Title: **Our indigenous species in the Ruamāhanga Whaitua summary**

Purpose: To assist the Ruamāhanga Whaitua Committee to understand the indigenous biodiversity in the whaitua

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Key points

- The number of native (indigenous) species in the catchment has dramatically declined since the arrival of Europeans and clearance of land for pastoral use. There was a dramatic change from a landscape that was predominately indigenous species to one that was predominately exotic with less than 4% native vegetation cover remaining in the Ruamāhanga Valley.

- The loss of native biodiversity relates to the loss of mauri (the life-force that exists in the natural world) through nature working together in a balance to large tracts of mono culture.

- The loss of forest cover affected the ability of the land to absorb and filter nutrients.

- While there is great water quality in the upper reaches of the whaitua, the river morphology is quickly influenced by pastoral land use and the river becomes shallower and has less riparian vegetation cover. This can lead to an increase in temperature and periphyton. This river morphology affects what species can live here and prevent migratory movement.

- Wetlands are valuable, they clean water, mitigate the effects of flooding and they reduce the effects of climate change with their ability to absorb carbon dioxide and sequester carbon. There are only 3% of wetlands remaining in the Ruamāhanga Whaitua, this is another contributor of loss of mauri and balance.

- Significant impacts on aquatic ecosystems include:

    - Loss of riparian vegetation, wetlands and forest cover

    - River channelisation

    - Fish passage blockage/scheme effects

- Wairarapa Moana is a significant area for indigenous fish, plants and birds and is highly valued for mahinga kai by Maori.

- There are twenty native freshwater fish currently found in the whaitua. Eleven of these are considered nationally vulnerable or nationally declining.

- 16 of the 20 native fish rely on the connection to the sea (diadromous). The Ruamahanga River via Lake Onoke provides the main migration pathway between the ocean and freshwater for our indigenous fish. This concept is known as ki ti uta ti kai.

- Introduced fish influence the abundance and diversity of indigenous fish. Brown and rainbow trout, valued for sports fishing, are predators of native fish species especially non migrationary fish such as dwarf galaxiids. They are widespread in the whaitua and many rivers/lakes support significant fisheries.

- Aquatic plants have important roles in aquatic ecosystems. They are a source of weaving material, provide habitat for a range of species and play a significant role in nutrient cycling. The nutrient cycling is particularly important in shallow lakes, such as Wairarapa Moana to stabilise lakebed sediments and reduce suspended sediments generated by wind and waves and

maintaining water clarity. Loss of aquatic plants from shallow lakes such as Lakes Wairarapa and Onoke is a significant cause of their current degraded state (poor water clarity and ecology).

- There are 79 native bird species, 29 in the nationally threatened and 50 in the non-threatened categories. Lake Wairarapa provides significant habitat for indigenous birds. The Ruamahanga River bed is important breeding ground for black-billed gull (tarapuka), banded dotterel (pohowera) and black fronted dotterel.

1. Introduction

Before the arrival of people to New Zealand the Wairarapa Plain supported a vast forest from Mount Bruce in the north to Palliser Bay in the south, interspersed with wetlands near the rivers, around Wairarapa Moana and the coastline. The interwoven nature of the forest, river and wetland ecosystems enabled interconnections between habitats and provided a wide range of niches for species living in the catchment. Land and water ecosystems are influenced by climate variables and soils and landform. However, today the effects of land use and other human based pressures such as introduced plants and animals affect biodiversity and are more significant than natural factors.

Riparian vegetation and connectivity between different habitats (rivers, wetlands, lakes and groundwater) are also important for aquatic ecosystems.

There are a wide range of aquatic habitats in the Ruamāhanga Whaitua, broadly categorised as streams, rivers, wetlands and lakes. Within each of these there is significant diversity of environments. For example, a reach of stream can be ephemeral (flows only after rain), intermittent (flows during the wetter months but is dry during summer) or perennial (flows all year round). These waterbodies can provide niche environments for species that are susceptible to predation or competition- such as mudfish. There is a diversity of environments such as shallow or deep, coarse substrate or sand and silt, swift or slow streams and high or low levels of dissolved oxygen. This variety of habitats across the whaitua is important as they provide for a diverse range of aquatic flora and fauna.

It is important to have good connectivity between water habitats with riparian habitats. This is especially important for migratory fish as they migrate through rivers, wetlands and lakes to the sea. Riparian habitats provide important food sources such as leaves and insects, and also suitable spawning areas for some fish species such as the giant kokopu which spawns in terrestrial vegetation during freshes/floods).

1.1 Importance of native biodiversity

Although New Zealand's land-based primary production (such as farming, forestry and horticulture) is based on introduced species, its success relies the underlying biological systems and clean air and water.

Native forests in the headwaters reduce sedimentation and runoff, and act as a natural filtration system. The native forest acts like a sponge, retaining rainfall in high rainfall events, reducing the severity of flooding. These "sponges" retain water and release increased flows in drier periods.

Vegetation cover on the hill country, stream banks and riparian areas reduces erosion, and the riparian zone filters nutrient and microbial inputs. The large amounts of organic matter in our soils are a legacy of the ancient acid-forming forests, which built up organic matter in stable forms that break down slowly (Hewitt 2012).

Wetlands and lakes are among the world's most productive and valuable ecosystems. They provide ecosystem services such as the maintenance of water quality and supply, as well as mitigating flooding and regulating atmospheric gases. Healthy ecosystems also play a positive role in reducing the effects of climate change through their ability to absorb carbon dioxide and sequester carbon.

The decomposition of waste and cycling of nutrients are enhanced by the natural ecosystems. Fish provide food for recreational and commercial fisheries and some have strong cultural values as mahinga kai.

Native vegetation in the rural landscape provides wildlife corridors and keeps down the number of crop pests.

Vegetated riparian areas reduce sedimentation, bacterial contamination and nutrient toxicity. Allowing native scrub to regenerate on marginal land allows for both carbon sequestration and biodiversity enhancement.

Over 80% of New Zealand's species are found nowhere else in the world (endemic). They are part of our identity and our culture. Retaining a diversity of species and habitats provides for more resilient ecosystems. Our primary production systems rely on few species and are vulnerable to climate change and introduced pests. Maintaining biodiversity is an insurance policy for the future.

2. Aquatic biodiversity

2.1 Native freshwater fish

Twenty one[1] native freshwater fish species have been recorded in freshwater environments– rivers, lakes and wetlands - in the Ruamāhanga whaitua. Although one of these – the grayling – is now extinct across New Zealand. The majority of these native species are endemic, meaning they are found nowhere else in the world. They are not well known to the public because they are typically small, and well camouflaged, remain hidden (cryptic) and nocturnal.

Of the twenty native species that can still be found in the catchment, 11 are classified by the Department of Conservation (DOC. Two species, the lamprey and shortjaw kokopu are "Nationally Vulnerable". Nine species are[2] "At Risk: Declining". Several of these species such as the giant kokopu are rarely sighted, and the majority of species populations are likely to be in decline. Compared with other rivers in the region, the Ruamahanga River appears to have lower diversity and abundance of native freshwater fish than other rivers in the region (Joy 2002).

Sixteen of these 20 native freshwater species are 'diadromous', which means they migrate between freshwater environments and the sea to complete its life cycle. In the Ruamāhanga whaitua, diadromy is an important feature, as it means the majority of the fish present within the catchment must migrate through Lake Onoke twice during their life time. This influences the distribution of fish, as there are naturally less fish species as the distance increases from the coast because different fish have different 'migratory drives' to head inland and also differing abilities to negotiate both natural and man-made barriers. A range of species, including longfin eel, koaro, redfin bully and lamprey, do migrate all the way to the headwaters (and back) in the Ruamāhanga Whaitua but it is expected that this journey is far harder these days than previously (see below).

[1] If introduced species are included this number rises to 35.
[2] The two Nationally Vulnerable species are lamprey and shortjaw kokopu. The nine species At Risk: Declining are longfin eel, redfin bully, bluegill bully, torrentfish, inanga, giant kokopu, koaro, brown mudfish and dwarf galaxias.

2.2 Native fish and the importance of habitat

1. The decline in fish populations is linked to changes in habitat and water quality as a result of landcover changing from indigenous forest to pastoral and urban land use. Many of these fish live in wetlands and the extensive loss of wetlands has had a significant effect.

2. River channelisation and diversions, and loss of riparian margins have significantly altered remaining habitat. This habitat is further impacted through water abstraction and deterioration in water quality.

3. Barrage gates, weirs and culverts are barriers to native fish that migrate (are diadromous). These structures affect the distribution of species, if they can't migrate past a structure they can be absent from upstream areas.

4. Introduced species such as trout and perch significantly impact the distribution and abundance of some native species (e.g. dwarf galaxias).

5. Commercial and recreational harvest impact species such as long and shortfin eel and whitebait.

2.3 Important freshwater fish and invertebrate species in the Ruamāhanga Whaitua

This section provides some specific information on a few examples of aquatic fish and invertebrate species that have "high" biodiversity value in the Ruamāhanga whaitua.

2.3.1 Inanga

Inanga are the most common and widespread of the five galaxiid species that are known as 'whitebait', and are classed as "At Risk: Declining". They are a lowland species, while they are found as far inland as Masterton they are more abundant in downstream reaches. They prefer slower flowing areas of rivers and streams and also inhabit lakes and wetlands.

Adult inanga migrate downstream to intertidal areas in autumn and eggs are laid amongst bankside vegetation on high spring tides. After the tide has receded the eggs are left high and dry until the following high spring tide a month later, at which time the eggs hatch and larvae are washed out to sea where they spend around 22 weeks growing before they migrate back to freshwater as whitebait.

Inanga are moderately tolerant of water quality and habitat degradation when compared with other species. However, the main cause of decline is from habitat degradation associated with land cover modification - especially in intertidal spawning areas. Unlike the other four whitebait species they are not good climbers and instream barriers such as weirs can significantly restrict inland penetration.

2.3.2 Giant kokopu

"At Risk: Declining"

Figure 1. Giant kokopu

Giant kokopu are the largest of the five whitebait species and can be up to 60 cm long. They are found in coastal lakes and wetlands and the lower reaches of rivers. In the Ruamahanga River catchment they have been recorded as far inland as Carters Reserve (east of Carterton).

They are not often encountered and are the 2nd rarest inanga (whitebait) species to be found in the whaitua (shortjaw kokopu are the rarest). They prefer pool type habitats with gentle flows and ample riparian and instream cover such as undercut banks, log jams, large boulders, etc.

Spawning sites occur in the same general habitat as the adults. Eggs are deposited on bankside vegetation and organic matter during freshes (high flows) and eggs develop in the dry and only hatch following another fresh (significant rainfall event). Larvae are washed out to sea before returning to freshwater in the whitebait runs.

Major cause of decline- The loss of a significant proportion of wetland habitat along with extensive modification of remaining lowland river and lake habitat from activities such as channelisation and deforestation/loss of riparian margins.

2.3.3 Brown mudfish

At Risk: Declining

Figure 3. Brown mudfish

Figure 2. Brown mudfish in a hand for scale

Brown mudfish are considered a wetland specialist and are often found in wetland areas that typically dry up during the summer period. Brown mudfish can survive these dry periods for several

months if they can find a place that is damp, such as under a log. They do not coexist well with other species (which can outcompete and prey on them) and their adaptation to live in intermittently wet and dry wetland habitats allows them to avoid most other fish species. They are a non-diadromous (non-migratory) species and spawning occurs within adult habitat. Typical habitat includes shallow pools and puddles within wetlands and they are also found in overgrown and weedy streams and drains.

Major cause of decline- The extensive draining of wetlands has had a significant effect on this species which was probably once very widespread. They can still be found throughout the Ruamahanga River catchment (including in wetlands north of Masterton) but many populations appear restricted to small remnant wetlands which are largely fragmented and scattered across the catchment.

2.3.4 Kakahi

At Risk: Declining

Two species of kakahi (freshwater mussel) are recorded in the Ruamahanga River catchment. Historically these species were probably widespread and abundant, now they are primarily found in Lake Wairarapa and other nearby waterbodies such as Lake Pounui). Distribution outside this area is fragmented. Kakahi have been recorded in the Kopuaranga River and a tributary of the Waipoua River. They are found in lakes and rivers. In rivers they inhabit areas of slower flow in the finer substrates.

Major cause for decline- general degradation in habitat from increased sedimentation, deterioration in water quality and a reduction in the abundance of host fish species; kakahi larvae are parasitic and rely on certain suitable host fish. If these host species are not present, the breeding of kakahi and long-term survival of these populations might be at risk.

Figure 4. kakahi

Why are kakahi important and highly valued?

Kakahi are exceptional filter-feeders and can exert significant control over phytoplankton biomass. They may also play an important role in filtering and fixing suspended sediment. Declines in kakahi numbers have been linked with overall declines in wider ecosystem health.

3. Wetlands

Since European settlement, only 3% of the original wetland area remains. There are approximately 90 remaining wetlands in the Ruamāhanga Whaitua. The majority of these wetlands are small (75% are under 5ha in size) and are dominated by exotic species, such as willow or tall fescue. These remnant wetlands are vulnerable to other stresses, because of their lack of connectivity and small size. Populations of rare plants and animals are now only found at the remaining notable wetlands, such as Allen-Lowes Reserve, Fensham Reserve, Waingawa Swamp and Carter's Reserve. The

majority of the wetlands have suffered significant changes to their hydrology and are vulnerable to declining water supplies and increasing nutrient loads (Thompson 2012).

Wetlands were widespread and abundant on low lying land and depressions such as in river oxbows and on margins of lakes. In the wettest areas with open water, species such as raupo, sedges and rushes occur. The drier wetland margins have support flax, cabbage trees, manuka and mingimingi. At some sites, over time these species dried out the wetland and helped soil (peat) accumulate, which in turn allowed kahikatea, pukatea and swamp maire to colonise and develop into a dense swamp forest.

There are other wetland types such as the wetland turf communities on the margin of Lake Wairarapa. Non-forested swamps occurred throughout the plains and dominated the area around the lakes, where flooding was frequent (shown in Figure 4).

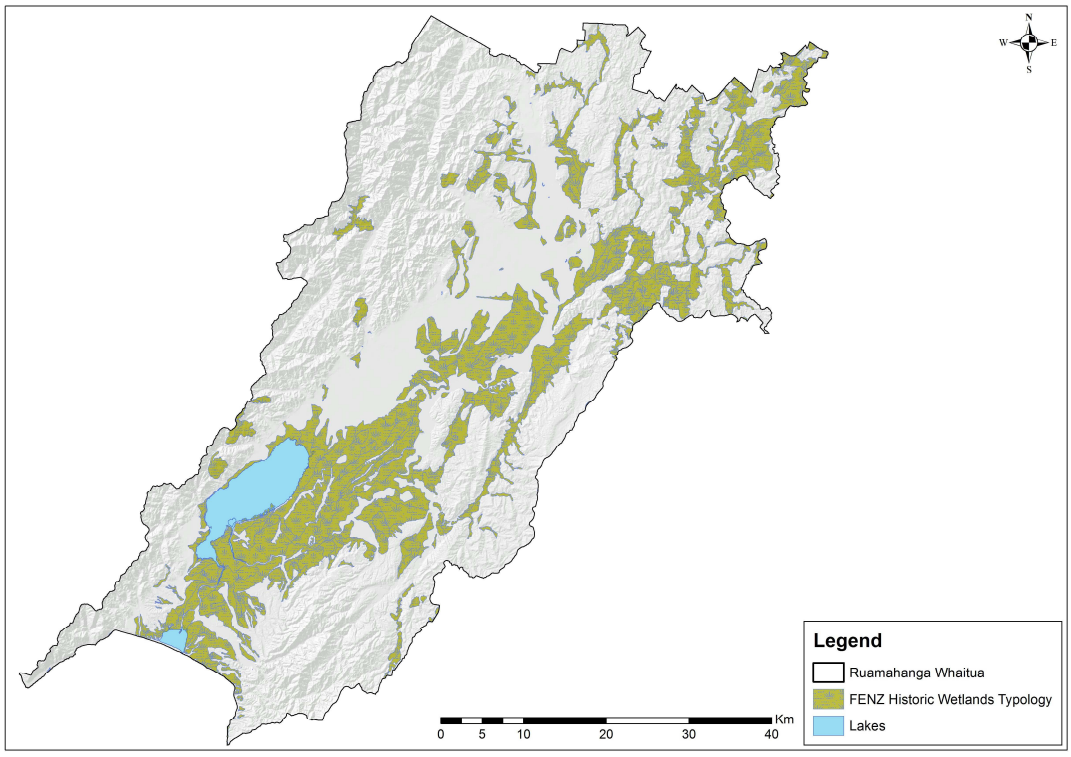

Figure 4: Historic extent of wetlands in the Ruamāhanga Whaitua

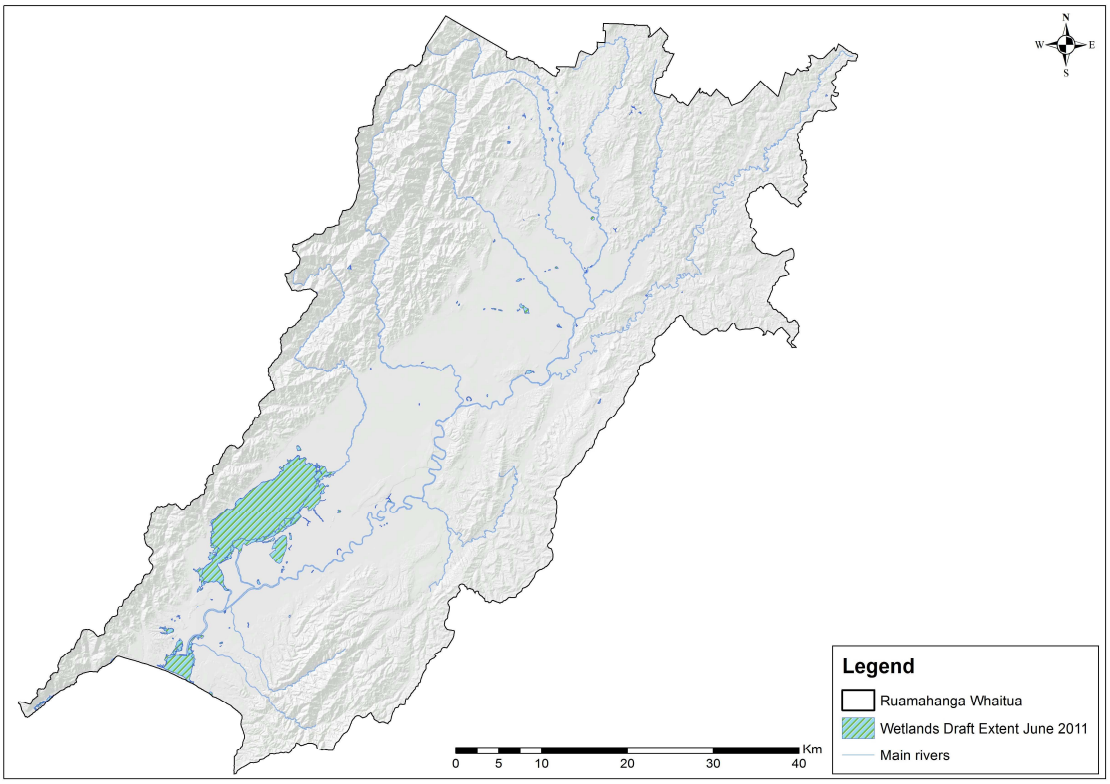

Figure 5: Current wetland extent in the Ruamāhanga Whaitua

4. Wairarapa Moana

Wairarapa Moana is the largest wetland complex in the southern North Island and contains the third largest lake in the North Island. The complex includes Lake Wairarapa, Lake Onoke, the lake-edge wetlands, (e.g Boggy Pond), Onoke spit and the Ruamāhanga channel between the lakes. Both Lake Wairarapa and Lake Onoke once had abundant and diverse aquatic flora.

- Wairarapa Moana has significant ecological values, as its large size and diverse habitat types have provided a refuge for a large variety of species, many of which are nationally threatened.
- An application for Ramsar status has been submitted to have Wairarapa Moana recognised as a wetland of international importance under the Ramsar Convention.
- Nearly one quarter of New Zealand's bird species have been recorded at Wairarapa Moana and it is a nationally important site for at least six species of waders (including some Arctic migrants).
- The shingle spit at Onoke supports the only breeding population of the nationally threatened Caspian terns in the region.
- 40-50 Australasian bittern (nationally endangered) rely on the lake-edge wetland habitat.
- Rare native turf plant communities are present

- Rare plants are also found at Onoke spit and in the wetlands.
- All of the freshwater fish species present in the region use the lakes and/or the surrounding wetlands as part of their lifecycle. Black flounder, yellow-belly flounder, lamprey, shortfin and longfin eel, as well as grey mullet have provided recreational and/or commercial fisheries.
- Introduced species such as perch and rudd are a dominant part of the fish community
- Native species are not often observed and some are in significant decline, such as black flounder.
- Bird diversity and abundance remained constant or increased in recent decades. Spotless and marsh crake have recently been 'rediscovered', having not been recorded since the early 1980s.
- Alders and willows have invaded into the wetland areas
- Aquatic plants have important roles in aquatic ecosystems as they are a food source and provide habitat for a range of species. They can also play a significant role in nutrient cycling in shallow lakes and stabilise lakebed sediments, reducing re-suspension of these sediments by wind and waves and maintaining water clarity. The loss of aquatic plants from these shallow lakes is one of the significant causes for their degraded state with poor water clarity and ecology.

5. Marine-Freshwater interaction

Lake Onoke flows into the dynamic, high-energy marine environment of Palliser Bay. The nutrient-rich waters of Cook Strait support significant fisheries and provide valuable feeding grounds and migration routes for marine mammals and seabirds. Sometimes these fisheries are at risk from large flooding events that bring down large amounts of sediment that smothers species, particular juvenile crayfish. The effect of flooding events on crayfish populations is not known for several years till crayfish reach adulthood.

6. Loss of ecosystem and biodiversity

Table 1. Nationally Threatened animals of the Ruamāhanga Whaitua

Common name	Scientific Name	National status
Australasian bittern	*Botaurus poiciloptilus*	Nationally Endangered
Banded dotterel	*Charadrius bicinctus*	Nationally Vulnerable
Bar-tailed godwit	*Limosa lapponica*	Recovering
Black billed gull	*Larus bulleri*	Nationally Critical
Black fronted tern	*Chlidonias albostratus*	Nationally Endangered
Black shag	*Phalacrocorax carbo*	Naturally Uncommon
Caspian tern	*Sterna caspi*	Nationally Vulnerable
Grey duck	*Anas superciliosa super ciliosa*	Nationally Critical
Little black shag	*Phalacrocorax sulcirostris*	Naturally Uncommon
Long-tailed cuckoo	*Eudynamys taitensis*	Naturally Uncommon
Marsh crake	*Porzana pusilla*	Relict
New Zealand dabchick	*Poliocephalus rufopectus*	Nationally Vulnerable
New Zealand falcon	*Falco novaeseelandiae*	Nationally Vulnerable

New Zealand pipit	*Anthus novaeseelandiae*	Declining
North Island kaka	*Nestor meridionalis*	Nationally Vulnerable
North Island rifleman	*Acanthisitta chloris*	Declining
Pied shag	*Phalacrocorax varius*	Nationally Vulnerable
Pied stilt	*Himantopus himantopus leucocephalus*	Declining
Red billed gull	*Larus novaehollandiae scopulinus*	Nationally Vulnerable
Red-crowned parakeet	*Cyanoramphus novaezelandiae*	Relict
Royal spoonbill	*Platalea regia*	Naturally Uncommon
South Island oystercatcher	*Haematopus finschi*	Declining
Spotless crake	*Porzana tabuensis*	Relict
Variable oystercatcher	*Haematopus unicolor*	Recovering
White-fronted tern	*Sterna striata*	Declining
White heron	*Ardea modesta*	Nationally Critical
Wrybill	*Anarhynchus frontalis*	Nationally Vulnerable
Fish		
Brown mudfish	*Neochanna apoda*	Declining
Giant kokopu	*Galaxias argenteus*	Declining
Koaro	*Galaxias brevipinnis*	Declining
Lamprey	*Geotria australis*	Nationally vulnerable
Longfin eel	*Anguilla dieffenbachii*	At risk (declining)
Inanga	*Galaxias maculatus*	At risk (declining)
Shortjaw kokopu	*Galaxias postvectis*	Nationally vulnerable
Dwarf galaxias	*Galaxias divergens*	At risk (declining)
Brown mudfish	*Neochanna apoda*	At risk (declining)
Redfin bully	*Gobiomorphus huttoni*	At risk (declining)
Bluegill bully	*Gobiomorphus hubbsi*	At risk (declining)
Bats		
Short-tailed bat	*Mystacina robusta*	Nationally Vulnerable
Long-tailed bat	*Chalinolodus tuberculatus*	Nationally Critical

Note: this table shows species in the whaitua in a nationally ranked system used by DOC. Some of these species may be highly valued by the local community and demand prioritisation to assist species survival.

Definition of classes:

Critical- species with extremely high probability of extinction in the wild within the immediate future
Endangered- species in danger of extinction, survival is unlikely if causal factors continue operating
Vulnerable- species likely to be moved into the endangered category in the near future if factors continue operating.
Declining, Naturally Uncommon, Relict- species that are thought to be at risk.

The extent of forest habitat loss can be seen in the maps below, but other habitat types, such as duneland were also affected.

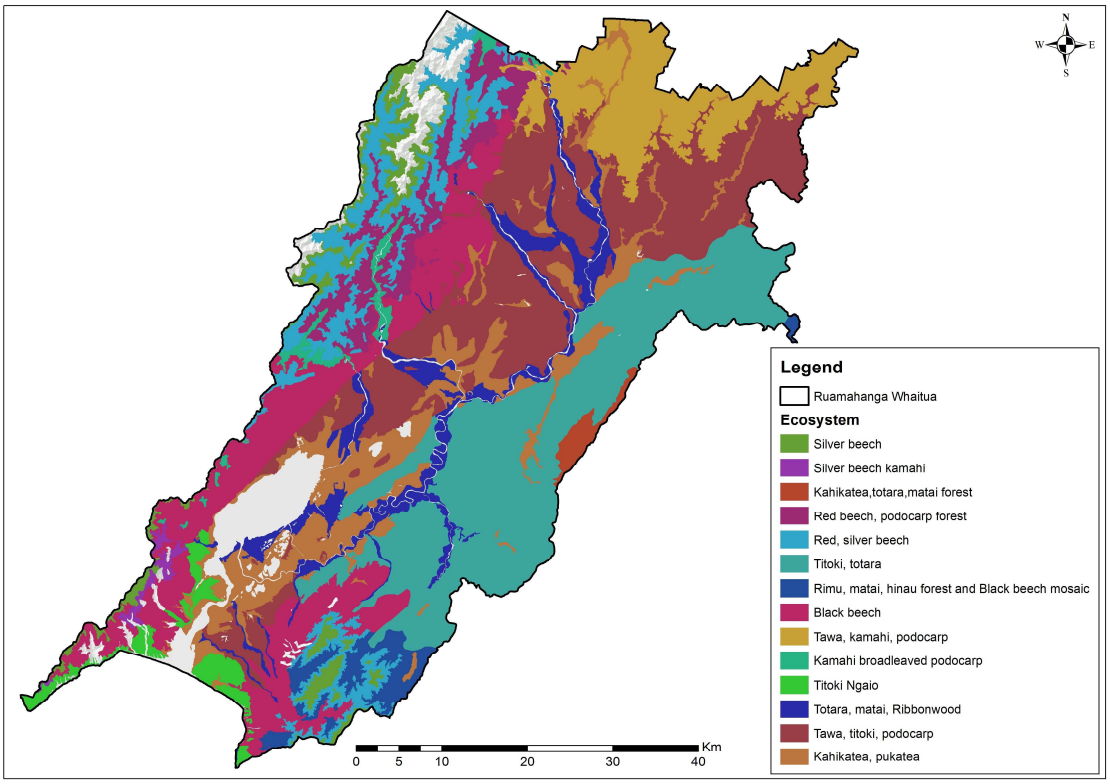

Figure 6: Main forest ecosystems that were once present in the Ruamāhanga Whaitua

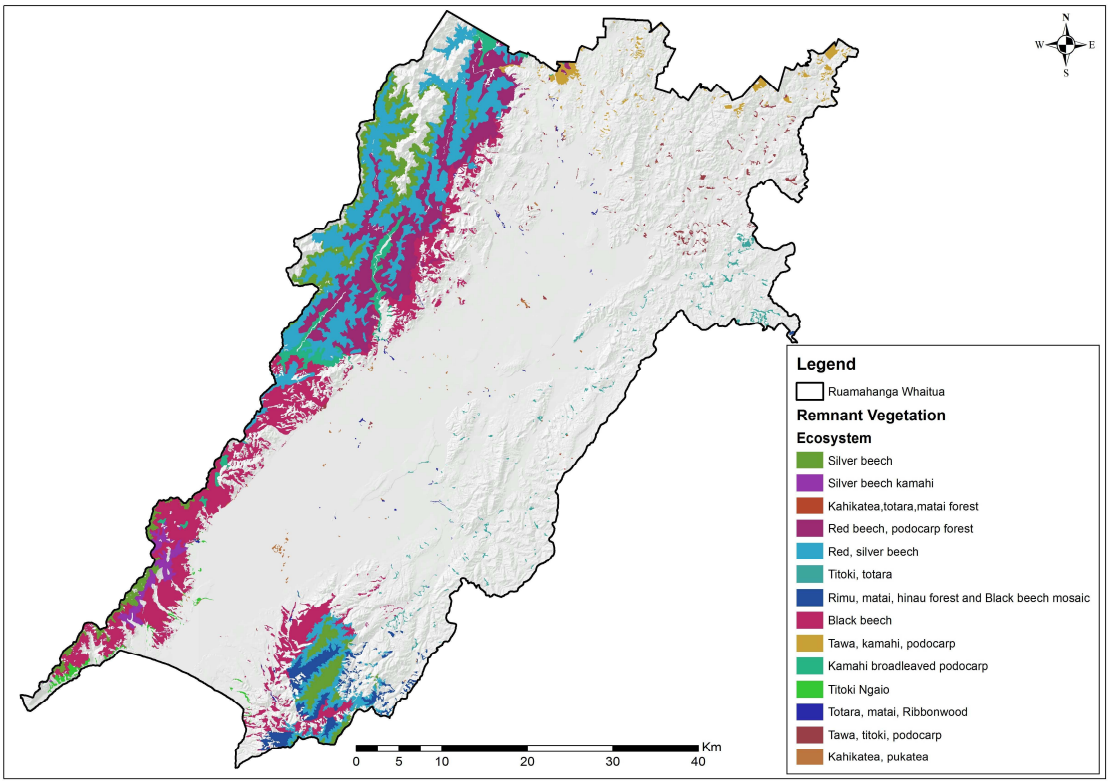

Figure 7: Remaining forest ecosystem types in the Ruamāhanga Whaitua

6.1 Loss of Indigenous species on the land

Species that were common pre Polynesian settlement

- Finsch's Duck
- Eyles' harrier
- NI takahe
- stout-legged wren
- various moa species
- kakapo

Species that were common in the 1870s -after the arrival of Europeans

- huia
- North Islandkaka, kereru, North Island robin, red and yellow-crowned parakeet, bellbird, tui, rifleman and long-tailed cuckoo were exceedingly common in the lowland forests.
- weka
- kaka, tui and kereru were present 'in their thousands' around Masterton

Braided rivers provided habitat for lizards and skinks, and specialist birds such as black-billed gull, dotterels and stilts.

The lakes, wetlands and fernlands of the lower Ruamāhanga Valley supported large numbers of NZ scaup, brown teal, grey duck, Australasian bittern, banded rail, NZ pipit, banded dotterel, pukeko, Australasian harrier and fernbird. The robust skink, Duvaucel's gecko, Markham's frog and Waitomo frog were also once in the whaitua (Beadel et al. 2000).

Forest provided habitat for short-tailed and long-tailed bats, both of which would have been common in the forests.

7. Aquatic Habitat degraded by human activity

Much of the forest of the plains was lost to widespread fires around the seventeenth century. Native grasslands and fernland that existed in a complex mosaic of vegetation types in swamps were removed.

Human activity and land-use intensification has cause major decline in species

- Loss of forests - During European settlement much of the remaining forest was removed to provide timber and land for agricultural development or for construction. Many of the remaining forests and wetlands were unfenced and grazing stock ate regenerating seedlings, trampled vegetation and altered the soil nutrient cycles.

- Loss of wetlands - Swamps were drained and native fernland and scrub cleared or grazed. The draining of wetlands and alteration of water levels impacted the plants and animals that relied on those moisture regimes. The loss of wetlands has continued over the last 150 years and large areas of the valley now have extensive drainage systems. Flood protection schemes have halted the frequent widespread flooding, altering the ecosystem cycles of the past. The Lower Valley Drainage Scheme decreased the size of the Lake Wairarapa catchment from over 300,000 to 90,000ha. The historic extent of all wetlands in the region has been reduced to less than 3% of the original extent (see Figures 4 and 5).

- Channelisation of rivers and streams to aid the management of flood waters altered the aquatic habitat. Straightening of the rivers shortened their overall length (and hence habitat), while the diversity of freshwater habitats was also often diminished (a meandering river typically allows for more riffles, runs and pools).

- Stopbanks can reduce the connectivity of rivers with adjacent habitats such as marginal riparian areas and wetlands.

- Piping and culverting of streams has resulted in a direct loss of stream habitat and while the most extensive culverts are typically limited to urban areas, culverts (small and large) are widespread in rural areas.

- The installation of physical barriers, such as barrage gates, culverts and weirs has impacted on the distribution of many of the fish species, as the majority need to migrate up and downstream to complete their life cycle.

- Changes in catchment landcover from indigenous forest to pastoral and urban landuses has degraded aquatic habitat through increased nutrient and sediment inputs. Reduced riparian vegetation and degraded habitat with less shade, less leaf litter (food) and less overall habitat

diversity (e.g., they are less interactions between the trees and the water and wood can provide key habitat).

- Riparian habitats are important for adult aquatic insect larvae, and for some fish species that spawn amongst riparian vegetation during high flows.

- Water abstraction from both groundwater and surface water alters flows and has a negative impact on aquatic habitats in rivers, wetlands and lakes. The changing water volume influences the amount of instream habitat (i.e., wet and dry areas, swift and fast flowing areas) and results in less buffering against water temperature increases.

8. Man-made water structures (water races and drains)

Man-made habitats such as reservoirs, farm dams, water races, drains and even waste-water treatment plant ponds can provide habitats for a range of fish species, including those classed as "At risk: Declining" by DOC. Recent surveys of a number of man-made drains in Wairarapa Moana recorded eight species of native freshwater fish including inanga, banded kokopu, brown mudfish and longfin eel. Koura (freshwater crayfish) were also recorded. These man-made environments can have similar biodiversity values to natural water bodies.

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Appendix 1: Conservation Actions

DOC manage 90,000ha of forests, wetlands and other lands within the Ruamāhanga Whaitua (see Figure 8). They also enter into covenants with private landowners.

GWRC undertakes biodiversity management in 12 Key Native Ecosystems (approx. 2,000 ha) in the whaitua, implementing pest control or planting and providing advice. There are138 QEII covenants in the whaitua, totalling 3,200ha.

Community groups that are involved in restoration actions in the whaitua include Papawai Stream Group, Whangaimoana Dunes Restoration Group, South Wairarapa Biodiversity Group, Ducks Unlimited, Friends of Onoke Spit and Mangatarere Restoration Society.

Major conservation project initiatives are:

- Wairarapa Moana- a joint initiative between GWRC, DOC, South Wairarapa District Council, Ngati Kahungunu ki Wairarapa, Rangitane o Wairarapa and Papawai and Kohunui marae. The project aims to protect and restore the ecology and enhance recreational and cultural opportunities at the wetland complex (www.waiwetlands.org.nz).
- Pukaha/Mt Bruce –native wildlife are being returned to the 950ha forest adjacent to DOC's National Wildlife Centre (www.pukaha.org.nz).
- Aorangi Restoration Trust project- a group of volunteers who are working collaboratively with DOC, GWRC, Tb Free NZ, local Iwi and recreational hunting representatives to restore Aorangi Forest Park and the surrounding natural areas (www.aorangitrust.org.nz).
- Project Kaka – this DOC/GWRC/TbFree NZ collaboration aims to restore native communities in a 22,000ha area in Tararua Forest Park (www.doc.govt.nz).

Nature Central – this is a partnership between DOC and Greater Wellington, Hawke's Bay and Horizons Regional Councils aims to improve communication and collaboration between the agencies and coordinate better natural resource management.

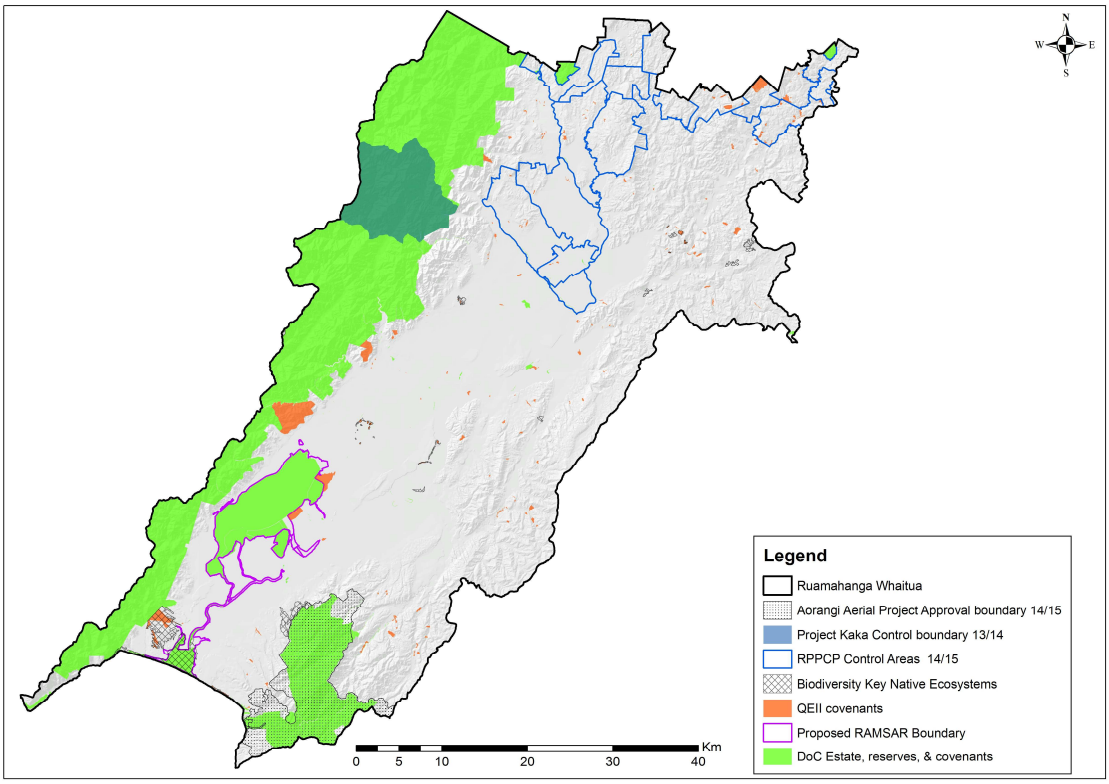

Figure 8: Conservation land and projects in the Ruamāhanga Whaitua

1.1 Land Ecosystems - how do they work?

The geological and climatic processes that shaped the valley have resulted in land forms with soils ranging from excessively drained and drought prone stony soil to dense very poorly drained clay soils – facilitating a wide diversity of terrestrial ecosystems.

- The floodplain soils derived from the sediment brought down by the rivers were developed by the vegetation communities that evolved over thousands of years. Initially shrub species such as tutu and native broom colonised the plains, but as fertility improved with time, canopy trees became established. The early forests were dominated by totara and to a lesser extent matai, both long-lived trees capable of dominating forest composition for many centuries.
- On the alluvial soils, different plant species filled the various niches available to them. Totara and matai occupied the fertile, but free-draining soil, while kahikatea and pukatea could tolerate higher moisture levels in the soil or longer flood periods (see Figure 9).

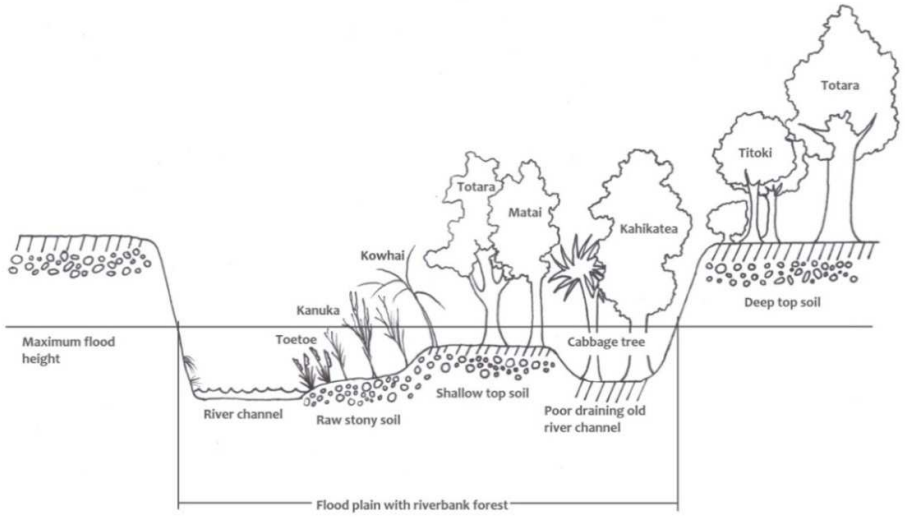

Figure 9: Conceptual diagram showing forest development on alluvial landforms.

Broadleaf species such as titoki and tawa co-existed with these forest giants, but the forest varied across the Ruamāhanga Whaitua with change in climate and soil conditions. To the north where the climate is colder, kamahi became the more important forest. Beech forests were found in the Tararua, Remutaka and Aorangi Ranges. Close to the coast are ngaio and nikau trees that are adapted to salt laden winds. Where frequent floods occurred, low stature grasses and toetoe grew, while shrub and scrubland species such as kanuka and koromiko colonised further from the rivers. The main forest types that are thought to have been present are shown in Figure 6.

Appendix 2. The loss of native species

Finsch's Duck, Eyles' harrier, North Island takahe and stout-legged wren had died out shortly after Polynesian settlement. Huia numbers declined sharply in the second half of the 19th century. One of the last huia sightings in the area was of two birds seen in the hills behind Lake Pounui in 1904, though it is widely believed that the species would have persisted in the remote parts of the Wairarapa as late as the early 1920s (Phillips 1963). Weka numbers declined as a result of forest clearance and the use of poison to control rabbits. They persisted much longer in the surrounding hill country, particularly the Aorangi Ranges, but these populations had also died out by the last decade of the 19th Century (Stidolph 1971). Some of the most recent local extinctions occurred as a result of extensive wetland drainage around the margins of Lake Wairarapa between the 1960s and 1980s. NI fernbird has not been recorded since the early 1950s and there have been substantial declines in populations of Australasian bittern and spotless crake.

The abundance of one freshwater fish, the grayling, declined rapidly from 1870s and it was thought to have become extinct in New Zealand by the 1930s (McLintock 2009). The loss of wetland extent and alteration of riverine and lakehabitat associated with landcover modification would have had implications for the majority of fish and invertebrates in the catchment. The abundance of many species has declined significantly (eg, longfin eel, giant kokopu, brown mudfish and kakahi) and that their range and distributions have been severely restricted. For some species, commercial and recreational harvesting, as well as competition and predation from introduced fish species, has also likely furthered the decline above that driven purely by changing landcover in the catchment.

Appendix 3. Table. Native fish species

Common name	Scientific name	Type of diadromy	Conservation class
Grayling		obligate?	extinct
Lamprey	*Geotria australis*	obligate	Nationally vulnerable
Longfin eel	*Anguilla dieffenbachii*	obligate	At risk (declining)
Shortfin eel	*Anguilla australis*	obligate	Not threatened
Inanga	*Galaxias maculatus*	facultative	At risk (declining)
Koaro	*Galaxias brevipinnis*	facultative	At risk (declining)
Banded kokopu	*Galaxias fasciatus*	facultative	Not threatened
Giant kokopu	*Galaxias argenteus*	facultative	At risk (declining)
Shortjaw kokopu	*Galaxias postvectis*	facultative	Nationally vulnerable
Dwarf galaxias	*Galaxias divergens*	non-diadromous	At risk (declining)
Brown mudfish	*Neochanna apoda*	non-diadromous	At risk (declining)
Common bully	*Gobiomorphus cotidianus*	facultative	Not threatened
Upland bully	*Gobiomorphus breviceps*	non-diadromous	Not threatened
Cran's bully	*Gobiomorphus basalis*	non-diadromous	Not threatened
Redfin bully	*Gobiomorphus huttoni*	obligate	At risk (declining)
Bluegill bully	*Gobiomorphus hubbsi*	obligate	At risk (declining)
Giant bully	*Gobiomorphus gobioides*	obligate	Not threatened
Common smelt	*Retropinna retropinna*	facultative	Not threatened
Torrentfish	*Cheimarrichthys fosteri*	obligate	At risk (declining)
Black flounder	*Rhombosolea retiaria*	obligate	Not threatened
Grey mullet		obligate	Not threatened
Yelloweye mullet	*Aldrichetta forsteri*	marine wanderer	Not threatened
Yellowbelly flounder		marine wanderer	Not threatened
Estuarine triblefin		marine wanderer	Not threatened
Stargazer		marine wanderer	Not threatened
Kahawai		marine wanderer	Not threatened

Native fish and the importance of habitat

The decline in fish populations (diversity and abundance) is linked to changes in habitat and water quality as a result of landcover changing from indigenous forest to pastoral and urban land use. Native species have evolved in rivers and streams in catchments dominated by indigenous forest. The loss of this forest cover and riparian margins, and the introduction of contaminants such as nutrients and sediment have altered the habitat and water quality so it less suitable for most native species. For example, if the water gets too warm, there is less habitat diversity, habitat is often degraded and critical spawning habitat has been lost. Many of these fish also live in wetlands and the extensive loss of wetlands has had a significant effect on the amount of habitat available.

Other general factors associated with landuse change that can affect native fish populations (and other native aquatic biodiversity values) include river channelisation and diversions, loss of riparian margins and water abstraction. Given that most species are migratory (diadromous), instream barriers, such as barrage gates, weirs and culverts, can stop fish from migrating, if the fish can't migrate past a structure they can be absent from upstream areas.

Introduced species such as trout and perch can also significantly impact the distribution and abundance of some native species such as the dwarf galaxias. The commercial and recreational harvest can also impact species such as long and shortfin eel and whitebait.

Appendix 4. Biodiversity data

As well as at Wairarapa Moana, GWRC and DOC complete biodiversity monitoring and surveys at other sites in the whaitua. River bird surveys were initiated in 1999 on the Waingawa, Tauherenikau and parts of the Ruamahanga Rivers. Since that time, annual surveys have been completed to assist GWRC's Flood Protection Department to minimise the impacts of their activities on these birds. Threatened river nesting species recorded include banded dotterel, pied stilt and black billed gull. The latter nationally critical species nest in the upper Ruamahanga River each year. Annual bird counts have been completed at three KNE sites for the past eight years, while rodent monitoring is completed every six months at Fensham Reserve and Tauherinikau remnants to check that the baiting regime is keeping rat numbers low.

Intensive monitoring of pests, birds and plant recovery is being undertaken in a 10 year program by DOC, Tb Free NZ, Landcare Research and GWRC (Project Kaka). One of the aims of the research is to investigate the efficacy of using three-year cycles of aerial 1080 for large-scale pest control.

Routine monitoring of rivers and lakes often collect information on biological communities but the primary objective of this monitoring and reporting relates to assessing ecological health/condition.

Macroinvertebrate, periphyton and macrophyte data are collected at 20 sites in the Ruamāhanga Whaitua under GWRC's Rivers State of Environment (RSoE) programme while phytoplankton and macrophyte data are collected under the Lakes State of Environment (LSoE) programme.

Targeted investigations, such as the Mangatarere Stream catchment water quality investigation, also provide additional sources of biodiversity information, as do investigations and reports undertaken by other organisations (e.g. DOC). National databases (e.g. NIWA's New Zealand Freshwater Fish Database; NZFFD) and predictive models (e.g. Fish distribution and invertebrate community condition models in the Freshwater Environments of New Zealand (FENZ) are also extremely useful sources of information.

DOC have identified a network of protected natural areas (PNAs) that meet criteria describing the extent of native vegetation, degree of naturalness, landscape and ecological diversity and representativeness .

Appendix 5. The State of our indigenous species today

The mountainous areas of the Tararua, Remutaka and Aorangi uplands remain clothed in original forest, albeit altered by the impacts of pests. On the lower slopes, much of the forest is now in pasture or scrub. Small remnants of the original floodplain forests can be found dotted across the landscape (see Figure 7) - Sulphur Wells, Greytown Bush and Tuhitarata Bush Scenic Reserve. Less than 2% of these lowland forest remnants remain and their small size and isolation make the remnants vulnerable to climatic extremes and pests. The loss of riparian extent is likely to be similar to that of the forests. Stream ecosystems are closely linked to their adjacent riparian habitat, through the interaction of food webs between the aquatic and terrestrial ecosystems, as well as the physical effects of bank vegetation providing shade and bank stability for the streams.

Appendix 6. Native species on the land

Significant changes in the diversity and distribution of bird species have resulted from the fragmentation of the forest cover. Tomtit, whitehead, rifleman and kakariki are now largely restricted to the Tararua, Remutaka and Aorangi Ranges. More mobile species such as tui, bellbird and kereru still disperse across the modified lowland landscape to exploit seasonally available food, but few now nest in the small forest remnants. Other natives, such as silvereyes, grey warblers and fantails are more adaptable and persist in gardens, exotic forests and the native remnants. Mostly, agricultural pastures dominate the valley are occupied by high numbers of exotic bird species, such as goldfinches, greenfinches, blackbirds, magpies and starlings. No native frog species remain, but three geckos (forest, common and Wellington green) and five skinks (copper, ornate, common, spotted and speckled) have been sighted in in the whaitua. A short-tailed bat colony is found in the Waiohine valley.

Threatened native plants in the whaitua

Species Name	Threat Status
Atriplex cinerea	Nationally Critical
Epilobium hirtigerum	Nationally Critical
Simplicia laxa	Nationally Critical
Muehlenbeckia astonnii	Nationally Endangered
Pterostylis micromega	Nationally Endangered
Amphibromus fluitans	Nationally Vulnerable
Anogramma leptophylla	Nationally Vulnerable
Carex cirrhosa	Nationally Vulnerable
Isolepis basilaris	Nationally Vulnerable
Lepilaena bilocularis	Nationally Vulnerable
Myrsine umbricola	Nationally vulnerable
Coprosma pedicellata	Declining
Coprosma virescens	Declining
Coprosma wallii	Declining
Lobelia carens	Declining
Mazus novaezeelandiae ssp novaezeelandiae	Declining
Peraxilla colensoi	Declining
Peraxilla tetrapetala	Declining
Poa billardierei	Declining
Teucridium parvifolium	Declining
Solanum aviculare var aviculare	Declining
Tupeia antarctica	Declining
Urtica linearifolia	Declining
Streblus banksii	Relict
Crassula ruamahanga	Naturally Uncommon
Korthalsella clavata	Naturally Uncommon
Korthalsella salicornioides	Naturally Uncommon
Stuckenia pectinata	Naturally Uncommon
Craspedia uniflora var grandis	Data deficient
Epilobium insulare	Data deficient
Ranunculus macropus	Data deficient

Appendix 7. The impact of introduced plants and animals

New Zealand's plants and animals evolved in the absence of mammals (apart from bats and marine mammals). This makes them very susceptible to invasion, browsing or predation pressure by introduced plants and animals. Pest plants can smother native bush and affect natural regeneration, while possums browse tree foliage, compete with native birds for food and eat chicks, eggs and invertebrates (Department of Conservation 2014).

Introduced pests and domestic stock accelerated the biodiversity loss that had begun with the habitat clearance. Birds, lizards and invertebrate populations were impacted, while the structure of the remaining forests was altered by the loss of preferentially browsed species.

- Deer damage native forests through browsing regenerating plants. Introduced to the Wairarapa in 1850s for hunting. By the 1920s, deer had spread through the forests, where they ate out the undergrowth causing extensive damage, but the impact of possum browse was not recognised until the 1940s (Brockie 1992).
- Goats damage native forests through browsing regenerating plants, while
- Pigs eat invertebrates and plough up the undergrowth.
- Rats, mustelids and cats eat birds, chicks, lizards and invertebrates and compete with native wildlife for food
- Hedgehogs are predators of ground-nesting birds, such as those that live on the rivers or coast. possums were released around Featherston for the fur industry in 1872
- Exotic fish species were released with the arrival of European settlers for food, sport and as biological control. Some compete with and prey on indigenous aquatic fauna (invertebrates and other fish), others such as rudd (a pest fish) can impact on aquatic flora through browsing. Trout and Perch are large predatory fish, which are classified as sports fish, and cause a decline in native fish diversity and abundance although the effects are not known. Brown and rainbow trout, are exotic species that are valued for sports fishing, and are widespread within the catchment. Many rivers/lakes support locally and regionally significant fisheries.
- Exotic aquatic plants are pest species that can significantly affect native aquatic plants. Exotic aquatic plants (hornwort, egeria and Canadian pond weed) occur in lakes and the slower flowing rivers and streams. They can outcompete and smother native plants, clog stream and river channels which alter the flow (habitat) characteristics and affect water quality through the respiration, causing a critical drop in dissolved oxygen levels.

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