

out to the peninsula trig station. The forest health on the island accounts for much of the abundance of tui and kereru.

A feature of the island was the low numbers of weeds species present. Most occur in the pasture, forest margins or scrubland along the summit ridge. Nevertheless, DoC maintains a vigilant weed control programme. A weed team of 5 people arrived on the island to conduct 3 weeks of weed control work while we were there. *Acaena* spp., common in the open grassland areas of the island, pose a major threat to

takahe chicks and are treated as a weed. The bidibids catch and accumulate on the juvenile plumage of takahe, trapping the young birds in the thick scrub they use for cover where they can starve to death.

Stoat traps are spread around the coastal edge of the island and on the main tracks to the summit and ridgeline as a defence against incursions from the mainland. The common occurrence of ground dwelling weta, skink and gecko gives an indication of what mainland NZ would have been like before the arrival of humans and the animal predators they introduced.



Vascular flora of the fringes of Waionui Inlet, Kaipara South Head

E. K. Cameron & P.J. Bellingham

Introduction

The Waionui Inlet is a shallow harbour at the northern end of Kaipara South Head, measuring c.6 km long x 2 km across at its widest point. It opens to the north, by the swift-flowing mouth of the Kaipara Harbour (Fig. 1), and is bordered by a shifting sand bar (Papakanui Spit). The Inlet is located at the north end of Woodhill Forest, a 12,500 ha commercial plantation forest (exotic pines) on stabilised, Holocene sand dunes, northwest of Auckland, on the South Kaipara Peninsula. A former State Forest, Woodhill is currently leased from the Crown by Carter Holt Harvey Forests Ltd (CHH), which purchased the rights to manage and harvest the pine plantation in 1990. Many of the few remaining natural areas in Woodhill are legally protected under a covenant between Ministers of Finance and State Owned Enterprises and CHH. Access is via the forestry roads or the Rangitira Beach. The following articles document many of the natural areas of vegetation at Woodhill: Mackinder (1984), Cameron & Bellingham (1986), Cameron (1987, 1988, 1994, 1998), Smale et al. (1995) and Bishop (1996).

Terrestrial and estuarine areas adjacent to the Waionui Inlet are Crown land administered by Department of Conservation (DoC), i.e. Waionui Marginal Strip (3ha), Ti Tree Island Conservation Area (8ha), and Papakanui (1088ha), Papakanui Spit (including the Papakanui Spit Wildlife Refuge)(25ha) and Ti Tree Island (5ha) Stewardship Areas (Anon. 1995) (see Fig. 1). The 2 km margin from South Head to Ti Tree Island is privately owned land. As part of Woodhill Forest, CHH manage the Waionui Covenant Area (148ha) which is kanuka (*Kunzea ericoides* s.lat.) forest, and to the south of the Papakanui Stewardship Area as commercial plantation forestry land. The western side of the Inlet is also part of a weapons training area used by the NZ Defence Force (until recently it was also a bombing range). The DoC administered land combined with the Waionui Covenant Area form the largest remaining area of indigenous vegetation on the

Holocene sands on the South Kaipara Peninsula.

Here we present a more complete vascular flora of the area than in Cameron & Bellingham (1986), together with notes on the vegetation and unusual species. This account is mainly based on a field trip on 1 July 1993 when the eastern and southern areas of the Waionui Inlet were visited by us; with other observations by EKC when leading an Auckland Bot Soc trip there on 19 February 1995, being a member of the Auckland Conservation Board trip 27 November 1998, and a visit to a site where *Mazus novaezeelandiae* occurred with DoC staff 11 May 1999; and observations by DoC staff in February 2001 and April 2002.

Description of the Waionui Inlet fringe vegetation

In the 1990s a second channel formed through the Papakanui Spit. This exit fluctuated over time, but by 1997 had firmly established as a deep second channel with associated sand banks on each side to the north (Barbara Waller pers. comm.). This new channel and associated flow changes within the Inlet have increased the erosion on the south-western part of Ti Tree Island which is clothed in kanuka (a more appropriate spelling would be Tea Tree Id). The previous Inlet channel is also still operating strongly.

The Waionui Inlet is sandy in the northern half and grades into mudflats with mangroves (*Avicennia marina*) at the southern end bordered by saltmarsh ribbonwood (*Plagianthus divaricatus*) and a manuka (*Leptospermum scoparium*) shrubland, which grades further into 6 m kanuka forest on the east side. The kanuka-covered dunes on the eastern side are up to c.0.5 km across (Waionui Covenant Area) and extend for nearly 1 km south of the tidal southern tip of the Inlet (part of Waionui Stewardship Area).

To the west of the Inlet is an active dune system representing the best dune assemblage in the Auckland region (Anon. 1995: 113). The highest dune

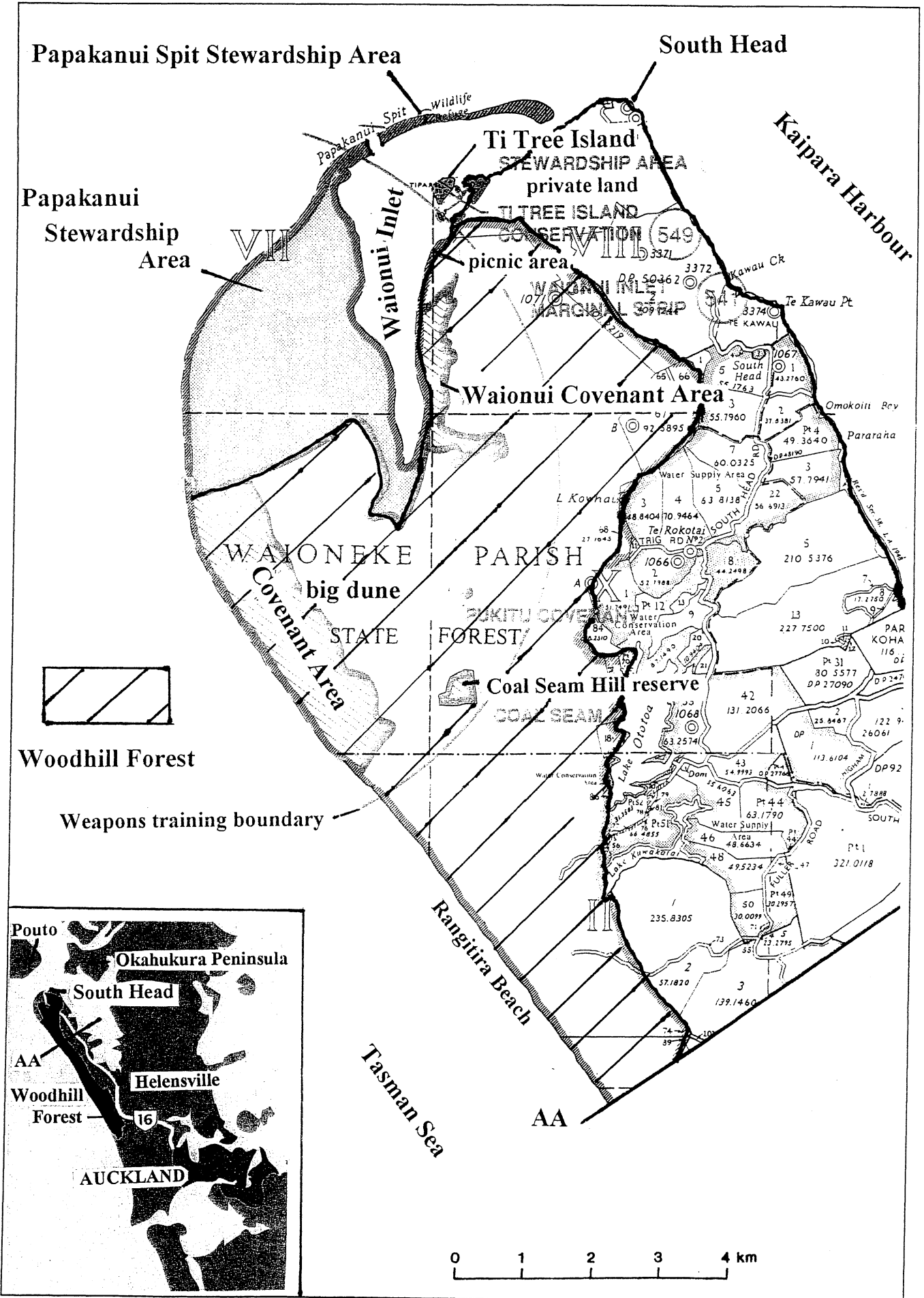


Fig. 1. Location of Waionui Inlet and status of the adjoining land (modified from Anon. 1995).

rises to over 50m (750m wide) and is a local landscape feature. Much of this western area is a bare, unconsolidated dune, with areas of sand-binding spinifex (*Spinifex sericeus*), pingao (*Desmoschoenus spiralis*), marram grass (*Ammophila arenaria*) and tauhinu (*Ozothamnus leptophyllus*), pockets of manuka and coastal toetoe (*Cortaderia splendens*), and wet dune slacks close to the Inlet. This area is only briefly commented on.

The vegetation of the southern end of the Waionui Inlet is briefly discussed by Cameron & Bellingham (1986) under "Area 3" based on a field trip in January 1986. The discovery of two unusual fern species for the Auckland region, *Cyclosorus interruptus* and *Thelypteris confluens*, by Bruce Burns in 1983 amongst *Baumea juncea* was the reason for searching here. In 1986 the former was found to be locally common but the latter was not seen. *Mazus novaezeelandiae* was discovered here for the first time in 1986, and several other species were recorded for the site.

Away from the damper areas the cover is pure kanuka c.6 (-10) m tall. Few other species reach the canopy except in the damp gully bottoms where houpara (*Pseudopanax lessonii*), mahoe (*Meliclytus ramiflorus*), mapou (*Myrsine australis*), cabbage tree (*Cordyline australis*), wheki (*Dicksonia squarrosa*), mamaku (*Cyathea medullaris*) and lancewood (*Pseudopanax crassifolius*) may be present. Towards the saltmeadows the canopy is only 2-3 m tall, and kanuka gives way to manuka, saltmarsh ribbonwood and very locally *Olearia solandri*. Towards the main tidal channels there was continuous cover of manuka up to c.2 m tall. The kanuka forest was severely damaged, by fallow deer (*Dama dama*) introduced to the area in 1900 (Davidson & Nugent 1990), pig rooting and, locally, cattle browsing, leaving a very depleted understorey of depauperate shrubs dominated by *Cyathodes juniperina* and occasional shrubs of *Corokia cotoneaster*, *Coprosma rhamnoides* and *Leucopogon fasciculatus*. The herbaceous flora of the kanuka stands is also grazed but includes species with limited distributions in the Auckland region, including *Lagenifera stipitata* and *Poa pusilla*.

Floristically the most important habitats were the depressions and drainage channels adjacent to the tidal inlets. Partially under kanuka/cabbage tree cover the herb flora in these depressions included various ferns (including *Cyclosorus interruptus*), *Euchiton* spp., *Pratia* aff. *angulata*, a spider orchid (*Nematocerus triloba*), *Carex virgata*, *Ranunculus amphitrichus*, *Mazus novaezeelandiae*, *Mentha cunninghamii*, *Hydrocotyle novae-zeelandiae*, *Isachne globosa* and *Baumea juncea*.

Between the manuka/saltmarsh ribbonwood shrub lands and the mangroves were extensive salt marshes of predominately oioi (*Apodasmia similis*) and locally saltwater paspalum (*Paspalum vaginatum*) on consolidated sand. Interesting communities existed where freshwater seeps were present, including areas

dominated by raupo (*Typha orientalis*) and *Bolboschoenus fluviatilis* at one site. At one area on the eastern margin of the Inlet, south of the picnic area, there is an area of open tidal mudflats with *Samolus repens*, *Isolepis cernua*, sea rush (*Juncus kraussii*) and *Schoenoplectus pungens*. *Selliera radicans* and glasswort were locally present, and needle tussock (*Austrostipa stipoides*) and eelgrass (*Zostera muelleri*) were evident between the picnic area and Ti Tree Island. The former at the upper margin of the sandy tidal flats, and the latter among mangroves on the tidal mudflats.

We failed to relocate "area 3" the site at south end of the Inlet where we found *Cyclosorus interruptus* and *Mazus novaezeelandiae* in 1986 (Cameron & Bellingham 1986). The area had been planted in young pines at the time of our first visit and it appeared to have been destroyed by the formation of a recent forestry skid site in 1993.

Vascular Flora

A total of 152 vascular species are recorded in the native vegetation up to 1 km south of the Inlet and 300m to the east, 76% are indigenous (see Appendix 1). Several species are threatened or have a regional stronghold at Woodhill (see below). The Woodhill dunes and kanuka forests are similar in formation, age and floristically to areas at the Pouto (Kaipara North Head) where 357 spp. have been recorded (Cameron et al. 2001). There is a large overlap between the 70 spp. recorded for Tauhara Estuary at Pouto and those recorded for Waionui Inlet (see Appendix 1).

Notes on selected species

A comment of whether a species is present or absent from the similar sand vegetation at Pouto, is based on Cameron et al. (2001). Distributions outside of Woodhill Forest are based mainly on herbarium specimens in AK & AKU.

Cyclosorus interruptus – a nationally threatened species ranked as 'Declining' (de Lange et al. 1999a). The Waionui Inlet appears to be the only known locality for this species in Auckland region and it is unrecorded for Pouto. (Note – this excludes the 2 undated historical collections by J. Adams from Miranda (AK 14057) & Miranda Hot Springs (AK 139503) in the Firth of Thames; the former is on the Auckland Conservancy boundary, the latter is 3 km south of it). All plants seen along the eastern margin of the Inlet in 1993 and 1995 were unhealthy with few fronds/plant, in contrast to the ones seen in 1986 that were growing amongst almost pure *Baumea juncea* in the open. Presumably the eastern habitat had become too shaded for this species: it may require canopy gaps for its survival. It was not seen by the *Mazus* and *Pratia* sites by Cameron Kilgour and Anthony Keene in 2001 or by Jonathan Boow and Cameron Kilgour in 2002 (C. Kilgour pers comm.). Since the only plants found in 1993-95 were unhealthy, it is important to revisit the site to determine whether this local

population has survived, and what management might be required to ensure its continuing survival here.

Desmoschoenus spiralis - a nationally threatened species ranked as 'Recovering: Conservation Dependant' (de Lange et al. 1999a). It was locally present forming small dunes on the western side of the Inlet (based on a drive through the bombing range). It is also present on the Pouto dunes.

Lagenifera stipitata - in New Zealand it is a predominantly west coast species growing on sand, occurring at Tauroa Peninsula, Waipoua, Pouto, Woodhill, Te Henga and Kawhia. There appear to be only two east coast records: Kaimaumu (*H.B. Matthews*, AK 35073); and Opoutere (SE Coromandel) on sand under pines (*C.C. Ogle*, CHR 404570). It appears to be a species that requires sites of early succession on dunes. It is common in most kanuka stands at Woodhill (a major stronghold for this species in NZ), but this habitat (consolidated dunes under early successional woody cover) is under threat by weed invasion and kanuka senescence. There is now no opportunities for expansion of kanuka onto the unstable dunes because they are planted in pines. The Woodhill pine plantations should be surveyed to see if it colonises there.

Mazus novaezeelandiae subsp. *impolitus* - a nationally threatened taxon ranked as 'Vulnerable' (de Lange et al. 1999a). The Waionui Inlet is the first known locality for this taxon in the Auckland region. It was first discovered in the southern part of the Inlet on a 4-wheel drive track by planted pines (*Pinus radiata*) in 1986 (Cameron & Bellingham 1986: 48). In 1987 during an Auckland Bot Soc trip two new dense populations of *Mazus* were found close to the initial one, but in a different habitat - it was spreading along animal tracks though the *Baumea juncea* (Cameron 1988). Our 1993 trip failed to relocate these populations (see above) but we did discover a >8m x 8m patch in a damp sand hollow, partially shaded by kanuka, between Lagoon Road and the south-eastern margin of the Waionui Inlet. This same population was visited and photographed by Auckland Bot Soc in February 1995. In November 1998 pampas (*Cortaderia jubata* & *C. selloana*) was starting to invade this site and by May 1999 pampas 2-2.5m tall dominated the hollow and the *Mazus* had died out. In February 2001, working for DoC, Cameron Kilgour and Anthony Keene located four *Mazus* sites between the south-east part of the Inlet and Lagoon Road (close to the overgrown site), one of these was > 50m long (Cameron Kilgour & Jonathan Bow pers. comm.). There is only one other *M. novaezeelandiae* record for the Auckland region: a small population discovered by Maureen Young behind the dunes under kanuka on the Okahukura Peninsula (12 km NE of Waionui Inlet) in December 1993 (AK 218631). On an Auckland Bot Soc field trip to this area in August 1995 we failed to relocate this population. It is unrecorded for Pouto.

Mentha cunninghamii - only a single patch seen on eastern side of Inlet, and not seen by us elsewhere in Woodhill. It is known at several sites along the Waitakere coast south of Muriwai (e.g. Te Henga, Mercer Bay Track & Huia). The only other Auckland region collections are historical by T. Kirk from Big Omaha (AK 11605-06) and Papakura (CHR 297142). N.T. Moar collected it from Lake Kanono at Pouto in 1950 (CHR 69856) and E.P. Turner a little further north at Te Kopuru pre-1937 (AK 108220). This species appears to have a predominantly bimodal distribution: dunes and coastal areas of the west coast of the North Island, or montane axial ranges of the North and South Islands (note - the 2 Kirk exceptions cited above).

Poa pusilla - this fine-leaved poa is common in most of the Woodhill kanuka stands. The west coast of the Auckland region is the main regional locality for this species, from Kaipara South Head to the Manukau Heads, and especially in Woodhill Forest. It is also locally common at Pouto.

Pratia aff. *angulata* (= *P.* "Woodhill") - a nationally threatened taxon ranked as 'Vulnerable' in the 'Taxonomically Indeterminate' category (de Lange et al. 1999a). It appears to be an endemic undescribed species to Kaipara South Head, distinguished from *P. angulata* s.str. by the presence of stiff, white hairs on the upper leaf surface and margin (Murray & Cameron 1990). We first discovered it in the adjacent Coal Seam Hill reserve in 1986 and commented that it "*P. angulata*" seemed out of place under kanuka on ridges and mid-faces (Cameron & Bellingham 1986). Subsequently Rhys Gardner collected it under 3m tall manuka from southern part of the Inlet in April 1993 (AK 215081) and we discovered three populations in July 1993 along the south-eastern margins of the Waionui Inlet in damp sand hollows under kanuka and/or manuka (west of Lagoon Rd), in contrast to the drier habitat on Coal Seam Hill. During a DoC survey in February 2001 Cameron Kilgour and Anthony Keene located this taxon at four sites on the west side of Lagoon Road (possibly the same ones as we saw) and at four sites on the east side of the road within 0.5 km of the Inlet (Cameron Kilgour & Jonathan Bow pers. comm.) (AK 252678-79). In summary, *P.* aff. *angulata* has been recorded from at least 9 sites over a distance of <6 km, at least 8 sites on the south-east of the Waionui Inlet and one in Coal Seam Hill reserve. *Pratia angulata* s.str. is unknown to us in the Woodhill area.

Schoenoplectus pungens - the eastern margin of the Waionui Inlet (to just south of Ti Tree Island) appears to be at its northern geographical limit in New Zealand. In 1993 all plants were sterile and <30cm tall. Possibly it has recently established here. It may be spreading northwards, because the first collection on the Waitakere coast was only in 1981 (*R.O. Gardner 3050*, AK 153716).

Senecio quadridentatus - an Auckland regionally threatened species ranked as 'Declining' (de Lange et

al. 1999b), widely scattered in the Auckland region, and Woodhill Forest appears to be one of its regional strongholds (EKC pers. obs.). It is unrecorded for Pouto.

Thelypteris confluens - a nationally threatened species ranked as 'Vulnerable' (de Lange et al. 1999a). There are only two known sites for this species in the Auckland region. It was collected in the southern Waionui Inlet by Bruce Burns in 1983, and not seen there since (AKU 15136). More recently a small population was discovered in the Waitakere (Te Henga) wetland in 1998 by Mark Bellingham (Cameron & Bellingham 1998). It is locally abundant at Pouto, which appears to be the NZ stronghold for the species.

Other values

The mobile sand spit (Papakanui Spit) and the estuarine area of the Waionui Inlet are of international significance as nesting habitat and feeding areas for threatened bird species and as roosting and feeding areas for migratory waders (Anon. 1995: 113). The spit is an important breeding and roosting area for three tern species (white-fronted, Caspian, fairy). Up to 200 Caspian terns used to nest there until 1990 when nesting birds were run over by vehicles and since then only use the area for roosting and fishing (Barbara Waller pers. comm.). NZ and banded dotterels, variable oystercatchers and bittern also breed in the general area, and reef herons visit (Gwenda Pulham pers. comm.). From the Ornithological Society's records (Mar 2000- Feb 2002) for the 10 km square encompassing most of the Waionui Inlet and Papakanui Spit, 74 bird species have been recorded; making it one of the most diverse bird squares for Auckland and probably nationally as well (David Pye pers. comm.). Each time we have visited the manuka areas of the southern part of the Inlet fernbirds have been present. Most of the bird species have benefited by the fairy tern predator trapping for mustelids, cats and rats that DoC has funded for the last five nesting seasons (Gwenda Pulham pers. comm.).

Animal damage and exclosures

Feral fallow deer have been present in Woodhill for over 100 years and have been hunted there for over 75 years (Smale et al. 1995). Hunting is regulated by CHH. Deer have had a devastating impact on the native Woodhill vegetation where some of the kanuka understorey is reduced to a grazed ground cover and divaricating or prickly shrubs (pers. obs.). To assess this impact exclosure plots were placed in three of the kanuka areas of Woodhill in 1983, including one at the south end of the Waionui Inlet. They were remeasured 1993 (Smale et al. 1995) and 2000. Data from these long-term exclosures gives unequivocal evidence that deer have impoverished the species richness of the kanuka communities, and have reduced to negligible levels the regeneration of most palatable species, e.g. mahoe, houpara and koromiko (*Hebe stricta*). Unchecked, not only will there be no replacement of

existing populations through their failure to regenerate, but also current successions in the kanuka communities will tend to communities that bear no resemblance to ungrazed ones (Smale, et al. 1995). The 2000 re-measurement of the same exclosures offered more evidence of the same depressing trend (I.J. Payton pers. comm.). Furthermore numbers of several groups of soil invertebrates were significantly greater inside exclosures than outside in these forests (Wardle et al. 2001). During visits to the Waionui Inlet kanuka fringes we usually sighted deer, and deer droppings and footprints were common.

Feral pig rooting was evident in the damp hollows during most visits to the kanuka fringes of the Inlet. Cattle are used by CHH to control pampas in the young pine plantation areas. Cattle occasionally escape from the electric fenced plantation areas and graze in the kanuka stands. Possums are present throughout Woodhill.

Bishop (1996) for an MSc University thesis documented the vegetation dynamics in two kanuka reserves in south Woodhill: Hodges Basin and Old Lookout. He found the soil seed-banks were dominated by exotic annuals and short-lived perennials, and that the seed rain was depauperate compared with other New Zealand studies but kanuka and rewarewa were the prominent native species present.

Threats

The vegetation and threatened plant species of this area are threatened by habitat modification by browsing mammals (deer, pigs, possums and to a lesser extent cattle), weed establishment (especially pampas grasses), forestry activities, vehicle activity (4-wheel drives), weapon training activity and fire. Vehicles are mainly kept out of sensitive areas like sand dunes and estuarine habitats in most other areas around Auckland, but sadly at South Kaipara Head it seems to be a case of 'out of sight out of mind'!

Discussion

Fourteen threatened native plant species (8 national, 6 regional) occur in the native bush areas throughout Woodhill Forest. Of these, six (5 national, 1 regional) occur on the fringes of Waionui Inlet, and 3 occur nowhere else in the Auckland region. Of these, two ferns have possibly become locally extinct through habitat destruction over the last 7-19 years. Other species have their regional stronghold at Woodhill. The duneland kanuka forests of Woodhill are among the best in NZ and deserve to be protected in their own right (Smale et al. 1995). The diversity of the native vegetation is being severely degraded by grazing mammals, especially by fallow deer. Pig rooting, and cattle and possum browsing is also evident. Browsing opens up the vegetation for weed invasion, especially by pampas grasses.

DoC recognised the Kaipara South Head, including the Waionui Inlet, as a Key Area in the Auckland region in

1995 and proposed to change the status from Stewardship to Conservation Park (Anon. 1995: table 8). This change has still not been implemented. This is unfortunate because the area urgently requires a

status that reflects its biological and geomorphological value, which in turn hopefully would lead to better management of the asset.

Recommendations

- Implement urgently the change of land status from Stewardship to Conservation Park with an associated management plan and the capacity for close liaison with CHH and the NZ Defence Force. This would also provide the mechanism to restrict camping, vehicles, weapon training and other potentially destructive activities.
- Locally eradicate (or exclude) the grazing feral mammals (especially the deer) and the predators of nesting birds. Because of the area's outstanding flora and fauna values it should be considered for 'mainland island' status (i.e. permanently exclude all animal pests).
- Control environmental weeds establishing in the native vegetation, especially the existing pampas grasses, brush wattle (*Paraserianthes lophantha*), buffalo grass (*Stenotaphrum secundatum*), Mexican devil (*Ageratina adenophora*), paddy lucerne (*Sida rhombifolia*), Spanish heath (*Erica lusitanica*) and gorse. Gorse threatens to invade the open semi-stable dune areas.
- Carry out more field surveys to clarify the current status of the threatened plants that have been recorded for the area, and to look for additional records using GPS (habitats in shifting sand are difficult to relocate) for recording localities of all threatened plants. Establish the less common threatened taxa in *ex-situ* cultivation to ensure survival of the genotypes.

Acknowledgements

We thank Carter Holt Harvey Forests (CHH) for facilitating access, Barbara Waller (local resident) for comment on changes to the area, Gwenda Pulham and David Pye (Ornithological Soc members) for local bird information, Cameron Kilgour and Jonathan Boow (DoC) for commenting on a draft of this article, Marie Alpe (DoC) for clarifying land status, Mark Smale (Landcare Research) and Marjorie Cutting (ARC) who accompanied us on 1 July 1993; EKC thanks Bot Soc members on the 19 Feb 1995 field trip, and Bec Stanley, Thelma Wilson, George Wilson (all from DoC) and Chayne Zinsli (CHH) for the field trip on 11 May 1999.

References

- Anon. 1995: Conservation Management Strategy for Auckland 1995-2005, vol. I. Department of Conservation, Auckland Conservancy.
- Bishop, C.D. 1996: Seed-bank and vegetation dynamics of coastal, kanuka (*Kunzea ericoides*) forest on Holocene dunes of the south Kaipara Peninsula. Unpublished MSc thesis, Biological Sciences, University of Auckland.
- Cameron, E. K. 1988: Northern Woodhill. *Auckland Botanical Society Journal* 43(2): 50-51.
- Cameron, E. K. 1994: Vascular flora, vegetation and conservation issues of Lake Kereta and adjacent bush, South Kaipara. *Auckland Botanical Society Journal* 49(1): 21-27.
- Cameron, E. K. 1998: Flora of Lake Kowhai and adjacent bush, Northern Woodhill. *Auckland Botanical Society Journal* 53(2): 78-82.
- Cameron, E. K.; Bellingham, R. M 1998: *Thelypteris confluens* – an addition to the Waitakeres. *Auckland Botanical Society Journal* 53(1): 38.
- Cameron, E. K.; Bellingham, P.J. 1986: Woodhill State Forest – notes on several natural areas. *Auckland Botanical Society Newsletter* 41(2): 46-52.
- Cameron, E. K.; Jones, S.; Wilcox, M.D.; Young, M.E. 2001: Flora and Vegetation of Pouto Peninsula, North Head of Kaipara Harbour, Northland, New Zealand, 26-29 January 2001. *Auckland Botanical Society Journal* 56(1): 38-51.
- Davidson, M. M.; Nugent, G. 1990: Fallow deer. In: King, C.M. (ed.): *Handbook of New Zealand mammals*, pp. 490-506. Oxford University Press, Auckland.
- de Lange, P.J.; Cameron, E. K. Stanley, R. 1999b: Threatened and uncommon plants of the Auckland Region and Kermadec Islands (2). *Auckland Botanical Society Newsletter* 54(1): 37-41.
- de Lange, P. J., Heenan, P. B., Given, D. R., Norton, D. A., Ogle, C. C., Johnson, P. N. & Cameron, E. K. 1999a: Threatened and uncommon plants of New Zealand. *N.Z. Journal of Botany* 37: 603-628.
- Mackinder, J. 1994: Some botanical notes on Lake Ototoa, South Head, Kaipara. *Auckland Botanical Society Newsletter* 39(2): 25-29.
- Murray, B. G.; Cameron, E. K. 1990: An update on the cytogeography of *Pratia*. *N.Z. Journal Botanical Society Newsletter* 22: 7-8.
- Smale, M. C.; Hall, G.M.J.; Gardner, R.O. 1995: Dynamics of kanuka (*Kunzea ericoides*) forest on South Kaipara spit, New Zealand, and the impact of fallow deer (*Dama dama*). *New Zealand Journal of Ecology* 19(2): 131-141.
- Wardle, D. A.; Barker, G. M.; Yeates, G. W.; Bonner, K. I. Ghani, A. 2001: Introduced browsing mammals in New Zealand natural forests: aboveground and belowground consequences. *Ecological Monographs* 71: 587-614.

Appendix 1. Flora of the fringes of the Waionui Inlet and a comparison with Pouto

This species list is based on the native vegetation on the eastern (south of Ti Tree Id) and southern side (as far south as the kanuka extends) of the Waionui Inlet. Ten records are also included from the western side (bombing range) based on what was seen from a vehicle on Nov 1998.

Key

* = adventive species

a = abundant

c = common

o = occasional

l = local

s = scarce (< 5 plants seen)

Ad = present in adjacent area (within 100m)

Ca = recorded here by Cameron (1988), not seen during present survey

C&B = recorded here by Cameron & Bellingham (1986), not seen during present survey

Po = recorded for general Pouto area (Kaipara North Head is only 7.5 km north of Papakanui Spit) by Cameron et al. (2001)

TE = recorded specifically from Tauhara Estuary at Pouto by Cameron et al. (2001)

W = recorded from bombing range (west side of Inlet) as seen from a vehicle, with a separate abundance rating in parentheses.

Plant group	Abundance at Waionui Inlet	Pouto	Waionui Inlet vouchers
Ferns (19 + 0) (= native + naturalised totals)			
<i>Asplenium flaccidum</i>	o	Po	
<i>A. polyodon</i>	s	Po	
<i>Blechnum novae-zealandiae</i> (incl swamp form)	lc	Po	
<i>Cyathea dealbata</i>	o	Po(TE)	
<i>C. medullaris</i>	o	Po	
<i>Cyclosorus interruptus</i>	o		AK 212137, AKU 15135
<i>Dicksonia squarrosa</i>	o-lc	Po	
<i>Diplazium australe</i>	s	Po	
<i>Doodia australis</i>	c	Po	
<i>Hypolepis ambigua</i>	l	Po	
<i>Microsorium pustulatum</i>	o-lc	Po	
<i>Paesia scaberula</i>	o	Po	
<i>Pneumatopteris pennigera</i>	l	Po	
<i>Pteridium esculentum</i>	o	Po(TE)	
<i>Pteris macilenta</i>	o	Po	
<i>P. tremula</i>	c	Po(TE)	
<i>Pyrosia eleagnifolia</i>	o		
<i>Rumohra adiantiformis</i>	s		
<i>Thelypteris confluens</i>	C&B	Po	AKU 15136
Dicotyledons (55 + 26)			
<i>Ageratina adenophora</i> *	lc	Po(TE)	
<i>Anagallis arvensis</i> s.str.*	o	Po	
<i>Apium</i> "white denticles"	l	Po(TE)	AK 212148
<i>Aster subulatus</i> *	o	Po	
<i>Avicennia marina</i>	la	Po(TE)	
<i>Calystegia sepium</i>	lc	Po(TE)	
<i>Carmichaelia australis</i>	o	Po	
<i>Centella uniflora</i>	l	Po	
<i>Chenopodium ambrosioides</i> *	Ad	Po	
<i>Cirsium vulgare</i> *	o	Po	
<i>Conyza albida</i> *	o	Po	
<i>Coprosma crassifolia</i>	o-c	Po	
<i>C. rhamnoides</i>	o	Po(TE)	
<i>C. robusta</i>	o	Po	
<i>C. propinqua</i> x <i>C. robusta</i>	s	Po	
<i>Corokia cotoneaster</i>	o-lc	Po	
<i>Cotula australis</i>	Ad		
<i>Crepis capillaris</i> *	o	Po	
<i>Cyathodes juniperina</i>	o-la	Po	
<i>Epilobium rotundifolia</i>	s	Po	
<i>Erica lusitanica</i> *	lc		
<i>Euchiton gymnocephalus</i>	l		
<i>E. sphaericus</i>	o	Po	AK 212139
<i>Galium propinquum</i>	l		
<i>Gamochaeta spicata</i> *	o		
<i>Geniostoma rupestre</i> subsp. <i>ligustrifolium</i>	o	Po(TE)	
<i>Haloragis erecta</i> s.str.	s	Po	
<i>Hebe stricta</i> var. <i>stricta</i>	s	Po	
<i>Hydrocotyle novae-zeelandiae</i>	o-lc		AK 212135

<i>Kunzea ericoides</i> s.lat.	la; W(la)	Po(TE)	
<i>Lagenifera stipitata</i>	l-o	Po	
<i>Leptospermum scoparium</i>	la; W(la)	Po	
<i>Leucopogon fasciculatus</i>	Ad	Po	
<i>L. fraseri</i>	s	Po	
<i>Lobelia anceps</i>	l	Po(TE)	
<i>Lotus pedunculatus*</i>	o	Po	
<i>Lupinus arboreus*</i>	o	Po	
<i>Macropiper excelsum</i> subsp. <i>excelsum</i>	o	Po	
<i>Mazus novaezeelandiae</i> subsp. <i>impolitus</i>	l		AK 212126, AKJ 19093
<i>Melicytus ramiflorus</i>	o	Po(TE)	
<i>Mentha cunninghamii</i>	l	Po	AK 212145
<i>Muehlenbeckia complexa</i>	lc	Po(TE)	
<i>Myosotis laxa*</i>	l		
<i>Myrsine australis</i>	lc	Po	
<i>Olearia solandri</i>	o	Po(TE)	
<i>Oxalis rubens</i>	Ad	Po	
<i>Ozothamnus leptophyllus</i>	W(la)	Po	
<i>Paraserianthes lophantha*</i>	lc	Po	
<i>Parsonia ? heterophylla</i>	s	Po	
<i>Persicaria decipiens</i>	lc	Po	
<i>Phytolacca octandra*</i>	l	Po(TE)	
<i>Plagianthus divaricatus</i>	o	Po(TE)	
<i>Polycarpon tetraphylla*</i>	Ad		
<i>Pomaderris</i> aff. <i>phyllicifolia</i>	s	Po	
<i>Pratia</i> aff. <i>angulata</i> (= <i>P. "Woodhill"</i>)	s		AK 212143
<i>Prunella vulgaris*</i>	l		
<i>Pseudopanax lessonii</i>	s	Po	AK 212141
<i>P. crassifolius</i> x <i>P. lessonii</i>	o	Po	
<i>Ranunculus amphitrichus</i>	l	Po	AK 212138
<i>Samolus repens</i>	o-lc	Po(TE)	
<i>Sarcocornia quinqueflora</i>	l	Po(TE)	
<i>Selliera radicans</i>	l	Po(TE)	
<i>Senecio bipinnatisectus*</i>	o	Po	
<i>S. biserratus</i>	o		
<i>S. diaschides*</i>	o	Po	AK 212134
<i>S. esleri*</i>	o		AK 212136
<i>S. glomeratus</i>	s	Po	
<i>S. hispidulus</i>	o	Po	
<i>S. jacobaea*</i>	s		
<i>S. minimus</i>	o-lc	Po	
<i>S. quadridentatus</i>	o-lc		
<i>Sida rhombifolia*</i>	Ad		AK 247181
<i>Silene gallica*</i>	o	Po(TE)	
<i>Solanum americanum</i>	o	Po	
<i>S. aviculare</i>	s		
<i>S. nigrum*</i>	s		
<i>Sophora ? microphylla</i> (drift seed only)	l	Po	
<i>Stellaria parviflora</i>	l	Po	
<i>Trapaeolum majus*</i>	s		
<i>Ulex europaeus*</i>	lc	Po(TE)	
<i>Vellereophyton dealbatum*</i>	Ad	Po	AK 212140
<i>Verbena bonariensis*</i>	Ad		
<i>Wahlenbergia littoricola</i> subsp. <i>vernicaosa</i>	lc	Po	AK 221757
Monocotyledons (41 + 11)			
<i>Aira caryophyllea</i> s.str.*	lc	Po	
<i>Ammophila arenaria*</i>	W(lc)	Po(TE)	
<i>Apodasmia similis</i>	o-lc; W(la)	Po(TE)	
<i>Austrostipa stipoides</i>	lc		
<i>Baumea articulata</i>	l-o	Po(TE)	
<i>B. juncea</i>	lc	Po(TE)	
<i>Bolboschoenus fluviatilis</i>	l		AK 212146
<i>Carex flagellifera</i>	o		
<i>C. pumila</i>	W(la)	Po	
<i>C. secta</i>	l	Po	

<i>C. virgata</i>	lc	Po(TE)	
<i>C. "raotest"</i>	o	Po(TE)	
<i>Cordyline australis</i>	o	Po	
<i>Cortaderia jubata*</i>	lc	Po	
<i>C. selloana*</i>	c; W(la)	Po(TE)	
<i>C. splendens</i>	o; W(la)	Po	
<i>Cyperus congestus*</i>	o	Po(TE)	
<i>C. ustulatus</i>	o-lc	Po(TE)	
<i>Desmoschoenus spiralis</i>	W(l)	Po	
<i>Dichelachne crinita</i>	o	Po	
<i>Eleocharis acuta</i>	lc	Po	
<i>E. sphacelata</i>	l	Po	
<i>Gastrodia aff. sesamoides</i>	Ca	Po	AK 179251
<i>Gladiolus undulatus*</i>	Ad		
<i>Isachne globosa</i>	lc	Po	AK 212144
<i>Isolepis cernua</i>	o	Po(TE)	
<i>I. nodosa</i>	o	Po(TE)	
<i>Juncus articulatus*</i>	C&B	Po	
<i>J. aff. caespiticus</i>	C&B	Po	
<i>J. kraussii</i> var. <i>australiensis</i>	o-lc	Po(TE)	
<i>J. planifolius</i>	C&B	Po	
<i>Lepidosperma australe</i>	l-o	Po	
<i>L. laterale</i>	o-lc	Po	
<i>Microlaena stipoides</i>	l	Po(TE)	
<i>Morelotia affinis</i>	o	Po	
<i>Nematocerus triloba</i> (ex <i>Corybas</i>)	l	Po	AK 212142
<i>Oplismenus hirtellus</i> subsp. <i>imbecillis</i>	o-lc	Po(TE)	
<i>Paspalum vaginatum*</i>	la	Po(TE)	
<i>Phormium tenax</i>	o-lc	Po(TE)	
<i>Poa pusilla</i>	o-lc	Po	
<i>Pterostylis alobula</i>	l	Po	
<i>Schoenoplectus pungens</i>	lc		AK 212147
<i>S. tabernaemontani</i>	lc	Po	
<i>Schoenus maschalinus</i>	l	Po	
<i>Spinifex sericeus</i>	W(lc)	Po(TE)	
<i>Sporobolus africanus*</i>	Ad	Po	
<i>Stenotaphrum secundatum*</i>	o		
<i>Thelymitra pauciflora</i>	Ca		
<i>Typha orientalis</i>	o-lc; W(l)	Po(TE)	
<i>Vulpia myuros*</i>	o		
<i>Zostera muelleri</i>	lc		
<i>Zoysia pauciflora</i>	lc	Po	AKU 19094



Acknowledgement: Ewen Cameron helped in the proof-reading of this AZBS Journal, and Mike Wilcox for contributing towards the colour printing costs in the New Caledonia article.

