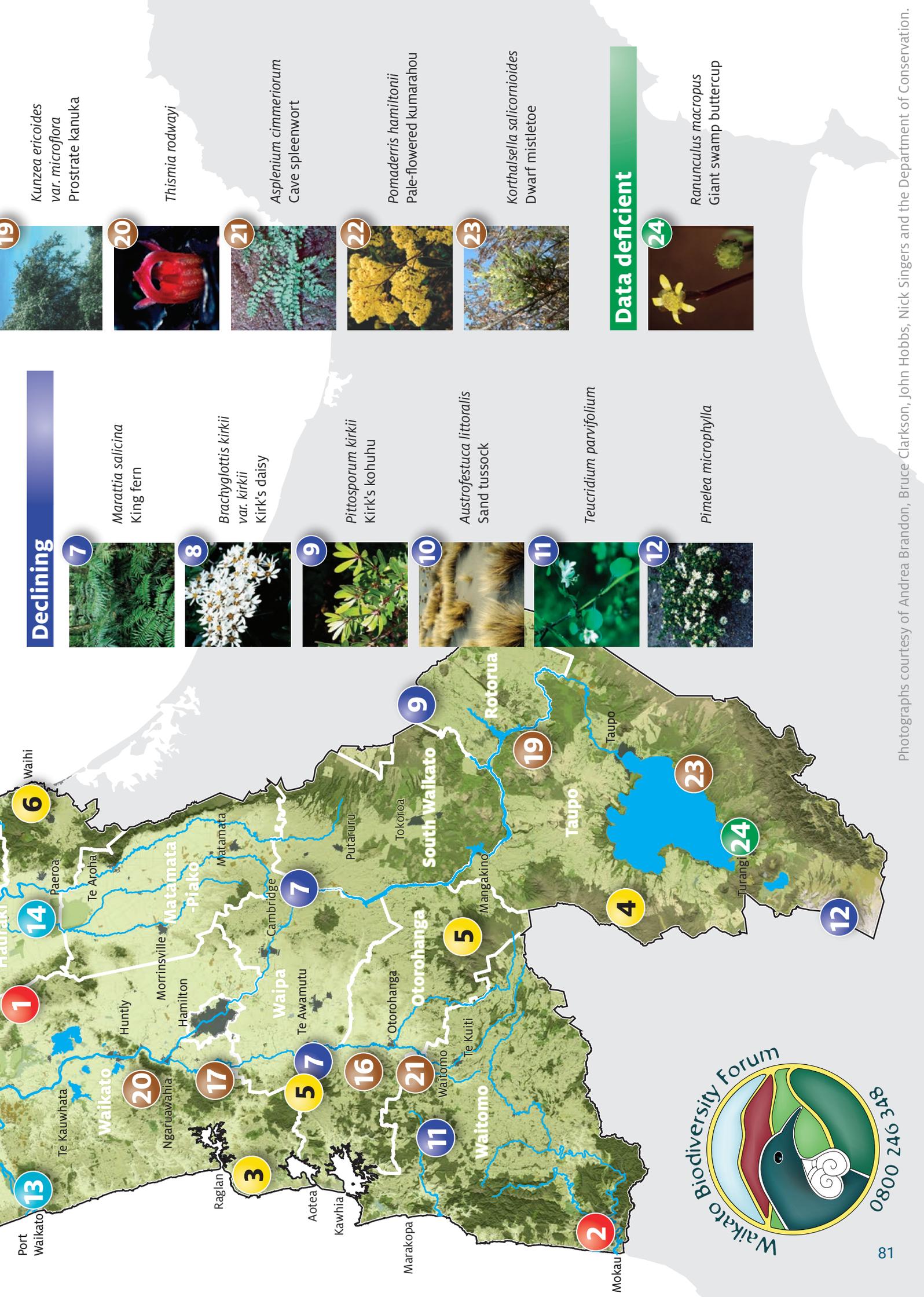


*Sophora fuivida*

18



*Celmisia adamsii*  
var. *adamsii*  
Coromandel daisy



**Declining**

7

*Marattia salicina*  
King fern



8

*Brachyglottis kirkii*  
var. *kirkii*  
Kirk's daisy



9

*Pittosporum kirkii*  
Kirk's kohuhu



10

*Austrofestuca littoralis*  
Sand tussock



11

*Teucrium parvifolium*



12

*Pimelea microphylla*



19

*Kunzea ericoides*  
var. *microflora*  
Prostrate kanuka



20

*Thismia rodwayi*



21

*Asplenium cimmeriorum*  
Cave spleenwort



22

*Pomaderris hamiltonii*  
Pale-flowered kumarahou



23

*Korthalsella salicornioides*  
Dwarf mistletoe



**Data deficient**

24

*Ranunculus macropus*  
Giant swamp buttercup



