**DRAFT**

# A REVIEW OF ECOLOGICAL VALUES AND FUTURE MANAGEMENT OF WAITUTU FOREST, SOUTHLAND



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Prepared for:

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**Waitutu Forest is "probably the most important forest in the world"**

*Eminent botanist, Dr. David Bellamy*

Photographs from Greene, Dilks and Wright (2007)

# EXECUTIVE SUMMARY

Waitutu Forest is located in the southwest corner of the South Island, and is part of Te Waahi Pounamu - South West New Zealand World Heritage Area. Its cultural and ecological importance has long been recognised through consistent use by the takata whenua over a long period and concerted campaigns by conservation groups to bring about its eventual inclusion in Fiordland National Park in 1999. Waitutu is renowned for its landforms and waterways, including coastal landforms, marine terraces, alluvial terraces, recent glacial surfaces, and hill country and montane vegetation and habitats. The sequence of raised marine terraces characterise Waitutu and is nationally important.

Waitutu's extensive podocarp-dominant, mixed beech-podocarp, beech, and hardwood forests are nationally important because they are part of the largest tract of intact unmodified lowland native forest in New Zealand and form a vegetation sequence from the coast to the alpine zone. These forests also contain the greatest abundance and diversity of podocarps within Fiordland. Naturally rare habitats include coastal turf communities, gravel beaches, and dunes. At least 29 threatened species of plants, from coastal, forest, and bog habitats are present. Waiutu is nationally important for its large and diverse population of threatened mistletoe species. The fauna of Waitutu is remarkable for its large populations of kaka and yellow-crowned parakeet, widespread population of mohua, small but important populations of pateke and possibly orange-fronted parakeet, population of patchily-distributed South Island robin, and high population densities of common forest bird species. Waitutu provides habitat for over 25 threatened bird species and several threatened terrestrial and freshwater invertebrates. Four threatened fish species are present, including healthy populations of longfin eel.

Waitutu is under threat from the impacts of introduced pest animals. Possums, deer, stoats, and rats have been implicated in the decline of several species. For example, kaka are being predated on the nest, mohua are likely to be suffering from stoat predation, and mistletoes are being browsed and killed by possums. Most populations of forest birds appear to be in decline. Nevertheless, Waitutu presents a remarkable opportunity to restore viable ecosystems and species. Waitutu has several advantages over other areas in terms of pest control, including its remoteness, the presence of physical barriers to animal movement, the early stage of possum invasion, a strong history of previous control work and research, many interested stakeholders, and strong community backing.

Waitutu is unique and irreplaceable (there are no equivalent places nationally), contains a suite of iconic threatened species, makes a significant contribution to regional and national biodiversity, is vulnerable to introduced pest animals, contains regionally and nationally representative vegetation types, and represents an ecosystem type (lowland coastal forest) that is nationally under-represented in areas that receive protection from animal pests. On these grounds, Waitutu should receive ongoing intensive pest control.

We recommend large-scale pest control is undertaken at Waitutu to protect the forest canopy, possum-palatable plants, and South Island kaka. This would involve possum control over 48,000 ha over five years and subsequent control of reinvasion fronts, in combination with stoat control over 9,435 ha. Waitutu is currently the site of a large scale research project examining the effects of ungulate and rodent pests on forest ecosystem processes. Integrated control of all pest animals at Waitutu would maximise the potential for biodiversity conservation, and should be considered at the conclusion of this research.

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APPENDICES



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# 1. INTRODUCTION

'Waitutu' is defined as that land contained within the former Waitutu State Forest and including SILNA[1] lands. That is, the area bounded approximately by the mouth of Big River and eastern shores of Lake Hakapoua in the west, the southern and eastern shores of Lake Poteriteri, the coastline to the south, and from near the southern tip of Lake Hauroko to the mouth of Track Burn in the east.

Waitutu Forest is located in the southwest corner of Fiordland National Park, and is part of Te Waahi Pounamu - South West New Zealand World Heritage Area (Figure 1). Waitutu Forest is part of the largest tract of unmodified lowland native forest remaining in New Zealand, stretching from the coast across an altitudinal sequence of marine terraces and into the alpine environment (Department of Conservation 2000). The series of ancient uplifted marine terraces represent a unique and internationally recognised geological and ecological sequence, running from shoreline to alpine summit.

Vegetation in Waitutu Forest includes beech-dominant, podocarp-dominant, hardwood-dominant, and mixed forest, and also areas of stunted bog forest and shrub lands. The vegetation of Waitutu Forest is also more diverse than forests in higher rainfall areas of Fiordland. Coastal habitats and freshwater systems within Waitutu Forest are of national importance.

The habitats in Waitutu supports a range of wildlife, including more than 30 threatened species of birds, fish, lizards, and terrestrial and freshwater invertebrates. The South Island kaka population is one of the largest remaining on mainland New Zealand (Department of Conservation 2000), but is in rapid decline. Kereru, blue duck, kea, mohua, yellow-crowned kakariki and long-tailed bats are present. At least 29 threatened plant species occur in forest, bog, and coastal habitats.

Possums have only recently (1980s) colonised Waitutu Forest and consequently its ecological values remain high. If significant possum control is not initiated, it is predicted that there will be dramatic negative effects on these values. The effects of this are not just local, but national in scope: lowland coastal forest habitat is seriously under-represented in the areas that receive protection from animal pests.

# 2. POLICY

## 2.1 Fiordland National Park Management Plan

The Fiordland National Park Management Plan (Department of Conservation 2007a) identifies many ecological values of Waitutu, including the marine terraces, unmilled lowland tracts of forest, vegetation, and threatened flora and fauna. Section 4.5 (Introduced animals) of the plan is particularly relevant to this project. Objective 1 for pest animal control is:

[1] Land reserved under the South Island Landless Natives Act 1906.

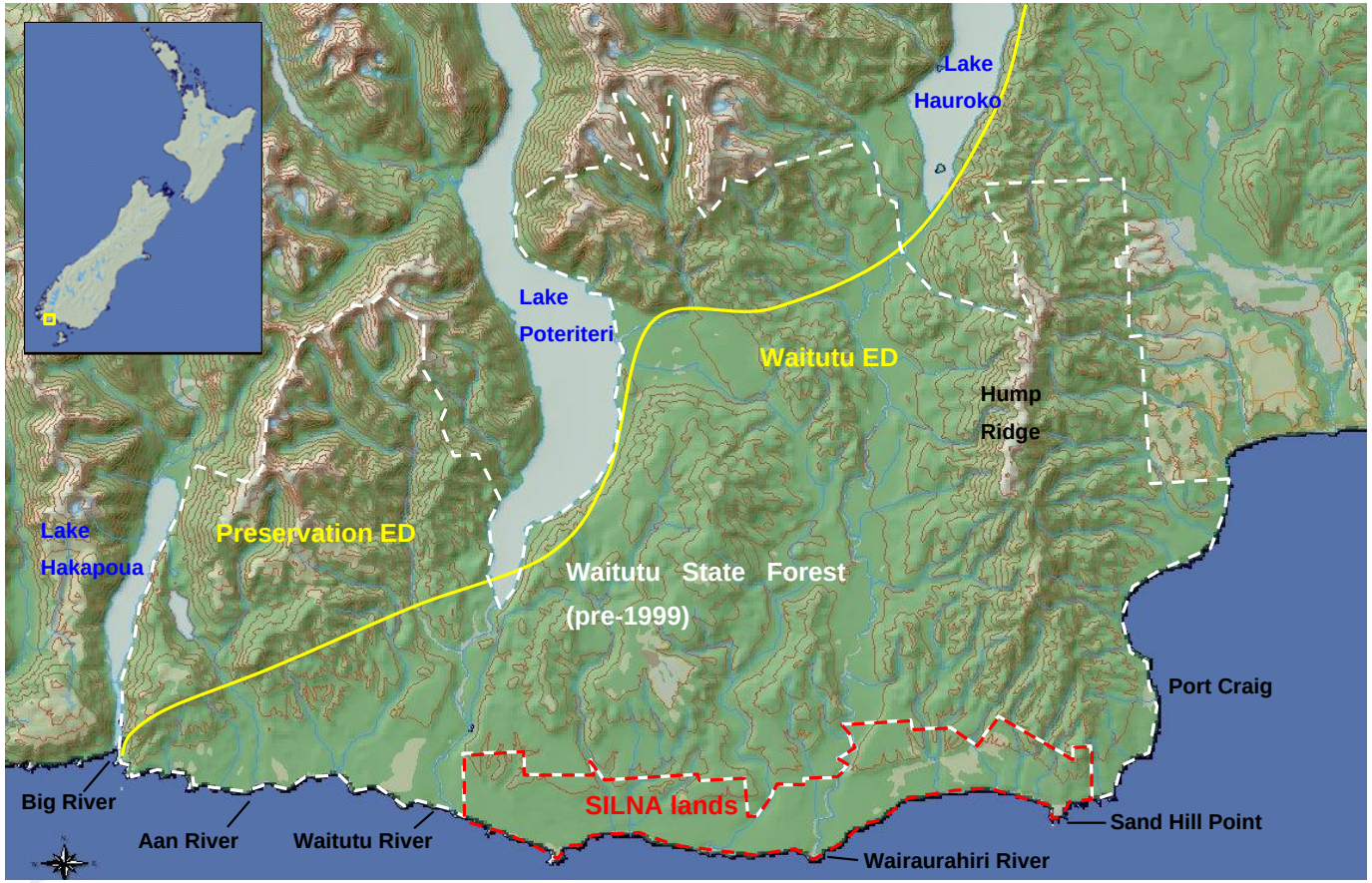


Figure 1: Location of Waitutu within New Zealand (inset) and approximate boundaries of Ecological Districts (EDs; yellow), Waitutu State Forest prior to incorporation into Fiordland National Park (white dash), and SILNA lands (red dash).

"To preserve those areas of high natural biodiversity values in Fiordland National Park most at risk from introduced animals"

while the first implementation point states that:

*"…High ranking areas* [for pest animal control] *are likely to be those with unique ecosystems, threatened species, areas of high damage (or high susceptibility to damage), and areas not yet colonised by pest animals"*
Comment: both of these statements apply to Waitutu.

Implementation plans for specific animal pests include:

*"Priorities for specific deer control measures include…Protecting endemic species and/or ecosystems within Fiordland National Park. Such places will need to be either large or have defendable boundaries. An assessment is required to determine priority places"*
Comment: Waitutu may reach the criteria for priority control.

*"Aim for the eradication of goats within Fiordland National Park…"*

*"…priorities for possum control in Fiordland National Park are as follows:*
*a) Continue the current emphasis on possum control in … sites in Waitutu Forest so as to protect the high natural values within those places"*
Comment: Waitutu specified.

*"Control and, where practicable, eradicate mustelids"*
Comment: Waitutu is not identified as a priority place for future stoat control.

*"…Future places where* [rodent] *control programmes may be considered include the Eglinton, Clinton, Arthur and Cleddau Valleys for the purpose of protecting bat and mohua populations"*
Comment: although Waitutu is not specified here, it has bat and mohua populations.

*"Control the spread of pigs within Fiordland National Park and restrict pigs to their current range. If pigs are confirmed outside of their current range, eradication will be attempted. Control operations will be focussed in the following places:*
*a) Southern coast of Fiordland National Park; and*
*b) The less steep areas in the south eastern part of Fiordland National Park"*
Comment: Waitutu is located within the specified areas.

## 2.2 Southland/West Otago Conservation Management Strategy

The Conservation Management Strategy for Mainland Southland/West Otago 1998 – 2008 (Department of Conservation 2000) identifies the Waitutu - Rowallan landscape unit as containing ecologically significant areas such as extensive lowland forest, marine terraces, freshwater systems, and coastal dunes. These are recognised as providing habitats for many threatened plant and animal species. Pest animals, particularly possums and red deer, are identified as a problem in Waitutu, with westward colonisation by possums still occurring. Two ecological objectives in the plan (p. 192) are applicable to this project:

3. *To survey the extent of possum colonisation in Waitutu and control populations with the intention of halting colonisation further westward (as national Priorities allow), and reducing populations to as low a level as possible.*

4. *To survey forest health. Where detrimental effects are occurring decide on appropriate action to remedy the problem and implement.*

## 2.3 DOC Statement of Intent 2007-2010

The DOC Statement of Intent 2007-2010 (Department of Conservation 2007b) contains five Intermediate Outcomes required to achieve the Department's high level goal of protecting and restoring New Zealand's natural, historic and cultural heritage:

*2.1 The damage from harmful organisms in New Zealand is reduced*
*2.2 The natural character of managed places is maintained or improved*
*2.3 Managed threatened species have a lower risk of extinction*
*2.4 A representative range of New Zealand's natural heritage is protected*
*2.5 A representative range of historic and cultural heritage is protected, restored and interpreted*

All of these outcomes are applicable to Waitutu. However, several outcomes are not being achieved: harmful organisms (e.g. possums) are increasing their impact on Waitutu's values (2.1), the natural character of Waitutu is deteriorating (2.2), and managed threatened species (e.g. mohua) are under threat of local extinction (2.3).

## 2.4 DOC Annual Report for year ended 30 June 2007

To maintain or improve the natural character of managed places, the Department will set up explicit indicators nationally to help set criteria for reporting on progress towards reporting on ecological integrity.

An indicator of one of the components of ecological integrity has been developed, and work is under way to assemble the data required to pilot its implementation. The measure is a proportion (or percentage) based on the number of native species that are actually present compared with the number that should be present (species occupancy). It can be refined to include information about security and representation, which is the subject of two research programmes now underway and funded through the Cross Departmental Research Pool. This measure will be mapped to indicate the state of biodiversity, and used to identify valued sites where biodiversity is under imminent and serious threat, and therefore most deserving of conservation work (termed 'vital sites'). A prototype process for identifying valued and vital sites, funded as part of the Natural Heritage Management System programme of work, is now under way, with a planned completion date of mid-2008 (Department of Conservation 2007c).

## 2.5 New Zealand Biodiversity Strategy

The New Zealand Biodiversity Strategy (DOC/MfE 2000) reflects New Zealand's commitment to the Convention on Biological Diversity. The strategy sets out in broad terms the government's response to declining indigenous biodiversity. It sets out national goals and principles for managing New Zealand's biodiversity, and action plans for achieving the goals.

## 2.6 Other

Waitutu is part of World heritage site - Te Wāhipounamu/South West New Zealand. The World Heritage listing of Waitutu provides a commitment from the government and the international community to assure its long term protection, while recognising its importance at a global level.

# 3. HUMAN HISTORY

## 3.1 Pre-European

Pre-European history in the Waitutu area is characterised by early Maori colonisation and successive displacements by conquering tribes (Table 1). Relatively consistent use by the takata whenua over a long period is evident in the presence of several archaeological sites (such as caves, find spots[1], and middens) along the Waitutu coastline (Environment Southland 2007).

Table 1: Summary of pre-European history in the Waitutu area.

| Year/Period | Event | Details |
|---|---|---|
| 1000 years before present | The Kati-raka first arrive in Murihiku | |
| End of 12th century | Te Rapuwai supplant the Kati-raka | |
| 14th century | Descendents of the Takitimu migration canoe supplant Te Rapuwai | The Waitaha tribe arose from the crew of Takitimu, incorporating the earlier tribes. |
| Early 16th century | Ngati-Mamoe retire southward from northern NZ after being defeated by Ngati-Ira and Rangitane tribes | Ngati-Mamoe clash with Waitaha, but eventually merge with this tribe.<br>Culture is 'archaic' in form, and hunter-gatherer based. |
| 16th century | Population movement to the west as moa become scarce | Permanent settlements at Tiwai, Riverton, Wakapatu, and Pahia relied on a network of encampments for resource gathering e.g. at Sandhill point (barracouta fishing, other seafood, and forest birds), Lake Hauroko (eeling camps), and Preservation Inlet (fishing). Access to these sites was along |

[1] The location where an archaeological find is discovered.

| Year/Period | Event | Details |
|---|---|---|
| | | the coast or up the Waiaurahiri River. |
| Mid-17th century | Ngai-Tahu branch of the east North Island Ngati-Kahungunu tribe cross to South Island | Ngai-Tahu bring a recently derived 'classic' North Island culture.<br>Ngai-Tahu clash with Ngati-Mamoe/Waitaha who retreat into Southland and Fiordland. |
| End of 18th century | Contact with Europeans<br>Widespread relocation of Maori to urban areas | |

## 3.2 European

Early European history of the area is characterised by exploitation of biological and mineral resources. As late as the 1970s, Waitutu Forest was still primarily considered a timber resource (Table 2).

Table 2: Summary of early European history in the Waitutu area.

| Year/Period | Event | Details |
|---|---|---|
| Late 1700s to 1835 | European sealing parties | Chalky Inlet a preferred site. |
| 1829 - 1838 | Whaling stations | Cuttle Cove, Preservation Inlet. |
| 1853 | Crown purchases more than seven million acres of land in the Southland region (the Murihiku Purchase), for £2,600 | Ngäi Tahu have always maintained that Fiordland was not to be included in the Murihiku Purchase. |
| Late 1860s - early 1870s | Coal mining | Coal Island, Preservation Inlet. |
| 1874-1879 | Construction of Puysegur Point lighthouse | |
| 1883 | John Hay, Commissioner of Crown Lands describes Waitutu area as suitable for agricultural settlement | |
| 1886 - early 1900s | Gold mining | Preservation Inlet area (Long Beach, Wilson River, Coal Island). |
| 1890s | Townships | Cromarty and Te Oneroa, Preservation Inlet. |
| 1894 | McIntyre sawmill | Cromarty, Preservation Inlet. |
| 1896 | Waitutu coastal track cutting | |
| Early 1900s | Summer grazing rights granted<br>Associated track building and bridge construction | Hump Ridge and Princess Mountains.<br>From Te Waewae Bay across upper Waiaurahiri River. |
| 1901 - 1904 | Release of red deer | Near Lake Hauroko. |
| 1905 | Waitutu is omitted from newly formed Fiordland National Park | Based on John Hay's comments in 1883. |

| Year/Period | Event | Details |
|---|---|---|
| 1906 | South Island Landless Natives Act (SILNA) 1906 | 20 km long coastal strip in Waitutu granted to Maori in compensation for land taken by the Government for European settlers. |
| 1908 | Telephone line | Along Waitutu coastal track to Puysegur Point lighthouse. |
| 1916 - 1932 | Port Craig sawmill and settlement; logging of *c*.1400 ha | About half of the Maori land (the section east of the Wairaurahiri River), known as West Rowallan, was logged in the 1920s from Port Craig. West of the river the forest was untouched. |
| 1916 | Tramways and viaducts | Edwin Burn, Francis Burn, Percy Burn, Sandhill Point. |
| Mid-1920s | NZFS reconnaissance survey of timber resources | Waiaurahiri valley and terraced land west of the river. |
| 1929 | Radio station | Puysegur Point. |
| 1947-1948 | National Forest Survey | Forest between Hump Ridge and Lake Hakapoua. |
| early 1970s | NZFS undertakes track maintenance and hut building | Waitutu coastal track. |
| 1970 | NZFS survey of pulpwood resources | Waitutu State Forest. |
| 1970? | NZFS proposes Southland Beech Management Scheme, which includes Waitutu SF | |

## 3.3 Recent

Widespread recognition of Waitutu's ecological values, conservation campaigns to secure those values, and eventual gazetting as national park, characterise the recent history of the Waitutu area (Table 3).

Table 3: Summary of recent history in the Waitutu area.

| Year/Period | Event | Details |
|---|---|---|
| 1972 | Waitutu Incorporation formed by owners of 23 sections granted under Landless Natives Act 1906 | 850 present owners and descendants give a total of about 10,000 potential owners. |
| 1972 | Nature Conservation Council successful in having Waitutu removed from Southland Beech Management Scheme (albeit for further evaluation) | |
| 1976 | Feltex NZ Ltd, as owners of Lindsay and Dixon Ltd, commence negotiations to secure long-term cutting rights over Waitutu Block | |
| Late 1970s | Nature Conservation Council and Department of Lands and Survey negotiate with Waitutu Incorporation to protect Waitutu land | Negotiations fail and Feltex/Waitutu deal confirmed. |

| Year/Period | Event | Details |
|---|---|---|
| 1984 | Inter-governmental hearings on proposal to grant Waitutu national park status | 1,200 public submissions received.<br>NGO campaigns include report by Joint Campaign on Native Forests (made up of Environment and Conservation Organisations of NZ Inc, Federated Mountain Clubs of New Zealand, Royal Forest and Bird Society, and Native Forests Action Council). |
| 1987 | DOC set up | |
| 1987 | Waitutu SF allocated to DOC as a stewardship area | |
| 1988 | National Parks and Reserves Authority recommends to Government that Waitutu receives national park status | Recommendation endorsed by NZ Conservation Authority. |
| 1988 | Hump Ridge Track envisaged | |
| Late 1980s | Roading consent granted to service Waitutu Block logging | Road would pass through NZFS/DOC lands. |
| 1989 | Crown renegotiates with Waitutu Incorporation | The initial proposal involved swapping the land for the 5,000 ha Rowallan Forest administered and allocated to DOC. That exchange was rejected by the then Minister. There was good co-operation from both parties and the negotiation proceeded on the basis of a cash/annual annuity. The negotiations eventually fail. |
| 1993 | Lindsay and Dixon and Waitutu Incorporation announce a new deal to log Waitutu | The contract provided for possible Crown intervention and proposed an exchange for sustainable managed forests held by the New Zealand Forestry Corporation and DOC. |
| 1994 | Waitutu Incorporation fails in its appeal against the refusal of the district council to issue certificates of compliance enabling the incorporation to fell indigenous timber on the Waitutu block | |
| 1996 | Deed of Settlement between the Crown and Waitututu Incorporation | NZ Government grants Waitutu Incorporation cutting rights over 11,582 ha of beech forest in Longwood Range and $13.55M in exchange for passing Waitutu cutting rights to the Crown in perpetuity; the 20 km long strip of coastal Maori land will now be be managed by DOC as if it were part of Fiordland National Park, although the Waitutu Incorporation still retains ownership. |
| 1997 | Waitutu Block Settlement Act | Ratifies 1996 Deed of Settlement. |
| 1999 | Addition of 48,200 ha of Waitutu Forest to Fiordland National Park | |
| 2001 | The Waitutu Paiki Trust, a SILNA land owner, gains resource consent to sustainably manage their 113 ha Paiki block | Strong opposition from Forest and Bird. |
| 2001 | Hump Ridge Track officially opened | There are now *c*.2,500 guided walkers and additional independent walkers using the track per year. |

| Year/Period | Event | Details |
|---|---|---|
| 2003 | Owners of Paiki block threaten to clearfell if the Government doesn't offer enough compensation | |
| 2003 | Government buys a 125 ha SILNA block of land in West Rowallan forest | |
| 2004 | DOC Southland Conservancy granted Biodiversity Funding of $130k to protect the Biodiversity Values within Waitutu Forest | |
| 2006 | Waitutu funding cut by $58k | Insufficient funding left to carry out planned broad scale possum control programme - possum control restricted to research sites. |

# 4. ECOLOGICAL CONTEXT

## 4.1 Waitutu and Preservation Ecological Districts

Waitutu Forest is mostly located within Waitutu Ecological District (ED), Te Waewae Ecological Region (ER), with two smaller northern and north-western portions located in Preservation ED, Fiord ER. Waitutu ED is characterised by its vegetation, geology, and topography, with more mountainous areas of Fiordland to the west and north and mostly agricultural land to the east.

Landcover in Waitutu and Preservation EDs is predominantly indigenous vegetation in the form of forest (92 and73% of landcover respectively) and tall tussock grassland (1 and 18% of landcover respectively), reflecting low levels of human activity in the area (Table 4).

The climate in Waitutu ED is moist and cool. Mean annual rainfall is 1,200-4,000 mm, with rainfall declining from west to east, except for Hump Ridge. Rainfall will be higher in the parts of Waitutu Forest that extend into Preservation ED (mean 3,200-8,000 mm p.a.) (McEwen 1986).

The geology, soils, vegetation, and distinctive flora and fauna of the parts of Waitutu and Preservation EDs that are within Waitutu Forest are outlined in detail below.

## 4.2 Protected areas

A large proportion of Waitutu is located within Fiordland National Park. Waitutu is also contiguous with Conservation Area - Rowallan Forest (9,700 ha) in the north east. One Nga Whenua Rahui (Rowallan PO9511) and several covenants are present near the coast (DOC 2008; Table 4; Figure 1).

Table 4: Protected areas present in Waitutu (DOC 2008).

| Conservation Unit | Name | Area (ha) |
|---|---|---|
| **DOC** | | |
| C430001 | Fiordland National Park (part) | 1,260,742.2 |
| C460002 | Conservation Area - Angus Burn, Waitutu | 8.5 |
| C460003 | Conservation Area - Wairaurahiri, Waitutu | 3.0 |
| C460004 | Conservation Area - Wairaurahiri, Waitutu | 14.9 |
| C460005 | Conservation Area - Main Coast Road, Waitutu | 0.4 |
| C460006 | Conservation Area - Main Coast Road, Waitutu | 4.0 |
| C460007 | Conservation Area - Okaka Road, Waitutu | 0.4 |
| C460008 | Sand Hill Point | 13.9 |
| C460014 | Conservation Area - Main Coast Road, Waitutu | 0.4 |
| **Covenant** | | |
| C460015 | Waitutu Block Covenant | 2,260.4 |
| C460016 | West Rowallan Sec 5 Blk XII Covenant | 125.3 |
| C460017 | Orbell SILNA Covenant (Sec 1&5 Blk XIII Rowallan S) | 230.6 |
| C460018 | Rowallan Blk XIII Sec 9 Covenant | 60.1 |
| C460019 | Waitutu Blk XIII Sec 4 Covenant | 113.7 |
| **Nga Whenua Rahui** | | |
| PO9511 | Rowallan | n/a |
| **Queen Elizabeth II Covenants** | | |
| 5/13/095 | West end of Te Waewae Bay Rd, 45km from Tuatapere | 100 |

## 5. GEOLOGY, LANDFORMS, AND SOILS

The Hauroko Fault crosses Waitutu ED in its most south-western corner, juxtaposing the pre-Late Cretaceous plutonic and metamorphic rocks of the 'Fiordland Complex' in mountainous areas to the south west with a Tertiary sequence comprising the western portion of the Waiau Basin, which underlies the greater part of Waitutu ED. The Hump Ridge anticline (up to 1067 asl) brings resistant Eocene sandstone to the surface as an elongate topographic dome. In a small area between Sand Hill point and Port Craig, there are outcrops of pre-tertiary basement. Lithologies include basic metavolcanics and foliated metadorite, and hematitic conglomerate. In the relatively low altitude area between the Hump Ridge and the Fiordland Complex, younger tertiary sediments overly the Eocene sandstone. Here, rocks are uniformly soft and easily erodable, and mainly comprise Miocene mudstone and sandy mudstone with local conglomerate and pebbly sandstone (Ward 1988).

These soft rocks contain an extensive sequence of at least 13 mudstone marine terraces that characterise Waitutu ED. Ward (1988) describes these as extending from 3 to 1,040 m asl (i.e. 3, 60, 90, 140, 230, 320, 370, 460, 580,660, 780, 870 and 1,040 m asl). The terraces, which range from an estimated 3,000 to 940,000 years old, extend 13 km inland and are crossed by alluvial terraces related to glaciation of the immediate hinterland. Ward (1988) stated that:

> *"The Waitutu marine terrace sequence can be judged as the best in New Zealand…using the composite criteria of the number, maximum age, altitudinal range, areal extent and degree of preservation of the marine*

> *terraces, and their clear relationships to fluvoglacial terrace systems and glacial erosion of the hinterland. Preservation of the summit-level surface enhances the geomorphological significance of the southern Fiordland region, by providing a further datum allowing semi-quantitative study of the rates of geomorphic development involving combinations of simple tectonism with glacial, fluvial and marine erosion of both Tertiary and basement rocks on various time scales up to 1-2 million years."*

The sequence of marine terraces is one of the most well-preserved in New Zealand and is rated nationally important. For this reason, and because the youngest terraces are still forming to create a broad intertidal platform which can extend hundreds of metres offshore, the coastline from Big River to Track Burn has been identified by the Department of Conservation as an area containing significant values (see ACSV 14-04 in Appendix 5) (Environment Southland 2007). Section 4.2.1 Landform of the Fiordland National Park Management Plan (Department of Conservation 2007a) states that the Waitutu marine terrace sequence is a special feature of the park and arguably the best example of its kind in New Zealand. Other important geological sites in the Waitutu area are presented in Table 5.

Waitutu also contains coastal landforms comprising cliffs, gravelly beaches on tidal platforms, and some small sand dunes (McEwen 1987). Other major landforms include the valleys of Wairaurahiri River and Waitutu River which have catchments dominated by large lakes. Wairaurahiri River and Waitutu River have been ranked 19$^{th}$ and 20$^{th}$ out of all New Zealand rivers, based on natural heritage values. Big River, Wairaurahiri River, and Waitutu River are classified as Type I waters of national importance due to the presence of blue duck and flood forest, nationally significant lakes, and threatened fish species. All rivers arise from highly natural catchments (Chadderton *et al*. 2004). Other waterways of importance include the Aan River, Grant Burn, Crombie Stream, Percy Burn, Francis Burn, and Edwin Burn (Department of Conservation 2000).

Lake Hakapoua and Lake Poteriteri are nationally significant because they are two of the three largest lakes in New Zealand that are free of introduced invasive macrophyte species and still contain intact native macrophyte communities. They also contain some of the largest unfished stocks of longfin eel remaining in New Zealand and are therefore important for the long-term survival of this threatened endemic species (Chadderton *et al*. 2004).

Soils on rolling and hilly land are formed from sedimentary rocks and are strongly leached to podzolised. There are podzols, some with poor drainage, on river and marine terraces, which have formed from loess and river outwash gravels. On the crests of the ranges there are blanket peats. Alluvial soils are present in the valleys (McEwen 1987).

Table 5: Inventory of Important Geological Sites and Landforms in the Waitutu area (Kenny and Hayward 1993).

| Name | Location | Description | Significance | Importance[1] | Vulnerability[2] |
|---|---|---|---|---|---|
| G14 Blue Cliff Miocene fauna, near Port Craig | Coastal cliff at west end (head) of Te Waewae Bay. C46/779362. | Age: Miocene | Moderately diverse Kapitean fauna | C | 3 |
| G52 Lake Hakapoua debris dam | Lake Hakapoua, south coast of South Island, B46/419308 | | Classified as an extremely well defined landform of scenic value | C | 3 |
| G84 Port Craig Tertiary sequence | Coastal platform and cliffs from old Port Craig wharf (C46/752280) north to the Whata track (C46/742299), south-west side of Te Waewae Bay, C46/742299 | Bioclastic limestone overlapping unconformably on to basement amphibolite, then progressively younger transgressive sandstone/ mudstone sediments. Port Craig Formation sediments overlying unconformity include barnacle plate limestone, shellbeds, basal conglomerate.<br><br>Age: Oligocene, Miocene, Pliocene | Magnificent example of submarine turbidites (Oligocene) overlain unconformably by a nearshore bioclastic limestone/breccia sequence (Pliocene). Regionally significant unconformity of Late Miocene age, reflecting progressive uplift of Hump Ridge horst during Middle Miocene. Includes the only diverse Kapitean (Late Miocene) fauna in the southern South Island, 1.8 km NNW of Port Craig, where the Whata track to Port Craig leaves the beach and goes up the cliff | C | 3 |
| G121 Waitutu uplifted marine terraces | Waitutu River area, southern Fiordland, C46/515270 | | One of the most well preserved sequences of uplifted marine terraces in New Zealand giving detailed Quaternary uplift history of southern Fiordland | B | 3 |

[1] A. International: site of international scientific importance; B. National: site of national scientific, educational or aesthetic importance; C. Regional: site of regional scientific, educational or aesthetic importance.

[2] 1. Highly vulnerable to complete destruction or major modification by humans; 2. Moderately vulnerable to modification by humans; 3. Unlikely to be damaged by humans; 4. Could be improved by human activity; 5. Site already destroyed (not necessarily by human activity).

# 6. VEGETATION AND HABITATS

Waitutu Forest contains a high diversity of vegetation and habitat types which reflect complex relationships with the physical environment. Interactions between drainage, fertility, soil type, altitude, and aspect influence vegetation composition (e.g. Mark *et al*. 1988).

Waitutu's forests are of national importance because:

- an intact forest canopy stretches from the coast to alpine tops;
- the forests contain the greatest abundance and diversity of podocarps within Fiordland (B. Rance, Department of Conservation, pers. comm.);
- intact vegetation patterning on gentle topography at modest altitudes is nationally uncommon (B. Rance, Department of Conservation, pers. comm.)
- it comprises one of the largest tracts of unlogged lowland forest in New Zealand (Department of Conservation 2007a);

## 6.1.1 Forests

Waitutu contains a mosaic of forest-types. Podocarp-dominant forests are present on low altitude marine terraces near the coast. Mixed beech-podocarp forests occur on low and mid-altitude, flat or rolling country away from coast. Beech forests (mostly silver beech or mountain beech dominant) are present on steep and high altitude country above about 450 m to the tree line at about 900 m. Hardwood-dominant forest (e.g. southern rata, kamahi, broadleaf) occurs near the coast (McEwen 1987).

Podocarp Forest

Podocarps (rimu, miro, and Hall's totara) are dominant almost throughout. Hardwoods including southern rata, kamahi, pokaka, and large broadleaf are also present. The shrub storey is floristically rich for western Southland. There are smaller areas of steepland podocarp forest (steep ridges at south end of Hump Ridge), manuka-podocarp forest (very exposed ridge crests), and rata-podocarp forest (coastal terrace from Port Craig to Wairaurahiri River) (Nicholls 1976).

Podocarp-Beech Forest

Silver beech and mountain beech appear among podocarps (rimu, miro, Hall's totara, yellow silver pine, pink pine, and kahikatea in swampy areas) and hardwoods (kamahi, and some broadleaf, pokaka, and southern rata) and become increasingly dominant as elevation increases (Nicholls 1976).

Beech-Podocarp Forest

This forest type has an upper altitudinal limit of *c*.450 m asl, which is the regional limit for rimu. Silver and mountain beech, or either alone, are abundant throughout. Podocarps are very scattered or occur in local small groups (Nicholls 1976).

Beech Forest

Short to very stunted silver beech and mountain beech dominates forest above 450 m asl on the Hump Ridge and the southern spurs of the Princess and Cameron Mountains (Nicholls 1976).

Hardwood Forest

This forest type is present as a narrow strip above, and occasionally below, sea cliffs from the Wairaurahiri River mouth to Big River. It is characterised by a windshorn canopy of southern rata and kamahi, with local mountain beech (Nicholls 1976). Some matipo, broadleaf, and fuchsia can also be present (Johnson 1979).

### 6.1.2 National Forest Survey Forest types

The New Zealand Forest Service National Forest Survey (NFS) of Waitutu Forest and Waitutu Maori Land identified 40 forest types (Table 6). Of greatest significance are probably the podocarp types, especially the denser rimu-dominant types (i.e. P1, P2, & PR), because these are the largest expanse of these forest types in Southland and some of the most intact and extensive within New Zealand.

Table 6: New Zealand Forest Service National Forest Survey Forest Classes for Waitutu.

| Forest Type | Tenure | | Total |
|---|---|---|---|
| | Ex-State Forest | Maori Land | |
| **P (Podocarp forest)** | | | |
| P1 | 426 | 837 | 1,263 |
| P2 | 655 | 285 | 940 |
| PR (with southern rata) | 0 | 113 | 113 |
| P3a | 547 | 0 | 547 |
| SP | 193 | 22 | 215 |
| MP (with manuka) | 62 | 0 | 62 |
| **Subtotal** | **1,883** | **1,257** | **3,140** |
| **PB (Podocarp-beech forest)** | | | |
| K2 (with kahikatea) | 8 | 0 | 8 |
| K3 (with kahikatea) | 350 | 0 | 350 |
| PB | 1,479 | 66 | 1,545 |
| PB1 | 562 | 0 | 562 |
| PB2 | 1,732 | 139 | 1,871 |
| PB4 | 1,748 | 0 | 1,748 |
| PB5 | 923 | 1,069 | 1,992 |
| PB5/7 | 538 | 0 | 538 |
| PB6 | 1,583 | 260 | 1,843 |
| PB7 | 609 | 12 | 621 |
| PB8 | 711 | 0 | 711 |
| Y | 320 | 20 | 340 |
| **Subtotal** | **10,563** | **1,566** | **12,129** |
| **BP (Beech-podocarp forest)** | | | |
| BP1 | 5,078 | 104 | 5,182 |
| B3 | 160 | 0 | 160 |
| B5 | 1,792 | 0 | 1,792 |
| B9 | 266 | 81 | 347 |

| Forest Type | Tenure | | Total |
|---|---|---|---|
| | Ex-State Forest | Maori Land | |
| BO | 629 | 56 | 685 |
| BV | 952 | 153 | 1,105 |
| SPB | 3,296 | 0 | 3,296 |
| S | 2,948 | 10 | 2,958 |
| S2 | 1,243 | 0 | 1,243 |
| **Subtotal** | **16,364** | **404** | **16,768** |
| **B (Beech forest)** | | | |
| B6 | 29 | 0 | 29 |
| M | 15,332 | 0 | 15,332 |
| R | 32 | 0 | 32 |
| **Subtotal** | **15,393** | **0** | **15,393** |
| **H&S (Hardwood forest and shrubland)** | | | |
| C | 290 | 287 | 577 |
| A | 201 | 0 | 201 |
| **Subtotal** | **491** | **287** | **778** |
| **Misc** | | | |
| F | 15 | | 15 |
| FS | 74 | 240 | 314 |
| W | 45 | 0 | 45 |
| XP1 (logged P1) | 114 | 0 | 114 |
| XP2 (logged P2) | 245 | 0 | 245 |
| XPB (logged PB) | 4 | 0 | 4 |
| Z | 74 | 15 | 89 |
| DC | 34 | ? | 34 |
| **Subtotal** | **605** | **255** | **860** |
| **Total** | **45,299** | **3,769** | **49,068** |

Ogle (1984) found that forest on the flood plain of the Angus Burn was different from the BV type previously mapped in the NFS. Floodplain forest had more mountain beech (*Nothofagus solandri* var. *cliffortioides*) and did not have rimu (*Dacrydium cupressinum*) and kamahi (*Weinmannia racemosa*) when compared to non-floodplain forest. The increased fertility and flooding regimes are key determinants of the vegetation pattern.

### 6.1.3 Bog vegetation

Bogs in the upper Angus Burn comprise cushions of *Centrolepis ciliata*, above a mat dominated by *Eleocharis gracilis*, *Schizeilema nitens*, *Cotula squalida*, *Gunnera monoica*, *Nertera scapanioides*, *Juncus antarcticus*, *J. bulbosus*, and *J. pusillus*. Around fallen logs and the bases of shrubs is a taller but less dense turf containing *Geum leiospermum*, *Geranium microphyllum*, *Acaena anserinifolia*, and *Viola cunninghamii*. Shaded bog edges contain *Tetrachondra hamiltonii*, *Ranunculus ternatifolius*, *Ourisia modesta*, *Abrotanella filiformis*, and *Montia fontana*. *Juncus articulatus*, *Eleocharis acuta*, and occasional *Potamogeton cheesemanii* and *Gunnera prorepens* are present where water remains the longest (Ogle 1984).

Ogle (1984) stated:

*"That the Angus Burn bog areas do not match established vegetation types supports my view that the community is unusual, not only for Waitutu, but nationally also. H.D. Wilson makes the point that unmodified wetlands frequently have unusual species compositions, which is supported by my observations in a number of parts of New Zealand."*

Bog shrubland and scrub

Scattered shrubs or patches of scrub are present on bogs in the Angus Burn. Characteristic species are *Olearia laxiflora*, *Coprosma* spp., and *Myrsine divaricata* (Ogle 1984).

### 6.1.4 Alpine vegetation

Tussock grasses of the genus *Chionochloa* dominate the alpine zone. *Chionochloa teretifolia*, a regional endemic, reaches its southwestern limit in the mountains immediately north of Waitutu. Common herbs include alpine daisies (*Celmisia*), native carrots, buttercups, speargrasses and many other species (Department of Conservation 2007a).

Alpine shrubland

Alpine shrublands are present on the Hump Ridge above the treeline. Characteristic species are *Coprosma pseudocuneata*, *Dracophyllum uniflorum*, *D. menziesii*, *Olearia colensoi*, and mountain toatoa (*Phyllocladus alpinus*) (Nicholls 1976).

### 6.1.5 Coastal vegetation

Coastal habitats with distinct plant communities include dunes, dune hollows, wet crevices near the sea, coastal rocks, fans and terraces, dry rubbly fans, and steep mudstone cliffs (Johnson 1979). Several threatened species are present, including *Austrofestuca littoralis*, pingao, and *Euphorbia glauca*.

Coastal shrubland occurs as a narrow strip above, and occasionally below, sea cliffs from the Wairaurahiri River mouth to Big River. Characteristic species are *Brachyglottis rotundifolia* var. *rotundifolia*, *Olearia avicenniifolia*, and *Dracophyllum longifolium* (Nicholls 1976).

Sand Hill Point is a nationally important dune/beach community (a rating of 15 or more out of 20), while one other site is only one point short, and all sites rate 10 or more (Table 7). Gravel beaches and turf communities represent naturally rare habitats (see Section 6.2.2).

Table 7: Ratings for dune/beach communities on the Waitutu coast (Johnson 1992). Nationally important dune/beach communities have a rating of 15 or more out of 20.

| Name | Description | Rating | | | | |
|---|---|---|---|---|---|---|
| | | Diversity | Natives | Modification | Weeds | Total |
| Big River | *Austrofestuca littoralis* near beach; pingao on low dunes; *Coprosma propinqua* in dune hollows; scrub fringe of *Olearia aviceniifolia*; rata forest with matipo, broadleaf; many other coastal communities nearby | 3 | 3 | 4 | 4 | 14 |
| Waitutu River | Dense pingao with shore convolvulus and patches of turf; *Carex* and *Juncus* sward extending under dead former forest; scrub of *Coprosma* and manuka; rata/broadleaf forest; boulder beach backed by low terrace scarp, capped with turf, sedge sward then scrub fringe to rata/kamahi forest | 2 | 2 | 4 | 3 | 11 |
| Waiaurahiri River | Hardly any dune vegetation; sedge and *Juncus* swards on coastal edge, backed by rata/kamahi forest; gravel storm beach at river mouth has turfy hollow behind with many species | 2 | 2 | 3 | 3 | 10 |
| Blowholes Beach | Sea rocket (*Cakile edulenta*) at beach head; dune with pingao and *A. littoralis*; crest with clubrush, holy grass; scrub of *O. aviceniifolia*, *C. propinqua*, tree ferns; rata and kamahi forest; *Carex pumila* and creeping bent | 1 | 3 | 4 | 3 | 11 |
| Sand Hill Point | Pingao and *A. littoralis* on dunes; sparse *A. littoralis* and herbs on small plains of sand, pebbles and midden material; tall dune face with pingao and *A. littoralis* and less cocksfoot and flax; dune crests dominated by clubrush; rata, kamahi, broadleaf, mahoe etc forest on oldest dunes; small patch *Euphorbia glauca* | 4 | 4 | 4 | 4 | 16 |

## 7. FLORA

The lowland part of Waitutu contains an extraordinary diversity of plants, with a total native flora of 385 species having been recorded (Table 8). The diversity of herbaceous species (118), ferns (68), trees and shrubs (76), sedges (32) and orchids (19) is notable in a regional and national context, particularly since there is a broad latitudinal trend toward less-diverse forests in the south. Of the native flora, 101 were found primarily on the coast, including 49 herbaceous species, 14 grasses and 16 sedges. The inclusion of the adjacent alpine areas would significantly increase the floristic diversity of the area.

This flora is considered to be the most diverse for any lowland predominantly forested region in Southland (B. Rance, Department of Conservation, pers. comm. 2008).

Table 8: Flora recorded in lowland Waitutu by structural class (B. Rance, Department of Conservation, pers. comm. 2008).

| Structural Class | Indigenous | Exotic | Total |
|---|---|---|---|
| Ferns | 69 | | 69 |
| Podocarps | 9 | | 9 |
| Trees & shrubs | 76 | 5 | 81 |
| Mistletoes | 5 | | 5 |
| Climbers & vines | 11 | | 12 |
| Herbs | 118 | 23 | 141 |
| Grasses | 21 | 15 | 36 |
| Sedges | 32 | | 32 |
| Rushes | 12 | 6 | 18 |
| Orchids | 19 | | 19 |
| Other monocots | 15 | | 15 |
| **Total** | **388** | **49** | **437** |

## 7.1 Threatened species

A feature of the Waitutu flora is the large number of threatened plant species. This area has one of the most diverse threatened floras in southern New Zealand, probably second only to Masons Bay (B. Rance, Department of Conservation, pers. comm. February 2008). At least 29 nationally threatened and uncommon vascular species have been recorded (Table 9). Approximately half of these (11) have been recorded from the coast, five from swampy areas (either within forest or as clearings), six from forest habitats, two from peaty open upland sites, and one from aquatic lake habitat. At least one threatened non-vascular plant species is present within Waitutu (Table 10).

Ogle (1984) stated that the Angus Burn area supported a number of rare and uncommon plants. He suggested that further survey work was required to determine whether these distinctive and special communities are found in other parts of the Waitutu area.

Table 9: Nationally threatened (as per de Lange *et al*. 2004) and locally uncommon vascular plant species recorded in Waitutu (B. Rance, Department of Conservation, pers. comm. 2008).

| Species | Common Name | Notes |
|---|---|---|
| **Nationally Vulnerable** | | |
| *Ranunculus ternatifolius* | | |
| **Serious Decline** | | |
| *Carex litorosa* | | |
| *Hydatella inconspicua* | | |
| *Euphorbia glauca* | | parts of the coast |
| *Myosotis pygmaea* var. *pygmaea* | | |
| *Tetrachondra hamiltonii* | | |

| Species | Common Name | Notes |
|---|---|---|
| **Gradual Decline** | | |
| *Alepis flavida* | yellow flowered mistletoe | |
| *Austrofestuca littoralis* | sand tussock | |
| *Desmoschoenus spiralis* | pingao | |
| *Epilobium chionanthum* | | |
| *Libertia peregrinans* | | Sand Hill Point |
| *Ourisia modesta* | | |
| *Peraxilla colensoi* | scarlet mistletoe | |
| *Peraxilla tetrapetala* | red mistletoe | |
| *Pimelea lyallii* | | Sand Hill Point |
| *Raukaua edgerleyi* | raukawa | |
| *Tupeia antarctica* | | |
| **Sparse** | | |
| *Carex capillacea* | | |
| *Crassula ruamahanga* | | |
| *Gentiana lineata* | | |
| *Grammitis rigida* | | |
| *Hypolepis amaurorachis* | | Coastline |
| *Wahlenbergia congesta* | | |
| **Range Restricted** | | |
| *Acaena microphylla* var. *pauciglochidiata* | | Sand Hill Point is the south-western distribution limit for this species |
| *Anisotome lyallii* | coastal carrot | |
| *Chionochloa acicularis* | | |
| *Lachnagrostis ammobia* | | |
| *Pimelea crosby-smithiana* | | Endemic to Hump Ridge (*c*.900 m asl in shrubland and herbfield) |
| *Rumex neglectus* | | Evidence of continuing decline, but insufficient to trigger Gradual decline |
| **Data deficient** | | |
| *Euchiton polylepis* | | Sand Hill Point; small and easily over-looked; believed to be uncommon |
| *Stenostachys laevis* | | Probably not threatened, but certainly uncommon, and easily overlooked |
| **Not Threatened** | | |
| *Calystegia soldanella* | shore convolvulus | Rare in the area |
| *Pittosporum eugenioides* | tarata | Local and disjunct from other populations in the SW of the South Island (Anon 1984) |
| *Plagianthus regius* | ribbonwood | |

Table 10: Threatened non-vascular plant species (as per Hitchmough *et al*. 2007) recorded in Waitutu Forest.

| Species | Common name | Comments |
|---|---|---|
| **Nationally Critical** | | |
| *Plagiochila baylisii* | | Lower terrace; podocarp beech forest (Tangney 1988) |

## 7.2 Mistletoes

Waitutu is a nationally important site for mistletoe conservation and has been recognised as such by the Department of Conservation Mistletoe Recovery Group. The site is important for its diversity of loranthaceous mistletoes, containing all four large leaved mistletoe species (*Peraxilla colensoi, P. tetrapetala, Alepis flavida*, and *Ileostylus micranthus*). This includes all three species of beech mistletoe, and Waitutu may be the only recorded site where they occur together. Waitutu is also significant for the abundance of mistletoe plants and the extent of habitat (B. Rance, Department of Conservation, pers. comm. 2008).

Mistletoe presence has been linked to the absence of possums, resulting from the barrier to their westward movement posed by the Wairaurahiri River. Possums colonised the area between Waitutu and Wairaurahiri Rivers from about 1983, being concentrated around the coastal margin and river courses. They reached the area to the west of the Waitutu River in about 1986, but numbers did not build up until the population increased in the area to the east and forced animals across the Wairaurahiri foot bridge (Ogle 1997). Recent monitoring has detected possums (albeit in low densities in some areas) throughout much of Waitutu (see Section 13), and higher possum densities are correlated with lower mistletoe condition (Table 11; Baxter 2000). Mistletoe monitoring elsewhere shows a very clear link between declines in mistletoe condition and increases in possum density following establishment of a possum population (e.g. Sessions *et al*. 2001; Sweetapple *et al*. 2002; Phil Knightbridge, Department of Conservation, pers comm. June 2006), which leads to declines in mistletoe populations as a result of reduced flowering and fruiting and increased mortality rates. To protect the Waitutu mistletoe populations it is essential that effective possum control is undertaken. Currently, there is no management of regionally significant mistletoe populations within Southland (B. Rance, Department of Conservation, pers. comm. 2008).

Table 11: Mistletoe surveys to date in Waitutu.

| Year | Method | Outcome/ conclusions |
|---|---|---|
| 2006 | Foliar Browse Index | East Waitutu - 8/16 remaining<br>Poteriteri - 0/25 remaining<br>Difference due to possum control<br>All mistletoe east of the Waitutu River are likely to become locally extinct in several years without effective possum control |

# 8. FAUNA

## 8.1 Mammals

Long-tailed bats (*Chalinolobus tuberculatus* (South Island); classified as 'Chronically Threatened - Nationally Endangered') have been recorded in Waitutu Forest (Department of Conservation 2000). New Zealand fur seals (*Arctocephalus forsteri*), leopard seals (*Hydrurga leptonyx*), and New Zealand sea lions (*Phocarctos hookeri*; listed as 'Range Restricted') haul out occasionally along the coast. Several introduced mammalian pests are listed in Section 12.

## 8.2 Avifauna

The extensive and relatively unmodified forests support a diverse and abundant avifauna (McEwen 1987). Fifty-eight bird species (eight introduced) have been recorded in Waitutu Forest (Table 12).

Recent Past

Previous authors have described the significant features of Waitutu's bird populations as:

- Outstanding populations of South Island kaka and yellow-crowned parakeet. Theses species have declined throughout much of New Zealand and are virtually absent from large areas of Fiordland National Park, especially the region adjacent to Waitutu.
- Distinctive populations of discontinuously distributed mohua and South Island robin.
- High population densities of many forest birds, e.g. New Zealand pigeon, South Island fantail, grey warbler, bellbird, and tui.
- Records for 27 threatened species, including those of coastal, forest, alpine, and freshwater habitats.

Factors thought to have influenced the high representation of forest birds in Waitutu are:

- large area of tall, comparatively warm, lowland forest;
- the presence of many podocarps;
- the relatively unmodified nature of the forest (e.g. low possum numbers).

Current Status

Recent work in Waitutu has highlighted the impacts of introduced predators on bird populations (Greene, Dilks and Wright 2007):

- kaka are still present in moderate numbers;
- kaka populations have a highly skewed female:male sex ratio in Waitutu (1:6.7) compared to other sites (e.g. 1:1.6 in the Eglington Valley);
- this indicates predation of female kaka on nests;

- five minute bird counts in Waitutu indicate:
  - *c*.25 species of forest birds;
  - mohua, robin, and falcon are rare;
  - kereru and parakeets are present in low-moderate numbers;
- overall, Waitutu bird populations seem to be significantly reduced since 1985;
- the medium-term outlook for kaka and mohua populations is poor without effective possum and stoat control (cf. O'Donnell *et al*. 1996).

Table 12: Avifauna recorded in Waitutu Forest (sources: Wildlife Service 1983; Anon 1984; Elliot and Ogle 1985; Ogle 1988; Southey 1999, 2000a, 2000b; Ewans undated a), and listed by threat classification (Hitchmough *et al*. 2007). Introduced species are shown with an asterisk.

| Species | Common Name | Comments |
|---|---|---|
| **Nationally Critical** | | |
| *Anas chlorotis* "South Island" | pateke, South Island brown teal | Small population in Big River/Lake Hakapoua area and several other sightings of 1-2 birds from 1992-2000; population at critically low levels. Regional variation in plumage and morphology, particularly between Fiordland and northern remnant populations. All Fiordland birds that have been sampled show evidence of hybridisation with grey or mallard ducks (O'Connor *et al*. 2007). |
| *Cyanoramphus malherbi* | orange-fronted parakeet | Positive sighting from the north side of Wairere Stream; population at critically low levels |
| *Egretta alba modesta* | kotuku, white heron | |
| **Nationally Endangered** | | |
| *Anas superciliosa superciliosa* | grey duck | Rivers |
| *Eudyptes pachyrhynchus* | Fiordland crested penguin | Nesting colony on eastern side of Big River |
| *Falco novaeseelandiae* "southern" | southern falcon | Throughout; significant population |
| *Hymenolaimus malachorhynchos* | blue duck, whio | May be locally extinct |
| *Mohoua ochrocephala* | mohua, yellowhead | Scattered throughout; population may have declined fourfold from 1984 to 2000 |
| *Nestor meridionalis meridionalis* | South Island kaka | Largest population in NZ in mid-1980s; numbers low in nearby FNP; large podocarp-dominant areas crucial to density and distribution; still relatively common but population appears to be declining |
| *Nestor notabilis* | kea | Hump Ridge |
| *Podiceps cristatus australis* | southern crested grebe | May be locally extinct |
| **Nationally Vulnerable** | | |
| *Egretta sacra sacra* | reef heron | |
| *Leucocarbo chalconotus* | Stewart Island shag | |
| *Megadyptes antipodes* | yellow-eyed penguin | May breed at Sandhill Point |
| *Xenicus gilviventris* | rock wren | |
| **Serious Decline** | | |
| *Gallirallus australis australis* | western weka | Not known in the Waitutu area since the 1960s |

| Species | Common Name | Comments |
|---|---|---|
| **Gradual Decline** | | |
| *Acanthisitta chloris chloris* | South Island rifleman | Patchy distribution |
| *Apteryx australis* | Southern tokoeka | Survey required to confirm spread into area |
| *Cyanoramphus auriceps* | yellow-crowned parakeet | High numbers in Wairuarahiri Valley in 1984 and 2000, suggesting a stable population |
| *Eudynamys taitensis* | long-tailed cuckoo | Seasonal |
| *Eudyptula minor minor* | southern little blue penguin | |
| *Hemiphaga novaeseelandiae* | kereru, New Zealand pigeon | Good numbers |
| *Puffinus griseus* | sooty shearwater | |
| **Range Restricted** | | |
| *Pterodroma inexpectata* | mottled petrel | |
| **Sparse** | | |
| *Bowdleria punctata punctata* | South Island fernbird | Several relatively recent sightings |
| *Catharacta antarctica lonnbergi* | brown skua | May breed along the coast |
| *Phalacrocorax carbo novaehollandiae* | black shag | Nesting colony on Waitutu River |
| **Not Threatened** | | |
| *Anas rhynchotis* | Australasian shoveler | |
| *Anthornis melanura melanura* | bellbird | Common throughout |
| *Anthus novaeseelandiae novaeseelandiae* | New Zealand pipit | |
| *Ardea novaehollandiae* | white-faced heron | |
| *Aythya novaeseelandiae* | New Zealand scaup | Common |
| **Carduelis carduelis* | goldfinch | |
| **Carduelis chloris* | greenfinch | |
| **Carduelis flammea* | redpoll | |
| *Chrysococcyx lucidus lucidus* | shining cuckoo | Seasonal |
| *Circus approximans* | Australasian harrier | |
| *Cyanoramphus novaezelandiae novaezelandiae* | red-crowned parakeet | Low numbers in 1980s |
| **Cygnus atratus* | black swan | |
| **Fringilla coelebs* | chaffinch | |
| *Gerygone igata* | grey warbler | Common throughout |
| *Haematopus unicolor* | variable oystercatcher | |
| *Hirundo tahitica neoxena* | welcome swallow | |
| *Larus dominicanus dominicanus* | southern black-backed gull | |
| *Mohoua novaeseelandiae* | brown creeper | Moderately common |

| Species | Common Name | Comments |
|---|---|---|
| *Ninox novaeseelandiae novaeseelandiae* | morepork | Widespread in low numbers, may be vulnerable to nest predation |
| *Petroica australis australis* | South Island robin | Localised; low numbers due to absence of red beech forest? |
| *Petroica macrocephala macrocephala* | yellow-breasted tit | Common throughout |
| *Phalacrocorax melanoleucos brevirostris* | little shag | Nesting colony on Grant Burn |
| *Phalacrocorax varius varius* | pied shag | Nesting colony on Waitutu River |
| *Prosthemadera novaeseelandiae novaeseelandiae* | tui | Localised, but good population; may be seasonal movement |
| **Prunella modularis* | dunnock | |
| *Rhipidura fuliginosa fuliginosa* | South Island fantail | Common throughout |
| *Tadorna variegata* | paradise shelduck | Common on rivers throughout |
| *Todiramphus sanctus* | sacred kingfisher | |
| **Turdus merula* | blackbird | |
| **Turdus philomelos* | song thrush | |
| *Zosterops lateralis* | silvereye | Uncommon |

## 8.3 Herpetofauna

Takitimu gecko (*Hoplodactylus cryptozoicus*, Data Deficient) was recorded beside the Percy Burn Viaduct in 2006. This species is also known from the Rees Valley and Takitimu Mountains (Anon 2007).

There are few herpetofauna records in BIOWEB for Waitutu ED (Table 13). The single record for green gecko (*Naultinus* sp.) was described as "From: Thomas, BW 1982: A review of the herpetofauna of southern New Zealand. Date estimated. Originally noted as *Heteropholis* sp. Unsubstantiated report of one Green Gecko". All of New Zealand's green geckos are nationally threatened to some degree (Hitchmough *et al*. 2007).

Table 13: Herpetofauna records for Waitutu Ecological District (BIOWEB accessed 1 February 2008), and listed by threat classification (Hitchmough *et al*. 2007). Introduced species are asterisked.

| Species | Common Name | Location | Date |
|---|---|---|---|
| **Data Deficient** | | | |
| *Hoplodactylus cryptozoicus* | Takitimus gecko | Near Percy Burn | 2006 |
| **Not Threatened** | | | |
| **Litoria ewingii* | whistling frog | Near Francis Burn E2068900 N5425400 | 15-01-84 |
| *Naultinus* sp. | green gecko | Francis Burn E2069000 N5429000 | 01-01-80 |

## 8.4 Freshwater fish

Wairaurahiri River and Waitutu River are two of the few remaining large rivers in New Zealand with completely unmodified catchments, making them ideal for native aquatic fauna.

The New Zealand Freshwater Fish Database has records for 14 freshwater fish species in Waitutu (Table 14), only one of which is introduced (rainbow trout (*Onchorhyncus mykiss*) has also been recorded nearby in Lake Poteriteri). Of the indigenous species, three are nationally threatened: longfin eel (*Anguilla dieffenbachii*) is listed as 'Chronically Threatened - Gradual Decline', and shortjaw kōkopu (*Galaxias postvectis*) and lamprey (*Geotria australis*) are listed as 'At Risk - Sparse' in Hitchmough *et al*. (2007). Shortjaw kōkopu is an apparently isolated southern population (McEwen 1987). Most search effort has been undertaken in Wairaurahiri River and its tributaries.

Giant kōkopu has been recorded in the Aan River and Lake Innes. Longfin eel has been recorded in Aan River, an unnamed stream in Knife and Steel Harbour, Grant Burn, Crombie Stream, Percy Burn, Francis Burn, Edwin Burn, Wairere Stream, Waikakapo Stream, Wairaurahiri River, and tributaries of Wairaurahiri River. Shortjaw kōkopu has been recorded in an unnamed stream in Knife and Steel Harbour, Crombie Stream, Percy Burn, and Edwin Burn. Lamprey has been recorded in Aan River, Grant Burn, Crombie Stream, Wairaurahiri River, and tributaries of Wairaurahiri River.

Table 14: Freshwater fish recorded in Waitutu Ecological District 1972-1998 (New Zealand Freshwater Fish Database, NIWA 2008), listed by threat class (Hitchmough *et al*. 2007). Introduced species are asterisked.

| Species | Common Name |
|---|---|
| **Gradual Decline** | |
| *Galaxias argenteus* | giant kōkopu |
| *Anguilla dieffenbachii* | longfin eel |
| **Sparse** | |
| *Galaxias postvectis* | shortjaw kōkopu |
| *Geotria australis* | Lamprey |
| **Not Threatened** | |
| *Anguilla australis* | shortfin eel |
| *Cheimarrichthys fosteri* | Torrentfish |
| *Galaxias brevipinnis* | Koaro |
| *Galaxias fasciatus* | banded kōkopu |
| *Galaxias maculatus* | Inanga |
| *Gobiomorphus cotidianus* | common bully |
| *Gobiomorphus hubbsi* | bluegill bully |
| *Gobiomorphus huttonii* | redfin bully |
| *Retropinna retropinna* | common smelt |
| **Salmo trutta* | brown trout |

## 8.5 Terrestrial invertebrates

Hump ridge is the type locality for 21 species of Coleoptera and about 10 species of Lepidoptera, has high levels of endemism, and contains some species of restricted distribution (Elliot and Ogle 1985, McEwen 1987; Table 15). In a survey of marine terraces between Angus Burn and Crombie Stream, Patrick (1988) found two species endemic to southern Fiordland: *Dorcus philpotti* (Coleoptera: Lucanidae) and *Proteodes* n.sp. (Lepidoptera: Oecophoridae). Two of the gastropoda listed by Mason (1988) from the same marine terraces are nationally threatened (Table 15). Waitutu ED is considered to be important for land snail fauna because it was not glaciated (McEwen 1987).

Table 15: Threatened, uncommon, and important terrestrial invertebrates recorded in Waitutu. Taxa are listed by threat class (Hitchmough *et al*. 2007).

| Species | Common name | Notes |
|---|---|---|
| **Sparse** | | |
| *Mecodema rex* | carabid beetle | Hump Ridge; possibly threatened by rodents |
| **Range Restricted** | | |
| *Flammulina lateaperta* | land snail | Coastal |
| *Ptychodon blacki* | land snail | Forest |
| *Mecodema litoreum* | carabid beetle | Coastal forest, type locality Hump Ridge (for syn. *M. dissonum*) |
| **Not Threatened** | | |
| *Anchomenus libitus* | carabid beetle | Type locality Hakapoua |
| *Aponotoreas villosa* | Lepidoptera | Type locality Hump Ridge |
| *Asaphodes aphelias* | Lepidoptera | Type locality Hump Ridge |
| *Diglymma marginale* | Lepidoptera | Type locality Hump Ridge |
| *Dorcus philpotti* | stag beetle | Endemic to southern Fiordland |
| *Glyphipterix aenea* | Lepidoptera | Type locality Hump Ridge |
| *Grypotheca triangularis* | Lepidoptera | Type locality Hump Ridge |
| *Holcaspis impigra* | carabid beetle | Type locality Hump Ridge (for syn. *Pterostichus fenwicki*) |
| *Izatha mira* | Lepidoptera | Type locality Hump Ridge |
| *Mallobathra aphrosticha* | Lepidoptera | Type locality Hump Ridge |
| *Mecodema femorale* | carabid beetle | Type locality Hump Ridge |
| *Neoferonia fossalis* | carabid beetle | Type locality Hump Ridge (for syn. *Pterostichus fossalis*) |
| *Proteodes* n.sp. | Lepidoptera | Endemic to southern Fiordland |
| *Reductoderces illustris* | Lepidoptera | Type locality Hump Ridge |
| *Rhytida otagoensis* | land snail | Apparently common only in western Southland and at a few more northerly locations near Piano Flat and Kaitangata (Efford 1998) |
| *Scoparia clavata* | Lepidoptera | Type locality Hump Ridge |
| *Scoparia subita* | Lepidoptera | Type locality Hump Ridge |
| *Taenarthrus philpotti* | carabid beetle | Type locality Hump Ridge |

## 8.6 Freshwater invertebrates

The nationally threatened koura (*Paranephrops zealandicus*; Gradual Decline) has been recorded in Waitutu (Table 16).

Table 16: Freshwater invertebrates recorded in Waitutu 1984-1998 (New Zealand Freshwater Fish Database, NIWA 2008), listed by threat class (Hitchmough *et al*. 2007).

| Species | Common Name | Location |
|---|---|---|
| **Gradual Decline** | | |
| *Paranephrops zealandicus* | koura | Percy Burn<br>Edwin Burn<br>Crombie Stream<br>Unnamed stream in Knife and Steel Harbour |

# 9. NATIONAL PRIORITIES FOR BIODIVERSITY PROTECTION

The Waitutu Area fully meets three of the four national priorities for protecting rare and threatened biodiversity on private land (Statement of National Priorities, DOC/MfE 2007).

***National Priority 1: To protect indigenous vegetation associated with land environments that have 20% or less remaining in indigenous cover.***

Most of Waitutu is covered in indigenous vegetation and most of its land environments fall into the "Less Reduced and Better Protected" category (>30% indigenous cover remaining and >20% protected - Walker *et al*. 2007). Small areas of land within Waitutu fall within the 'Acutely Threatened' category (<10% of indigenous cover remaining). These areas are located south-east of Lake Poteriteri and near the Kaikokopu Stream-Wairaurahiri River confluence.

***National Priority 2: To protect indigenous vegetation associated with sand dunes and wetlands, ecosystem types that have become uncommon due to human activity.***

A number of wetlands and dune systems (one of national importance) are present within Waitutu.

***National Priority 3: To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.***

Originally rare ecosystems (see Section 6.2.2) present in Waitutu include coastal turfs, gravel beaches and sand dunes.

***National Priority 4: To protect habitats of acutely and chronically threatened indigenous species.***

Waitutu provides habitats for at least 44 acutely and chronically threatened species of plants and birds.

# 10. NATIONALLY RARE ECOSYSTEMS

Nationally rare ecosystems (Williams *et al*. 2006) present in the Waitutu area include coastal turfs, gravel beaches, and dunes.

Coastal Turfs

Rogers (1999) studied turf communities along the Waitutu coast. The communities were restricted to 15 km of the Waitutu marine terrace mudstones, with their overlay of fluvioglacial outwash gravels (Ward 1988), between easternmost Wairaurahiri River and westernmost Grant Burn (Table 23). The main conclusions reached by Rogers (1999) were:

- there was a marked absence from Waitutu turfs of *Isolepis cernua* and *Crassula moschata*, which are indicators elsewhere, along with *Lilaeopsis novae-zelandiae*, of damp or wet soils;
- Also absent from sampled sites was *Selliera radicans*, a dominant of turfs elsewhere;
- The capping gravels are absent on a promontory at Long Point, where a large turf has developed on a mudstone-derived clay-loam soil. This turf also supports high species diversity and few adventives;
- Four of the five Waitutu turfs were classified as "Association C" *Leptinella dioica*-(*Gunnera monoica*) herbfield, and one site as "Association F" *Leptinella dioica*-(*Selliera radicans*)-(*Isolepis cernua*) herbfield, despite the absence of the latter two species;
- These classifications belie the turfs' rich and relatively unusual composition, with prominent species such as *Schoenus nitens*, *Ranunculus multiscapus*, *Pratia angulata*, *Eleocharis acuta*, *Schoenus maschalinus*, *Gunnera dentata*, *Poa pusilla*, *Sonchus kirkii*, *Rytidosperma setifolium*, *Ophioglossum coriaceum*, *Lagenifera petiolata*, *Marchantia berteroana*, and *Viola cunninghamii*;
- Long Point displayed a wide mix of unusual turf constituents such as *Rytidosperma setifolium*, *Senecio lautus*, and *Sonchus kirkii*.
- Given the high pellet densities, deer exert heavy impact upon the Waitutu coastal fringe, with circumstantial evidence that considerable rearward and longitudinal expansion of turfs has resulted;
- Waitutu coastal turfs offer the most reliable insights nationally into their spatial relationships with adjacent coastal scrub and forest.
- There were no nationally threatened or local species or few provincially significant entities. *Gunnera dentata* was found only in Fiordland turfs.

Table 23: Turf communities along the Waitutu coast (Rogers 1999).

| Locality | Grid Ref NZMS 260 | Altitude (m) | Area (ha) | Landform Lithology | Physio-graphy | High Priority Site |
|---|---|---|---|---|---|---|
| Crombie Stream | C46/615229 | 40 | 0.15 | glacial gravels | interfluve | Yes: buffering. |
| Angus Burn | C46/580235 | 3 | 0.24 | glacial gravels | interfluve | Yes: representativeness, naturalness, buffering, species diversity. |
| Long Point | C46/557225 | 15 | 0.30 | mudstone | interfluve | Yes: representativeness, naturalness, size, buffering, species diversity. |
| Waitutu Point | C46/538236 | 16 | 0.30 | glacial gravels | interfluve | Yes: size, buffering. |
| Grant Burn | B46/459249 | 5 | 0.03 | mudstone | colluvial footslope | No. |

DOC is working in partnership with Landcare Research on two aspects of coastal turfs: a) geography, pedology, and plant biogeography; b) community responses to a release of grazing pressure (Landcare Research 2008).

Gravel/Shingle Beaches

Landcare Research, as part of research into rare ecosystems, have selected shingle beaches as an ecosystem that is widespread nationally, has never been surveyed nationally for plants or invertebrates, is highly threatened by urbanisation, weeds, adjacent agriculture, and introduced animals, and contains both threatened plants and fauna, and endemic plants (Landcare Research 2008a). In 2006–07 Landcare Research completed sampling plants and invertebrates on 49 shingle beach sites around the New Zealand coast. The only coastline remaining to be sampled on the South Island is in Southland, Fiordland and the Marlborough Sounds (Landcare Research 2008b).

Dunes

Sites in Waitutu with dunes are covered previously in Section 6.1.5.

## 11. NATURAL HERITAGE MANAGEMENT SYSTEM

DOC is implementing a Natural Heritage Management System (NHMS) intended to record inventory information about ecological and heritage values. The purpose of the system is to provide objective information to enable DOC and the community to select best outcomes for natural heritage areas (by setting clearer goals, choosing priority actions, and planning more consistently and transparently), and report on achieving those outcomes. The NHMS project began in 2002 and has recently reached the implementation phase (Office of the Auditor-General 2006).

As part of this project, the most important places to undertake biodiversity work need to be identified. These important places are proposed to be called "vital sites" and are those sites where intensive and comprehensive biodiversity management is expected to contribute most towards restoring and maintaining the most ecological integrity

across the full range of New Zealand ecosystems, and where it is at highest risk of loss.

Given the large diversity of species, ecosystems, habitat types (including terrestrial, freshwater and saltwater systems), and geology in the Waitutu area, as well as the significant recent decline of threatened species and the relatively recent arrival of possums, it seems that the Waitutu area should be ranked as a vital site.

# 12. PESTS

## 12.1 Pest plants

Waitutu Forest is generally free of weeds and the only weed control undertaken is along the coastline. This involves an annual flight, generally in December, to undertake surveillance and control work. Species targeted are marram (*Ammophila arenaria*), gorse (*Ulex europaeus*), and broom (*Cytisus scoparius*). Following past marram control initiatives, the entire Fiordland Coast (including southern Fiordland), is being maintained at zero density (Lynne Huggins, Department of Conservation, pers. comm., January 2008).

## 12.2 Pest animals

At least ten species of introduced mammals are present in Waitutu (Table 17).

Table 17: Pest animals recorded in Waitutu.

| Species | Common Name | Notes |
|---|---|---|
| *Cervus elaphus scoticus* | red deer | Released Lillburn (1901), north of Hump Ridge (1901-1904), Bluecliffs Beach (1901), Dusky Sound (1909); now widespread |
| *Lepus europaeus* | brown hare | Alpine grasslands |
| *Mus musculus* | house mouse | Widespread |
| *Mustela erminea* | stoat | Colonised as far as Waiaurahiri River by 1895; now widespread in low numbers |
| *Oryctolagus cuniculus* | European rabbit | Recorded at Sand Hill point by Dorizac (1963), but not reported since |
| *Rattus exulans* | kiore | Rare? |
| *Rattus norvegicus* | Norway rat | Rare? |
| *Rattus rattus* | ship rat | Present from late 18th century; now widespread to common |
| *Sus scrofa* | feral pig | Escapees from Tuatapere/Orepuki area and possibly released from Port Craig (1920s); now very common east of Lake Poteriteri |
| *Trichosurus vulpecula* | brushtail possum | Liberated in Longwoods (1875), Merivale area (1900), Waiau mouth (1925); uncommon west of Wairaurahiri River until 1984 |

## 12.3 Scale of pest animal impacts

Impacts of pest animals include modification of plant community composition through selective browsing of palatable species (e.g. by possums and deer) and predation of indigenous wildlife (e.g. by stoats and rats) (Table 18).

Table 18: Potential impacts of pest animals in Waitutu.

| Species | Impacts | Reference(s) |
|---|---|---|
| red deer | • modification of plant community composition through preferential feeding on palatable species;<br>• inhibition of regeneration;<br>• changes in below-ground processes such as nutrient cycling;<br>• may reduce Lepidoptera diversity | Fiordland area<br>Mark *et al*. (1991)<br><br>Waitutu<br>Patrick (1988) |
| brown hare | | |
| house mouse | • potential to affect forest regeneration and populations of native invertebrate and avian seed-feeders through seed consumption;<br>• population explosions related to seed masting of beech and rimu increases numbers of stoats, which switch to birds as prey when mouse numbers decline | Waitutu<br>Wilson *et al*. (2006)<br>Wilson *et al*. (2007) |
| stoat | • bird predation | |
| European rabbit | • browsing of coastal species | |
| kiore | • bird predation, seedling and seed predation | |
| Norway rat | • bird predation, seedling and seed predation | |
| ship rat | • bird predation, seedling and seed predation | |
| feral pig | • linked to absence of ground birds;<br>• changes in below-ground processes such as nutrient cycling and fertility | Waitutu<br>Anon (1984) |
| brushtail possum | • reduction of all palatable species such as Southern rata, kamahi, Hall's totara, pokaka, wineberry, fuchsia, *Raukaua simplex*, and mistletoe;<br>• canopy dieback;<br>• decrease in bird numbers, including threatened species;<br>• bird predation;<br>• diet overlap (e.g. mistletoe, rimu fruit) with native species such as kaka;<br>• changes in below-ground processes such as nutrient cycling<br>• seedling & seed predation | Waitutu<br>Baxter (1995c, 2000b)<br>Coleman (1991)<br>Southey (1999, 2000a, 2000b) |

### 12.3.1 Brushtail possums

Possums have been absent from Waitutu until relatively recently (Table 19). The implications of this late colonisation are threefold:

- numbers are still low in many areas;
- adverse effects of possums are lower than for areas of New Zealand with a longer colonisation history;
- there is the potential to retain much of the pre-possum natural character of the Waitutu.

Table 19: Colonisation history of Waitutu by brushtail possums.

| Date/ period | Area found |
|---|---|
| 1875 | liberated in Longwoods |
| 1900 | liberated in Merivale area |
| 1925 | liberated at Waiau mouth |
| 1960s | Waitutu essentially possum-free |
| early 1970s | first crossing of Waiaurahiri River |
| until 1984 | uncommon west of Wairaurahiri River |
| 1991 | • possums well established east of Waiaurahiri River<br>• widespread in low numbers between the Waiaurahiri River and Waitutu River<br>• newly established in coastal forest west of Waitutu River |
| present day | • probably the entire Waitutu colonised<br>• area west of Waitutu River probably has established populations |

## 13. PREVIOUS MONITORING

Vegetation

There are numerous vegetation sample plots within Waitutu (Table 20).

Pest Animals

The Department of Conservation has undertaken sporadic possum monitoring in Waitutu since 1978, and targeted possum control operations since 1996 (Table 21). Possum monitoring and control has been undertaken for the purposes of:

- assessing spread of possums to the west;
- slowing the spread of possums;
- assessing the effectiveness of control efforts;
- protecting Landcare Research project sites;
- protecting possum-vulnerable ecological values in treatment areas.

Table 20: Vegetation monitoring in Waitutu Forest.

| Year/Period | Details | Measurements | Conclusions |
|---|---|---|---|
| 1978-1979 | NZFS established 136 permanent forest monitoring plots along transects | GRASSLAND - Point distance<br>FOREST - Quadrat tree diameter<br>FOREST - Quadrat Sapling<br>FOREST - Quadrat Seedling<br>FOREST - Recce inventory<br>GRASSLAND - Stereo photo<br>GRASSLAND - Transect data | |
| 1978 | NVS | Deer - Presence/Absence - 1.14 m radius<br>Deer - Point Distance-Nearest Neighbour - 3.00 m radius<br>Feral Pig - Presence/Absence - 1.14 m radius<br>Feral Pig - Animal Sign<br>Possum - Presence/Absence - 1.14 m radius<br>Possum - Animal Sign<br>Permanent plots - stem diameter measurements<br>Permanent plots - seedling counts<br>Recces - browse data | |
| 1984 | NZFS forest plots remeasured | Deer, feral pig, possum, and hare - Presence/Absence - 1.13 m radius<br>Deer - Point Distance-Nearest Neighbour - 2.00 m radius<br>Deer - Disappearance Rate - Swath | Deer numbers stable (i.e. similar to 1978). |
| 1992 | 155 recce plots established | | |
| 1996-1998 | 106 of original NZFS plots and 155 recce plots remeasured | FOREST - Pellet line data<br>FOREST - Quadrat tree diameter<br>FOREST - Quadrat Sapling<br>FOREST - Quadrat Seedling<br>FOREST - Recce inventory | |
| 1998 | Waitutu exclosures | Recce inventory<br>Quadrat tree diameter<br>Quadrat sapling<br>Quadrat seedling | |

| Year/Period | Details | Measurements | Conclusions |
|---|---|---|---|
| 2001 | Waitutu Landcare Projects - Ungulate Exclosure Experiment | FOREST - Recce inventory<br>FOREST - Quadrat tree diameter<br>FOREST - Quadrat seedling<br>FOREST - Quadrat sapling<br>FOREST - Quadrat tree diameter (2)<br>FOREST - Quadrat seedling (2)<br>FOREST - Quadrat seedling (3) | |
| 2001-2002 | Waitutu Landcare, DOC Projects – Stand mapping | Permanent plots of 1.5 ha or 2.2. ha at seven sites – Stems > 10 cm dbh of all canopy species and > 2.5 cm dbh of all subcanopy species in each plot were mapped (species and dbh and position were recorded) | |

Table 21: Possum control and monitoring operations undertaken in Waitutu.

| Year/ Period | Project/Area | Pesticide, Bait and Method Used | Outcome | Reference(s) |
|---|---|---|---|---|
| 1978–<br>1980s | Several assessments carried out | | Possums cross Waitutu River from east. | |
| 1991 | DOC-funded Forest Research Institute assessment of possum management | 250 lured toxic baits | 5 kills: kill ratio 0.03%; possums recently arrived west of Waitutu; possums widespread but low densities between Waitutu and Waiaurahiri Rivers; possums well established and probably growing quickly east of Waiaurahiri River; control measures recommended | Coleman (1991) |
| 1994 | DOC possum presence/absence survey | observational, some trapping | possums in low densities as far as Big River and yet to colonise large areas of western Waitutu | |
| 1995 | DOC possum surveys | 2088 trap nights, traps at 50 m intervals on 47 possum lines | possum density west of Waitutu low to moderate; Waitutu River only partially effective barrier to migration; control measures recommended | Baxter (1995a, 1995b) |

| Year/ Period | Project/Area | Pesticide, Bait and Method Used | Outcome | Reference(s) |
|---|---|---|---|---|
| Jan 1996-Feb 1997 | DOC, Waitutu Incorporation, and private land in Waitutu River area | contractors undertook initial knockdown over 3,300ha using traps and cyanide to 2% RTC; afterwards grid network of Philproof bait stations containing 1080 and Talon centered on 1,150 ha core control area near Waitutu River; trial using Feratox cyanide bait stations in late 1997 | | |
| 1996-1998 | NZFS vegetation lines | 1340 trap nights; 1800 pellet counts | 0-21.5% | |
| Nov 1996 | volunteer trip Waiaurahiri River | 1 trap catch line | 25% | |
| Feb 1997 | possum control residual trap catch monitoring | 400 transects, 20 traps every 20 m | 0-6.67% (mean 1.89%) in east Waitutu; 0-1.67% (mean 0.39%) in west Waitutu | |
| Nov 1997 | Waitutu River | possum control residual trap catch monitoring | combined trap catches <1% | |
| Dec 1997-Feb 1998 | Waitutu | possum control residual trap catch monitoring | 1.9% in east Waitutu; 0.47% in west Waitutu | |
| Sep 1997-May 2000 | maintenance of possum control in Waitutu River 1,150 ha core control area | Bi-monthly rebaiting stations, installation, removal, and/or rebaiting of Feratox lines | | |
| 1997-2000 | additional area of 2,225ha to the east and west of the core area around the Waitutu River | Traps and cyanide | | |
| Mar 1998 | Lake Poteriteri | trap lines, Feratox lines | 0-17.3% | |
| Mar and Apr 1999 | Slaughter Burn<br>Aan River | trap lines, poison lines | 0-15.5%<br>6.25% | |
| 1999 | upper Big River | Possum surveys | 0 possums found | |
| Feb 2000 | Waitutu River area | density monitoring, 44 trap lines | 2.1%-7.9% (mean 4.1%); higher catch rates outside control areas | |
| 2002 | Crombie River | Possum survey | 21% RTC around Crombie River | |
| 2004 | ground based possum control is carried out to protect Landcare Research study sites1,515 ha | traps and Feratox to 5% RTC | | |
| 2005-2006 | DoC monitoring grids set up at Waitutu and Poteriteri | Waitutu to receive possum control Poteriteri is non-treatment area | | |

| Year/ Period | Project/Area | Pesticide, Bait and Method Used | Outcome | Reference(s) |
|---|---|---|---|---|
| 2006 | Possum monitor over 15,574ha from Big River to Wairaurahiri River and from the coast north to level with the southern limit of Lake Poteriteri | | west of Waitutu River 4%RTC, east of Waitutu River 12%RTC, Lake Poteriteri 17%RTC | |
| 2006 | 1579 ha around research sites | Possum control using traps and Feratox Target 5% RTC | 4% RTC | |
| 2007 | 2,500 ha | ground based possum control (target 3%RTC) | <1%RTC | |

Waitutu and Poteriteri Monitoring Grids

The Department of Conservation Murihiku Area Office and RD&I Section have established a 1,000 ha study site in the lower Waitutu area. A ground-based possum control operation within this area is planned for May 2007 using existing funding. A similar non-treatment site is located in a large flat on the eastern side of Lake Poteriteri. Grid systems have been set-up at both sites to enable intensive monitoring of forest birds.

The research at these sites aims to achieve the following objectives:

- To determine the effectiveness of a broad-scale, ground regime (Feratox), in reducing possum abundance to less than 3% RTC.
- To determine the effectiveness of the possum control regime, in the presence of high mustelid abundance, for management of kaka, an acutely threatened taxa.
- To evaluate the umbrella species concept through determining what other biodiversity benefits are produced by the demographic response of managed kaka populations (i.e. changes in distribution and density of other forest bird and plant species).
- To determine the benefits of broad-scale possum control on vegetation composition using indicator species (e.g. mistletoe).
- To establish the status of, and trends in, forest structure and composition in the presence of unmanaged rodent and ungulate populations.
- To determine the trends in animal pest abundance in Waitutu Forest.

There has also been some monitoring of rodent and mustelid populations (Table 22).

**Commented [e1]:** Note, these objectives (and the work occuring in Waitutu) are from the Waitutu Monitoring Plan (Draft) by Wright, Dilks and Greene 2005. Even though it is in draft I think its appropriate to cite it as the work RD&I are conducting there in collaboration with Murihiku Area Office is outlined in this plan, prepared on their behalf at the request of Southland Conservancy.

## 14. EXISTING INFRASTRUCTURE AND FUTURE REQUIREMENTS

**Tracks/Walkways:** The southern coast walkway runs from Blue Cliffs to Big River, providing good access to the coastal area. A public track runs from Lake Hauroko over a swing bridge at the head of the Wairaurahiri River and across to Lake Poteriteri. A route exists between Waitutu Hut and Slaughterburn Hut.

**Huts and Bivvies:** DoC huts (12 bunk) are located near the mouth of both the Wairaurahiri and Waitutu Rivers. The Waitutu Incorporation has a lodge located at the mouth of the Wairaurahiri River with a resident caretaker and a hut at Long Point. The Slaughterburn Hut (a 2 bunk biodiversity/hunter hut) is located near the confluence of the Slaughterburn and Waitutu Rivers. Two biodiversity bivvies are located on Terrace 6 and the Crombie Stream.

**Commented [e2]:** Do you need to indicate who owns these? LCR in the case of the bivvies and the Slaughter burn hut is an unpermitted hut

Table 22: Rodent and mustelid monitoring undertaken in Waitutu.

| Year/ Period | Project/Area | Pesticide, Bait and Method Used | Outcome | Reference |
|---|---|---|---|---|
| Feb 2000 | As part of possum density monitoring | 44 trap lines | Rats 2.1%RTC | |
| Nov 2002-Feb 2007 | Rodent and mustelid monitoring at Slaughter Burn (Nov 02), Lake Poteriteri (Feb 06), and Waitutu Coast (Feb 07) | Six lines, 10 tunnels per line | Stoats tracking 90-100% at Slaughterburn and lower Waitutu. At Poteriteri the tracking rates have been slightly lower;<br>Concluded that rodents not necessary to maintain stoat population;<br>Assumed that invertebrates and birds play a significant role in stoat diet | |

**Commented [e3]:** The work conducted on rodent and mustelid at slaughter burn was originally funded by the Stoat programme but has been continued and expanded into LP and WC in association with the research investigation # 3928, DOCDM-26093 and current monitoring of birds – some note to that effect would be appropriate otherwise its not clear why it is occuring

**Bridges:** There are swing bridges crossing the Wairaurahiri and Waitutu Rivers at either end. A 3-wire bridge has been installed mid-way down the Waitutu River .

Some of these bridges and bivvies were installed specifically to assist with research field work.

**Deer Exclosure Plots:** The Murihiku Area has three deer exclosure plots in the lower Waitutu area. These were installed in 2001 are in good condition and due to be re-measured in February 2008.

**Rodent and Mustelid Monitoring:** A series of mustelid and rodent monitoring lines have been established and monitored at both the Waitutu research site and the Poteriteri non-treatment site.

Seed fall monitoring has also been established (approximately 160 trays at various locations).

There is currently no monitoring for pigs.

**Commented [e4]:** this was installed to support the rodent mark recapture work undertaken by LCR. They funded the infrastructure

**Commented [e5]:** note previous comment in table regarding this monitoring

**Commented [e6]:** This was initiated in 2001 in association with the research programme, is ongoing but was exapanded into Lake Poteriteri when the bird grids were set up. With the exception of Lake Poteriteri the seed traps are located within the seven mapped stands

**Commented [e7]:** Thats correct but there was for several years using transect lines looking at degree of disturbance and microbial activity and seedling recruitment. More targetted at pig impacts rather than a direct measure of pig populations

# 15. INTEGRATION WITH OTHER WORK

## 15.1 DOC management

### 15.1.1 Weed control, recreation, historic places

Weed control is generally limited to the coast and therefore these operations are unlikely to be easily integrated with pest control work elsewhere. However, if space was available, weed monitoring flyovers could be used to transport staff and equipment for pest control operations.

Current maintenance of the track network, bridges, and huts will make Waitutu more accessible during pest control operations.

## 15.2 Other agencies

### 15.2.1 Landcare Research - forest dynamics (OBI)

Waitutu Forest is the location of a major ecological research initiative now funded as an 'Outcome Based Investment" led by Manaaki Whenua (Landcare Research). This project is ambitious, long-term research on the impacts and consequences of natural processes, herbivores and human disturbances on native forest, to a level of detail never before attempted in New Zealand. Manaaki Whenua is collaborating with researchers from DOC, Cambridge University (UK), Institute of Ecosystem Studies (USA), and Arthur Rylah Institute (Australia), with support from the Waitutu Incorporation.

Waitutu Forest was selected for the study because it has a series of marine and alluvial terraces of varying ages and fertility. Forest structure and composition have been

**Commented [e8]:** Started back in 2000 using NSOF $$ from LCR and DOC research $. Now funded via OBI, DOC, IES, NERC with subcontracts to Arthur Rylah etc.

mapped at three sites on each terrace, and ten different experiments have been set up at each site.

Research has involved:

- Mapping of vegetation;
- Tagging of more than 15,000 seedlings as part of studies into species ~~recruitment and~~ mortality;
- Rodent tracking;
- Seedfall monitoring
- Analysis of red deer gut contents to find dietary preferences;
- Measurement of below ground microbial activity;
- Development of a forest dynamics model, SORTIE/NZ;
- Weather Stations at Waitutu Coast and Lake Poteriteri;

Forest managers will benefit from this research through a greater understanding of:

- The impacts of multiple herbivores and what benefits may or may not be expected if just one pest or several were controlled;
- Whether undesirable changes in forest ecosystems are site or context specific, or whether the changes are the product of more general irreversible processes (Landcare Research 2003).

### 15.2.2 Department of Conservation

Kaka Research

DOC RD&I currently has seven female kaka radio tagged at Poteriteri and one tagged in the Waitutu River area. Kaka appear to remain in the general areas in which they were caught. Sexing of caught kaka revealed a highly skewed female:male sex ratio in Waitutu (1:6.7) compared to other sites in New Zealand, indicating predation of female kaka on nests. Predation of juveniles was also occurring. While kaka are still present in moderate numbers, the medium-term outlook for this species is poor without effective predator control.

In January 2008, kaka nesting trees were banded below and, where possible, above nests. Fenn traps (baited with salted rabbit meat) and bait stations (with Contrax bloc) were placed around the trees.

## 16. COMMUNITY-BASED INITIATIVES AND INTERESTS

The following community groups are potential stakeholders in the preservation and restoration of Waitutu. Several of the groups undertake, or plan to undertake, predator control within the area.

**Commented [e9]:** Seven sites in total, 3 alluvial, 4 intermediate terraces)

**Commented [e10]:** there are a minimum of 20 projects and they are not all specifically associated with each site, but are part of the programme either to support parameterisation of the model or provide relevant information for interpretation etc. Can send more details if you want.

**Commented [e11]:** this does not represent the work - more detail is required, could send an outline of the main components if the authors wish to represent the work more completely, its my preference that this is done

**Commented [e12]:** Tagging was to get at mortality of seedlings, not recruitment.

**Commented [e13]:** need to emphasize mark recapture not really tracking.

**Commented [e14]:** These were installed by DOC to support the monitoring plan, the only weather station installed by LCR in support of the research programme was the one at Terrace six

## 16.1 Waitutu Incorporation

Waitutu Incorporation administers 2,171 ha of land in southern Waitutu. The land has about 800 owners and is held under Maori freehold title, having been granted under the South Island Landless Natives Act 1906 (SILNA) as compensation against lands taken elsewhere (Waitutu is not ancestral land, but there is evidence of early Maori occupation and the long association has resulted in strong feelings towards the land under current ownership). There are two further freehold sections totaling 250 ha within the original Waitutu grant (New Zealand Government 1996).

The Waitutu Incorporation are supporters of the Landcare Research and DOC research being undertaken and have been involved in the planning and consultation from the outset. Landowners have willingly offered DOC access to their facilities within Waitutu Incorporation Land.

Waitutu Incorporation owns Waitutu Lodge near the mouth of the Wairaurahiri River. The custodian currently undertakes possum and stoat trapping, mainly to sell the fur.

## 16.2 Wairaurahiri jet stoat control initiative

Wairaurahiri Jet holds a concession to operate a commercial jet boating trips from Lake Hauroko to the mouth of Wairaurahiri River. The company undertakes stoat control along the eastern side of Wairaurahiri River using kill traps mostly sponsored by local individuals, families, and organisations. As at 18 December 2007, two weasels, 164 stoats, and 26 rats had been caught (http://www.wjet.co.nz).

## 16.3 Westies Cave Hut Trust upgrade

Westies Cave Hut is a private hut located east of Big River mouth (NZMS B46 433 254), and maintained by a trust. It was upgraded in January 2008.

## 16.4 Hump Ridge Track Trust

The Hump Ridge Track opened in November 2001. It is a 3 day/2 night circuit tramp, which incorporates Bluecliffs Beach, Hump Ridge, old logging tramways and viaducts, and Port Craig. The Trust plans to instigate a 'Bring on the Dawn Chorus' campaign which includes pest eradication and environmental enhancement projects (http://www.humpridgetrack.co.nz). Currently, lodge managers are catching possums and stoats around Port Craig Village, but it is intended to extend this trapping over a much wider area next season. This will be partially achieved through sponsorship of traps (Marianne Widmer, General Manager, pers. comm. March 2008).

## 16.5 Port Craig Viaducts Trust

Four viaducts form part of the South Coast Track which passes through Waitutu Incorporation lands before ending at Waitutu River. The viaducts were built of Australian hardwood in the early 1920s to service the Port Craig sawmill. The 36 m high and 125 m long Percy Burn viaduct is the largest surviving wooden viaduct in the world. The Viaducts Trust was set up to restore and preserve the viaducts, with

the Percy Burn viaduct being fully repaired in 1994 and the other viaducts refurbished in 1999.

### 16.6 Recreational groups

Members of the Southland Tramping Club and other tramping clubs from throughout New Zealand regularly visit the area. Federated Mountain Clubs is advocating for a 'Poteriteri Wilderness' covering part of the Waitutu area. Wilderness designation does not restrict conservation management activities.

### 16.7 Conservation groups

Forest & Bird has been active in the campaign to preserve Waitutu Forest for many years.

Coast Beach Cleanup (run by DOC Te Anau) periodically passes through the area.

Roger McNaughton of the Southland Conservation Board is very supportive of pest animal control in Waitutu Forest (Colin Bishop, Department of Conservation, pers. comm. 2008).

### 16.8 Hunting

Deer stalking is popular in the Waitutu area, particularly during the roar. Pig hunters visit occasionally. DOC biodiversity teams regularly use the hunter/biodiversity hut at Slaughter Burn (Colin Bishop, Department of Conservation, pers. comm., 2008).

### 16.9 White baiting

White baiting is popular at the mouth of the rivers during the season.

## 17. COMPARISONS WITH OTHER AREAS RECEIVING INTENSIVE PEST CONTROL

The Department of Conservation prioritises pest control based on values at risk. The following briefly describes Operation Ark (Table 24) and Mainland Island (Table 25) sites currently receiving pest control, and compares them to Waitutu. An additional site, Pembroke Wilderness Area, is included because funding initially earmarked for Waitutu was diverted to this area in 2006. Descriptions of two Operation Ark sites (see Table 24 for a summary of all Ark sites) are given in greater detail as they occur relatively close to Waitutu.

### 17.1 Pembroke Wilderness Area

The Pembroke Wilderness Area covers 18,000 ha in Fiordland National Park between Milford Sound and Martins Bay. Pembroke has been identified in the Fiordland National Park Management Plan as a priority area for possum control because it is one of the areas most affected by possums. Control has been by aerial drops of sodium monofluoracetate (1080). Monitoring has been carried out in conjunction with

possum control and has involved recording improvement in the condition of some tree species such as totara and mähoe (DOC 2007).

## 17.2 Operation Ark sites

Arthur, Clinton, and Cleddau Valleys

The Clinton-Arthur-Cleddau Operation Ark site is located about 70 km north of Te Anau and is centred around the Milford Track. It comprises *c*.97 km of protected river in the Clinton, Arthur and Cleddau catchments in Fiordland National Park. An additional 26 km of river in the Worsley and Castle catchments is protected by the efforts of the Fiordland Wapiti Foundation. The forests in these valleys comprise mostly silver beech, though in the lower reaches of the Clinton Valley there is some red beech, and the lower reaches of the Arthur and Cleddau Valleys there is rimu (*Dacrydium cupressinum*), totara *(Podocarpus hallii*), and miro (*Prumnopitys ferruginea*). Threatened species present include mohua (small remnant population) and whio/blue duck (one of the largest populations left in the South Island). The whio population is one of four areas in the South Island identified by the Whio Recovery Group as being a key site for whio conservation and whio are the focus of attention for Operation Ark at this site. The valley also supports populations of southern tokoeka (*Apteryx australis*) and weka.

Pest control and monitoring that has been undertaken includes:

- Stoat trapping (began in 2002, now >100 km of lines with traps at 200 m intervals);
- Stoat and rat monitoring (tracking tunnels, since 2001);
- Whio monitoring;
- Possum control (aerial 1080).

Whio breeding success and survivorship have increased dramatically since stoat control was initiated, with a subsequent increase in whio population size (Elliott and Suggate 2007).

Eglinton Valley

The Eglinton Valley, located between Te Anau and Milford Sound, is the site of a 16,500 ha Operation Ark pest control programme. Vegetation is predominantly silver beech (*Nothofagus menziesii*) and mountain beech (*Nothofagus solandri* var. *cliffortoides*) forests on hillslopes and a mosaic of red beech (*Nothofagus fusca*) forest, shrublands, and open grassland on valley floors. The valley provides habitat for several threatened species including kaka, mohua (a small remnant of a recently much larger population), whio/blue duck, yellow crowned parakeet, southern short-tailed bats (the only known mainland population), and long-tailed bats (a large population). It also contains the nationally threatened plants *Carex tenuicaulis*, *Dechampsia cespitosa*, *Uncinia strictissima*, and mistletoes *Peraxilla tetrapetala*, *P. colensoi*, and *Alepis flavida*. The valley is regarded as one of the most important beech forest sites in the South Island.

Principal pest animals hindering ecosystem recovery include possums, stoats, and rats. Deer numbers are low compared to other parts of Fiordland National Park due to hunting pressure. Weed species are common in this site and there is a history of stock grazing in the valley, which ceased in the late-1990s. Ecosystem restoration projects in the Operation Ark control area currently involve:

- Possum control (aerial 1080);
- Stoat control (traps at 200 m intervals over 40 km, since 1999);
- Stoat monitoring (10 lines of 10 tracking tunnels, since 1999);
- Rodent control (bait stations over 950 ha at 100 × 100 m intervals, since 2006);
- Long- and short-tailed bat monitoring;
- Mistletoe monitoring;
- Skink/gecko monitoring.
- Research by Landcare Research and DOC.

Monitoring has revealed that möhua and bats have been protected where rat bait stations were operative. However, to rebuild möhua numbers and to ensure sustainability of the bat populations, control areas need to be expanded (Elliott and Suggate 2007).

Table 24: Operation Ark sites, predator control, and targeted protected species (Elliott and Suggate 2007).

| Site | Primary Predator Control | Target Protected Species |
|---|---|---|
| Wangapeka-Fyfe (Kahurangi) | Stoat trapping, AHB possum control | Whio |
| Hawdon-Poulter (Canterbury) | Stoat trapping, bait station and aerial 1080 rat control, possum control via aerial 1080 | Orange-fronted parakeet, möhua |
| South Branch Hurunui - Mainland Island (Canterbury) | Stoat trapping, bait station and aerial 1080 rat control, possum control | Orange-fronted parakeet, möhua |
| Oparara-Ugly (Kahurangi) | Stoat trapping | Whio |
| Landsborough (Sth Westland) | Stoat trapping | Möhua, whio |
| Dart-Caples (Western Otago) | Stoat trapping, bait station and aerial 1080 rat control, possum control | Möhua |
| Catlins (South-East Otago) | Stoat trapping, bait station rat control, AHB aerial 1080 possum control | Möhua |
| Eglinton (Fiordland) | Stoat trapping, bait station rat control, aerial1080 possum control | Möhua, short-tailed and long-tailed bats |
| Blue Mountains (Southland) | Monitoring only | Möhua |
| Clinton, Arthur, Cleddau (Fiordland) | Stoat trapping, aerial 1080 possum control | Whio, möhua |

Other Fiordland Pest Control

- Hunters trapping to protect blue duck.

- Pest control operations in the Murchison Mountains 'Special Takahe Area' to protect takahe.

## 17.3 Mainland Islands

Mainland islands aim to protect and restore habitats on the mainland of New Zealand through intensive management of introduced pests. They are called "islands" because they are defined areas that are isolated by geographical features or, more commonly, intensive management of pests. Mainland islands require constant monitoring to check the effectiveness of management. There are six Department of Conservation Mainland Islands (Table 25).

Table 25: Department of Conservation Mainland Island pest control operations in New Zealand.

| Name | Details | Ecological Values | Work Undertaken |
|---|---|---|---|
| Boundary Stream | • 802 ha;<br>• Lowland forest (300 m asl) to montane forest, (1000 m asl);<br>• Eastern flanks of Maungaharuru Range;<br>• Hawkes Bay | • A diversity of habitats for flora and fauna;<br>• Threatened plants e.g. kaka beak, yellow-flowered mistletoe;<br>• Unusual plants e.g. neinei at the northern limit of its range, a unique pink-flowered kaka beak, and an 800-year-old matai;<br>• A diverse range of native birds including threatened species such as north island brown kiwi, kereru, kaka and NZ falcon;<br>• Largest reserve within Maungaharuru Ecological District | • Poisoning and trapping mustelids using Fenn traps<br>• Killing possums and rodents using bait stations;<br>• Hunting and shooting deer, goats and pigs within and outside reserve;<br>• Control of introduced plants;<br>• Monitoring of forest health, birds, and lizards;<br>• Re-establishing native plants and animals formerly present;<br>• Scientific research |
| Hurunui | • 12,000 ha;<br>• Montane beech forest;<br>• Hurunui River catchment of Lake Sumner Forest Park;<br>• Canterbury | • One of the most intact beech forest systems left in Canterbury;<br>• A healthy population of mohua, and the only known, significant population of orange-fronted parakeet;<br>• Other forest species such as kaka, NZ falcon, cuckoo, kea, great spotted kiwi, yellow crowned parakeet, and South Island robin;<br>• 32 native bird species have been recorded in the South Branch | • Bird monitoring - 5 minute bird counts; mohua banded and breeding success, survival rates, population growth, and movements monitored; kiwi monitored for productivity, population trends, and home ranges.<br>• Possum and stoat control - bait stations;<br>• Possum monitoring - trap catch lines;<br>• Rat control and monitoring;<br>• The hare population is |

| Name | Details | Ecological Values | Work Undertaken |
|---|---|---|---|
| | | | measured to monitor changes when the stoat population is reduced;<br>• Fencing;<br>• Wasp monitoring;<br>• Weed control;<br>• Seedfall traps;<br>• Mistletoe monitoring |
| Paengaroa | • 107 ha + 13 ha of Railcorp land;<br>• Banks of the Hautapu River, near Mataroa, Wanganui | • *Coprosma obconica* - known at only one other North Island site and a few sites in the South Island;<br>• *Pittosporum obcordatum*;<br>• *Korthalsella clavata and K lindsayii*;<br>• The country's largest population of *Olearia gardnerii* | • Posssum control - first aerial 1080 drop in 1992;<br>• Weed control started in 1990<br>• Seedfall monitoring |
| Rotoiti | • 5,000 ha;<br>• Predominantly red, silver and mountain beech forest;<br>• Alongside Lake Rotoiti within Nelson Lakes National Park | • Representative of a habitat type that occupies about 1 million ha or 15% of NZ's indigenous forests;<br>• SI kaka (low numbers), yellow-crowned parakeet, SI robin, and long-tailed bat;<br>• Mistletoe | • Possum, rodent, mustelid, deer, cat, chamois, pig, hedgehog, hare, and wasp control and monitoring;<br>• 5 minute bird counts;<br>• Kaka and robin monitoring;<br>• Lizard survey and monitoring;<br>• Great spotted kiwi have been reintroduced;<br>• Plant and vegetation monitoring - mistletoes, *Pittosporum patulum*, foliar browse index, beech and tussock seeding;<br>• Weed control |
| Te Urewera | • 50,000 ha;<br>• lowland to subalpine forest and mires, lowland fernland, exotic grassland, aquatic communities, riverbed communities, subalpine scrub and shrubland, and scrub and regenerating shrubland on recent slip sites<br>• Northern end of Te Urewera National Park | • full complement of North Island native forest birds apart from weka;<br>• kokako (over 90 pairs, largest managed population in NZ), NI brown kiwi, blue duck/whio, NI kaka, kereru;<br>• scarlet, yellow, and red mistletoes | • Possum control (ground based trapping and cyanide);<br>• Stoat Fenn trapping (4,013 ha);<br>• Rat snap trapping (1,500 ha);<br>• Deer control (shooting, 2,500 ha);<br>• 5 minute bird counts;<br>• Foliar browse index;<br>• Seedling monitoring lines;<br>• Monitoring of kokako breeding success, kiwi chick survival, rata growth, pirirangi (red mistletoe) distribution, and forest canopy |

| Name | Details | Ecological Values | Work Undertaken |
|---|---|---|---|
| | | | density |
| Trounson Kauri Park | • 450 ha;<br>• old growth kauri and regenerating broadleaf forest;<br>• Northland | • North Island brown kiwi, kukupa, and kauri snails, banded kōkopu, various weta species, long-tailed bat, kokako (reintroduced on a trial basis), and the highest-density of North Island brown kiwi populations in Northland (under threat from a northward-advancing ferret population);<br>• one of the best examples of kauri forest in NZ. | • control and monitoring of possums, rodents, mustelids, rats, and feral cats;<br>• ecosystem monitoring |

# 18. RELATIVE MERITS OF WAITUTU

## 18.1 Ecological values

- protection status
  - most of Waitutu is part of Fiordland National Park;
  - part of Te Waahi Pounamu - South West New Zealand World Heritage Area;
  - contains several covenants and other protected areas;

- landforms and waterways:
  - major landforms include coastal, marine terraces, alluvial terraces, recent glacial surfaces, and hill country and montane areas;
  - nationally important sequence of raised marine terraces;
  - at least two additional sites of geological importance;
  - nationally important rivers and lakes;
  - nationally important coastline;

- vegetation and flora:
  - complex vegetation-soil interaction on marine terraces;
  - one of the largest tracts of intact unmodified lowland podocarp forest in New Zealand;
  - vegetation sequence from the coast to the alpine zone;
  - greatest abundance and diversity of podocarps within Fiordland;
  - diverse coastal vegetation, including a nationally important dune/beach site;
  - at least 29 threatened plant species from coastal, forest, upland, and bog habitats;
  - large and diverse populations of threatened mistletoe species;

- fauna:
  - large populations of kaka and yellow-crowned parakeets;
  - widespread population of mohua;

- small but important populations of pateke and possibly orange-fronted parakeets;
- 22 other threatened bird species recorded;
- population of patchily distributed South Island robin;
- high population densities of common forest bird species;
- four threatened fish species;
- good populations of longfin eel;
- populations of nationally threatened terrestrial and freshwater invertebrates;

- low levels of modification:
  - few weed species mainly restricted to the coast;
  - short history of possum colonisation and still low numbers of possums in western areas;
  - little human impact.

## 18.2 Advantages of Waitutu for integrated pest control/management

Waitutu has several advantages over other areas in terms of pest control:

- remoteness;
  - less conflict with other users;

- physical barriers to the movement of animal pests;
  - large rivers (Waitutu, Wairaurahiri, Big) and lakes (Poteriteri, Hakapoua);
  - mountainous terrain to the north and west, and Hump Ridge to the east;
  - barriers define control area;
  - barriers constrain pest animal re-invasion;

- restoration at a range of scales;
  - ecosystem - large lowland forest;
  - species - threatened taxa, e.g. kaka, mohua, mistletoes;

- early stage of possum invasion
  - low numbers in some areas;
  - feasible reduction to very low numbers in all areas;
  - potential recovery of vegetation and species (e.g. mistletoe);

- history of previous control work and research;
  - commitment;
  - datasets;
  - infrastructure;

- interested stakeholders/community backing;
  - local community;
  - iwi;
  - conservation groups;
  - concessionaires;
  - recreational groups.

Overall Assessment

**Commented [e15]:** I wonder if it would be useful to indicate that because of the research investment both LCR and DOC we also stand to gain significant understanding post control of pests at Waitutu….

How does Waitutu 'stack up' against other areas receiving intensive pest control? Te Urewera is the only site of comparable size to Waitutu, and subsequently the only site with a similarly broad range of vegetation types. These habitats, however, do not extend to the coast and are on very different basal geology and landforms. Compared to both Operation Ark and Mainland Island sites, Waitutu is similar in that it contains important populations of several threatened species. However, the potential for recovery of threatened species populations at Waitutu is higher than at most of these sites because the history of possum invasion is more recent and the damage caused by these pests has been less. As a result, forest habitats at Waitutu are likely to be in better condition, and more able to recover their previous condition and function. In addition, productive, podocarp-dominant, lowland forest is much more extensive at Waitutu than in any of the other Fiordland sites currently receiving intensive control of pests. These factors mean that with effective control of pest animals, Waitutu could potentially support very large populations of threatened species.

The ecological attributes associated with Waitutu and their relative merits are the key issue in relation to this review, irrespective of existing biodiversity protection. There is no site in the North Island that compares with Waitutu. There are only limited natural areas that adjoin the coast, at Coromandel, East Cape, in Northland, and in the southern North Island. The best examples are perhaps between Opotiki and East Cape, but none are comparable with Waitutu in terms of basal geology, landforms, quality of vegetation, range of threatened species, and history of pest animal invasion and effects.

A similar comparison can be made with other parts of the South Island. The only east coast site worthy of comparison is the Catlins, but this has a long history of logging, farming, and pest modification of forests. The west coast of the South Island, from Whanganui Bay south to Fiordland, includes many examples of relatively intact sequences from the coast to alpine habitats. However, with the exception of the Haast plain, none of these include extensive lowland plains or terraces. The Haast plain has an extensive wetland complex grading into forest and mountain habitats, but has a long history of pest modification and doesn't include the sequence of marine terraces and indigenous forest types present at Waitutu.

There are many intact high quality natural coast-to-mountain sequences in Fiordland, but none are of the same character as Waitutu and they all have a different history of pest modification. The same applies to Stewart Island.

There is no other intact sequence of relatively unmodified indigenous vegetation extending from the coast across marine terraces to alpine mountains in New Zealand.

The podocarp-dominant forests at Waitutu are also nationally rare, with comparably sized examples located only at Whirinaki, Pureora, and on the West Coast of the South Island. None of the North Island sites adjoin the coast (or are part of an intact coast-to-mountain sequence). The other South Island sites are not comparable in terms of basal geology, landforms, overall sequence, and pest history.

In summary, Waitutu should receive intensive pest management because it:

- is unique and irreplaceable (there are no other places containing the same combination of ecosystems and species);
- contains regionally and nationally representative habitats;
- provides habitat for iconic, threatened species (mohua, kaka, mistletoes, etc) and a high number of threatened species, many of which could achieve large populations if pests were controlled sufficiently. It should be noted that the current level of pest control is insufficient to sustain these populations;
- contains lowland coastal forest habitat that is nationally under-represented in areas that receive protection from animal pests;
- makes a significant contribution to regional and national biodiversity protection;
- is highly vulnerable to impacts from introduced pest animals;
- is one of the last remaining sites with the potential to limit damage done by possums;
- would become a showcase for the Department of Conservation, regionally and nationally.

## 19. FUTURE MANAGEMENT SCENARIOS

**Commented [e16]:** I believe that Terry and Peter commented here so I will not do so

Four pest management scenarios for Waitutu have been developed as part of this review - refer to Appendices 1-4. The scenarios range from very large scale pest management that achieves multiple outcomes, to an option of 'doing nothing'.

The four management scenarios are listed below, and methods, costs, strengths, weaknesses, and risks of adoption have been examined in Appendices 1-4.

1. Large-scale pest control to protect forest canopy, possum-palatable plants, and South Island kaka: involves possum control through 48,000 ha over five years, and subsequent control of reinvasion fronts; stoat control through 9,435 ha.
2. Small-scale pest control to protect forest canopy, possum-palatable plants, and South Island kaka: involves sustained possum control through Landcare Research and RD&I study sites (2,500 ha) over five years, using ground-based methods that minimise non-target (ie rats, stoats) kill; stoat control through 1,000 ha RD&I study site at Waitutu.
3. No possum control, South Island kaka nest protection in RD&I Waitutu and Poteriteri study sites: banding nest trees of radio telemetry-monitored kaka and surrounding with traps and bait stations.
4. Do nothing.

Each scenario has been tested against the range of desired outcomes that have been previously suggested for the Waitutu area, which are either focused on protecting a particular ecological resource, or satisfying the needs of stakeholders. These outcomes are:

- Continuing DOC Southland's commitment to maintain possum numbers at very low levels around Landcare Research study sites.

- Maintaining DOC Southland's commitments to DOC RD&I's research objectives in Waitutu.

- Protection of the ecological values of Waitutu Forest that are at risk from possum impacts, especially:
  - South Island kaka - which also require sustained stoat control.
  - Mistletoe species.

Only Scenario 1 will achieve all of these outcomes across the whole of Waitutu. Scenario 2 will achieve these outcomes over less than 10% of the forest area. Scenario 3 will fail to protect mistletoes and other possum-susceptible values, and Scenario 4 will result in the inevitable decline of several iconic species and the potentially irreversible collapse of ecosystems. We recommend Scenario 1 as the best practicable method for achieving these outcomes across the whole of Waitutu.

We note that the outcomes described above do not include control of all animal pests because the effects of rodent and ungulate pests are a focus of the Landcare Research study (see section 15.2.1). Control of pigs, deer, rats, and mice will likely be required to realise the full potential of Waitutu for biodiversity conservation, but can only be addressed at the conclusion of the Landcare Research study. Adoption of Scenario 1 would be a useful stepping stone toward integrated management of all pests at the site.

## ACKNOWLEDGMENTS

Brian Rance, Andrea Goodman, and Colin Bishop (Department of Conservation, Southland Conservancy) provided helpful information on the ecological values in Waitutu Forest.

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# SCENARIO 1: LARGE-SCALE PEST CONTROL TO PROTECT FOREST CANOPY, POSSUM-PALATABLE PLANTS, AND SOUTH ISLAND KĀKĀ POPULATION

| Management Actions | Estimated Cost | Strengths | Weaknesses/Risks |
|---|---|---|---|
| **2007-8 and 2008-9, then 2011-12**<br><br>Ground-based possum control between Wairaurahiri and Waitutu Rivers.<br><br>(9,435 ha)<br>Whole treatment area covered in consecutive years, then again after 3 years (possibly aerial).<br><br>3% RTC target in 2008-9<br>1% RTC target in 2009-10 | <u>Possum Control</u><br><br>$320,000 per annum at $34 / ha (includes result monitoring and project management costs)<br><br><u>Outcome Monitoring</u><br><br>Mistletoe monitoring<br>Kaka monitoring<br>(funded by RD&I?) | • Ground-based possum control satisfies DOC Southland's commitments to Landcare's and DOC RD&I's research objectives.<br>• Preferred possum control method for other stakeholders.<br>• Benefits to forest canopy and palatable plants over a large area.<br>• Reduction of possums to very low levels may increase the time before possum control is required again. | • Potentially more complex than aerial control, therefore higher risk of failure.<br>• Ground-based methods less likely to achieve RTC targets than aerial methods, given the large scale and short timeframe.<br>• No control of rodents or mustelids, therefore lower potential benefits such as reduced predation of breeding kaka by stoats (aerial 1080 may mean stoat trapping is not necessary).<br>• Costs/benefits of intensive treatment in consecutive years (versus regular interval or trigger threshold-timed control) are not clear. |
| **2009-2014**<br><br>Establish mustelid trapping system between Wairaurahiri and Waitutu Rivers.<br><br>(9,435 ha) | <u>Stoat Control</u><br><br>Cut tracks and set up 1 single-set DOC 200 per 10 ha = $215,000<br>4 services per annum ($19,000) for 5 years = $95,000 | • Relatively low-cost, once trapping infrastructure in place<br>• Treatment area will also have very low possum densities, meaning main threats to kaka will have been substantially removed. | • High set-up cost<br>• Significant uncertainty that a low-check stoat trapping regime will succeed – non-treatment stoat monitoring may be required, and management may need to be adjusted (increased trap density, service frequency), increasing |

| Management Actions | Estimated Cost | Strengths | Weaknesses/Risks |
|---|---|---|---|
| Service traps quarterly. | Result/outcome Monitoring<br>Small mammal monitoring funded by RD&I?<br><br>Kaka population monitored by RD&I (nesting success, distance sampling?) | | costs.<br>• Effort may be wasted in years when kaka do not breed.<br>• Existing small mammal monitoring limited to 1,000 ha RD&I area. |
| **2011-2015**<br><br>Aerial 1080 possum control in 3 treatment blocks, south to north, between Lakes Poteriteri and Hauroko.<br><br>(38,000 ha)<br><br>**2016**<br>Protect north-western boundary from reinvasion | Possum Control<br>$380,000 per annum at $30 / ha<br>$4,000 per annum for boundary control?<br><br>Result/Outcome Monitoring<br>Small mammal monitoring = $7,500 per operation<br><br>Mistletoe monitoring: $?<br>Foliar Browse Index (FBI): $? | • Very large area treated in a short period of time<br>• Benefits to forest canopy over a very large area<br>• Aerial 1080 is probably the most cost-effective possum control technique in this situation.<br>• Potential biodiversity benefits from short-term control of rats and stoats.<br>• May benefit from recent improvements in large-scale pest control techniques | • High annual costs needing to be sustained.<br>• Operational risks of aerial methods given Waitutu's weather/climate?<br>• Boundary control should also take place along Waitutu and Wairaurahiri, as these are only partial barriers to possum reinvasion.<br>• Additional monitoring costs if there are desired outcomes that require rat/stoat control (e.g. kaka, mohua protection). |
| **Ongoing**<br><br>Monitoring of South Island kaka population response to possum and stoat control. | Funded by RD&I? | • High-quality monitoring in place for kaka recovery project.<br>• Murihiku Area makes a valuable contribution to developing and improving management prescriptions for South Island kaka recovery. | • Funding may not be sustained once research objectives are achieved. |

# SCENARIO 2: SMALL-SCALE PEST CONTROL TO PROTECT FOREST CANOPY, POSSUM-PALATABLE PLANTS, AND SOUTH ISLAND KĀKĀ POPULATION

| Management Actions | Estimated Cost | Strengths | Weaknesses/Risks |
|---|---|---|---|
| Annual possum control using Traps and cyanide (paste and feratox®) at Landcare Research sites (1,500 ha), and RD&I site, Waitutu. (1,000 ha).<br><br>Total area 2,500 ha<br><br>target 3% RTC | Possum control<br>$85,000 per annum at $34 / ha<br>(includes result monitoring and project management costs)<br><br>Result/outcome monitoring<br>Small mammal monitoring<br>Mistletoe monitoring<br>Kaka monitoring<br>(funded by RD&I / Landcare?) | • Ground-based possum control satisfies DOC Southland's commitments to Landcare's and DOC RD&I's research objectives, and is the preference of other stakeholders.<br>• Limited resources freed up for other projects<br>• Benefits to forest canopy and palatable plants throughout treated area. | • No control of rodents or mustelids, therefore fewer additional benefits such as reduced predation of kaka by stoats.<br>• High reinvasion rate because treatment blocks are relatively small, and discrete. |
| Seasonal stoat control in RD&I Waitutu study site.<br><br>(1,000 ha)<br><br>target <5% tunnels tracked | Stoat control<br>Set up 1 single-set DOC 200 per 5 ha (tracks already in place) = $32,000<br><br>12 services per annum = $12,000<br><br>Result/outcome monitoring<br>Small mammal monitoring<br>Kaka monitoring<br>(funded by RD&I?) | • Relatively low cost once trapping infrastructure in place<br>• Treatment area will also have very low possum densities, meaning main threats to kaka will have been substantially removed.<br>• Moderate set-up cost<br>• Limited resources freed up for other projects | • Potential conflict with RD&I kaka research objectives (response of kaka to possum control only)<br>• Reinvasion of stoats may be high because of relatively small size of treatment block.<br>• Effort may be wasted in years when kaka do not breed. |

| Management Actions | Estimated Cost | Strengths | Weaknesses/Risks |
|---|---|---|---|
| **Ongoing**<br>South Island kaka population monitoring.<br>• response to possum and stoat control (nesting success, survival, gender ratios, distance sampling, treatment and non-treatment areas?). | Funded by RD&I? | • High-quality monitoring in place for kaka recovery project.<br>• Murihiku Area makes a valuable contribution to developing and improving management prescriptions for South Island kaka recovery. | • Funding may not be sustained once research objectives not achieved. |

# SCENARIO 3: NEST PROTECTION TO PROTECT SOUTH ISLAND KĀKĀ POPULATION

| Management actions | Estimated cost | Strengths | Weaknesses / risks |
|---|---|---|---|
| No possum control. | $0 | • Substantial resources freed up for other projects | • DOC Southland fails to meet its commitments to Landcare's and DOC RD&I's research objectives, if possum numbers recover to above-target levels<br>• Landcare and DOC RD&I research programmes put at risk?<br>• No protection for forest canopy, palatable plants and vulnerable fauna (e.g. kaka) requiring sustained possum control. |
| South Island kaka nest protection at Waitutu and Poteriteri RD&I research sites.<br><br>• Metal-banding of nest trees; placement of stoat traps and bait stations targeting rats in rings around nest trees. | 200 single-set DOC 200 traps = $8,000 (protection for 12-15 nests per season)<br>Nest-finding and trap servicing: 800 hrs/ $25-30,000 per annum?<br><br><u>Result/Outcome Monitoring</u><br>Small mammal monitoring<br>Kaka monitoring<br>(funded by RD&I?) | • Makes use of existing RD&I kaka research programme (catching, banding, transmitterising), possibly allows some sharing of labour between RD&I and Murihiku Area<br>• Similar techniques have increased nesting success of North Island kokako, where trap and bait station servicing is frequent. | • Requires nest locations to be pinpointed. This capability is at risk when research programme concludes.<br>• Potential kaka research conflicts (confounding effects in both treatment and non-treatment sites)<br>• Nest hole turnover may increase the required nest-locating effort.<br>• Pest reinvasion is continuous, and kaka fledglings may continue to be vulnerable while on the ground, under this regime.<br>• Only cost-effective for protecting a small number of nests.<br>• Possibly just as cost-effective to run a small (500 ha) seasonal possum and stoat control project in Waitutu site, using existing grid track infrastructure for traps and bait stations? |

| Management actions | Estimated cost | Strengths | Weaknesses / risks |
|---|---|---|---|
| | | | • Unmonitored kaka continue to be at risk - overall Waitutu population may continue to decline. |
| **Ongoing**<br>South Island kaka population monitoring.<br>• response to possum and stoat control (nesting success, survival, gender ratios, distance sampling, treatment and non-treatment areas?). | Funded by RD&I? | • High-quality monitoring in place for kaka recovery project.<br>• Murihiku Area makes a valuable contribution to developing and improving management prescriptions for South Island kaka recovery. | • Funding may not be sustained once research objectives not achieved. |

APPENDIX 4

# SCENARIO 4: DO NOTHING

| Strengths | Weaknesses / risks |
|---|---|
| • Substantial resources freed up for other projects | • DOC Southland fails to meet its commitments to Landcare's and DOC RD&I's research objectives, if possum numbers recover to above-target levels.<br>• Landcare and DOC RD&I research programmes put at risk, because experimental design requires low possum abundance in treatment areas?<br>• No protection for forest canopy, palatable plants and vulnerable fauna (e.g. kaka) requiring sustained possum control.<br>• Decline in mistletoe populations.<br>• Decline (and local extinction?) of South Island kaka.<br>• Decline in other, unmonitored, taxa that may be benefiting from existing levels of pest control (mohua, brown teal?, long-tailed bat?). |