# Vegetation of Mangarakau Wetland

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## 1 Introduction

This report provides a summary of vegetation and environmental data from Mangarakau Wetland, Tasman District, to support a community-led application for Ramsar designation of the wetland. The methodology follows a national approach developed for monitoring freshwater wetlands in New Zealand as outlined in the Wetland Monitoring Handbook (Clarkson et al 2004). This summary is based on sampling of plots, considered to be representative of the major vegetation types, and an overall assessment of wetland condition using the Wetland Condition Index (Clarkson et al. 2004).

## 2 Background

Mangarakau Wetland was sampled for vegetation, hydrology, algae and invertebrates (aquatic and terrestrial) during three separate site visits: November 2003, February 2006, and February 2007 (see also separate reports; Basher 2009, Kilroy 2009, Watts 2009, Suren to come). The full sampling team comprised Bev Clarkson, Brian Sorrell, Catherine Chague-Goff, Neil Fitzgerald, Corinne Watts, Les Basher, Donna Sutherland, Alastair Suren, and Rob Smith. For this vegetation report, the sampling team members were Bev Clarkson, Brian Sorrell, Catherine Chague-Goff and Neil Fitzgerald. Between 2003 and 2007 fires swept through parts of the wetland and razed the vegetation in plots 4 and 5 to the ground; resulting in changes in species composition noted in subsequent visits (see Appendix 1 and separate reports).

## 3 Methods

Vegetation and environmental data were collected in 2003 from six plots which were established to encompass the range of major vegetation types encountered within the wetland (Table 1, Fig. 1). Quadrats of size 2m x 2m were marked with wooden poles and labelled with numbered aluminium tags. Within each quadrat, species cover assessed in both canopy and understorey layers following the methods of Clarkson et al. (2004). The maximum height for each species and vascular and non-vascular plant species lists were also recorded. Environmental parameters measured in the field included pH, conductivity, water table and temperature. In addition, foliage samples of the dominant species and soil cores were collected for chemical analyses at the Landcare Research Laboratory, Palmerston North.

**Table 1 Vegetation types sampled at Mangarakau Wetland in 2003**

| Plot | Plant species composition | Vegetation structure |
|---|---|---|
| 1 | *Baumea arthrophylla/Gleichenia dicarpa* | Sedgeland |
| 2 | *Typha orientalis-Baumea arthrophylla* | Reedland |
| 3 | *Baumea arthrophylla-Typha orientalis* | Sedgeland |
| 4 | *Lepidosperma australe-Baumea arthrophylla* | Sedgeland |
| 5 | *Phormium tenax*/*Gleichenia dicarpa* | Fernland |
| 6 | *Phormium tenax/Coprosma tenuicaulis-Baumea arthrophylla* | Flaxland (Tussockland) |

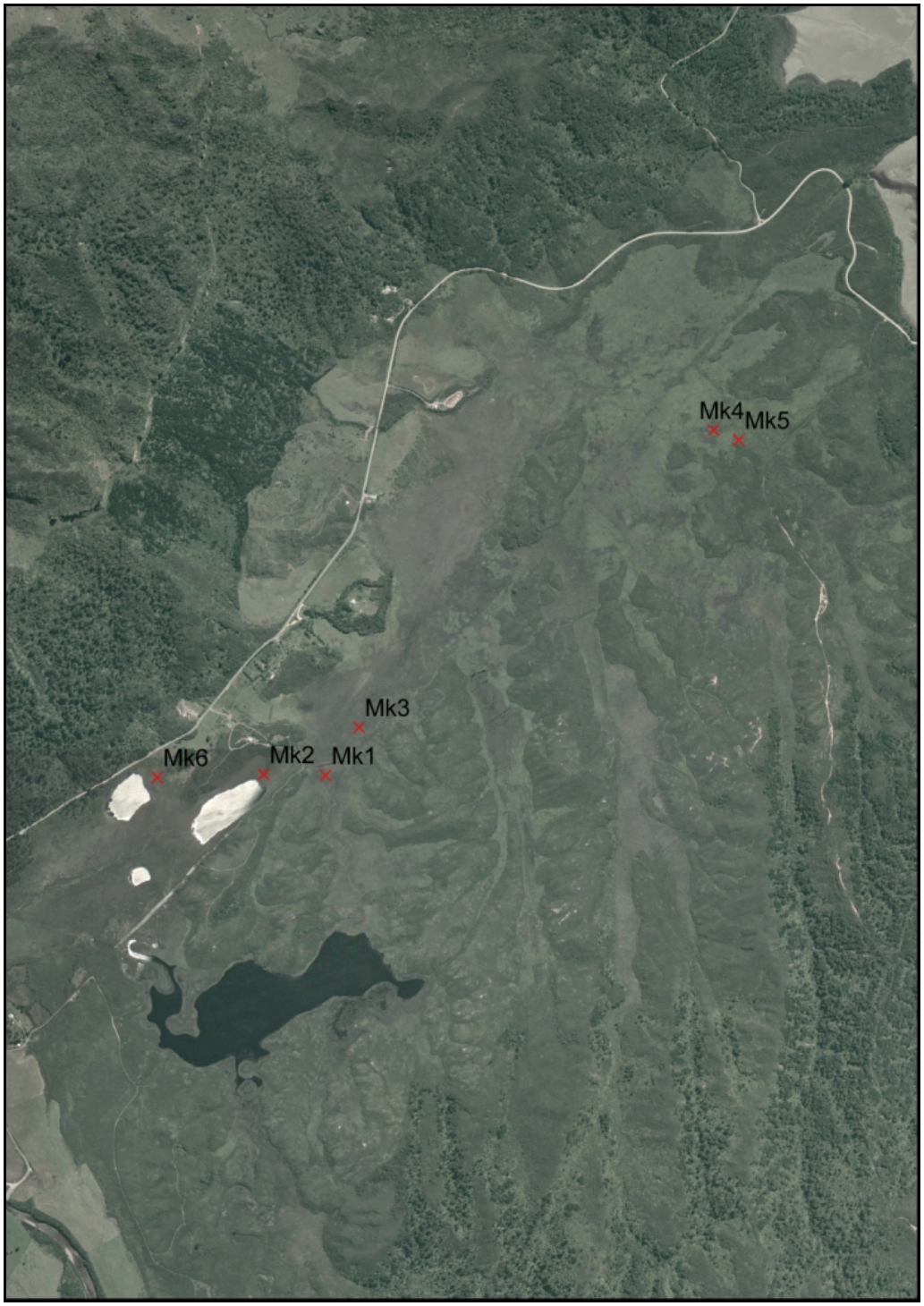


**Fig. 1. Location of the six plots sampled at Mangarakau Wetland (from Basher 2009)**

The overall wetland condition (Clarkson et al. 2004) based on divergence from the assumed natural condition was assessed and scored using the following five indicators:

- Change in hydrological integrity;
- Change in physicochemical parameters;
- Change in ecosystem intactness;
- Change in browsing, predation and harvesting regimes;
- Change in dominance of native plants.

Each indicator is made up of several components, e.g., damage by domestic or feral animals (see Appendix 1), which are compared against the assumed pre-European settlement

condition and scored on a 0–5 scale (5='natural' condition; 0=extremely modified). This is based on field reconnaissance of the whole wetland, synthesis of historical and other information and interpretation of plot data, following the assessment guidelines in the Handbook (Clarkson et al 2004). A sub-index for each wetland indicator is then calculated by averaging the scores of its component, and these are summed to give an overall wetland condition index out of 25.

Data from the Wetland Plot Sheets and Wetland Record Sheet were entered into the recently established New Zealand Wetland database (wetlanddatabase@landcareresearch.co.nz ). This enables comparison with other wetlands throughout New Zealand in order to assess the ecological quality and relative significance of individual wetlands.

## 4 Results

### *3.1 Vegetation and Nutrients*

The main vegetation types encountered at Mangarakau were *Baumea arthrophylla* sedgeland, raupo reedland, *Gleichenia dicarpa* fernland, harakeke flaxland (or tussockland), and open water. Other minor types which would be picked up with a more thorough reconnaissance of the wetland may be present. No threatened species was recorded during the survey, as we focused on characterising the vegetation and nutrient status of the main vegetation types. However, threatened species are likely to be present in the wetland because of its relatively intact condition and large size. A comprehensive list of species present has apparently been compiled by the Friends of Mangarakau volunteer group.

The pH values for water (5.52–6.03) and soil (4.58–5.32) are relatively high for New Zealand wetlands (Johnson & Gerbeaux 2004, Clarkson et al. 2004, Sorrell & Gerbeaux 2004). In addition, soil nutrient values (N: 1.21–2.32%; P: 551–1513 mg/kg) are also relatively high whereas soil carbon levels are relatively low (26.6–42.7%).

The species composition and the nutrient characteristics suggest this wetland is a relatively fertile minerotrophic wetland, which can be classified as a swamp according to the wetland classification system of Johnson and Gerbeaux (2004). Minor areas dominated by *Gleichenia dicarpa* and the less nutrient-requiring sedges, e.g. *Baumea rubiginosa, Baumea teretifolia*, would fit into the fen wetland type, but the wetland is mostly a swamp.

### *3.2 Wetland Condition*

The plot condition scores (Appendix 1) range from 17–20 out of a possible total of 20, which indicates a low to very low level of invasion by introduced species in the core of the wetland. The overall wetland condition score is 21.25 out of 25. This ranks it in the top 30% of wetlands in the database (holding records for 101 of the 'best' New Zealand wetlands) and in the top 15% of swamps. Wetlands (particularly swamps) with higher scores tend to be situated in indigenous vegetation-dominated catchments in national parks, reserves, or on off-shore islands.

Swamps are susceptible to invasion by a suite of troublesome introduced plant species, particularly fast-growing deciduous trees such as crack willow (*Salix fragilis*) and grey willow (*Salix cinerea*). This is partly because these trees can readily exploit the 'empty niche' space in New Zealand herbaceous swamps and grow vigorously because of the inherently high nutrient levels. Swamps in the North Island in particular have extensive invasions of willows, e.g., the swamp systems of Whangamarino Wetland, an important Ramsar site in the Waikato. Willows have the potential to completely change the structure and functioning of wetlands in New Zealand. They overtop and displace indigenous herbaceous species, alter

natural successional trajectories, cause seasonal nutrient pulses due to their deciduous nature, and change habitat suitability for invertebrates, birds, fish and other wildlife.

The absence of willow and the low levels of introduced plants within Mangarakau Wetland raise the ecological significance of this wetland as few swamps remain in relatively intact condition. Active management of weeds and pests is currently undertaken by the Friends of Mangarakau volunteer group, with positive biodiversity outcomes. However, the presence of a few grey willow trees noted in 2003 on pasture near the road entrance close to the wetland indicates that this species is in the catchment and continued vigilance will be needed to ensure it doesn't invade the wetland and degrade ecological values.

## 5 Conclusions

Mangarakau Wetland is a significant wetland because it is a good example of an intact, relatively large swamp system containing a variety of indigenous vegetation types and, unlike most swamps elsewhere in New Zealand, has not been modified by weed invasion. It has a high wetland condition index, scoring 21.25 out of 25, which ranks it in the top 15% of swamps in New Zealand. Mangarakau is also likely to provide habitat for several threatened plant, bird and fish species. These are all important factors to consider in the proposed application for Ramsar designation of the wetland.

## References


Basher, L. 2009: Soils and hydrology at Mangarakau wetland. Internal Report, Landcare Research, Nelson. 6p.

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Clarkson B.R., Sorrell B.K., Reeves P.N., Champion P.D., Partridge T.R., Clarkson B.D. 2003: Handbook for monitoring wetland condition. Coordinated Monitoring of New Zealand Wetlands.A Ministry for the Environment Sustainable Management Fund Project. 74 p. Available on website: http://www.landcareresearch.co.nz/research/biocons/restoration/docs/handbook2004.pdf

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Sorrell, B., Gerbeaux, P. 2004: Wetland ecosystems. *In*: Harding, J., Mosley, P., Pearson, C., Sorrell, B. Freshwaters of New Zealand. New Zealand Hydrological Society & New Limnological Society, Caxton press, Christchurch.

Watts, C. 2009: The invertebrate fauna of Mangarakau Swamp. Internal Report, Landcare Research, Hamilton. 5p.

## Appendix 1: Mangarakau Wetland Record and Plot Sheets from New Zealand Wetland Database

### WETLAND RECORD SHEET

**Wetland name:** Mangarakau Wetland **Date:** 18/11/2003
**Region:** Nelson-Marlborough **GPS/Grid Ref.:** 2466000 6062000
**Altitude:** 15 m asl **No. of plots sampled:** 6

| Classification: I System | IA Subsystem | II Wetland Class | IIA Wetland Form |
|---|---|---|---|
| Palustrine | Permanent | Swamp | Basin |

**Field team:** Bev Clarkson, Brian Sorrell (2003). Subsequent visits: 2006 Catherine Chague-Goff, Neil Fitzgerald, Corinne Watts; 2007 Catherine Chague-Goff, Les Basher.

| Indicator | Indicator components | Specify and Comment | Score 0– 5[1] | Mean score |
|---|---|---|---|---|
| Change in hydrological integrity | Impact of manmade structures | Some roads adjoining wetland. A few tracks and old drains within wetland | 4 | 4.33 |
| | Water table depth | Still intact except perhaps for very margins | 4.5 | |
| | Dryland plant invasion | Only on very margins | 4.5 | |
| Change in physico-chemical parameters | Fire damage | Very old fire damage noted[1] | 4.5 | 4.67 |
| | Degree of sedimentation/erosion | None observed | 5 | |
| | Nutrient levels | Probably slightly elevated only on margins adjacent farmland (west) | 4.5 | |
| | Von Post index | Not applicable (swamp) | - | |
| Change in ecosystem intactness | Loss in area of original wetland | Probably about one third lost downstream | 3.5 | 3.75 |
| | Connectivity barriers | Still mainly intact; mostly indigenous catchment | 4 | |
| Change in browsing, predation & harvesting regimes | Damage by domestic or feral animals | Very little observed; probably some feral animals present | 4.5 | 4.5 |
| | Introduced predator impacts on wildlife | None observed but likely to be some | 4 | |
| | Harvesting levels | None observed. Small amount of cultural harvest (flax) and for sphagnum has been recorded. | 5 | |
| Change in dominance of native plants | Introduced plant canopy cover | Mainly on margins (e.g., gorse), esp adjacent farmland (west). Occasional exotics in wetland. | 4 | 4 |
| | Introduced plant understorey cover | Mainly on margins. Occasional exotics within wetland | 4 | |
| **Total wetland condition index** /25 | | | | 21.25 |

[1] Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

**Main vegetation types:** *Baumea arthrophylla* sedgeland, Raupo reedland, *Gleichenia dicarpa* fernland, Harakeke tussockland (or flaxland), Open water. Probably other minor types present. DOC and NZ Native Forests Restoration Trust (Friends of Mangarakau) will have detailed records.

**Native fauna:** Fernbird, bittern, mudfish etc. DOC and NZ Native Forests Restoration Trust (Friends of Mangarakau) will have detailed records.

**Other comments:** Current herbaceous vegetation likely induced by fire. Two fires occurred between 2003 (when permanent plots were established) and 2006, and swept through plots 4 and 5. Excellent example of healthy swamp system. Invasion by exotic plants potentially a major threat (as in North

Island swamps), especially grey willow, which occurs on farmland adjacent to the wetland. Wetland has been purchased/ protected by NZ Native Forests Restoration Trust, QEII Open Space Covenant and DOC. Managed by Friends of Mangarakau volunteer group.

| **Pressure** | **Score**[2] | **Specify and Comment** |
|---|---|---|
| Modifications to catchment hydrology | 2 | Most of upper catchment still in indigenous cover |
| (Degradation of) Water quality within the catchment | 2 | Probably some runoff from farmed areas to west |
| Animal access | 2 | Western boundary with farmland currently fenced |
| Key undesirable species | 4 | A few grey willow individuals noted on pasture near entrance to wetland. Potentially a major threat. Gorse, blackberry also present |
| % catchment in introduced vegetation | 2 | Majority of catchment in indigenous vegetation |
| Other landuse threats | | |
| **Total wetland pressure index** /30 | 12 | |

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 18/11/2003 **Plot no:** 1
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2466685 6062423
**Field leader:** BRC, BKS **Structure:** Sedgeland **Composition:**Bau arth/Gle dic

| **Canopy** (bird's eye view) | | | **Groundcover** | | |
|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** |
| *Baumea arthrophylla* | 68 | 0.97 | *Blechnum novae-zelandiae* | + | |
| *Gleichenia dicarpa* | 20 | 0.53 | *Eleocharis gracilis* | + | |
| *Lepidosperma australe* | 10 | 0.80 | *Carex* sp. fine (no flowers) *C. echinata*? | + | |
| *Phormium tenax* | 2 | 1.15 | *Coprosma tenuicaulis* | + | |
| *Leptospermum scoparium* | 1 | 0.74 | Liverwort (medium) | + | |
| *Baumea rubiginosa* | + | | Liverwort (leafy) | + | |
| | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Centella uniflora, Baumea teretifolia*

**Comments:** Tag number 4941. Foliage collected 22 Feb 2007. Field water sampled 14 Feb 2006.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 0 | 5 | |
| Understorey: % cover introduced spp[3] | 0 | 5 | |
| Total species: % number introduced spp | 0 | 5 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 20 | In excellent condition |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:** (CC-G sampled 14 Feb 06) Temperature: 18.5°C

| | | | |
|---|---|---|---|
| Water table cm | - | Water conductivity uS (if present) | 85.4 |
| Water pH (if present) | 5.61 | Von Post peat decomposition index | N/A |

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | 1115 | Total C % | 31.6 |
| Bulk Density T/m$^3$ | 0.07 | Total N % | 1.8 |
| pH | 5.17 | Total P mg/kg | 693 |
| Conductivity uS | 0.48 | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Leptospermum scoparium* | %N | 0.58 | %P | 0.026 (%K = 0.47) |
| Species | *Baumea arthrophylla* | %N | 0.96 | %P | 0.033 (%K = 0.94) |

NB Foliage collected 22 Feb 2007 and analysed soon after

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 18/11/2003 **Plot no:** 2
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2466476 6062414
**Field leader:** BRC, BKS **Structure:** Reedland **Composition:** Raupo-Bau arth

| **Canopy** (bird's eye view) | | | **Groundcover** | | |
|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** |
| *Typha orientalis* | 80 | 1.80 | *Dactylis glomerata** | + | |
| *Baumea arthrophylla* | 20 | 1.75 | | | |
| *Baumea rubiginosa* | + | 1.75 | | | |
| *Coprosma tenuicaulis* | + | 0.85 | | | |
| | | | | | |
| | | | | | |
| | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Blechnum novae-zelandiae, Phormium tenax, Coprosma robusta, Baumea tenax*

**Comments:** Tag number 4937. Foliage collected 22 Feb 2007. NB Volumetric soil core unable to be collected as too sloppy and comprised mainly of living roots. Field water sampled 14 Feb 2006.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 0 | 5 | |
| Understorey: % cover introduced spp[3] | + | 4 | |
| Total species: % number introduced spp | 20 | 4 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 18 | |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:** (CC-G sampled 14 Feb 06) Temperature: 16.1°C

| | | | |
|---|---|---|---|
| Water table cm | - | Water conductivity uS (if present) | 119.4 |
| Water pH (if present) | 5.96 | Von Post peat decomposition index | N/A |

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | | Total C % | |
| Bulk Density T/m$^3$ | | Total N % | |
| pH | | Total P mg/kg | |
| Conductivity uS | | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Typha orientalis* | %N | 1.04 | %P | 0.083 (%K = 1.35) |

NB Foliage collected 22 Feb 2007 and analysed soon after

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 18/11/2003 **Plot no:** 3
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2466779 6062570
**Field leader:** BRC, BKS **Structure:** Sedgeland **Composition:**Bau arth-raupo

| **Canopy** (bird's eye view) | | | **Subcanopy** | | | **Groundcover** | | |
|---|---|---|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** | **Species** | **%** | **H** |
| *Baumea arthrophylla* | 75 | 1.10 | | | | *Carex echinata* | + | |
| *Typha orientalis* | 20 | 1.15 | | | | *Eleocharis gracilis* | + | |
| *Baumea teretifolia* | 5 | 0.80 | | | | *Baumea teretifolia* | + | |
| | | | | | | Liverwort (medium) | + | |
| | | | | | | Moss leafy | + | |
| | | | | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Drosera binata, Baumea tenax, Lepidosperma australe, Coprosma tenuicaulis*

**Comments:** Tag number 4940. Foliage collected 22 Feb 2007. Field water sampled 14 Feb 2006.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 0 | 5 | |
| Understorey: % cover introduced spp[3] | 0 | 5 | |
| Total species: % number introduced spp | 0 | 5 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 20 | |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:** (CC-G sampled 14 Feb 06) Temperature: 18.1°C

| | | | |
|---|---|---|---|
| Water table cm | - | Water conductivity uS (if present) | 124.6 |
| Water pH (if present) | 5.74 | Von Post peat decomposition index | N/A |

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | 711 | Total C % | 26.6 |
| Bulk Density T/m$^3$ | 0.1 | Total N % | 1.46 |
| pH | 4.64 | Total P mg/kg | 649 |
| Conductivity uS | 0.35 | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Baumea arthrophylla* | %N | 0.74 | %P | 0.032 (%K = 1) |

NB Foliage collected 22 Feb 2007 and analysed soon after

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 18/11/2003 **Plot no:** 4
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2467894 6063502
**Field leader:** BRC, BKS **Structure:**Sedgeland **Composition:** Lep aus-Bau arth

| **Canopy** (bird's eye view) | | | **Subcanopy** | | | **Groundcover** | | |
|---|---|---|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** | **Species** | **%** | **H** |
| *Lepidosperma australe* | 50 | 0.85 | | | | Liverwort (thalloid) | | |
| *Baumea arthrophylla* | 45 | 0.90 | | | | Liverwort (medium) | | |
| *Tetraria capillaris* | 5 | 0.75 | | | | | | |
| *Baumea rubiginosa* | + | 1.30 | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Glechenia dicarpa, Cirsium vulgare*, Blechnum novae-zelandiae*

**Comments:** Tag number 4943. Field water measurements sampled 15 Feb 2006. Foliage collected 22 Feb 2007.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 0 | 5 | |
| Understorey: % cover introduced spp[3] | 0 | 5 | |
| Total species: % number introduced spp | 0 | 5 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 20 | |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:** (CC-G sampled 15 Feb 06) Temperature: 20.9°C

| | | | |
|---|---|---|---|
| Water table cm | | Water conductivity uS (if present) | 121.8 |
| Water pH (if present) | 6.03 | Von Post peat decomposition index | 9 |

NB Field water measurements sampled 15 Feb 2006

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | 997 | Total C % | 33.6 |
| Bulk Density T/m$^3$ | 0.08 | Total N % | 1.96 |
| pH | 4.72 | Total P mg/kg | 812 |
| Conductivity uS | 0.33 | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Baumea arthrophylla* | %N | 0.57 | %P | 0.022 (%K = 0.78) |

NB Foliage collected 22 Feb 2007 and analysed soon after

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 18/11/2003 **Plot no:** 5
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2467992 6063471
**Field leader:** BRC, BKS **Structure:** Fernland **Composition:** Pho ten/Gle dic

| **Canopy** (bird's eye view) | | | **Subcanopy** | | | **Groundcover** | | |
|---|---|---|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** | **Species** | **%** | **H** |
| *Gleichenia dicarpa* | 50 | 1.15 | | | | *Blechnum novae-zelandiae* | + | |
| *Phormium tenax* | 30 | 2.55 | | | | | | |
| *Coprosma tenuicaulis* | 11 | 1.50 | | | | | | |
| *Baumea rubiginosa* | 9 | 1.50 | | | | | | |
| *Baumea tenax* | + | | | | | | | |
| | | | | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Carx coriacea, Ulex europaeus Leptospermum scoparium*

**Comments:** Tag 4942. Burnt between Nov 2003 and Feb 2007 (site visits). As a result, foliage collected in 2007 may have enriched nutrient levels cf 2003. Field water measurements sampled 15 Feb 2006.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 0 | 5 | |
| Understorey: % cover introduced spp[3] | 0 | 5 | |
| Total species: % number introduced spp | 0 | 5 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 20 | |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:** (CC-G sampled 15 Feb 06) Temperature: 18.7°C

| | | | |
|---|---|---|---|
| Water table cm | 5.52 | Water conductivity uS (if present) | 91.8 |
| Water pH (if present) | | Von Post peat decomposition index | N/A |

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | 587 | Total C % | 32.5 |
| Bulk Density T/m$^3$ | 0.13 | Total N % | 2.02 |
| pH | 4.58 | Total P mg/kg | 1195 |
| Conductivity uS | 0.64 | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Gleichenia dicarpa* | %N | 0.9 | %P | 0.034 (%K = 0.66) |
| | *Baumea rubiginosa* | %N | 0.92 | %P | 0.046 (%K = 0.53) |

NB Foliage collected 22 Feb 2007 and analysed soon after

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 18/11/2003 **Plot no:** 6
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2466157 6062412
**Field leader:** BRC, BKS **Structure:**Tussockland (flaxland)**Composition** Pho ten/Cop ten-Bau arth

| **Canopy** (bird's eye view) | | | **Subcanopy** | | | **Groundcover** | | |
|---|---|---|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** | **Species** | **%** | **H** |
| *Phormium tenax* | 40 | 2.20 | | | | *Lotus pedunculatus** | + | |
| *Coprosma tenuicaulis* | 25 | 1.70 | | | | *Juncus edgariae* | + | |
| *Baumea arthrophylla* | 20 | 1.60 | | | | *Carex virgata* | + | |
| *Baumea tenax* | + | 1.30 | | | | Liverwort (leafy) | + | |
| *Rubus fruticosus** | 3 | 0.90 | | | | Liverwort ?*Riccardia* | + | |
| *Blechnum novae-zelandiae* | 1 | 0.70 | | | | | | |
| *Typha orientalis* | 10 | 1.60 | | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Baumea rubiginosa, Coprosma robusta, Coprosma Xcunninghamii*

**Comments:** Tag 4939. Field water measurements sampled 15 Feb 2006. Foliage collected 22 Feb 2007.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 3 | 4 | |
| Understorey: % cover introduced spp[3] | + | 4 | |
| Total species: % number introduced spp | 17 | 4 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 17 | |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:** (CC-G sampled 15 Feb 06) Temperature: 15.0°C

| | | | |
|---|---|---|---|
| Water table cm | | Water conductivity uS (if present) | 136.8 |
| Water pH (if present) | 5.92 | Von Post peat decomposition index | 7 |

NB Field water measurements sampled 15 Feb 2006

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | 1064 | Total C % | 42 |
| Bulk Density T/m$^3$ | 0.06 | Total N % | 2.83 |
| pH | 5.28 | Total P mg/kg | 1926 |
| Conductivity uS | 1.23 | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Phormium tenax* | %N | 0.66 | %P | 0.064 (%K = 0.53) |

NB Foliage collected 22 Feb 2007 and analysed soon after.

**WETLAND PLOT SHEET**

**Wetland name:** Mangarakau **Date:** 15/02/2006 **Plot no:** 4
**Plot size (2m x 2m default):** 2m x 2m **Altitude:** 15 m a.s.l. **GPS/GR:**2467894 6063502
**Field leader:** NF, CC-G, CW **Structure:**Sedgeland **Composition:** Bau arth

| **Canopy** (bird's eye view) | | | **Subcanopy** | | | **Groundcover** | | |
|---|---|---|---|---|---|---|---|---|
| **Species**[1] (or Substrate) | **%** | **H** | **Species** | **%** | **H** | **Species** | **%** | **H** |
| *Baumea arthrophylla* | 94 | 0.70 | | | | Liverwort | + | |
| *Lepidosperma australe* | 5 | 0.58 | | | | | | |
| *Tetraria capillaris* | + | 0.35 | | | | | | |
| *Baumea rubiginosa* | 1 | 0.75 | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1] % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

**Additional species in vicinity in same vegetation type:** *Glechenia dicarpa, Coprosma tenuicaulis, Centella uniflora*

**Comments:** Tag number 4943. Plot was burnt a few (?) months ago. *Lepidosperma australe* cover reduced by fire *cf* 2003 sampling. Field water measurements and soil cores sampled this visit. Foliage collected 22 Feb 2007. NE corner of plot is 2.0 m S of probe well.

| **Indicator** (use plot data only) | **%** | **Score 0–5**[2] | **Specify & Comment** |
|---|---|---|---|
| Canopy: % cover introduced species | 0 | 5 | |
| Understorey: % cover introduced spp[3] | 0 | 5 | |
| Total species: % number introduced spp | 0 | 5 | |
| Total species: overall stress/dieback | NA | 5 | |
| **Total** /20 | NA | 20 | |

[2]5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high
[3]Add subcanopy and groundcover % cover for introduced species

**Field measurements:**Water temperature 20.9°C

| | | | |
|---|---|---|---|
| Water table cm | | Water conductivity uS (if present) | 121.8 |
| Water pH (if present) | 6.03 | Von Post peat decomposition index | 9 |

NB Field water measurements sampled 15 Feb 2006

**Soil core laboratory analysis** (2 soil core subsamples)**:**

| | | | |
|---|---|---|---|
| Water content % dry weight | 997 | Total C % | 33.6 |
| Bulk Density T/m$^3$ | 0.08 | Total N % | 1.96 |
| pH | 4.72 | Total P mg/kg | 812 |
| Conductivity uS | 0.33 | | |

**Foliage laboratory analysis** (leaf/culm sample of dominant canopy species)**:**

| | | | | | |
|---|---|---|---|---|---|
| Species | *Baumea arthrophylla* | %N | 0.57 | %P | 0.022 (%K = 0.78) |

NB Foliage collected 22 Feb 2007 and analysed soon after.

**Appendix 2 Mangarakau Wetland biotic, environmental and foliage data from New Zealand Wetland Database (see Mangarakau data.xls spreadsheet; 2p).**