OPPORTUNITES FOR ECOLOGICAL RESTORATION IN THE TAKAKA CATCHMENT

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Ko Philip Simpson taku ingoa
Ko Takaka te awa
Ko Pikikiruna te maunga
Ko Te Tai Mohua te moana
Ko Ara o te Pohara taku turangawaewae

Takaka is the river
Takaka Hill is the mountain
Golden Bay is the sea
Pohara Valley is where I stand

VISION: To match the remarkable living environment of the Takaka catchment with ecological health, restored and maintained by community action.

Cover: Robin Slow, "Nga manu o Mohua" He Writes "[Manu] were kaitiaki, guardians of places; they flew across the sky as comets brightening the sky, they haunted the dark places expressing warnings and danger, and they sang."

The birds reflect ecological health. Who has seen a young kereru lately?

The name "Golden Bay" is popularly thought to reflect the discovery of gold in the 1850's. However, the Maori name for the district is "Mohua", the name for the yellowhead or "bush canary", and the bay itself is "Te tai mohua". A distinctly yellow after-glow is a feature of most clear evenings, sometimes reflected in the sea, and this seems to be a far more evocative origin for the name "Golden Bay" - a direct translation from Maori identity.

Revised March 2009

1. INTRODUCTION

1.1 Background

This report was commissioned by the Tasman Environmental Trust (TET) in order to develop a strategic view of opportunities for the Cobb Mitigation Fund, on the advice of its Cobb Mitigation Fund sub-committee. The fund has been generated by Cobb Power Limited as mitigation for consent to operate the Cobb River Power Scheme for a 35-year period from 2001. As a condition for consent, the three iwi in the Bay (Ngati Tama, Te Atiawa and Ngati Rarua) jointly sought mitigation to improve the health of the river (for eel passage, for instance), a stand supported by Fish and Game New Zealand. The iwi also sought a community focus for the use of the fund. Accordingly, over the past three years, with advice from a local sub-committee, TET has been allocating funds to community groups for ecological restoration projects. TET has relied on individuals and groups to identify the projects they wish to undertake. However, an overview strategy was considered desirable to assist the Trust to manage the fund wisely and to help applicants focus attention on matters outlined in the Deed (November 2002):

- Enhancing natural character, aquatic habitat and amenity, water quality or fishery values at and around the Cobb Valley and reservoir, the wider Takaka catchment, and the Waikoropupu Springs and the rivers and streams flowing from those springs;
- Enhancement of natural and manmade wetlands;
- Riparian vegetation enhancement.

This report is not a strategy in terms of an action plan because the specific actions need to be community led. However, it helps to focus attention on the main areas of concern within the catchment and perhaps identifies projects with a larger scale in space and time than has hitherto been possible.

1.2 Limits of the catchment

Most of the Takaka River Catchment can be readily defined by high ridges and peaks. In limestone country, however, there may actually be no surface streams but rather underground channels that recharge the ground water and emerge as springs along the valley. Parts of Canaan and Mt Arthur lie in this category. A further category includes small coastal catchments that do not link with the Takaka River but may either have been past channels or contribute to an integrated set of coastal landforms that are ultimately influenced by events in the Takaka River. These include the Motupipi River and estuary and several small streams draining local hills at Pohara (Ellis Creek, Pohara Creek, Winter Creek). For simplicity and to unify the coastal area, the catchment is considered to include the eastern side of Rangihaeata Peninsula, the coastline from the Takaka River mouth to Abel Tasman Point, and the catchments that open to the sea around this coast.

1.3 Consultation

The key agencies consulted were the Department of Conservation, the Tasman District Council, Fish and Game New Zealand Nelson Marlborough Region, Fonterra and Manawhenua ki Mohua. A background paper was distributed to a range of community groups, and a number of local individuals were consulted.

1.4 Social and ecological context

West of the Takaka Hill lies a special place, with dramatic landforms, a relatively benign climate, and diversity and uniqueness in the rocks, soils, flora and fauna. Surrounded by National Park land (Kahurangi and Abel Tasman), the human society derives a living in an equally diverse manner from traditional land and water uses through to services that support a thriving tourism industry, based largely on recreation and landscape appreciation with a special feeling for 'end of the road' isolation. Although formerly more exploitive, society is strongly conservation oriented or committed to sustainable resource uses. Identification of and respect for, iwi concerns is evident.

1.5 Principles of Ecological Restoration

- Base actions on Landscape Ecology, which focuses on processes, spatial patterns and linkages
- Restore ecological systems (forests, dunes, wetlands, etc)
- Identify interrelationships (land, rivers, the coast)
- Make action catalytic, facilitating nature to do most of the work (for free).

2. ECOLOGICAL BACKGROUND

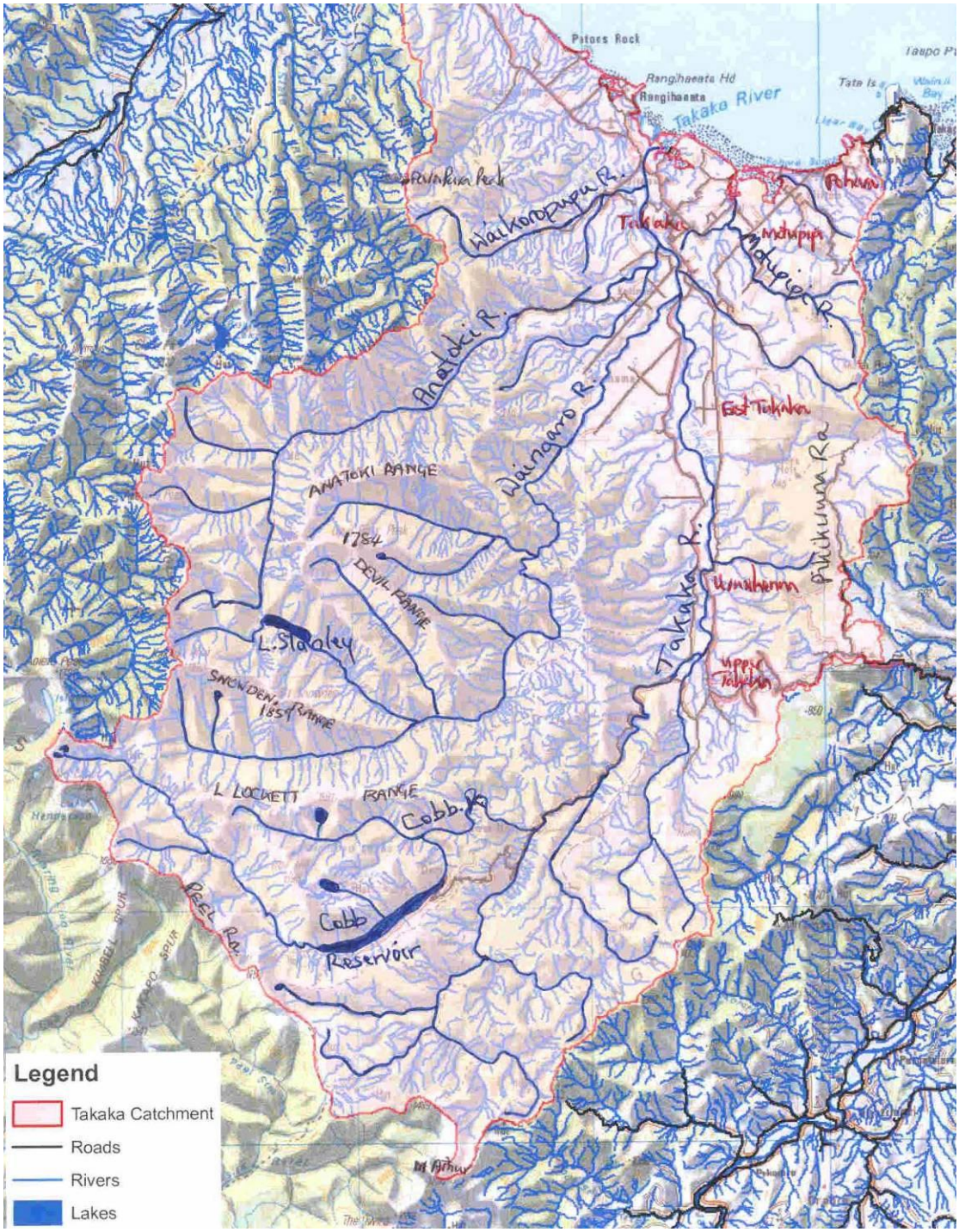
In this section important features of the ecological setting in each resource area are described, followed by a statement of their implications in terms of sensitivities and values.

2.1. Topography

A classic medium-sized New Zealand catchment (92,800ha), the Takaka River and its main tributaries drain alpine headwaters (reaching over 1800m elevation) through a narrow valley, opening to coastal wetlands (formerly) and estuaries. The headwaters are often ice-sculptured, and the valley is bordered by outwash terraces of varying age and fertility. What is special are the geological formations (including marble and limestone areas, creating stream-less tablelands, underground caverns and associated sinkholes and springs), the fault scarps, land-slide induced lakes and elevated reefs and blocks of rock. The unequal disposition of land east and west of the river valley results from the fault angle depression created by the Pikikiruna Fault: the west is wet and wild bush-clad wilderness of ancient volcanics, silt and sandstone and schist, while the east is a narrow band of mostly steeply incised limestone.

View from Kakapo Peak to Lake Stanley (770m) and Devil Range. The lake was formed by the 1929 Buller Earthquake which caused a landslide (beyond the right foreground) along the line of the Haupiri Thrust on the lower flank of Mt Snowden (1859m), the highest point in the Takaka Catchment. A "thrust" is an old low angle fault that probably left a zone of unstable rock in this area. While an active topography, the geology is ancient Paleozoic volcanics, silt/ sandstone and schist. Bushline is between 1400 and 1500m. Copyright, Skylark Productions.

On this topographic diversity rests the ecosystem and species diversity of the flora and fauna. The preservation and restoration of special landforms such as terrace sequences, karst topography (including sinkholes), wetlands and estuarine margins, including their natural vegetation cover, is especially important.



The Takaka River and its catchment. There are several notable features. The fundamental role of the Pikikiruna Fault, means that the eastern side of the catchment has short streams draining hills while the west has long rivers draining mountains. The catchment is predominantly mountainous with the valley (where everyone lives) a small proportion. Mountains in the SW have been glaciated (resulting in outwash terraces in the valley) with tarns. The three main rivers and several smaller rivers all link in the lower valley creating a distinct flood plain. A small but diverse coastal zone between Rangihaeata and Abel Tasman Head is strongly influenced by the river, which brings nutrients into the sea, cuts cliffs at Rangihaeata, deposits silt on the seabed and sand for building dunes, and has cut low-lying areas that have been reflooded to form tidal estuaries.

2.2. Geology

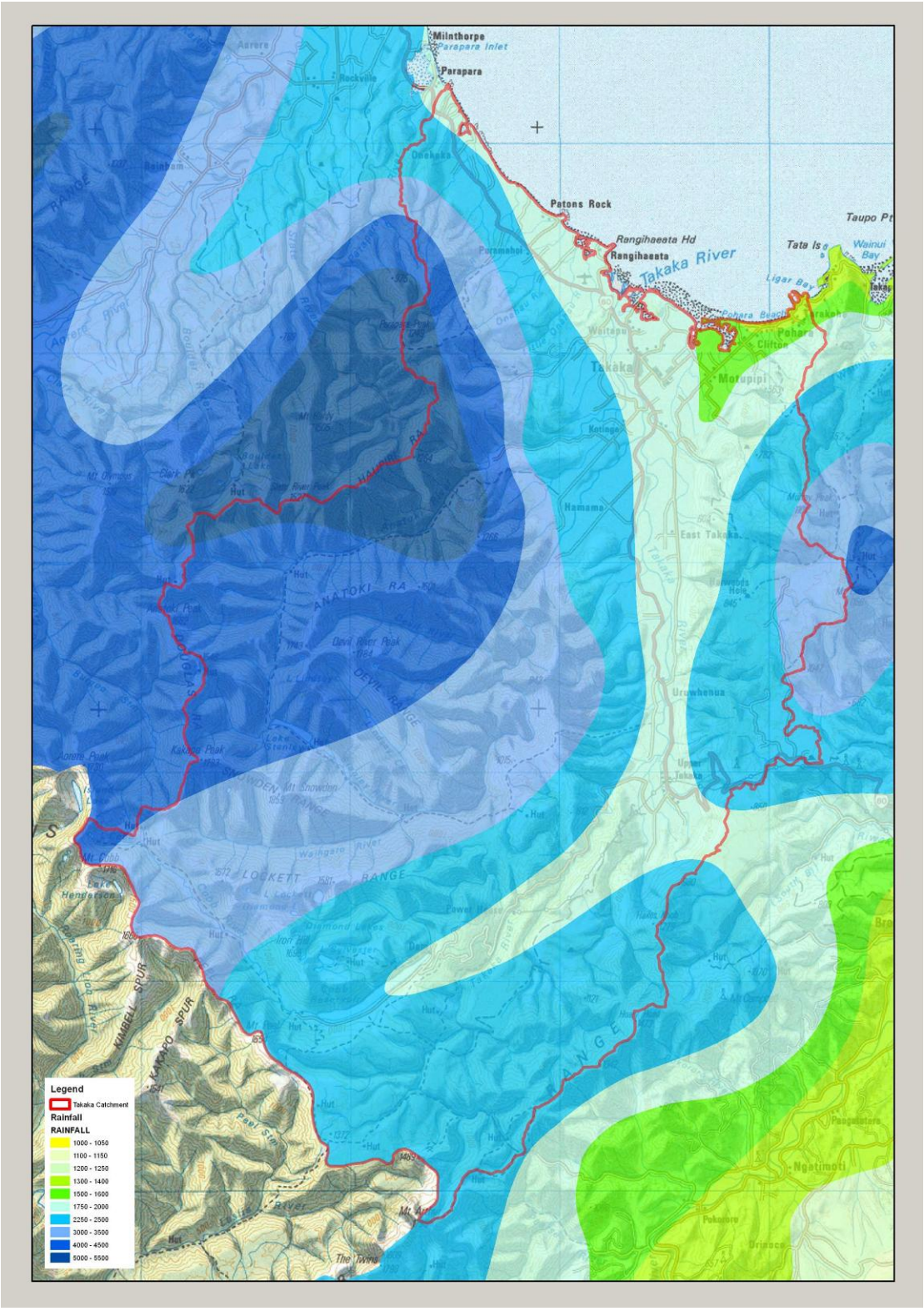
The Takaka catchment includes New Zealand's oldest fossil-bearing rocks (early Cambrian limestone) through to the youngest riparian and coastal sand. Volcanic (basalt, andesite and ultramafic-including asbestos,) and metamorphic rocks (schists, granite, marble) are associated with the sedimentary layers. Pikikiruna schist is a rock-type unique in New Zealand, derived from metamorphosed quartzite. Oolitic limestone, or oolite, in the Devil Range, is also unique in New Zealand, consisting of limestone granules with a concentric shell structure around a grain of sand or fossil fragment acting as a nucleus. Fossil bearing limestone and calcareous mudstone form patches in the lower country, often associated with narrow beds of coal. Suites of outwash terraces line the valley. Paleozoic, Tertiary, Pleistocene and Recent formations have all been fragmented, elevated and eroded into an incredibly complex pattern.

The chemical and physical properties of the rocks underlie the evolution of the landforms and soils and form the basis of the character and diversity of existing habitats and ecosystems, including local endemic species. Some of the geological structures have intrinsic value themselves and need to be protected from unwarranted disturbance and despoilment from weeds and pests.

2.3 Climate and weather

With strong altitudinal and east-west gradients there is no single pattern of climate and weather. But the central New Zealand location and the rain-shadow impact of mountains mean that the climate is generally sunny (2200 hours in the lower valley) and protected from persistent southerly or westerly winds. Rare high wind is capable of felling isolated trees in the valleys. Rainfall is generally high, ranging from about 1200mm in the NE to over 5000mm in the western ranges. However, summer drought is a feature (for instance 1973, 2001) and periodically has great impact on vegetation. Likewise, heavy rainfall is possible, reflecting a "west coast" affinity, with flooding of the lower Takaka valley and slope instability in the mountains, hills and river valleys. Frost is a significant feature of the valleys, but there is a strong maritime influence as well, so that some warm temperate species can extend well inland. Overall, the weather can be described as benign, but dramatic with occasional extreme events.

The stand out feature is the high rainfall combined with high sunshine. From an ecological restoration perspective, however, drought, flooding and frost are important cautionary considerations within this generally permissive environment.



Rainfall is lowest in the NE (1200mm) and greatest along the western ranges especially near Parapara Peak (over 5000mm). The Valley lies in a rain shadow. Most rain falls in spring and autumn from the north to west frontal systems while winter southerlies bring snow to the ranges. Any month can have heavy rain, dry periods or snow.

2.4 Soils

High geological, topographic and climatic diversity means that soil chemistry and structure is equally diverse, resulting in a complex pattern of natural communities (although this pattern is seriously disrupted across the lowlands, as described below). Endemic calcicol (calcium tolerant) plants feature in limestone and marble areas. Acid tolerant species feature in schist and granite areas. Leaching of older outwash terraces has led to a pakihi-type vegetation, originally featuring trees like yellow-silver pine. The fertile free-draining alluvial valleys are characterised by totara forest, while the flood plains of the lower valley are (or were) characterised by kahikatea and pukatea swamp forest and harakeke (flax) wetlands. Tidal flow results in salt-tolerant estuarine vegetation around the coast.

These variations need to be reflected closely in restoration planting, not only to maintain the natural pattern of diversity but to guard against failure, which is costly in terms of resources and opportunities. The generally fertile soils, often open, rocky character of the landforms and equable climate also mean that weed growth can be rife and wild animal populations (goats, possums, pigs, predators) a threat.

2.5 The aquatic environment

The fault angle depression created by the Pikikiruna Fault along the eastern side of the Takaka Valley plots the general courses of the five main rivers of the Takaka catchment: the Takaka (including the Cobb) River, the Waingaro, the Anatoki, the Waikoropupu and the Motupipi. These river systems create the landforms and link the mountains and hills to the sea. However, within this beautiful pattern lies the unique feature of the Takaka hydrological environment, the limestone- and marble-based pattern of underground caverns, springs, and surface karst features of terrain, holes, caves, dolines (sinkholes) and dry rivers. It is this combination of features that sets the Takaka catchment aside as one of the hydrogeological gems of New Zealand, if not the world. Associated with this world of hidden habitats are unique species of animals (see below).

2.5.1 The Takaka River system

The upper reaches of the Takaka, Waingaro and Anatoki rivers are pristine, stable systems originating in ice-sculptured rocky peaks with tarns and sometimes rock avalanche lakes (such as L. Stanley, formed after the Buller Earthquake of 1929), snow tussock grasslands, scrublands and herbfields, descending through extensive beech forest into deep gorges before debouching onto the lowland plains. These headwaters form the core of Kahurangi National Park and are a recreational treasure as well as a nationally significant centre for biodiversity, especially among alpine plants such as *Hebe*. The Takaka River, once it reaches the valley begins to lose water through the alluvial gravels and into the cavernous marble beneath the valley. When the flow is less than 9.4 cubic metres/second, part of the river is dry, and only reflows near the confluence of first the Waingaro then the Anatoki. Becoming dry obviously poses serious ecological constraints on both the aquatic ecosystem and the riparian land along the river, because there are limits on water availability, fluctuations in temperature and restricted flushing of aquatic pests. (Didymo, has been recorded throughout the Takaka River.) Contrary to popular belief, the Cobb Power Scheme

actually reduces the time the river is dry, by releasing water during dry periods. The lower Takaka River is tidal and the river mouth has created a delta of high ecological value.

The wilderness character of the upper catchments means that species that are rare elsewhere can survive, unless introduced pests are an issue. This is the case for whio (blue duck) in the Flora catchment (a tributary of the Takaka) and strenuous efforts to trap predators by the Friends of Flora and Friends of Cobb, partly funded by the Cobb Mitigation Fund, are paying off. Similar controls on possums, deer and pigs will ensure the survival of rare endemic plant species, such as Dall's pittosporum. There are opportunities to enhance populations in the vicinity of the dam and reservoir.

Whio chicks born on the Flora Stream, 2007, following intensive predator control. Department of Conservation

On the activity of rivers: Simon Walls writes (PNA report, DOC 2000, unpublished, page 13): " Constant fluvial processes have sorted alluvium, added silt layers to floodplain surfaces, changed river channels to leave oxbow lakes, added and removed riverbanks, re-worked older gravels, inundated sinkholes, sliced the ends of lateral fans, cut into the fault angle rocks on the valley sides, built complex deltas, scoured steep sided gorges in hard rock and contributed vast amounts of material to coastal areas." It is important that, within the confines of common sense, these processes are enabled to continue.

2.5.2 The Cobb Reservoir, Dam and Power House

The Cobb reservoir was filled in 1955, designed to collect water in wet events and gradually release the water during summer dry periods, enabling a 32MW electricity generation. The spillway is overtopped several times a year, averaging 8, but the minimum control level has been exceeded only once, during the very dry year of 1973. Peak flows in the Takaka River today are similar to the previous natural peak flows, with a tendency towards a longer duration because outflow from the dam is

less than inflow to the reservoir. The number of occasions that the reservoir will spill over is predicted to decline if electricity production is increased beyond 32MW. Major floods are important in a river system because they 're-set the hydrological clock' by filling the nooks and crannies and flushing the channels. Such an event might be important in future for the natural control of didymo. The natural drying up of the central valley river is little changed by the action of power generation except that when the threshold for drying is near power generation will cause temporary reflow. Overall the duration of drying is reduced 60 days/year by the addition of more water. The power station and dam obviously block the river to both upstream and downstream movement of aquatic life and translocation of elvers and mature eels has been suggested. The reservoir is the largest body of water in the Takaka catchment and serves as a significant recreational asset requiring good quality road access into the alpine area. In an area with many lakes formed by landslides, Cobb Reservoir could be similarly regarded, only of human origin, but with all the natural qualities of similar lakes such as Lake Stanley (the second largest water body), which has a land-locked population of koaro.

The Cobb Reservoir during the 2000-2001 summer drought. The power scheme has an operating water level range of 13.7m and the level at this time was 794.25m asl., just below the minimum operating level. The dam prevents movement of fish into or from the reservoir. (Photo courtesy of Georgina King, Environmental Management Services Ltd, Napier, 2001).

2.5.3 Arthur Marble and Takaka Limestone caves and aquifers

A paleocave system developed in the Arthur marble during the formation of the NW Nelson peneplain in the Late Cretaceous and Early Tertiary. Tectonic movements

Barbara Sparrow at the entrance of a limestone cave near her Uruwhenua property. This cave was 'lost' within a pine plantation and a bull-dozer was driven over the entrance during harvesting. It is about to be 'lost' again. Such events highlight the sensitive nature of caves. The vegetation around caves needs to be stable native bush, fostering a healthy cave hydrology, atmosphere and food supply for cave animals.

have reactivated this cave system so that it now contains over one cubic kilometre of water, most of which emerges at the Waikoropupu Springs. Interacting with this aquifer is a similar but smaller hydrocave system within much younger Tertiary limestone that overlies the marble. It is recharged by rainfall and seepage from the eastern hills, and emerges in a series of springs along East Takaka and near Paynes Ford. These small springs have generally been disturbed and restoration of their natural vegetation is desirable. The karst caves of the Takaka catchment are world famous for cavers (including Harwoods Hole and Moonsilver) and there are several small systems accessible by the general public for observing the beautiful limestone formations that form in the absence of disturbance. The limestone caves are also the home for several unusual animals, including some sap sucking insects that live off plant roots, and New Zealand's largest spider is known only from a cave at Motupipi

and a similar site in north Westland. They also have great scientific value for their subfossil bird, frog and invertebrates remains. Restoration of vegetation around cave entrances is a good way of enhancing the values within, especially if native forest influences the hydrology, atmosphere and cave species.

Takaka River from the East Takaka Road during a dry period (from Cawthron Report 635, 2001). River water flows through the surface gravel and into underground channels in the limestone. This is a natural phenomenon, but has substantial impact of aquatic life. Vertebrate and invertebrate migration is disrupted and the shallow and sluggish water above the dry zone encourages the growth of algae.

2.5.4 Waikoropupu Springs

To iwi, the Waikoropupu Springs represent one of the most important taonga (treasures) in Aotearoa. The springs are waitapu (sacred waters).

With a mean flow of 13.2 cubic metres/second, the 'Pupu' Springs are the largest in New Zealand, issuing very pure water from the Arthur Marble aquifer. Although most of the water is several years old the flow does respond to rainfall and river flow (in the Takaka and Waingaro) and water quality could possibly be influenced by surface features. The rate of decline of groundwater level in some wells is broadly related to the rate of decline of spring flow, suggesting that a high level of extraction could influence the spring flow. There is also some influx of seawater (0.5-0.7%) from very deep caverns. The springs constitute one input to the Waikoropupu River, another branch of which drains hills along the SW slope of Parapara Peak, one of the very high rainfall zones of the Takaka catchment. The springs' emergence reflects a high degree of geological complexity in the area. High rainfall and 'easy' outwash terraces of varying fertility around the springs has led to a cover of pakihi scrub (which is rich in low fertility-tolerant, often ancient plant species, especially ferns) and wilding pines, with little original bush remaining. The Motupipi coal measure is an impervious cap over the marble. Where it occurs on the surface it is erodible and infertile and contributes to the unusual ecological character of the area.

The lower Waikoropupu River including the Springs and their immediate environment emerges as a high priority place for ecological restoration.

2.5.5 The Motupipi River

The Motupipi is a small river system with a curious mix of components. Much of the catchment rises in limestone, forming spectacular gorges along the eastern hills with streams flowing only during rain events. Part arises as springs on the lower flood plain almost within the Takaka urban area. The Takaka River has probably overflowed into the Motupipi. The river meanders across fertile dairy flats and is a source of concern over water quality. It opens into a double estuary bisected by the 'island' Motupipi itself, a remnant of the Motupipi coal measure deposit, with unusual forest composition. The area has important historical associations for both Maori and Pakeha, is currently a favoured whitebaiting river and provides many opportunities for ecological restoration.

2.5.6 The coastline

The coastline considered relevant to this report on the Takaka River catchment includes the following elements:

- the eastern side of Rangihaeata Peninsula,
- the Takaka River mouth, tidal reach and delta
- Waitapu estuary
- Rototai Beach (including the Sopers Hill schist dome)
- Motupipi estuary (including Rototai and Clifton sections)
- Pohara beach, including a sand spit
- Limestone Bay (including Tarakohe), coastal limestone bluffs
- Ligar Bay- Tata Beach, beaches, estuaries and granite headlands. (The limestone Tata islands lie off-shore)

The delta of the Takaka River has been formed by numerous separate channels. The river has flowed hard against the Rangihaeata Peninsula and cut cliffs along its eastern flank. The river is tidal and large areas form estuary. Adjacent to some inland channels the flood plain supports small areas of dense forest, including totara, kahikatea, pukatea and rata. An artificial channel carries water directly to the sea and some of the old channels are silting up. Much of the flood plain is farmed, mostly covered by a treeland of the above species as well as kowhai. On the adjacent hill-slope of inland Rangihaeata there is a remnant of near -natural beech (hard, black), podocarp (rimu, kahikatea, matai, miro and totara) and rata forest. The delta offers quality recreation experience.

All these places have been severely impacted by one or more aspects of development, roading, subdivision, drainage or weed invasion. Yet, this is an ecologically productive zone and parts have intensive tourist, historical and landscape value. There are unlimited opportunities for ecological restoration. Coastcare in Golden Bay (part of a national programme developed by the Dune Restoration Trust of New Zealand) has been involved in many dune and coastal slope plantings of native species (such as spinifex and pingao in place of marram), pest and weed control and education. Administered by TDC, Coastcare is funded by land development levies and while focussed on reserve land is also able to extend into private land on a voluntary basis.

2.5.7 Takaka River Management

(The following information is from Webby et al., 2000: Takaka River Catchment Flooding Study, TransAlta New Zealand Ltd.)

The amount of annual expenditure by TDC on channel maintenance works is considerable (1996/1997 - $96,000, 1997/1998 - $127,000, 1998/1999 - $164,000). This reflects the steepness of the river bed (average slope 0.32%) and the consequential aggressiveness of flood events as they travel downstream. Damage to banks typically occurs as a result of the maximum annual flood event, which has a peak discharge in the range of 207-689 m^3/s at Harwoods (1975-1999) and 578 -1226 m^3/s at Kotinga Bridge (1970-1999). However, the damage that occurs is not necessarily due primarily to the magnitude of the peak discharge but rather the duration of the high flows (and hence flow velocities) coupled with the antecedent ground moisture conditions.

The types of bank repair methods used in the Takaka River comprise rock revetment work, rock groynes, willow planting and occasional placement of toe rock only with willow planting on top. The annual maintenance expenditure is typically split roughly equally between rock work and willow work. However, following the major July 1998 flood event the $164,000 expenditure on damage repairs was split approximately two thirds and one third between rock work and willow planting respectively.

Crack willows have long been used in bank stability but have never been very effective because they grow too fast, too large and fall over. Smaller bitter willows are now favoured, with periodic 'mowing' to maintain a dense growth capable of filtering silt and flood debris out to limit damage to fencing. Crack willow is targeted for removal, offering opportunities for native riparian species.

Gravel removal from the river bed beaches has been routine for many years but is becoming replaced by a 'sustainable river system' which prevents gravel removal but allows moving gravel to minimize damaging water flow. The sustainable river concept enables the multiple uses of the rivers to be more integrated, with farm production, water, trout (Fish and Game), habitat and biodiversity (Conservation, Forest and Bird), recreation and landscape all with potentially competing interests. An over-arching philosophy towards river management is embodied in the concept of Integrated Catchment Management (ICM)

At the time of European settlement some of the river had a crown strip (20m) along each bank. However, movement of the channel over time has eradicated most of these. Today, most of the riverbank from the mouth to Upper Takaka is privately owned. While land owners are currently positive towards granting access for fishing or swimming, informal arrangements carry no guarantee, and this is something that Fish and Game New Zealand are concerned about. Competing interests are strongly encouraging the re-establishment of riparian reserves and this process also offers opportunities for native plant establishment.

2.6 Vegetation and Flora

While some local extinctions may have occurred since human occupation of the area (for instance, pakihi podocarps, maire and pingao) the floristic composition is largely intact. However, the vegetation has been extremely modified, with virtually all land below about 500m (and sometimes much higher) cleared for timber and farming, drained or invaded by introduced species. Clearance has been most intensive on flat land, sunny aspects and relatively easy hill-slopes, while the shaded steep mountain valleys and ridges have remained largely untouched – 60% to 70% of the catchment, most of it now National Park. A discontinuous rim of original vegetation remains in private ownership between the conservation hinterland and cleared lowland farmland.

There are major opportunities for ecological restoration throughout the lowland zone including forests, wetlands, estuary margins and coastal sand vegetation.

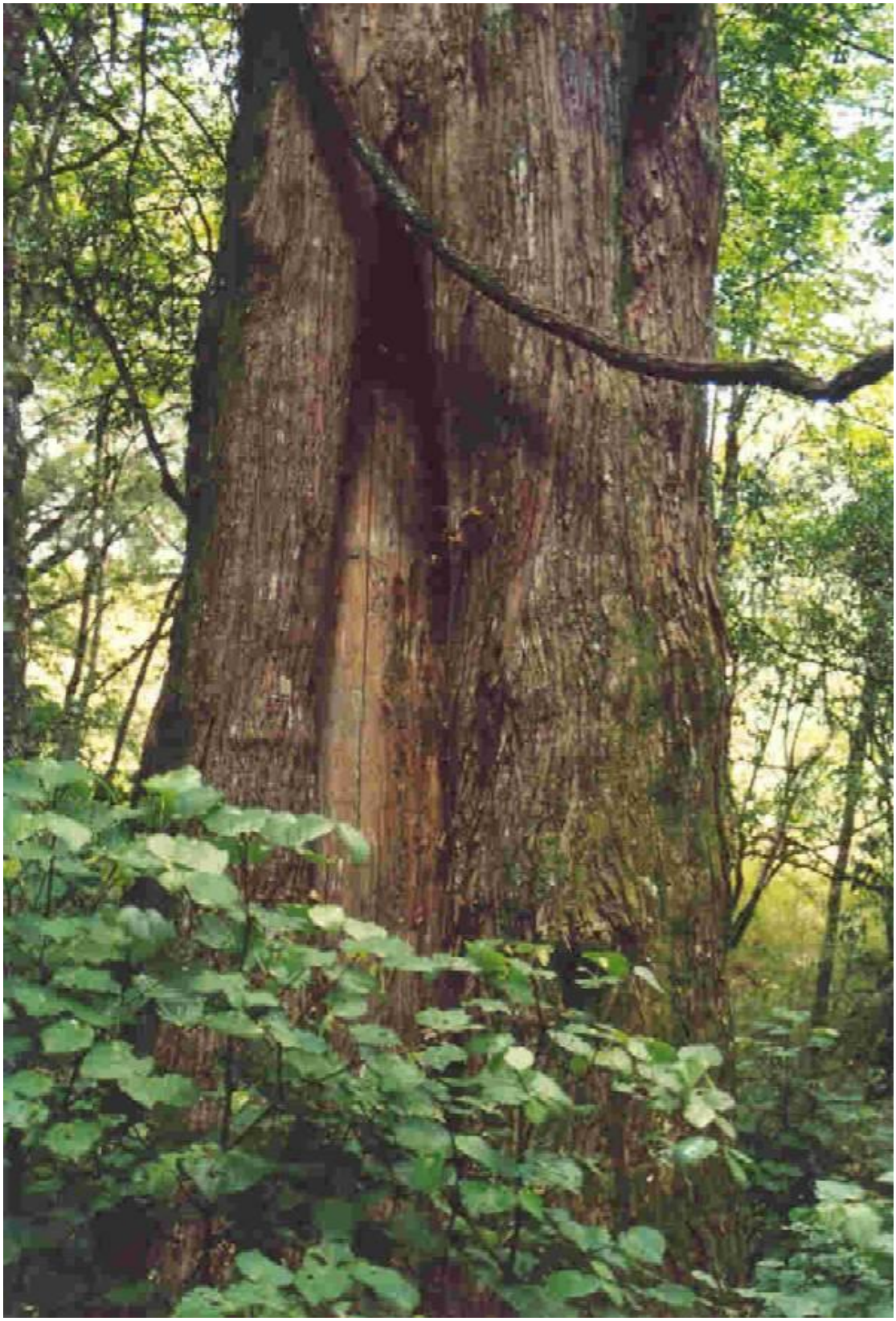
2.6.1 Pre-human vegetation pattern

The main natural factors influencing vegetation pattern are altitude (temperature, frost and rainfall), history of disturbance (landslides, floods, wind and snow storms,

drought), soil chemistry (acidity, nutrient availability) and physical character (structure and moisture).

In the Takaka catchment a narrow band of coastal vegetation occupied the rocky bluffs, sandy beaches and dunes, estuaries, tidal reaches of rivers, and wetlands. Extensive fresh-water wetlands (harakeke, cabbage trees) occupied the lower valley, gradually giving way to swamp forest composed of kahikatea and pukatea. Beech forest (black and hard) extended to the coast in suitable places and northern rata forest was widespread. On drier alluvial soil, totara forest was widespread with a mix of flood plain species such as ribbonwood, narrow leaved lacebark and tawa. Beech was a component of this forest with kowhai in open places along streams and on bluffs. A warmer thermal belt with reduced frost allowed coastal species to extend well inland, such as nikau, akeake and titoki. With increasing altitude beech forest became continuous composed of hard, red and silver beech, this extending to bushline between 1300 and 1400masl. The forest was interrupted in places with wet soil or exposed rock outcrops, especially limestone and on these surfaces a range of local endemic species occurred. On wet outwash terraces pakihi forest including yellow pine, pink pine and silver pine occurred. Above natural bushline a mix of shrubs, snow tussocks and herbaceous plants occurred according to soil moisture, rockiness and aspect, with snow an important influence, including avalanches into the bush. This vegetation was especially rich in species as a result of the geological and landform diversity, and relatively limited impact of recent glaciation.

The composition was also greatly influenced by the central New Zealand location and associated natural conditions. The rich physical environment enabled a full suite of typical widespread species to flourish, as well as many typically uncommon New Zealand plants like fierce lancewood. Several species approach their southern or western limit in the catchment or nearby, such as cedar, tanekaha, milk tree, NZ privet (hangehange) and tawa. Others reach their northern limits from a wider distribution along the Southern Alps, such as many species of *Hebe* and *Celmisia*. Still others are local central NZ species such as *Scutellaria novae-zelandiae* and there are many locally endemic species based on the distinctive soils especially limestone, such as *Hebe albicans*. (A list of threatened species is maintained by DOC, see Appendix II)



Remnants of original forest are important in many ways: they indicate the natural pattern of vegetation and soils; they protect unmodified soil beneath them; they are habitats for flora and fauna above and below the ground; they are templates for restoration and they are a genetic source for propagation. They reflect aspects of human history too, in this case use of the inner bark by Maori inhabitants during the 19th Century to make a patua, a basket for preserving birds such as kereru and tui, an archaeological taonga now very rare in the Takaka catchment.

This intricate pattern offers unlimited opportunities for restoration for it has been largely displaced throughout the lowlands. Riparian areas offer particularly favourable environments for restoration owing to their open character and moist, often low-frost conditions.

2.6.2 Current vegetation pattern

The main features of the current pattern of native vegetation include:

- places that have been left intact because of terrain, such as limestone bluffs and estuaries;
- valley remnants that have escaped logging and fire usually because of steepness and shading;
- small valley floor remnants kept for intrinsic value or as sustainable resources by original and later settlers;
- regeneration of new vegetation such as totara forest, bracken fern, kanuka, manuka and broad-leaved species such as tree ferns, whiteywood and five-finger on hill-slopes and wet terraces. Secondary vegetation is particularly widespread on the western hills above the Takaka valley and is, in general, well on the way to becoming forest, albeit with a range of introduced species such as pines.
- Introduced species are particularly prominent along coastal sand (marram grass), river-banks (willows), rock outcrops (banana passionfruit) and roads (old mans beard) and many represent escapes from gardens (cotoneaster).

Remnants are highly valuable templates to copy, sources of plant material and opportunities to sustain natural processes, such as restoring water quality. Naturally regenerating native vegetation can be managed to remove invasive species such as wilding pines. Wild animal control (pigs, possums and goats for instance) is necessary as part of the regeneration process. Returning lost species is a major opportunity: for instance pingao and spinifex to coastal sand dunes; harakeke and *Carex secta* to wet areas (or areas that can be made wet by re-watering); tawa, northern rata, narrow-leaved lacebark and ribbonwood to alluvial forest.

Owing to the special character of the Takaka flora and vegetation, ‘eco-sourcing’ - the propagation and planting of local plant material only - is extremely important.

The classification of Land Environments (LENZ) offers an approach to broadly prioritise places for ecological restoration (see MAP of LENZ units Appendix III).

2.7 Fauna

Like the vegetation, the fauna has been dramatically changed by human impacts. But unlike the flora, extinction has been common, especially among birds. Harvesting, loss of habitat and the impact of introduced predators are the main reasons for loss. Wetland birds are particularly vulnerable from loss of habitat, including marsh crake, banded rail and Australasian bittern. Blue duck is restricted to a few mountain streams as a result of predation. Forest birds such as kereru breed with difficulty owing to

predation from rats, stoats and possums. The western weka has declined dramatically in recent years for unknown reasons but habitat disturbance and predation are likely impacts. Coastal birds including little blue penguin, reef heron and little pied shag, are in decline as a result of disturbance in their coastal habitat.

Freshwater fish are present in virtually all the waterways of the Takaka catchment including small farm drains with low water quality. Shortfin and longfin eels are widespread, as are inanga. Some species such as koaro and kokopu, are sensitive to disturbed environments and prefer waterways with vegetation cover and a diversity of habitats. Migratory species are impacted by blocked passages from culverts and dams. Many waterways have been straightened and cleared of vegetation (influencing temperature, nutrient status and habitat diversity). Wetlands (where inanga mature) have been seriously reduced, and spawning sites are exposed to stock disturbance and land development.

Evidence suggests that where these impacts are removed the fish population responds well, so restoration activities such as riparian planting will have benefits. Introduced aquatic weeds (for instance *Lagarosiphon major*) impact on water quality by reducing oxygen and smothering food sources. The long-term impact of 'Didymo' is yet to be determined but recreational activities such as boating, diving and fishing pose a major risk for spreading it throughout the catchment. Aquatic weeds are most prolific where sunlight has access to the water body, the flow-rate is reduced and nutrients such as effluent runoff enrich the water. All of these aspects provide opportunities for ecological restoration with regard to the aquatic fauna, including invertebrates.

The invertebrate fauna of Takaka is renowned for two reasons: the several species of large landsnail, *Powelliphanta,* and the limestone cave fauna. Landsnails are being severely impacted by predation from wild pigs. The cave fauna appears relatively secure but there is an issue relating to their food preference - the roots of trees entering the cave. Native species may be preferable.

Habitat creation, predator control, weed control and habitat improvement to remove restraints on migration, breeding and food supply are all possible restoration activities relating to the fauna. Moving animals to secure habitats, especially birds, snails and fish, is also possible. (Moving fish from shrinking pools in the naturally drying Takaka River has been a common practice for years.)

3. LANDSCAPE

Landscape is the synthesis of natural and human environments. It offers a window to our identity and a check on how we are doing. Few would dispute that the landscapes of the Takaka catchment are special. The combination of landform, colour and light, the interactions of land and water, especially the sea, the prominence of rocky outcrops, and the juxta-position of farmland and natural features such as trees and mountain wilderness, are simply pleasing. There are some eye-sores - straightened waterways, geologically polluted coastline, gouged hillsides, poorly positioned buildings, exposed tracks, and weed infested vegetation - to name a few.

A particularly relevant initiative has been “Trees on Farms”, whereby the trees typical of the valley floor - totara, black beech and kahikatea, for instance, have been planted in groves or as specimen trees. The totara groves of Takaka valley are special, but with time exposed trees die, and the occasional drought and wind has an impact. Large old primeval trees from the prehuman forest are rare and particularly vulnerable. For the landscape character of the farmland to be maintained, trees need to be planted. Roadsides, farm shelter and waterways offer opportunities for tree planting.

New Zealand’s unique rare cave spider (*Spelungula cavernicola*), is found only from limestone caves in Takaka and Oparara. Its body length is 25mm and legs span up to 30cm - our largest spider. It catches its prey (such as cave weta and flies) on the ceiling or by descending from a drag-line. The vegetation around the cave entrance and immediately above the cave is vital to maintain a healthy environment for the cave fauna. Photographed by Grant Stirling (Stirling Images)

Te Papa image

Apart from wetlands, bluffs and parts of the coast, the Takaka Valley was originally densely clothed in tall forest, mostly totara, kahikatea or beech, depending on the soil. During the late 19th Century, virtually all this forest was cleared for farming, and in the period immediately after, when rough ground was widespread and grazing less intensive than nowadays, new trees established - groves of kahikatea on the lower flood plain, scattered or dense totara on the drier alluvium up-valley. While the mature trees are resistant to grazing no new trees can establish and eventually the old trees will die: gradually this important rural landscape is losing its trees.

A 'mountains to the sea' philosophy also offers insight into the inter-relationship of habitats along a sequence. Landscape ecology is a discipline that explores ecological processes at a landscape scale investigating the values of corridors, shapes of natural features and their age and density. Interactions between public conservation land and surrounding private land are particularly relevant when ecological restoration is a possibility. Landscape planning at a property scale and between properties could underpin restoration actions, with stream stability and high water quality major objectives.

3.1 Recreation and interpretation.

For many people the Takaka catchment, at least the lowland part of it, is not especially user-friendly for outdoor activities such as biking and walking, or learning about natural places through interpretation facilities. There are notable exceptions, such as Waikoropupu, both the springs and the Pupu hydro scheme walkway. There are other initiatives such as planned cycle-ways, one of which follows the old tramway built to carry logs from East Takaka to Waitapu. An important part of ecological restoration is public support and understanding. Project Crimson's "rata trail" is an example that encourages participation. There are many other opportunities to create interpreted trails.

4. ECOLOGICAL RESTORATION PRIORITIES

- Whatever enhancement actions are undertaken, they need to be consistent with the policies and work programmes of the Department of Conservation (DOC), and the Tasman District Council (TDC), although in both cases changes in public opinion can motivate shifts in how and what actions are taken. Staff at DOC specialize in environmental management and could be consulted for technical input.
- Some of the enhancement actions funded by the Cobb mitigation fund will be carried out by community groups (e.g., Friends of Cobb) and take place on the DOC estate, and therefore will need to complement the ongoing DOC work programme, particularly with regard to predator control.
- The specific examples cited below have not been checked for feasibility or conflict with local government policies and practices, or landowner desires or capacities. They are suggestions that have emerged during consultation. Any further action will need to be negotiated with the appropriate parties, and the practicalities, including economic aspects, worked through.

4.1 Generic issues and specific examples

4.1.1 Secure and maintain existing natural biodiversity

DOC carried out a Protected Natural areas survey in 2000 and identified a number of natural areas worthy of protection in the Golden Bay Ecological District (which covers most of the private land within the Takaka Catchment). This survey has never been implemented. An informal voluntary Significant Natural Areas (SNA) programme is being implemented by the TDC, with selected volunteer properties being surveyed over the last few years, but with hopes for a more comprehensive survey in future. Many landowners are protecting natural areas themselves or through covenanting via the QEII (Appendix IV). All surviving natural areas contribute immeasurably to the ecological character of the catchment. Surveying, fencing, weed and pest control and species enhancement are all required in innumerable small natural areas on private land and these initiatives require funding. Although the very best of these natural areas may be formally protected, in general conservation management is the important factor.

- **Wetlands:** Existing fragments of wetlands need to be protected from stock and rewatered if necessary.
- The Mitigation fund could be used to create wetlands by excavation. Sometimes the gravel removed can be used to off-set the cost. Heavy rain reveals part of the network of former wetlands across the lower flood plain and any of these could be enhanced to recreate an effective pattern of wetlands. River backwaters offer other possibilities, while sealing sinkholes also has potential. Planting appropriate native vegetation within and around created wetlands is also a valid use of the fund.

4.1.2 Managing the karst environment

Weeds, protecting landforms, karst landscape, interpretation of karst geology, restoring populations of calcicol species and plant communities on limestone

outcrops; pest control; restoring water and vegetation to sinkholes, understanding the underground fauna (such as the pupu flatworm which has been seen only once).

- Removal of parrot weed (*Myriophyllum aquaticum*) from Lake Killarney
- Dietary analysis of cave sucking insects to determine optimum (native) vegetation to restore around the cave entrance
- Restore springs such as Spittle Spring and others at East Takaka, Spring Brook, Windles near Paynes, Watercress Creek Motupipi, Maori Rd springs. All these springs are ideal for rehabilitation by planting around them the original species (such as kahikatea, matai, totara, kowhai), keeping stock out, removal of weed species.

Blue Lake at Rototai is one of the very few sinkhole wetlands with forest around it and serves as a model for restoration. The forest is secondary kanuka with regenerating black beech, kahikatea and rimu. The lake margin supports a stand of kuta. The blue colour of the water is thought to be derived from sulphides that leach from the Motupipi coal measure that overlies the limestone here.

4.1.3 Fresh-water fish habitat

All riparian plantings are important, with a focus on small creeks around the coast. The lower Waikoropupu River, including Spring Brook, is a priority for restoration. Inanga need flax swamps to mature in and secure places for spawning. The most important place for spawning is vegetation (flax, kuta, toetoe and other, even introduced grasses, sedges and reeds,) at the head of the Spring tidal wedge. The long-fin eel is declining. A handbook on methods to build fish passages is needed. (A file on blocked waterways is maintained by TDC.) There are many cattle crossings through small streams that could be culverted. Fencing of small streams (e.g., Ellis Creek) is important for galaxiids. Long-fin eel elver capture from the Cobb Power

Station for transfer to the Cobb Reservoir is feasible (Strickland, R. 2001: Cobb Power Station Elver Study, Cawthron Report No. 621).

This culvert under a driveway across a small Pohara stream completely eliminates the passage of most native fish because it overhangs both the water and surrounding wet ground. It needs a rock or concrete ramp up which poor climbers like inanga can swim.

4.1.4 Partnership with Manawhenua ki Mohua

The time has long gone when activities that significantly modify the land or water can be undertaken without regard for previous inhabitants and the views of existing manawhenua.

- It is necessary to secure, restore and sustain places for the traditional Maori harvesting of plant materials such as kuta, harakeke, kiekie and pingao (and possibly animal (for instance fish) and earth products), to avoid damage to archaeological sites and traditional landscapes, and to consult when planning potentially important resource developments.
- Land agreements as a result of Top of the South claims to the Waitangi Tribunal may identify opportunities for ecological restoration.

4.1.5 The Takaka River riparian zone

- **The river mouth delta** is a magnificent place with estuary, sandy beach and rocky shore in close proximity and it requires a plan to identify restoration opportunities such as weed control and planting.
- **Te Kakau Stream** (an old Takaka River channel), has serious *Lagarosiphon* , which reduces the oxygen level, and requires shading by fast growing native trees such as wineberry, tutu and karamu.
- Restoration areas along Takaka River include stretches above Lindsay Bridge (where crack willow is being removed, near Murrays Beach), below Lindsay Bridge adjacent to the Uruwhenua reserve, between Paynes Ford and Kotinga Bridge, the ox-bow area above Paynes Ford, and no doubt many other small stretches of reserve or private land. Based on TDC Department of Engineering policies, Sicon is contracted to carry out willow management along the Takaka and associated rivers. The contract and the schedule of work is headed by John Ellis (Tapawera) and Alan Sowman (Takaka) and these are the persons whom prospective applicants for funds to plant natives should contact for opportunities and site details.
- Public access to the Takaka River is limited because there are few marginal strips. A cycle way along the former tramway (built in the 1890's to carry logs from East Takaka to Waitapu wharf) is planned in the Ox-bow area and will require a buffer of native forest. TDC has identified "indicative walkways". Fish and Game New Zealand consider that a valid use of the Cobb Mitigation Fund is to assist with formal negotiations with land owners to buy narrow riparian strips of land (say 5m across), or to negotiate formal agreements like covenants that are transferable on the Title.
- Where river protection planting is required **flood plain native species** could be used instead of willows. **Cabbage trees** have been progressively dying (from Sudden Decline, as well as old age and stock damage to trunks, and lack of regeneration), and a planting programme is needed to restore this iconic flood plain-wetland species. Native species with fibrous root systems would be favourable for use in flood prone areas (Appendix VI) However, sometimes introduced

forest species (willow, sycamore) have created an ecosystem with habitat value and within which there is progressive native regeneration.

The aquatic weed Lagarosiphon in Te Kakau Stream adjacent to the Takaka township, is so dense that oxygen is depleted and other life is nearly impossible. The weed can be controlled by matting or spraying, but the long-term solution is to revegetate the banks using fast growing native vegetation (cabbage trees, flax, karamu, wineberry, whiteywood) to shade the banks, reduce the temperature, and foster native aquatic species. Photo: Trevor James, TDC

- Restoration of riparian vegetation along **Motupipi River**. Some macrophytes in the water do a good job by removing nutrients, so windows of light should be left. The stretch from the Dairy Factory to Sunbelt Crescent is very visible and messy. Crack willow removal would enable kayaking along river. The Council reserve includes pukatea and there may be an opportunity to extend this bush remnant. (Pukatea seeds prolifically and a secure habitat is needed for re-establishment rather than necessarily planting- this applies to many species. A principle for ecological restoration is to provide the conditions for nature to do much of the work.

- Rototai former rubbish tip site (TDC): coastal forest potential

- Motupipi Spit totara forest restoration

4.1.6 Enhancement of rare or notable plant species and ecosystems

- Silver pine logs have been exhumed in paddocks up the Waikoropupu valley. This **pakihi forest-type** is now gone from the catchment and could be restored based on models from further west.

This orchid (*Orthoceras strictum*,, horned orchid) is a representative of the pakihi flora which is well developed in the Waikoropupu catchment. The low fertililty soil leached by heavy rain supports a distinctive range of species, including silver pine, now extremely rare in the area, as well as a range of primitive ferns and shrubs such as hutu which otherwise grow in the wetter country further west. Protection and restoration of lowland pakihi, including removal of wilding pines, is a priority.

- **Reintroduce mistletoe** (*Alepis*, *Peraxilla*) to valley floor silver and black beech
- 'pitpat' (*Pittosporum patulum*) at Cobb, dall's pittosporum at Cobb; many others along valley floor (tawa, tanekaha, northern rata, black beech) and coastal forest (ngaio, milk tree). Plant list maintained by DOC.

- establish lowland forest on public land at Paynes Ford
- Identify and protect remnant **individual or groups of pre-human trees** (totara, kahikatea, matai, northern rata, pukatea, hinau) along the main valley (possible seed sources, as well as indicating original forest pattern).
- All coastal ecosystems (especially forest and sand dune, but also the landward margins of estuaries) require restoration actions. (Coastcare is active.)
- Tree planting on farms will help maintain the distinctive rural **landscape.** It would be appropriate for the TET to use the Cobb Mitigation fund to revitalise the 'Trees on Farms' initiative.

4.1.7 Plant and animal pest management

- "Flood weeds"- Tradescantia, periwinkle and Crocosmia, inhibit understorey development. Control areas for banana passion-fruit include NE part of catchment and Upper Takaka.
- **Wilding pines** have a serious impact on landscape integrity and can maintain populations on exposed rocks. Elimination is desirable along both east and west slopes above the Takaka Valley and in the Waikoropupu catchment. It would be desirable for forest owners to remove wilding pines after logging, as part of the logging agreement.
- **Weed invasion of limestone areas** prevents natural species from establishing - cotoneaster along Pohara coast, barberry throughout, Italian jasmine, climbing asparagus. Forest and Bird operate a "weed-busters" programme.
- **Willows** along rivers each area needs to be assessed independently because willows have been an important part of river control work and are not universally regarded as 'weeds'.
- **Predators** include possums, stoats, rats and pigs (sometimes hedgehogs are also identified as predators). Possum control using aerially applied 1080 is in widespread use on DOC land but, rightly or wrongly, receives considerable public criticism and alternative methods are also used, particularly hunting by landowners and regularly maintained bait stations. This campaign should continue. Rats and stoats have a major impact of bird reproduction and many groups and landowners are maintaining trap lines. Wild pigs severely impact on ground snails in elevated bush areas, and while hunting is widespread it is not adequate to control pigs and a poisoning programme is needed as well.

4.1.8 Dairying

- The most intensive land use in the valley, involving fertilizer use on the pasture, irrigation, concentrated stock numbers, local stock movement across the farms, effluent disposal from yards and sheds, pesticide and stock management chemicals, pathogens. Sheep farming is less intensive overall but can have a similar range of characteristics and impacts.

Wilding pines establish in open places where the seedlings can receive plenty of light. This happens when farmland is abandoned and natural regeneration of bracken fern, kanuka and manuka takes place. Or pines can grow on slips or rocky places. They spread from mature trees around settlements, shelter belts or woodlots. The pines grow much faster than the natives. In time they will blow over but fire might well encourage their return. Hence for the current generation of people for whom conservation, tourism and recreation is more important than farming unsuitable land, wilding pines interfere with the natural landscape and their removal (preferably by poisoning) is encouraged.

- "sustainable dairying" is a goal, involving nutrient budgeting to reduce nutrient runoff, and waterway protection
- the main concerns are nutrient (nitrogen, phosphorus) and pathogen (*E. coli*, *Giardia*, *Campylobacter*, *Cryptosporidium*, *Salmonella*) runoff to streams and rivers, and ultimately to coastal waters (where there is an impact on commercial harvest of mussels and other shell fish); despoliation of streams through pugging and sediment runoff from stream banks; loss of native habitat (riparian and other vegetation and wetlands) owing to the need to maximise high grade pasture, and water extraction.
- small and intermittently flowing streams are the most vulnerable; maintaining passages for fish migration is important

- solutions are to keep stock out of waterways by fencing, providing stock water facilities and bridged or culverted crossings; maintain dense riparian vegetation of grasses, shrubland, forest or a mix of these to protect the banks and water from erosion and runoff to the degree possible; avoid soil compaction, maintain or enhance native vegetation by fencing, pest management and planting (for instance shelter belts of mixed native species).
- Funding for minor activites comes from a variety of sources including TDC and Fish and Game. The Cobb fund could assist with this funding.

4.1.9 Other issues

- **Coastal planning** to protect rural land, identify places for development (TDC Eastern Golden Bay Study) or ecological restoration
- **Protect unusual soils** (e.g., sedge peat at Craigieburn Ck) **and representative suites of soils** reflecting complex geological patterns, as well as **high quality agricultural soils**, with the natural vegetation cover and soil fauna.
- **Bats** have been reported occasionally in the valley, and, given the many caves, attempts to foster a larger population may be warranted.
- **Information and education.** Land and water uses take place in a commercial, unpredictable and historical context, and, as standards and expectations in society as a whole change, new information and understanding may be necessary to recognise other values (eg., landscape for tourism, indigenous biodiversity) and modify existing practice

5. CONCLUSION

What are the most important ecological issues in the Takaka catchment that the Cobb Mitigation Fund might assist in resolving?

5.1 First, although the amount of money available would limit application, a major requirement is to secure and maintain existing natural biodiversity. Perhaps advocacy material, to encourage landowners to do this through management rather than regulation or land purchase, is good use of limited funds.

5.2 Second, general improvement of the aquatic environment through: riparian planting along waterways (including springs); protection of waterways from stock; improvement of the aquatic habitat, especially for native fish; linking existing natural areas; creating habitat for particular species enhancement; making aquatic areas more available for public use; and replacing weeds or short-term plants with indigenous vegetation of longer term species. A major need is to secure public access to the river through formal negotiation.

5.3 Third, to enhance specific ecosystems and species through a range of actions: especially planting, rescuing and translocation, and weed and pest control, particularly, but not exclusively, in limestone, coastal and pakihi ecosystems.

APPENDICES

APPENDIX I: Extract from Tasman District Biodiversity overview (Geoff Walls and Philip Simpson, TDC, 2004)

1. Golden Bay, Arthur and Wangapeka Ecological District summaries:

GOLDEN BAY ECOLOGICAL DISTRICT

Location and physical description

The Golden Bay ED covers approximately 43000 ha, three quarters of which lies outside the DOC estate. It includes the alluvial valleys of the Takaka and Aorere Rivers, plus older fluvio-glacial terraces alongside these valleys, the lower slopes of adjacent hills, and isolated blocks of older terrain (schist, coal measures, limestone) surrounded by alluvium; the coast from about Collingwood to Wainui Bay; and a small section of Separation Point granite along the Pohara to Tata Beach hills. Rainfall varies from about 1500 to 3000mm (east to west), with summer drought frequent on the alluvial areas, and frosty winters caused by cold air drainage from the surrounding high hills, apart from a warm thermal belt around the lower slopes.

Ecosystem types originally present

The District was originally dominated by podocarp forest, totara dominant on the drier alluvium, sometimes with black beech, and kahikatea swamp forest in wetter areas, associated with pukatea. Northern rata occupied coastal and lower limestone areas. Towards the coast open flax and cabbage tree swamp was common with estuaries and sand spits a feature of the river mouths and coastline. The wetter terraces with podsolized soil carried pakihi shrubland and forest with rimu and silver pine. Red, hard and black beech with rimu occurred over the lower slopes of the drier hills.

Existing ecosystems

Almost the entire district has been cleared of its original vegetation with scattered patches of alluvial forest (totara, black beech, kahikatea), and remnant rata on coastal limestone. On the other hand the original pakihi forest has been burnt but replaced by extensive manuka-dominant shrubland. Few alluvial wetlands remain but there are extensive estuaries. Snaddunes have largely been colonised by marram grass. Kanuka has replaced the beech forest on the drier hills. Farming, logging and mining have contributed to vegetation clearance, and regeneration of bracken fern, kanuka and manuka the dominant processes on abandoned farmland, sometimes with significant patches of young totara. Gorse, barberry, hawthorn, buddleja and Spanish heath are widespread weeds and banana passionfruit is prominent around the coast.

Degree of protection

Small patches of forest on alluvium and limestone rocks are protected in the valleys and on the coast. A large area of pakihi in the Aorere area is included in the Kahurangi National Park. The Washbourne Scenic Reserve includes a representative range of forest types. QEII covenants have become a popular way for landowners to protect bush remnants.

INDIGENOUS ECOSYSTEMS – GOLDEN BAY ECOLOGICAL DISTRICT				
Ecosystem type	Original extent (% of ED)	Proportion of original extent remaining (%)	Proportion of original extent/remaining area protected (%)	
			Original	Remain
Coastal sand dune and flat	10	20	1	5
Estuarine wetland	10	100	0	0
Fertile lowland swamp and pond	20	6	0.5	8
Infertile peat bog/pakihi	5?	50	10	20
Upland tarn	-	-	-	-
Lake	<1	100	50	50
River, stream and riparian ecosystems	2	50	2.5	5
Lowland podocarp forest	30	<1	<1	10
Lowland broadleaved forest	10	<1	<1	10
Lowland mixed forest	10	<1	<1	10
Lowland beech forest	1	<1	<1	10
Upland beech forest	-	-	-	-
Subalpine forest	-	-	-	-
Lowland shrubland	1	50	5	10
Upland/subalpine shrubland	-	-	-	-
Frost flat communities	-	-	-	-
Tussock grassland	-	-	-	-
Alpine herbfield and fellfield	-	-	-	-

Opportunities for further protection include:

- Coastal ecosystems, except estuaries (although the inland margin of estuaries usually grade into farmland, and are often weedy)
- All swamps, ponds, limestone sinkholes and riparian zones along rivers are high priorities for conservation and restoration.
- All forest remnants are priorities for conservation and restoration including areas of secondary totara, kanuka, kowhai and kahikatea.
- Coastal forests on limestone, granite and Tertiary rocks are priorities, including rata and beech.

ARTHUR ECOLOGICAL DISTRICT

Location and physical description

This is a very elongated district of mountains and hills that rise to 1875m and include the Arthur Range, Hope Range and Mt Owen. It is drained and flanked by large rivers. The geology is very complex, including Palaeozoic marble, graptolytic shale, granite, ultramafic serpentine, schist and meta-basalt. Soils are mostly leached or podzolised due to the fairly high rainfall. The climate is characterised by warm summers and cold winters.

Ecosystem types originally present

Formerly the ecological district would have been almost entirely covered in forest up to the bushline (about 1200m). There were tall podocarp forests in the lowland valleys, and pockets of broadleaved forests in sheltered lowland sites. Otherwise beech forests were most common, with black beech dominant in drier lowland sites, red beech dominant on mid slopes and silver beech (with varying amounts of mountain beech) dominant on upper slopes. Towards the bushline were low forests featuring pahautea (mountain cedar), southern rata and neinei (*Dracophyllum traversii*). Above the bushline were fringes of subalpine shrublands, above which were tussock grasslands, alpine herbfields and fellfields rich with mountain herbs. Frost flats, found in some inland valleys, would have contained infertile peat bogs and low-stature shrublands. Wetland ecosystems would have included fertile lowland swamps with kahikatea, harakeke (lowland flax), cabbage tree, tussock sedge (*Carex secta*) and raupo. Rivers and streams, including riparian ecosystems (trees, shrubs, flaxes, toetoe, etc.) and some braided river beds, would have made up a significant portion of the district. The tabulation gives estimates of the extent of these original ecosystems.

Existing ecosystems

Above the lowlands (above 600m) most of the former extent of the original ecosystems is still there. The condition of these ecosystems is of course depleted both in fauna and flora. In the lowlands (below 600m) about two-thirds of the original forest extent has gone. What remains is mostly in relatively small fragments, and much of the original forest cover on the hill country has been replaced by shrubland, some of which is regenerating in native forest plants. Most of the lowland wetlands have been lost. The tabulation gives estimates of the proportions of the original ecosystems that remain.

Degree of protection

Much of the land is protected within two national parks (Abel Tasman and Kahurangi). These however are almost entirely in the uplands (above 600m). Much smaller amounts are protected in reserves and covenants, largely in the lowlands. The tabulation gives estimates of how much of the original and remaining ecosystems have formal protection.

INDIGENOUS ECOSYSTEMS - ARTHUR ECOLOGICAL DISTRICT				
Ecosystem type	Original extent (% of ED)	Proportion of original extent remaining (%)	Proportion of original extent/remaining area protected (%)	
			Original	Remain
Coastal sand dune and flat	-	-	-	-
Estuarine wetland	-	-	-	-
Fertile lowland swamp and pond	<1	10	2	20
Infertile peat bog	<1	10	5	50
Upland tarn	<1	100	100	100
Lake	-	-	-	-
River, stream and riparian ecosystems	3	70	50	70
Lowland podocarp forest	8	10	5	50
Lowland broadleaved forest	5	20	5	25
Lowland mixed forest	12	40	10	25
Lowland beech forest	15	40	10	25
Upland beech forest	39	85	75	90
Subalpine forest	5	100	100	100
Lowland shrubland	<1	5	2	40
Upland/subalpine shrubland	3	100	100	100
Frost flat communities	<1	10	5	50
Tussock grassland	4	100	100	100
Alpine herbfield and fellfield	4	100	100	100

Opportunities for further protection include:

- Montane beech forest and mixed forest with varying amounts of broadleaved trees and podocarps (including pahautea, Hall's totara, toatoa, southern rata and pokaka) on slopes and gullies adjacent to Kahurangi and Abel Tasman National Parks. There are quite a few such areas, some featuring marble landscapes with jagged outcrops and sinkholes.
- Kanuka forest and mixed shrublands on slopes and gullies adjacent to Kahurangi and Abel Tasman National Parks.
- Lowland beech forest with scattered podocarps on valley hillslopes.
- Primary and secondary beech-podocarp forest remnants on hillslopes, valley flats and in riparian zones; mostly small.
- Kahikatea-totara forest with scattered matai and narrow-leaved lacebark on alluvial flat. A rare community now.
- Kanuka and kowhai low forest and shrubland on alluvial terrace. A rare community.
- Manuka shrubland on valley floors.
- Small *Carex*-raupo swamps on valley floors.
- Shrublands containing the rare shrub daisy *Olearia polita*, in localised valley basins.
- Frost flat communities in valleys in the SE of the district.
- Wangapeka River braided river-bed habitat.

WANGAPEKA ECOLOGICAL DISTRICT

Location and physical description

The Wangapeka ED is a very large area of mountains with some foothills and the upper parts of lowland valleys. About half lies within the Tasman District. This includes the northern half of the district (the Aorere and Takaka river systems) plus, in the SE the headwaters of the Wangapeka River, a tributary of the Motueka River. The ED includes the core of the Tasman Mountains with several ranges (Peel, Lockett, Snowden, Devil, Douglas and others) extending above bushline with many peaks above 1500m. Glaciated landscapes with lakes and tarns feature in these higher areas and there are several lakes caused by landslides.

A largely east-west pattern of rock types is represented, Cambrian sandstone and conglomerate in the east (with trilobites), through Ordovician and Silurian sandstone forming much of the mountainous core, to Carboniferous and Cretaceous granite in the west and north respectively. The climate is cold and snowy in winter, and there is generally high rainfall particularly in the north around Parapara Peak (1249m) where over 5000mm falls, reducing to about half this in the upper Takaka Valley.
Geological, topographic and climatic diversity contribute to a very high level of species diversity. Over 90% of the 116 thousand ha within the Tasman District lies within the Kahurangi National Park.

Ecosystem types originally present

Podocarp forest (kahikatea, totara, yellow silver pine, depending on the drainage and fertility) was present on the alluvial and outwash terraces, leading to lowland beech and mixed podocarp beech on the lower slopes. Above 600m silver beech forest was ubiquitous to tree line at about 1200-1300m. Above tree-line were subalpine shrublands, tussock grasslands and herbfields with numerous wetlands and aquatic areas, and peaks of barren rock and scree.

Existing ecosystems

Most of the original ecosystems remain unchanged. However, the lowland slopes and terraces have mostly been cleared for farming, leaving either remnant patches of forest (e.g., totara forest), remnant bush gullies along the upper edge of farms, or secondary shrubland and forest along the lower to mid-slopes. There are occasional areas of forest situated within the National Park, but most areas are around its edge.

Degree of protection

Only about 7% of the district lies outside protected areas. These are virtually all confined to the foothills along the western edge of the Takaka River valley and its tributaries: Waitui, from Kill Devil to Hamama, parts of the Waingaro and Anatoki catchments and at the head of Tukurua Creek.

INDIGENOUS ECOSYSTEMS – WANGAPEKA ECOLOGICAL DISTRICT				
Ecosystem type	Original extent (% of ED)	Proportion of original extent remaining (%)	Proportion of original extent/remaining area protected (%)	
			Original	Remain
Coastal sand dune and flat	-	-	-	-
Estuarine wetland	-	-	-	-
Fertile lowland swamp and pond	<1	10	0	0
Infertile peat bog	-	-	-	-
Upland tarn	<1	100	100	100
Lake	<1	100	100	100
River, stream and riparian ecosystems	1	99	98	99
Lowland podocarp forest	2	5	0	0
Lowland broadleaved forest	-	-	-	-
Lowland mixed forest	5	40	32	80
Lowland beech forest	5	80	65	80
Upland beech forest	60	90	90	100
Subalpine forest	5	100	100	100
Lowland shrubland	-	-	-	-
Upland/subalpine shrubland	5	100	100	100
Frost flat communities	-	-	-	-
Tussock grassland	5	100	100	100
Alpine herbfield and fellfield	5	100	100	100

Opportunities for further protection include:

- All lowland forest ecosystems, especially pockets of podocarp forest and mixed podocarp/broadleaved/lowland beech forest.
- Small areas of wetland in upper alluvial valleys and terraces
- Many of the foothill areas are regenerating shrublands of bracken, kanuka and manuka and include beech, podocarp and broadleaved components. These offer opportunity for protection in the long term.

2. CONCLUSIONS AND RECOMMENDATIONS

1. The Tasman District is a very special part of New Zealand in terms of indigenous biodiversity. It is unbelievably rich in natural ecosystems, species, geology and microclimate. These attributes are true assets and deserve celebration. There are several fundamental reasons for the rich biodiversity: the central location in New Zealand (allowing for species that are common, or reach their southern or northern limit), the diversity of rock types, soils and climates which together encourage local endemics (as on limestone and dolomite), the altitudinal range from coastal to alpine, enabling a complete sequence of life forms, a benign climatic history that suggests survival in refuges during the ice age, and relatively limited human migration into the rugged hinterland.

2. Much of the indigenous biodiversity of the district is intact in extent, if not pristine. The lowlands have suffered the greatest losses, in the human quest for timber, minerals, pasture, fertile ground and industrial and settlement sites. There is continued pressure on remaining indigenous ecosystems in the lowlands. The biggest challenge for biodiversity conservation is therefore protection of remaining lowland natural areas.

3. This overview uses the Ecological district framework as the basis for organising information about natural areas and their protection. The boundaries were initially drawn NZMS 242 maps at a scale of 1: 500,000. For local planning purposes these lines need to be drawn at a much finer scale and often the transcription from one scale to another introduces errors in the positions of boundaries. Sometimes the original authors of the districts were uncertain about all aspects of a district and subsequent knowledge, for instance by Department of Conservation staff, suggests that changes are needed in order to satisfactorily represent the true nature of a district. Such a review could be part of any follow-up to this report.

4. Table 2 records the ecosystems with 40% or less protected, per ecological district.

5. Priority assessment for protection of ED's in Tasman District. This assessment is derived by summing the proportions of remaining unprotected natural ecosystems represented in each Ecological District and taking the district-wide average. The figure does not reflect the situation regarding any particular ecosystem, nor the relative importance of each ecosystem in a district in terms of its original extent. It merely points the finger at ecological districts with opportunites for natural area protection. In the case of Motueka, although the opportunities are relatively low the actual area of natural ecosystems is remarkably limited and most sites are in fact protected. However, in this case the analysis reveals a high opportunity for ecological restoration.

The authors are hesitant to rank districts because of the implication that low ranked areas do not require attention. Furthermore, in many districts some parts are well protected while others are not. Wakamarama and West Whanganui for instance have large areas of national park but significant zones of lowland and coastal land where

there is little protected areas. Totaranui Ecological District ranks low because of the Abel Tasman National Park. However, the southern part of the district, where there is intensive settlement, multiple land uses and high recreational activity has a great need for protected areas to ensure that landscape quality matches the human values.

GROUP I	
1. Golden Bay	87
2. Moutere	58
3. Wakamarama	50
GROUP II	
4. West Whanganui	39
5. Arthur	37
6. Bryant	33
7. Motueka	33
GROUP III	
8. Rotorua	30
9. Heaphy	28
10. Totaranui	27
11. Ella	22
12. Wangapeka	20
13. Matiri	18
GROUP IV	
14. Reefton	8
GROUP V	
15 Travers	0
16. Red Hills	0
17. Lewis	0
18. Pelorus	0
19. Fishtail	0

TABLE 2: REMAINING ECOSYSTEMS WITH 40% OR LESS PROTECTED IN EACH E.D.

Ecosystem	Arthur	Bryant	Ella	G. Bay	Heaphy	Matiri	Motueka	Moutere	Reefton	Rotoroa	Totaranu	Wakama	Wangape	West Wh
Coastal sand dune and flat				*								*		
Estuarine wetland				*			*	*				*		
Fertile lowland swamp and pond	*	*		*	*		*	*		*		*	*	*
Infertile peat bog				*						*				
Upland tarn														
Lake														
River, stream and riparian ecosystem		*		*			*	*		*				
Lowland podocarp forest				*	*						*		*	
Lowland broadleaved forest	*	*		*								*		*
Lowland mixed forest	*	*		*	*							*		
Lowland beech forest	*			*				*						
Upland beech forest														
Subalpine forest														
Lowland shrubland	*			*				*						*
Upland/subalpine shrubland														
Frost flat communities			*							*				
Tussock grassland														
Alpine herbfield and fellfield														

6. Priority ecosystems.

TABLE 4: PROPORTION EACH ECOSYSTEM UNPROTECTED THROUGHOUT TASMAN DISTRICT
(based on text Tables)

Coastal sand dune and flat	49%
Estuarine wetland	63
Fertile lowland swamp and pond	61
Infertile peat bog	32
Upland tarn	0
Lake	11
River, stream and riparian ecosystem	34
Lowland podocarp forest	56
Lowland broadleaved forest	62
Lowland mixed forest	64
Lowland beech forest	33
Upland beech forest	6
Subalpine forest	0
Lowland shrubland	55
Upland/subalpine shrubland	0.9
Frost flat communities	33
Tussock grassland	0
Alpine herbfield and fellfield	0

The priority ecosystems are coastal dunes, flats and estuarine margins; lowland swamps; riparian ecosystems, especially in lowland areas; lowland forests of all kinds; lowland shrublands and frost flat communities.

7. A high proportion of the land containing indigenous ecosystems in Tasman District is formally protected for conservation (Appendix 1). There are three national parks, extensive other conservation lands and a network of small reserves and private land conservation covenants. However, this is no reason for complacency and the remaining opportunities for protection of natural areas on private land are ecologically

worthwhile. Efforts to protect them are readily justifiable on biodiversity conservation grounds. Most are in the lowlands and are therefore especially valuable. Conservation covenants and other formal protection agreements are successfully used throughout New Zealand, including Tasman District, and are recommended as tools. However, formal protection is not essential and many landowners protect their natural areas in a voluntary way. For this reason education about natural areas on a property is the most important single purpose of any natural area survey. Protection does not necessarily mean reservation.

8. There are well-established working models for how to work with landowners in order to assess the significance of natural areas on their land and to initiate ways to protect them. This report merely indicates which ecological districts and which ecosystems are priorities but it is recommended that this report is followed by a strategy to seek landowner support for an SNA project, identify significant natural areas, and implement ways to assist landowners to protect the priority areas.

9. All of the remaining natural areas in the district, whether formally protected or not, have suffered ecological degradation from exotic herbivores, predators and weeds. The degradation continues, and year-by-year losses occur, such as the disappearance of kiwi, kaka and mistletoes. Only in places where intensive restoration is taking place, such as at the Lake Rotoiti Mainland Island and Faulkners Bush in Wakefield, or the land snail covenant at Patarau, is the process being reversed. Techniques for ecological restoration of indigenous biodiversity are now well established in New Zealand. It is recommended that ecosystem restoration is built into the biodiversity conservation strategy of Tasman District Council. This report provides an initial basis for such an ecological restoration strategy.

APPENDIX II: Threatened plants and animals in the Golden Bay Ecological District (from Golden Bay ecological district PNA Report (Department of Conservation, 1999, unpublished)

(With reference to Northwest Nelson Ecological Region and Nelson/Marlborough Conservancy.)

SPECIES	COMMON NAME	STATUS
Phyllocladus trichomanoides	tanekaha	Rare in district, rare in region, uncommon in Nelson/Marlborough.
Libocedrus plumosa	kawaka	Very rare in district, rare in region, region only South Island locality.
Blechnum fraseri		Locally abundant in District, uncommon in Region. Not present in rest of Nelson/Marlborough.
Teucridium parvifolium		Rare in district, nowhere else in Region, local in Nelson/ Marlborough, third priority conservation status (Molloy and Davis, 1994).
Scutellaria novae-zelandiae	skullcap	Rare in District, nowhere else in Region, endemic to Nelson/ Marlborough, second priority conservation status (Molloy and Davis, 1994).
Brachyglottis sciadophylla		Rare in District, rare elsewhere in Region, rare in Nelson/ Marlborough.
Coprosma rubra		Uncommon in District, rare in Region, rare in Nelson/Marlborough.
Microlaena polynoda		Rare in District, rare in Region, local in Nelson/Marlborough.
Melicope ternata	wharangi	Rare in District, rare in Region, uncommon in Nelson/Marlborough.
Streblus banksii	towai large-leaved milk tree	Rare in District, rare in Region, mostly confined to islands in Nelson/Marlborough.
Streblus banksii	rengarenga	Confined to coastal cliffs in District, rare in Region, uncommon in Nelson/Marlborough.
Myosotis spathulata		Very rare in District, rare in Region, rare in Nelson/Marlborough.
Celmisia "pupu"		Locally abundant in District, endemic to Region.

Pseudopanax ferox	fierce lancewood	Rare in District, not elsewhere in Region, rare and local in Nelson/ Marlborough.
Sticherus flabellatus		Very rare in District, very rare in Region, Region only South Island locality.
Pseudopanax macintyrei		Uncommon in District, local in Region, strict calcicole.
Geniostoma rupestre	Hangehange	Uncommon in District, uncommon in Region, restricted to Nelson/ Marlborough in South Island)

7. Locally Extinct Species

These vascular plants were almost certain to have been present in the Golden Bay Ecological District at the time of European settlement, but because of a lack of early records, cannot be regarded with absolute certainty. Some of these species still survive just outside the ecological district and others are included to reflect affinities with the Nelson/Marlborough area.

SPECIES	COMMON NAME
Alepis flavida	yellow mistletoe
Atriplex billardierei	
Dactylanthus taylorii	pua o te reinga, woodrose
Desmoschoenus spiralis	pingao (re-introduced)
Dysoxylum spectabile	kohekohe
Entelea arborescens	whau
Halocarpus biformis	pink pine
Knightia excelsa	rewarewa
Monoao colensoii	silver pine
Lepidium banksii	coastal peppercress
Lepidium oleraceum	Cook's scurvy grass
Lepidothamnus intermedius	yellow pine
Mazus novaezeelandiae	dwarf false musk

Melicytus crassifolius	
Myriophyllum robustum	stout milfoil
Nestegis lanceolata	white maire
Nestegis montana	narrow-leaved maire
Peraxilla colensoi	red mistletoe
Peraxilla tetrapetala	upland mistletoe
Syzygium maire	swamp maire
Tupeia antarctica	mistletoe

8. Plants Currently at Risk

SPECIES	COMMON NAME	COMMENTS	THREATS
Brachyglottis sciadophylla		Fertile lowland sites. Three sites only.	Habitat loss (farming practices). Palatable (stock).
Coprosma rubra		Fertile lowland sites.	Habitat loss (farming practices). Palatable (cattle, possums).
Eleocharis sphacelata	kuta	Wetland dependant. Few sites.	Habitat loss (drainage). Palatable (cattle).
Euphorbia glauca	shore spurge	Restricted to coast. Only one known site.	Habitat disturbance (burning, road building, quarrying).
Honeria angustifolia	narrow-leaved lacebark	Floodplain, fertile sites.	Habitat loss (flood control and farming practices). Palatable (cattle).
Melicytus micranthus	swamp mahoe	Confined to moise alluvium. Two sites only.	Habitat loss (farming practices). Palatable (stock).
Melicytus obovatus		Calcicole, cliff dwelling.	Habitat loss (farming, quarrying, road building). Palatable (possums, goats).
Melicope ternata	wharangi	Coastal sites - frost-free. Few plants present.	Habitat loss (farming, quarrying, road building).

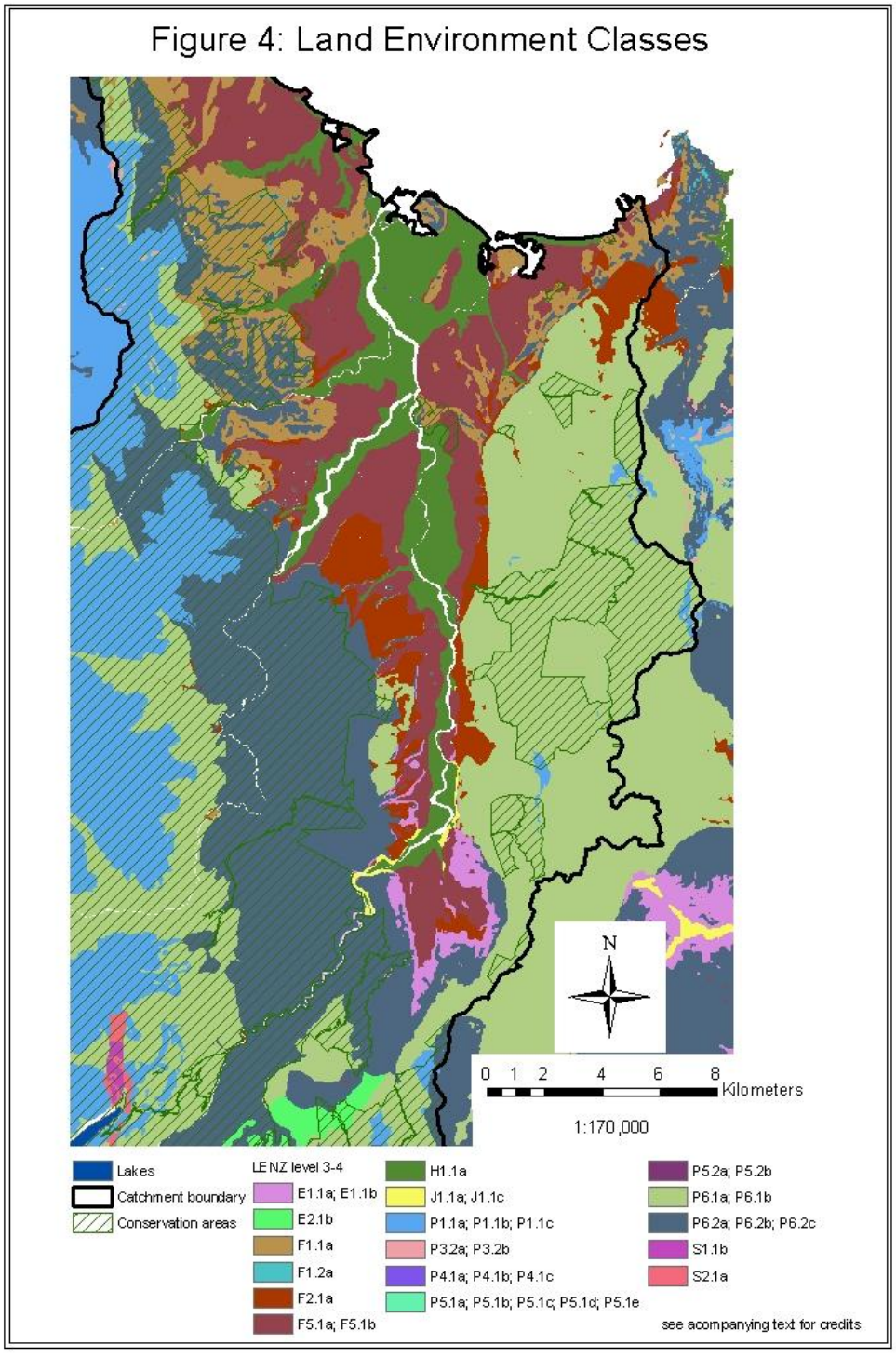
Nothofagus solandri var. *solandri*	black beech	Often riparian. Short-lived tree. Lack of regeneration.	Habitat loss (farming practices). Riparian vegetation. Management practices.
Plagianthus regius	lowland ribbonwood	Fertility dependent. Often riparian.	Habitat loss (farming practices). Riparian vegetation. Management practices.
Pseudopanax ferox	fierce lancewood	Few sites. Few adult plants. Now largely confined to limestone bluffs.	Habitat loss (farming practices). Palatable (possums).
Schoenoplectus tabernaemontani	lake clubrush	Dependant on fertile wetlands. One site only.	Habitat loss - drainage. Palatable (cattle).
Scutellaria novae-zelandiae	skullcap	Specialised niche - fertile, weed free sites. Seven known sites. Actively managed.	Habitat loss (farming practices) Weed competition. Palatable (cattle, possums).
Streblus banksii	Large-leaved milk tree, towai	Confined to coast - frost free fertile sites. Few plants	Habitat loss (farming, quarrying, roading practices). Palatable (cattle, goats, possums).
Stichorus flabellatus		Frost tender, requires open sites. Few plants at two sites.	Habitat loss (farming practices).
Teucridium parvifolium		Fertile sites. Few plants at four sites.	Habitat loss (farming practices). Palatable (stock, goats).

9. Vertebrates Currently at Risk

SPECIES	COMMON NAME	COMMENTS	THREATS
Eudyptula minor	little blue penguin	Ground nesting. Poor breeding success. At mercy of changes to marine environment.	Disturbance at breeding sites - dogs, vehicles, stoats, human activity. Fishing practices.
Botaurus stellaris	Australasian bittern	Raupo wetlands dwindling. Specialised niche. Ground nesting	Habitat loss - drainage, farming practices. Predators - stoats, cats.
	banded rail	Wetland dependant. Ground nesting.	Habitat loss - farm practices, development. Distrubance - dogs, people, vehicles. Predators - stoats, cats.

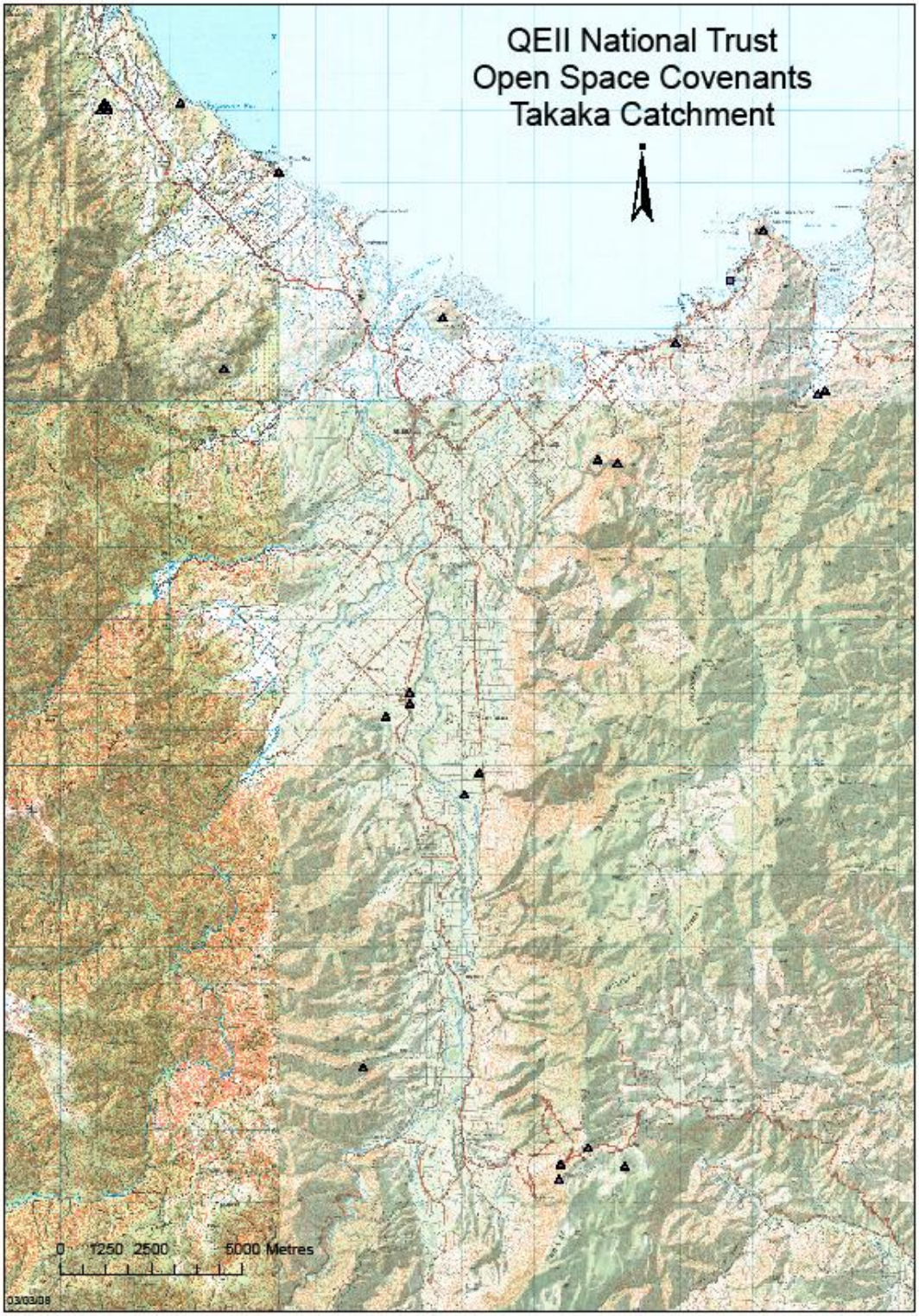
	[redacted]	Ground nesting. Specialised niche - low reeds and shrubland habitat.	Habitat loss - farm practices, development. Predators - stoats, cats.
Falcotinnunculidae	New Zealand falcon	Ground nesting. Nests outside District. Second priority conservation status (Molloy and Davis, 1994).	Habitat loss - farm practices. Disturbance and predators of nests - dogs, stoats, humans.
Strigidae novaezeelandiae	morepork owls	Forest dwelling species.	Habitat loss - farm practices. Predation of nests - stoats, cats, rats. Competition for food and nest sites with introduced little owl.
Egretta novaehollandiae	reef herons	Ground nesting. Sensitive to disturbance - easily frightened. Confined to more remote coasts. Third priority conservation status (Molloy and Davis, 1994).	Lack of secluded, safe nest sites. Disturbance - humans, dogs, boats. Predation of nests - stoats, rats.
Anthus novaeseelandiae	New Zealand scaup	Dependant on wetlands - open water. Ground nesting.	Habitat loss - drainage, farming practices. Disturbance and predation - human activity, shooting, stoats.
Porzana pusilla affinis	marsh crake	Specialised niche - wetlands. Ground nesting. Secretive.	Habitat loss - drainage, farm practices. Disturbance - dogs. Predation - stoats, cats.
	blue duck	Specialised niche. Ground nesting. Can no longer breed in District.	Loss of safe nest sites. Predation of nests - rats, stoats, dogs. Competition for food with trout.
	western weka	Resourceful generalists - have been considered nuisance. Rapid recent decline in numbers. Ground nesting, flightless.	Habitat loss - farming practices. Nest disturbance - rats, dogs, cats, stoats. Disease?
	Little pied shag	Breeds outside District.	Loss of safe nest sites - deforestation. Predators of nests - stoats, rats, possums. Changes in habitat - farming practices.
	great cormorant	Breeds outside District.	Loss of safe nest sites - predators, deforestation. Changes in habitat - farming practices.
Hemiphaga novaeseelandiae	kereru New Zealand pigeon	Breeds with difficulty in District. Second priority conservation status (Molloy and Davis, 1994).	Habitat loss - deforestation, farming practices. Nest predators - rats, cats, possums.
Nestor meridionalis	endemic kaka	Ground nesting. Breeds with difficulty in District.	Nest disturbance - dogs, people, vehicles.

APPENDIX III: LENZ land units in the Takaka Catchment



LENZ combines features of climate, landform and soil characteristics that have been shown to correlate with forest type, into a classification of different environments that might be expected to support distinctly different ecosystems. The environment types classified to LENZ level 3 in Takaka are shown in this figure. Level 4 classes were too many to effectively map on this scale. The 17 level 3 environments can be further separated into 33 level 4 environments. The specific codes are not so important here as the representation of each environment class within protected areas. Several of the lowland classes are under-represented in protected areas and may be important for restoration. Source: http://www.landcareresearch.co.nz/services/informatics/LENZ/about.asp

APPENDIX IV: Formally and informally protected Natural Areas in the Takaka Catchment



APPENDIX V: Native plants with fibrous roots for flood control

Native plants with fibrous roots for flood control

The following species were selected from "TAKAKA PLAINS AND VALLEYS NATIVE PLANT RESTORATION LIST", prepared by Shannel Courtney for Tasman District Council, June 2004. List 1 is based on trials conducted by Chris Phillips and Mike Marden for the Integrated Catchment Management programme for the Motueka River (http://icm.landcareresearch.co.nz/research/land/Trial1results.asp). **List 2 has other likely candidates. In general New Zealand plants have shallow root systems.**

LIST 1
Cordyline australis
Plagianthus regius
Phormium tenax
Hoheria angustifolia
Hoheria ovata
Pittosporum tenuifolium
Pittosporum eugenioides
Coriaria arborea

LIST 2

Aristotelia serrata
Coprosma areolata
Coprosma robusta
Coprosma rotundifolia
Griselinia littoralis
Griselinia lucida
Melicytus ramiflorus
Neomyrtus pedunculata
Schefflera digitata
Hebe salicifolia (inland only)
Hebe stricta var. atkinsonii
Fuchsia perscandens
Metrosideros robusta
Metrosideros diffusa
Metrosideros perforata
Rhopalostylis sapida
Ripogonum scandens
Acaena anserinifolia
Chionochloa conspicua
Cortaderia richardii
Dicksonia fibrosa
Dicksonia squarrosa
Microsorum pustulatum