

Waikumete Cemetery

Threatened and Uncommon Plant Survey 2001



Management Report



Waitakere City Council
Te Taiao o Waitakere

Waikumete Cemetery

Threatened and Uncommon Plant Survey and Management Report

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Prepared for
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by
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Waikumete Cemetery Threatened and Uncommon Plant Survey and Management Report (Final).

Summary

The Waikumete Cemetery was surveyed for regionally threatened and/or other uncommon gumland indigenous plants between October 1999 and May 2001. Two grasses, *Dichelachne inaequiglumis* and *Paspalum orbiculare*, were rediscovered the latter of which proved to be very common. The clubmoss *Phylloglossum drummondii*, and orchids *Pterostylis puberula*, were not seen, and these species are probably now extinct at Waikumete. Nevertheless healthy populations of the orchids *Microtis* aff. *parviflora*, *M unifolia*, and *Thelymitra* aff. *pauciflora* were located in several sites across the cemetery. We also rediscovered smaller populations of *Genoplesium pumilum*, *Thelymitra carnea*, and *T.* aff. *longifolia*. In addition, 3 species of *Pterostylis* and *Thelymitra*, the native oxtongue *Picris burbridgei* and bindweed *Calystegia marginata* were new uncommon plant discoveries for the cemetery. Of these the native oxtongue is rated "Vulnerable", three others, *Calystegia marginata*, *Pterostylis tasmanica*, and *Thelymitra tholiformis* "Declining", and *Caladenia atradenia* "Naturally Uncommon/Sparse" by the New Zealand Threatened Plant Committee (de Lange et al. 1999a). A further three, *Dichelachne inaequiglumis*, *Paspalum orbiculare*, and *Thelymitra aemula* have Regional Threat listings (de Lange et al. 1999b). Of all these species the presence of large populations of *Caladenia atradenia* and *Calystegia marginata* at its current extant southern limit makes Waikumete Cemetery Nationally Significant.

None of these plants are confined to the more seriously *Watsonia* infested parts of the cemetery. Although several species, including the grasses, and some orchids are common in the older, less intensively managed parts of the cemetery, the majority of the uncommon indigenous plants of Waikumete are confined to the northern and southern gumland vegetation. Here they are mainly threatened by the spread of pampas grasses (*Cortaderia jubata* and *C. selloana*), and natural succession from low open gumland to dense manuka (*Leptospermum scoparium*)/kanuka (*Kunzea* aff. *ericoides*) shrubland and forest.

Without careful management many of these gumland inhabitants will decline and become extinct. Suggested management options vary from proposed restoration/population enhancement plantings, spot-spraying/hand-weeding, to researching the use of fire as a long-term management tool. With regard to those sites where *Watsonia* control started in 1999 there is some evidence of recolonisation by some of the more hardy orchids and grasses.

Introduction

Based on the observations of early missionary and botanist William Colenso, and other explorers of the time the land that Waikumete cemetery now occupies was already covered in gumland scrub¹ during the 1840's (Dieffenbach 1843; Colenso 1844; Beever 1981). Whether this vegetation type was fire induced, or the natural consequence of the gradual podzolisation of the underlying soils has not, as far as we are aware, been determined (see also comments by Beever 1981). Irrespective of the origin of the vegetation type, Waikumete has long been recognised as an important place to view gumland scrub, with its attendant unusual assemblage of small herbs, grasses, orchids and ferns (Braggins 1974). Although much of the cemetery has been cleared of gumland vegetation, many small pockets of this vegetation type have either recolonised or persist amongst the graves. In addition two sizeable blocks of gumland scrub remain one protecting the main catchment of the stream that drains the cemetery, while the other occupies the steep southwestern slopes of Waikumete. Associated with these gumland remnants are various indigenous orchids, grasses, herbs, and ferns, many of them regionally scarce (de Lange et al. 1999b), while several are also listed as nationally threatened (de Lange et al. 1999a).

Unfortunately some exotic plants bought into the cemetery have thrived and invaded mainly the older graves, particularly in burial areas 1, 2 and 3. Because of their habit these invasive plants are destroying significant parts of the grave areas, and in addition are out-competing indigenous species, including the regionally scarce orchids, grasses and ferns. Several of these exotic plants, for example the various forms of *Watsonia*, are especially hard to control, and are now such a serious problem in the cemetery that effective control is believed only feasible by the use herbicides (M. Dixon & E.K. Cameron pers. comm.). Although herbicide application is believed necessary, at least until the larger infestations are controlled, the use of herbicide also poses a risk to indigenous flora of the cemetery. This risk to the indigenous flora of the cemetery is of particular concern to the administering authority, the Waitakere City Council.

Vegetative surveys of Waikumete cemetery were undertaken between October 1999 and May 2001 to determine

1. whether previously recorded rare or threatened indigenous species persisted at the site and
2. Whether the proposed spraying of *Watsonia* posed a risk to these species.

At the conclusion of the surveys, the persistence of 2 indigenous grasses and 7 orchids was established, and a further 17 orchids, and another two nationally uncommon dicotyledonous plants, a species of oxtongue, and a bindweed, added to the known flora of the cemetery. Of those species commonly encountered within the main utilised parts of the cemetery most

¹ a vegetation type dominated by manuka (*Leptospermum scoparium*), kanuka (*Kunzea ericoides* agg.) and the cyperaceous genera *Baumea*, *Schoenus*, *Tetraria* and *Lepidosperma* (Rumball & Esler 1975)

can be expected to become more common once the worst weed infested areas are cleared. Only one species, the native oxtongue (*Picris burbidgei*) appears to have succumbed to weed spraying but as seed of this species was obtained from Waikumete, the option exists to reintroduce it to suitable sites once weed control has ceased. Seed is currently held by the Auckland Regional Council Botanic Gardens.

Two target survey species, the orchid *Pterostylis puberula*, and fern ally *Phylloglossum drummondii* are presumed to be extinct within the cemetery. One species of fern *Leptolepia novae-zelandiae*, said to have been collected from Waikumete is not covered here because there is no evidence that it ever really grew at Waikumete, and in the unlikely event that it once did there is now no suitable habitat for it left within the area.

The Survey

Thirty visits were made to Waikumete between October 1999 May 2001. Visits were timed to cover the different growing/flowering seasons of New Zealand indigenous grasses and orchids. All parts of the cemetery were covered. The focus of our survey included the 2 grasses *Dichelachne inaequiglumis* and *Paspalum orbiculare*, fern ally *Phylloglossum drummondii*, and the orchids *Genoplesium pumilum*, *Microtis* aff. *parviflora*, *M. unifolia*, *Pterostylis puberula*, *P. tasmanica*, *Thelymitra carnea*, *T. aff. longifolia*, and *T. aff. pauciflora*, identified as survey priorities by the council. However, in addition to these species we located an additional 19 orchid and/or uncommon indigenous vascular species at Waikumete. An updated provisional Vascular Flora for Waikumete is appended (Appendix 1), a more comprehensive listing for the cemetery is being prepared by E.K. Cameron and A.E. Esler (E.K. Cameron pers. comm.).

Species Descriptions and Management Options

For each species the national and/or regional threat status is given (based on de Lange et al. 1999a, 1999b), this is followed by a (where possible) brief botanical description, then the cemetery distribution (Fig. 1, 2), notes and management options. For those seasonal species flowering times and/or periods when plants are likely to be visible (growing season) are given. All species covered are arranged by their basic life form, viz., grass, orchid, vine etc. Table 1 summarises locations where the survey species and any additional taxa discovered were found within the cemetery.

Grasses

Dichelachne inaequiglumis

gum grass

Threat Status: Regionally Vulnerable (de Lange et al. 1999b)

Description: Tufted grass of open clay pans and short turf. Leaf sheath dull or light brown, glabrous or minutely scabrid below collar, sometimes with scattered hairs. Ligule 0.1 - 0.5 mm, membranous, truncate, ciliate. Leaf-blade up to 15 cm × 1-2.5 mm, flat, tapered; margins minutely scabrid towards tip, occasionally both, surface with short hairs. Culm (stem) 25 - 70cm, internodes entirely glabrous, or slightly and minutely scabrid below purplish nodes. Panicle (flower head) 10 - 30 cm, lax; branches few, slender, in ± distant whorls, naked below; rachis, branchlets and pedicels short-scabrid, visible between spikelets. Spikelets purple, few. Glumes elliptic-lanceolate, acute; lower (2.5)-3-3.5-(4.5) mm, < lemma, upper (3.5)-4-4.5-(5.5) mm less than or equal or rarely > lemma. Lemma 4-6 mm, minutely scabrid, tip shortly bifid; awn 13.5-18.5 mm, purple, inserted c.0.5mm below lemma tip, column ± straight, awn twisting 2-3 times. Palea 3.5-4 mm, narrow-linear, keels scabrid near ciliate tip. Callus hairs (0.5) - c.1 mm. Rachilla prolongation to 0.2 mm. Lodicles 0.4-0.7 mm, cuneate, somewhat bilobed with a few apical hairs. Anthers 3, (0.9)-1.0-1.5-(2.5) mm in chasmogamous flowers, (0.1)-0.2-0.7 mm in cleistogamous flowers. Caryopsis 2-2.5 × 0.3-0.4 mm; embryo 0.2-0.4 mm; hilum 1.8-2.3 mm.

Distribution within Waikumete Cemetery: Locally common on open clay pans and within short bristle grass (*Rytidosperma*) turf throughout the less modified parts of the cemetery. This species is particularly abundant under *Eucalyptus* trees delineating the eastern and southern cemetery boundaries. Sometimes found as a "rupestral" on old tombstones.

Growing Season: October - May.

Notes: This annual to short-lived perennial grass was once typical of gumland scrub and open grasslands of much of the northern North Island, parts of the Wellington region, the West Coast of the South Island (Edgar & Connor 2000). It has also recently been discovered on Stewart (Rakiura) Island. In the Auckland Region this grass is probably more overlooked than genuinely threatened. It is usually first observed when the distinctive, wispy, reddish-green/purple-green flower heads become conspicuous in November.

Within the immediate Auckland area Waikumete has long been recognised as a stronghold for the species. Our survey confirmed that this grass is very common in any suitably open ground throughout the cemetery. It is particularly common under the *Eucalyptus* trees lining Eucalyptus drive, and along the hedge bordering Glenview Road. However scattered plants occur throughout the area maintained by the Friends of Waikumete Cemetery, up until, and including Burial Area 4. *Dichelachne* is largely absent from areas of dense *Watsonia* infestation, although in the less dense areas it is often a

conspicuous "rupestral" on old graves stones, rock pillars and other monuments. In the heavily mowed ground of Area 5 it is less common, although trimmed flowering specimens could still be found in most sites

Management Options: As *Dichelachne inaequiglumis* is perhaps one of the most common indigenous grasses of the gumland scrub, clay pans and old cemetery areas there is no reason to devise a specific management plan for it. Being a grass of sunny, open-areas it is naturally absent from the forested gullies, and the denser more shady tree plantings of the cemetery. During December 1999 *D. inaequiglumis* was also virtually absent from areas of dense *Watsonia*. Significantly, at the conclusion of the first stage of *Watsonia* control, *D. inaequiglumis* soon reappeared, or spread into the recently cleared/sprayed ground. By January 2001 it was very common in the majority of the December 1999 *Watsonia* control sites.

Paspalum orbiculare

native paspalum

Threat Status: Regionally Declining (de Lange et al. 1999b)

Description: Tufted grass up to 1 m tall. Leave rather stiff, bases loosely sheathing. Leaf-sheath subcoriaceous, striate, keeled, brown to purplish brown, mainly glabrous, but lowermost sheaths often with fine silky hairs; sheath apex extended upwards at each margin and fused with ligule. Ligules 1 - 2 mm, truncate entire. Leaf blade 10 - 20 - (30) cm × 3.5 - 5 mm, often narrower than summit of sheath, flat, rather rigid, midrib obvious, mostly without hairs except near the ligule; leaf margins finely scabrid, tapered to a fine but firm tip. Culm (20) - 35 - 70 cm, usually erect, sometimes semi-prostrate, slightly compressed, internodes hairless, striate. Panicle (flower head) erect, 6 - 12 cm, of 3 - 8 erect to somewhat spreading ± distant racemes; rachis slender, compressed to angular, finely scabrid on angles above. Racemes (2 - 4 cm; rachis narrowly winged, with very scabrid margins, 1.2 - 1.7 mm wide, with short white hairs at base, bearing 2 rows of single or paired, shortly pedicelled or almost sessile spikelets; pedicels sparsely scabrid; paired spikelets usually near centre of raceme. Spikelets 2 - 2.5 mm, imbricate, ovoid-elliptic to ovoid-orbicular, glabrous, obtuse, light brown. Lower glume 0, upper = spikelet, closely appressed to fertile florets, 3 (-5) nerved, glabrous; palea 0. Upper floret: lemma c.2 mm, elliptic-orbicular, cartilaginous-indurate, shining, brown, finely punctulate-striolate; palea less than or equal to, and narrower than lemma, membranous margins widened at base, forming wings enclosing flower; anthers c.1 mm, yellow to brownish, stigmas dark purple; caryopsis slightly > 1 mm.

Distribution within Waikumete Cemetery: Scarce. Confined to two sites on either side of Amber Grass. The first of these, comprising 19 separate clumps is present in and around planted pohutukawa (*Metrosideros excelsa*), *Lophostomum conferta*, and *Eucalyptus* spp. on a steep hill slope between the Dalmatian Mausoleums (Burial Area 4). The other is present on damp ground between the main Amber Crescent Gully and the graves below Amber Crescent (Burial Area 5). Here 15 or so clumps grow amongst vasey grass (*Paspalum urvillei*) and Kikuyu (*Pennisetum clandestinum*)

Notes: Edgar & Connor (2000) treat this grass as naturalised. We reject this view because Banks & Solander gathered this species from the Bay of Islands, New Zealand in 1769; it is also indigenous to many of the nearby South Pacific Islands and Australia, and has sticky seeds well suited to avian dispersal. Furthermore this species was reported as a conspicuous grass of northern New Zealand by our pioneering botanists, Allan Cunningham, William Colenso, Joseph Hooker, and John Buchanan. In New Zealand the range of *P. orbiculare* is contracting, and the species is now most frequently seen only in the far north and on some northern offshore and/or Hauraki Gulf islands. In the immediate Auckland area it occurs in three main areas, around Cornwallis, in scrub near Huia, and at Waikumete. At Waikumete the largest population grows in a small area of remnant gumland turf dominated by the indigenous grasses *Dichelachne inaequiglumis*, *D. crinita*, *Deyeuxia*

quadrisseta, *Rytidosperma biannularis*, and the introduced iridaceous *Aristea ecklonii*. Intermixed with all these grasses are some good patches of the sun orchid *Thelymitra colensoi* and onion-leaved orchid *Microtis* aff. *parviflora*. The main reason these indigenous species persist here seems to be that the slope of the roadside bank has prevented extensive mowing, whilst the nearby *Eucalyptus* and *Lophostomum* plantings have compacted the soil and presumably helped maintain the low fertility that these species need to thrive free from competition. However, within this area the whole habitat is threatened by the spread of the iridaceous weed *Aristea ecklonii*. Furthermore, indiscriminate, "release spraying" of planted pohutukawa (*Metrosideros excelsa*) has damaged the *Paspalum*.

Management Options: *Paspalum orbiculare* is easily grown from seed, and divisions of whole plants, provided these are well watered for the first few months of pot culture. Accordingly, because the species is so scarce at Waikumete *ex-situ* cultivation to build up a safeguard stock for replanting and translocation to other sites within the cemetery is advised. As a further measure Cemetery Staff and weed contractors should be educated about the presence of the *Paspalum*, and its field separation from the other introduced weedy *Paspalum* species (*P. dilatatum*, *P. urvillei*) so that further plants are not lost to spraying and lawn mowing. Research into the control of *Aristea* is also advised, as these species poses a serious threat to many other gumland habitats both within the Cemetery and elsewhere within reserves administered by the Waitakere City Council. As a short-term measure, careful hand weeding of *Aristea* in and around the main *Paspalum* site, should prevent further losses, as well as benefit other smaller indigenous grasses and orchids. Lastly, as a relatively low-growing, and tidy grass, *ex-situ* Waikumete stock of *P. orbiculare* could be introduced to other sites within the cemetery, perhaps to act as a buffer between the graves and those less modified indigenous habitats.

Orchids

Caladenia alata

Threat Status: Nationally this orchid is not listed as Threatened or Uncommon (de Lange et al. 1999a). However within the Auckland Region this species has only recently (2000) been recognised so its Regional status is still uncertain. Currently the largest populations in the region occur on Great Barrier Island, while on the mainland Auckland area it is only known from Waikumete. Therefore, although it may well occur elsewhere in suitable gumland habitats, until such time as this is confirmed the species should be viewed as regionally at risk. Waikumete forms the current southern limit for the species in New Zealand.

Description: Diminutive, hairy tuberous orchid usually growing singly. Leaf lying flat on soil surface, linear, 4 - 6 cm long, 0.1 - 0.3 cm wide, dark green to reddish-green, hairy. Flowering stem solitary, 5 - 8 cm long, wiry, reddish, hairy. Flowers 1 or 2 c.10 mm across, white or variously pigmented mauve, pale pink to almost cerise, externally darker from numerous sessile ovoid glands; dorsal sepal erect; lateral sepals and petals widely spreading. Labellum distinctly three-lobed, lateral lobes erect, column-embracing, entire, with purple bands; mid-lobe yellow to orange, recurved, with a prominent stalked basal gland either side. Lamina calli stalked, clubbed, yellow, in two rows nearly to the apex. Column with red bands, Capsule, small, pale white, prominently longitudinally striped red.

Distribution within Waikumete Cemetery: Confined to one site within gumland scrub south of Urupa .

Peak Flowering Time: September.

Notes: At Waikumete this is an uncommon orchid, whose brief flowering season and small size means that it is easily overlooked. *Caladenia alata* should be looked for in very open, almost bare clay, particularly in sites where *Thelymitra carnea* is present.

Management Options: All of the native orchids at Waikumete, except for *Corybas cheesemanii*, *C. oblongus*, *Gastrodia* aff. *sesamoides*, *Pterostylis agathicola*, both *Microtis* spp.; *Thelymitra colensoi*, and *T. aff. pauciflora*, require open, sunny, sparsely-vegetated (weed-free) habitats. Providing this habitat, especially at Waikumete, will prove difficult. Currently, the majority of the unusual and/or regionally scarce orchids are confined to sites that have recently been burned. Based on similar studies conducted elsewhere in New Zealand (e.g., Norton & de Lange *in sub.*), it is clear that fire presents the only suitable long-term and cost-effective means whereby orchid populations can be enhanced. However, the use of fire, even as carefully controlled burns, within an entirely urban cemetery presents some risk. Nevertheless, the spot-burns prescribed by Norton & de Lange (*in sub.*) for use within an equally sensitive wetland system (the Whangamarino), provide one sensible means with which to explore this option. Alternatives to fire, include hand weeding

and spot spraying. Although these measures can be effective they are too labour intensive to prove cost-effective, and are prone to human error. Furthermore, weeding does not necessarily guarantee flowering or the reactivation of dormant plant propagules (Norton & de Lange *in sub.*).

For Waikumete, this means that the council will need to decide which parts of Waikumete could be intensively weed managed or consider further research into determining safe disturbance regimes to ensure maximum diversity within fire-prone vegetation types. The alternative is to accept that there will continue to be a gradual loss of indigenous biodiversity within the gumland vegetation over time.

Caladenia atradenia

Threat Status: Sparse (de Lange et al. 1999a).

Description: Hairy tuberous orchid growing singly or in loose groups. Leaf erect, narrow, lanceolate, 10 - 16 cm long, 0.1 - 0.3 cm wide, dark green, hairy. Flowering stem solitary, fleshy, 10 - 20 cm long, reddish, hairy. Flowers 1 or 2 c.20 mm across, dark green to dark reddish-green, often with maroon or dark magenta markings, externally darker from numerous sessile ovoid glands; dorsal sepal strongly incurved over the column; lateral sepals spreading; petals widely spreading or suberect, often incurved distally. Labellum articulated on a very short claw, whitish with a few broad purple transverse bars; calli dark purplish-black, maroon or dark brown; apex recurved, distinctly 3-lobed. Column erect, incurved towards apex, greenish, spotted and blotched with red, narrowly winged. Capsule narrowly ovoid, green, often longitudinally striped red.

Distribution within Waikumete Cemetery: Abundant throughout the main central and southern gumland scrub areas, particularly within dry leaf litter within canopy gaps under tall manuka (*Leptospermum scoparium*).

Peak Flowering Time: October - Early November.

Notes: Waikumete Cemetery has one of the largest populations of *C. atradenia* known within the Auckland Region.

Management Options: See *Caladenia alata*

Caladenia bartlettii

Threat Status: None. A poorly understood and only recently (1997) confirmed species of gumland and kauri forest. Initial observations suggest that *C. bartlettii* is uncommon, such that it is possible that it may soon be listed as a regionally scarce species.

Description: Hairy, tuberous orchid, growing singly or in small colonies of 3-5 plants. Leaf linear, 6 cm × 1.5 mm, sparsely hairy. Flower stem solitary, very thin and wiry, up to 9 cm tall, Flower solitary c.15 mm across, rarely opening fully, distally deep pink, mauve or magenta fading to white at the centre, externally dark brownish or red, with numerous glandular hairs. Dorsal sepal erect and incurved, petals incurved or spreading, lateral sepals often partially united at base. Labellum three-lobed, white, transversely barred with red; lateral lobes entire, column embracing; mid-lobe yellow, entire. Lamina calli stalked, with yellow, globular heads, in two rows extending to base of the mid-lobe. Capsule small, dark brown or red, hairy.

Distribution within Waikumete Cemetery: Seen once in a single site within the gumland scrub of the southern gumland area.

Peak Flowering Time: November.

Notes: A poorly defined species, which may be the same as the Tasmanian *C. pusilla*. As currently circumscribed *Caladenia bartlettii* can be distinguished from the other *Caladenia* of Waikumete in possessing small (c.15 mm across) distally dark pink, mauve or magenta flowers. Of those species recorded from Waikumete, it is perhaps most similar to *C. alata*, from which it differs in its floral colouration, calli arrangement, and the fact that it flowers in November, not September. Never common in any particular place, this species prefers partially shaded gumland habitats or kauri (*Agathis australis*) forest where it grows within dry, semi-decomposed leaf litter.

Management Options: See *Caladenia alata*

Caladenia chlorostyla

Threat Status: None.

Description: Robust, hairy, tuberous orchid, growing singly or colonies of 10 - 40 plants. Leaf semi-erect, narrowly linear, 5-15 cm × 1 - 3 mm, bright green, hairy. Flower stem solitary, wiry, and green up to 30 cm tall, very hairy. Flowers 1-3(-5) c.11-16 mm across, greenish to pale greenish-white internally, externally greenish, or greenish-red, with numerous glandular hairs. Dorsal sepal narrow, erect and incurved, petals and sepals widely spreading. Labellum three-lobed, white, cream or greenish with prominent dark red bars, lateral lobes entire, column embracing; mid-lobe narrowly triangular, cream to pale yellow, with 6-10 pairs of linear, somewhat irregular marginal calli. Lamina calli globular, pale yellow, often with red stalks in two rows extending just to base of the mid-lobe. Capsule large, dark green variously striped red, hairy.

Distribution within Waikumete Cemetery: Locally common throughout the central and southern gumland areas of Waikumete.

Peak Flowering Time: October - January.

Notes: Despite its large size this orchid is easily overlooked even when flowering. At Waikumete, with the possible exception of *C. atradenia*, *C. chlorostyla* is the most abundant *Caladenia* species. There is some evidence that *C. chlorostyla* may be the same as the earlier named, and rather misunderstood *C. minor*.

Management Options: See *Caladenia alata*.

Corybas cheesemanii

Cheeseman's helmet orchid

Threat Status: None.

Description: Diminutive tuberous orchid, forming dense interconnected clonal masses; within dense manuka/kanuka (*Kunzea* aff. *ericoides*) stands. Leaf usually present, if so, then heart-shaped, 1-2 cm, pale green, typically semi-buried within leaf litter. Flowers solitary, often buried within leaf litter; borne on very short often incurved, white, fleshy, stalk. Flower 1 cm tall, fleshy, mushroom pink, sometimes dark maroon or white. Dorsal sepal arching completely over labellum. Petals much smaller than sepals, sometimes scarcely evident. Labellum forming a curved tube, its anterior margin abruptly deflexed under the tip of the dorsal sepal, at the base, on either side a narrow conical spur projects downwards between petal and sepal. Capsule borne on a greatly extended stalk, up to 48 cm long - this being often the only evidence that the orchid is present.

Distribution within Waikumete Cemetery: Known from a single site within dense manuka/kanuka at the northwestern margin of the main southern gumland vegetation.

Peak Flowering Time: June - August.

Notes: An unusual semi-saprophytic orchid, whose tendency to grow within leaf litter, and mid-winter flowering habit, means that it is often overlooked. The best time to look for this orchid is during November when the seed capsules have emerged from the leaf litter.

Management Options: Unlike the majority of the grasses and orchids discussed here, *C. cheesemanii* is tolerant of full shade, and provided the understorey of the dense manuka/kanuka scrub it favours, remains relatively weed free and intact, it is unlikely to be at risk. At Waikumete, this winter-flowering, cryptic orchid is probably more common than our surveys indicate.

Corybas oblongus

Spider orchid

Threat Status: None.

Description: Diminutive tuberous orchid, forming clonal masses; usually on sparsely vegetated clay within open forested stands. Leaf solitary, held near soil surface, ovate-oblong, apex acute, 1 - 5 cm, dark green, to grey-green, variously veined or spotted with red. Flowers 1(-4), 1 - 1.5 cm in size, borne on short erect, reddish-green, stalk. Dorsal sepal \pm same size as labellum, green or pale white, flecked red. Lateral sepals long, hair-like, greatly exceeding labellum length, petals similar but shorter. Labellum, dark maroon, c.5 - 10 mm long, horizontal, curved to form a cylinder with a wide circular mouth, this fringed with coarse, white teeth. Capsule borne on an extended stalk, up to 5 cm long.

Distribution within Waikumete Cemetery: Scarce. Known from a single site within dense manuka/kanuka at the northwestern margin of the main southern gumland vegetation.

Peak Flowering Time: September - October

Notes: Very uncommon at Waikumete, where the few plants seen suggest that the gumland habitat in which the plants are growing is less than optimum. *Corybas oblongus* is really a forest dwelling species, and although it has been found in gumland and peat bog habitats, plants in these situations scarcely ever flower. Its occurrence at Waikumete is probably accidental, as this wind-dispersed species is very common in the nearby Waitakere Ranges.

Management Options: As a presumed accidental colonisation, devising specific management actions for the small Waikumete population of the normally forest dwelling *Corybas oblongus* is impractical. It is considered that this species is more likely to establish itself further from wind-dispersed seed blown from the Waitakere Ranges, once the forested gullies of the cemetery mature.

Gastrodia aff. sesamoides

potato orchid/perei

Threat Status: None.

Description: Saprophytic orchid entirely lacking chlorophyll, forming extensive subterranean clonal masses of interconnected rhizomes. Rhizomes large, up to 8 × 3 cm, greyish-black, tuberous and somewhat warty, covered in papery scales. Above ground parts consisting of 1 or more flowering stems up to 1 m tall but usually much less. Stems erect, stout, somewhat fleshy, black or variously blotched dark brown, if bruised emitting a faint mushroom odour. Flowers (1-)10(-40) per stem, drooping. Individual flowers c.10 - 16 × 4-8 mm, off white, to pale pinkish-grey, variously spotted brown or dark pink, without obvious scent. Lateral sepals fused almost to level of labellum-tip. Labellum ovate-oblong, rather shortly fused to perianth tube; with margins covered in calli. Column almost as tall as labellum, very narrowly winged throughout. Capsules freely formed, drying grey.

Distribution within Waikumete Cemetery: Scarce, specimens have been found within bark distribution alongside the Urupa near the southwestern end of the cemetery, and under *Acacia* trees within the southern gumland vegetation.

Peak Flowering Time: December.

Notes: Waikumete plants exists in two colour morphs, one has flowers with blackened apices and the other has not. Some orchid enthusiasts consider both forms to represent different species. This suggestion requires further study.

Management Options: *Gastrodia aff. sesamoides* is a saprophytic orchid, whose maintenance depends on deriving nourishment from its symbiosis with various soil fungi, which are themselves attached to host trees by way of mycorrhiza. It is virtually impossible to successfully transplant specimens. Interestingly at Waikumete the appearance of this species within recently laid bark gardens is paralleled by observations of its spread within the same gardening media in other urban settings and towns (Cameron 1996; de Lange 1998). It is possible then that the Waikumete occurrences also partial result from seed lodged within the pine bark (cf. Cameron 1996). This is further suggested by the fact that plants within bark gardens have black floral apices, while those within nearby *Acacia*-dominated gumland scrub have uniformly coloured flowers. Whatever the origin of the plants, the main threat to them comes from browsing animals such as opossums, rabbits and hares. Obviously control of these herbivores will ensure that the orchids are able to flower and set seed.

Genoplesium pumilium

midge orchid

Threat Status: None - though regionally uncommon, except on Great Barrier Island.

Description: Reed-like, tuberous orchid, up to 45 cm tall but usually much less. Plants either solitary or occurring as diffuse patches; on open clay or within sparsely vegetated sites. Stem 1-2 mm diameter, green, erect and rush-like, leafless, until just below the inflorescence. Leaf rush-like, smaller than the inflorescence, often appressed to stem so that the plant appears leafless. Inflorescence, a raceme of c.3-30 closely spaced flowers. Individual flowers pale, green, or greenish-yellow, sometimes-flushed pink or purple, opening into a short wide bell bent on the ovary so as to face downwards. Dorsal sepal c.3 mm long, concave, lateral sepals slightly longer, spreading widely above, broad-elliptic apex mucronate. Petals shorter, Labellum broad-oblong, upper surface grooved and ± covered in papillose calli.

Distribution within Waikumete Cemetery: Known only from a single site within the southern gumland vegetation, where it is very uncommon.

Peak Flowering Time: April - July.

Notes: Unless flowering this orchid is easily overlooked, as the small, grass green, rush-like almost leafless stem hardly looks like an orchid. Furthermore this species is almost exclusively a late autumn to winter flowering species. Despite its current scarcity this orchid has been regularly reported from Waikumete since the early 1960's, and was at one time considered to be locally common (C.C. Ogle pers. comm.). The decline of this species at Waikumete can be linked to habitat loss following weed invasion, and the natural succession of gumland scrub to taller vegetation. As with many of the orchids found at Waikumete, this species becomes very common after fire.

Management Options: See *Caladenia alata*.

Microtis* aff. *parviflora

onion-leaved orchid

Threat Status: None.

Description: Rush-like, tuberous orchid, reaching up to 70 cm tall but usually much less. Plants typically occurring as dense, clonal masses on open clay or within short grassland. Stem erect, fleshy. Leaf often over-topping inflorescence. Inflorescence a dense raceme composed of numerous, crowded flowers. Flowers green, or yellowish-green. Dorsal sepal c.1.5-2 mm long, with short recurved tip; lateral sepals shorter, deflexed. Petals ± under dorsal sepal. Labellum broad at base, narrowing toward tip (somewhat triangular), apex ending in a down-turned apiculus; margin entire, smooth; anterior callus usually present but variable in size; basal calli prominent, sometimes in 2 pairs.

Distribution within Waikumete Cemetery: Abundant throughout cemetery in any open clay pan, pasture or mown turf.

Peak Flowering Time: October - January.

Notes: At present it is not certain if the New Zealand plants of *Microtis* aff. *parviflora* comprise one or more species, or indeed, if they are the same as Australian *M. parviflora*, or even whether this species is also in New Zealand. Whatever the situation the Waikumete form corresponds to the typical New Zealand form of this species aggregate. Though less common than *M. unifolia*, *M. aff. parviflora* is probably the next most abundant orchid in the cemetery area (Fig. 4). This orchid commonly occurs intermixed with *M. unifolia*, and together with that species was observed in all the Burial Areas excluding only the most heavily mowed turfs and those areas of very dense *Watsonia* infestation. This onion-leaved orchid is especially common in the grass bordering the Influenza Epidemic mass grave, and along Acmena Avenue between Freesia Road and Daffodil Drive. It is also very common in short grass and bare clay along Amber Crescent, where it can also be seen growing under planted pohutukawa and *Leptospermum polygalifolium*. It is also one of the few orchids to be found in areas of moderate to dense *Watsonia* infestation where it persists along access tracks. In several places where pampas grass (*Cortaderia jubata*, and *C. selloana*) and *Watsonia* have been sprayed, this orchid was one of three orchid species found "regenerating" in the sprayed ground. It was also notable as one of several "gumland" species, including *Pomaderris amoena*, and *Drosera auriculata*, seemingly able to tolerate moderate densities of Spanish heather (*Erica lusitanica*).

Management Options: As *Microtis* aff. *parviflora* is one of the most common orchids of gumland scrub, clay pans and the old cemetery areas there is no reason to devise a specific management plan for it. Being an orchid of sunny, open-areas it is naturally absent from the forested gullies and the denser shadier tree plantings of the cemetery. During December 1999, *Microtis* aff. *parviflora* was also virtually absent from areas of dense *Watsonia*.

Significantly, at the conclusion of the first stage of *Watsonia* control, *Microtis* aff. *parviflora* soon reappeared, or spread into the recently cleared/sprayed ground. By November 2000 it was sparsely distributed throughout the majority of the December 1999 *Watsonia* control sites. *Microtis* aff. *parviflora* is one of three orchids which have successfully colonised the intensively manicured lawns and gardens of the main cemetery area.

Microtis unifolia**onion-leaved orchid**

Threat Status: None.

Description: Rush-like, tuberous orchid, reaching up to 100 cm tall but usually much less. Plants typically occurring as dense, clonal masses on open clay or within short grassland. Stem erect, fleshy. Leaf often over-topping inflorescence. Inflorescence a dense raceme composed of numerous, crowded flowers, up to 30 cm long but usually much less. Flowers green, or yellowish-green. Dorsal sepal c.3 mm long, with acute, upturned tip; lateral sepals shorter, deflexed, apex sometimes coiling in on itself. Petals ± under dorsal sepal. Labellum oblong, somewhat narrowed at centre, apex truncate to slightly emarginate margin papillose and usually also crenate and undulate; anterior callus verrucose, often raised on a rounded ridge; large basal calli oval, prominent.

Distribution within Waikumete Cemetery: Abundant throughout cemetery in any open clay pan, pasture or mown turf.

Peak Flowering Time: October - January.

Notes: This species is the most commonly encountered orchid at Waikumete. Either growing are pure patches or intermixed with *M. aff. parviflora*, this species is conspicuous in all the main Burial Areas, even within the more intensively manicured lawns and gardens. It is also locally common in the exotic plantings of the Cremation Ash Lawn, and occasional specimens were found pushing through the more eroded asphalt of Acmena Drive, Amber Crescent and Amberly Drive. About the only area it was not seen was in the extremely dense *Watsonia* infestations which formerly dominated parts of the cemetery prior to the onset of *Watsonia* spray control

Management Options: As *Microtis uniflora* is the most common orchid of gumland scrub, clay pans and the old cemetery areas there is no reason to devise a specific management plan for it. Being an orchid of sunny, open-areas it is naturally absent from the forested gullies and the denser shadier tree plantings of the cemetery. During December 1999 *Microtis uniflora* was uncommon within areas of dense *Watsonia*. However, at the conclusion of the first stage of *Watsonia* control, *Microtis uniflora* soon reappeared, or spread into the recently cleared/sprayed ground. By November 2000 it was abundant throughout the majority of the December 1999 *Watsonia* control sites. *Microtis uniflora* is also the most common of the three orchids that have successfully colonised the intensively manicured lawns and gardens of the main cemetery area.

Orthoceras novae-zeelandiae

grassland orchid

Threat Status: None.

Description: Robust, fleshy-leaved, erect, tuberous orchid, reaching up to 80 cm in height. Stem rigidly erect, hairless. Leaves linear-lanceolate to linear channelled, acute, slightly shorter than stem. Inflorescence a raceme c.20 cm long, flowers 2-12, well separated, dark green, yellow green, dull reddish or almost black. Dorsal sepal 1-1.5 cm long and almost as wide, deeply concave, subacute; lateral sepals twice as long, 0.5 mm diameter, semiterete, erect or diverging. Petals narrow-oblong flat, usually notched at tip. Labellum spreading or deflexed, lateral lobes broad, oblique, mid-lobe larger, ovate, median callus near base, shortly conical with thick in-turned tip, this often yellow.

Distribution within Waikumete Cemetery: Uncommon, this orchid is confined to open clay patches within the southern gumland vegetation area.

Peak Flowering Time: December - January.

Notes: As this is usually an abundant orchid of dry, open clay the scarcity of this species at Waikumete is surprising. Therefore we suspect that this is another recent wind blown arrival from the nearby Waitakere Ranges.

Management Options: See *Caladenia alata*.

Plumatochilus tasmanicus

(= *Pterostylis tasmanica*)

Threat Status: Declining (de Lange et al. 1999a)

Description: An erect grass-green, tuberous orchid growing in diffuse patches of 1 - 5 plants. Flowering plants up to 30 cm tall. Stem enclosed in leafy bracts, rosette leaves numerous, up to 15 - 20 × 6 mm, ovate to lanceolate, apex acute; petioles conspicuously winged. Cauline leaves sparse, narrowly lanceolate, sheathing, Flower (galea) solitary, 15 - 20 mm. Dorsal sepal green, erect for most of its length then shortly horizontal, acute; lateral sepals united only near base, free parts linear, deflexed in fully open flowers. Petals green, mottled white, narrow and almost parallel-sided. Labellum conspicuous, terete, filiform, clad in long yellow plumose hairs, terminating in a dark black glandular tip.

Distribution within Waikumete Cemetery: Scarce. Known from a single site within the southern gumland vegetation.

Peak Flowering Time: October - December.

Notes: C.C. Ogle (pers. comm.) first discovered this species at Waikumete in the 1960's. Although assumed to be locally extinct, *P. tasmanicus* was rediscovered in December 2000, growing within a small area of open clay sparsely vegetated by stunted manuka. This attractive strongly mycorrhizal species, is especially vulnerable to plant collectors. Accordingly, over-collecting has destroyed some former Auckland habitats. As plants reproduce only by seed, and once they have flowered rarely flower again, indiscriminate collecting, more than habitat loss poses the greatest threat to this species. *P. tasmanicus* is one of a number of gumland orchids, which seem to require regular fires to increase their abundance. Currently this species is most common in the far north of New Zealand, in sites, which have been recently burned, e.g., Kaimaumau Swamp. With regard to the taxonomy of New Zealand orchids it has long been recognised that the genus *Pterostylis* is polyphyletic (B.P.J. Molloy pers.comm.). Accordingly a recent revision of the genus have proposed several new genera, including *Plumatochilus* which encompasses those *Pterostylis* possessing a plumose labellum, such as *P. tasmanicus*. At this stage it is not clear whether other generic proposals will affect the remaining *Pterostylis* found at Waikumete and discussed below.

Management Options: See *Caladenia alata*.

Pterostylis agathicola

kauri green hood

Threat Status: None.

Description: A leafy, grass-green, tuberous orchid growing in diffuse patches. Plants dimorphic. Sterile plants 6-10 cm tall, 2-3-leaved; leaves narrowly linear-lanceolate 3-6 cm long, 3-6 mm wide dark green, entire, acute to acuminate. Flowering plants 10-35 cm tall, the stems green or pale green, rarely reddish. Leaves 3-4, widely spaced and spreading, narrowly lanceolate, 4-10 cm long, 5-8 mm wide, dark or pale green, sessile, sheathing at base; midrib prominent; margins entire, apex acuminate. Flower (galea) solitary, occasionally in pairs, 24-28 mm long, erect or leaning forwards, translucent white and dark green with red-brown suffusions in the apex of the galea and lateral sepals. Dorsal sepal ovate-lanceolate in outline prominently expanded near base then tapered to a long acuminate apex. Lateral sepals, short, erect, extending high above the galea. Petals linear-lanceolate, strongly falcate, green with white stripes. Labellum erect, tongue-like, curved forwards and then twisted strongly to the right and protruding prominently through the lateral sepal sinus (flower mouth).

Distribution within Waikumete Cemetery: Scarce, seen in one site in the southern gumland vegetation, where it grew with *Pterostylis* aff. *graminea*.

Peak Flowering Time: August - November.

Notes: Like *Corybas oblongus*, *Pterostylis agathicola* is more typical of forested habitats, such as the Waitakere Ranges where, as the specific name implies it always grows in close association with kauri trees. As such we suggest that its presence at Waikumete although notable, as possibly the first time this species has been found growing away from living kauri, is another example of chance long-distance dispersal from the nearby Waitakere Ranges.

Management Options: As observed above, the presence of *Pterostylis agathicola*, as a kauri forest species, within Waikumete, is probably more accidental than a reflection on the availability of suitable habitat. We can only assume that, as the planted kauri forest within the gullies of the cemetery matures, this orchid, and perhaps other kauri dependant species like *P. brumalis* will either colonise or establish themselves further. As *Pterostylis agathicola* has no requirement for open clay pans or short scrub, no specific management measures are considered necessary.

Pterostylis trullifolia

trowel-leaved green hood

Threat Status: None.

Description: An erect tuberous orchid growing in dense clonal masses. Flowering plants up to 25 cm tall but usually much less. Stem green or reddish-green, slender, smooth or slightly rough to touch. Rosette leaves, petiolate up to 5 - 10 × 5 - 10 mm, broad-ovate to orbicular-cordate, apex acute to subacute, veins raised giving rugose (embossed) surface, petioles well defined. Cauline leaves several, lower most petiolate and trowel-shaped, upper 5 - 20 × 2 - 5 mm, sessile, linear-lanceolate. Flower (galea) usually solitary, 10 - 15 mm. Dorsal sepal, green, at first erect then becoming abruptly horizontal with an acute apex. Lateral sepals diverging from base to form a "U" or wide "W" shape from the front view, which is somewhat bulging in side view, tips rather long reaching well above galea. Petals almost as long as dorsal sepal, striped green and white. Labellum red, narrow-triangular, arched and protruding, apex subacute.

Distribution within Waikumete Cemetery: Confined to a single site at the edge of recently burned ground, at the southwestern margin of the southern gumland vegetation.

Peak Flowering Time: July - September.

Notes: *Pterostylis trullifolia* although colonising a range of habitats is more typical of clay banks and low scrub near forest rather than gumland scrub. Therefore its presence at Waikumete, within very infertile gumland soils was unexpected. The plants found grew in close association with another orchid, *Corybas oblongus*. As more suitable habitat for both these species is present within the clay banks bordering the gully systems that drain the main cemetery area, specific searches were made for them there. No further plants were found. Accordingly, we suggest that, as with *Corybas oblongus* and *Pterostylis agathicola*, the small population of *P. trullifolia* represent a recent colonisation of wind blown seed, perhaps from the Waitakere Ranges.

Management Options: The only known *Pterostylis trullifolia* population is confined to a small fire break/drain virtually covered in dense 2 m tall manuka. The plants seen are very small, and of those seen only a few had flowered. While opening up the vegetation is likely to benefit this species, and the small plants of *Corybas oblongus* associated with it, we suggest that the plight of those species confined to gumland systems and scarce elsewhere within Auckland is of more urgent priority. If, as we strongly suspect, the presence of this species at Waikumete is due to seed dispersal from the nearby Waitakere Ranges, it has either colonised elsewhere within the cemetery (and we have overlooked it), or it will do so again. For this reason we would not consider its management a priority.

Pterostylis* aff. *graminea

Threat Status: None.

Description: An erect, leafy, tuberous orchid growing in dense clonal masses. Flowering plants up to 40 cm tall but usually much less. Stem pale green to dark green, slender, smooth. Leaves 4-6, becoming larger toward the mid-section of stem, 5 - 15 × 0.5 - 1 cm, uppermost leaves overtopping flower, all leaves linear-lanceolate, strongly keeled, and decurved, with apex long acuminate. Flower (galea) solitary, 15 - 30 mm, green with white stripes, slightly nodding. Dorsal sepal, erect, green with some white stripes, rarely suffused red, distal portion horizontal with an acute apex. Lateral sepals diverging at a narrow angle, tips erect, caudate ± overtopping galea. Petals almost as long as dorsal sepal, striped green and white. Labellum red, oblong, scarcely arched and protruding, apex subacute.

Distribution within Waikumete Cemetery: Abundant in all gumland scrub and adjacent tall manuka/kanuka and *Acacia* forest.

Peak Flowering Time: September - November.

Notes: This, the most common of the green hoods at Waikumete, has been variously referred to as *P. graminea* var. *rubricaulis* (an earlier illegitimate name for *P. agathicola*) and *P. graminea*, it is neither. Recent DNA and critical morphological (B.P.J. Molloy pers. comm.) evidence suggests that the true *P. graminea* is a more southerly forest species, ranging from the mid Waikato south. The common orchid of gumland and Kauri forest is now believed to be a new, and yet undescribed species (B. P. J. Molloy pers. comm.).

Management Options: Although one of the more common orchids at Waikumete, *Pterostylis* aff. *graminea* is most common in the main gumland vegetation areas, and is best seen in the southern portion of that vegetation type. This orchid is tolerant of some shade but still requires relatively open habitats, so it is most common along the fire breaks and various trails which traverse the gumland scrub. In terms of management, there are no immediate requirements, although it is clear that this species will respond favourably to vegetation clearance, and it is one of several which are most common in the recently burned parts of the gumland vegetation of the southern portion of the cemetery.

Thelymitra aemula

blue sun orchid

Threat Status: Regionally Vulnerable (de Lange et al. 1999b).

Description: Rush-like, tuberous, solitary orchid. Flowering plant c.50 - 70(-100 cm) tall. Leaf dark green, broadly lanceolate, c. 10 - 30 cm long, c.5 - 12 mm wide, fleshy, deeply channelled, basal portion of underside minutely rough to touch. Stem dark green, sometimes suffused with red, robust, fleshy, loosely sheathed with 3-5 dark green leaf bracts. Flowers 10-30 per stem, these usually opening several at a time, uniformly sky blue. Individual flowers 10 - 20 mm across, sepals, petals and labellum broadly lanceolate with subacute apices. Column white, flushed pale purple with a narrow dark purple band near column apex, post-anther lobe not hooded and smaller than side-lobes. Column-arms flattened, held at rigid right angles from column apex, cilia marginal, pure white, numerous, those of either arm overlapping.

Distribution within Waikumete Cemetery: Uncommon. Sparsely distributed within the gumland scrub west of Amber Crescent, and throughout the recently burned sites of the southern gumland vegetation.

Peak Flowering Time: October - December.

Notes: This species, the largest species of sun orchid known at Waikumete, was originally described from gumlands near Birkenhead, Auckland. Usually growing as single plants, the majority of plants have been found along recently disturbed pathways, e.g., the track from Amber Crescent to the Water Tank, or within sites which have been burned sometime during the last 10 years. Of those other sun orchids present in the area, this species is perhaps most easily confused with *T. aff. pauciflora* (with which it often grows) unless the conspicuous, dark-blue, unspotted flowers with their white ciliate column arms can be seen. As the flowers only open in direct sunlight, fully expanded flowers are rarely seen. However, in their absence plants may still be distinguished by the flower spike, which has conspicuous leafy bracts subtending the flower buds, and by the finely tuberculate leaf base (these feel a bit rough if the leaf base is brushed lightly by the fingertips).

Management Options: Based on observations of this species elsewhere, it is likely that its populations can also be managed and enhanced most effectively by using fire. See *Caladenia alata*.

Theymitra carnea

pink sun orchid

Threat Status: None.

Description: Small, reed-like tuberous, solitary orchid. Flowering plant c.10 - 30 tall. Leaf dark reddish-green, c. 5 - 10 cm long, c.2 - 8 mm wide, narrow-linear, almost terete to shallowly channelled, upper third twisted or partially curled, whole leaf often blemished by rust spots. Stem green, reddish-green or pink, very wiry, often partially twisted. Flowers 1-6 per stem, scarcely opening fully, and if open, then only one at a time, uniformly salmon pink, yellow, or cream. Individual flowers 8 - 10 mm across, sepals, petals alike, broadly oblong. Labellum slightly smaller. Column pink, yellow or cream, apex slightly darker, post-anther lobe slightly hooded the upper margins bright yellow. Column arms oblique, bright yellow with toothed margins, cilia absent.

Distribution within Waikumete Cemetery: Aside from a small remnant colony scattered over the lawn between the Dalmatian Mausoleums and Amber Crescent (Burial Area 4), this species is confined to the open clay pans of the southern gumland vegetation.

Peak Flowering Time: August - September.

Notes: Waikumete specimens are notable in that they exist in two colour forms, the more common salmon pink, and the less common yellow. In the past New Zealand plants were called *T. imberbis*, being distinguished from Australian *T. carnea* because the column arms lack cilia. Although some orchid enthusiasts have returned to using this name, the taxonomic distinction has not been upheld by recent DNA based studies of this variation (B.P.J. Molloy pers. comm.).

Management Options: see *Caladenia alata*.

Thelymitra colensoi**sun orchid**

Threat Status: None.

Description: Medium-sized rush-like tuberous, orchid occurring either as solitary specimens or in dense clonal masses. Flowering plant c.10 - 30 tall. Leaf green to reddish-green, c. 5 - 15 cm long, c.5 - 10 mm wide, lanceolate, channelled, strongly keeled, fleshy, whole leaf often blemished by rust spots. Stem green, reddish-green or pink, firmly fleshy, often blemished by rust spots. Flowers 1 - 8 per stem, scarcely opening fully, except on very sunny days, and if open, then usually only one at a time, uniformly sky-blue or pale pink. Individual flowers 8 - 10 mm across, sepals, petals, labellum alike, lanceolate. Column pale blue, apex blackish-purple with a yellow margin, deeply cleft, fleshy, scarcely turned under. Column arms terete erect with dense, cottony white cilia.

Distribution within Waikumete Cemetery: Abundant throughout cemetery in any open clay pan, pasture or mown turf.

Peak Flowering Time: October - November.

Notes: We have chosen to refer all sparsely flowering, small blue sun orchids, with a deeply cleft column and thin scarcely turned under apex to *Thelymitra colensoi* rather than *T. pauciflora*. *Thelymitra colensoi*, named by Joseph Hooker in 1864, is one of the more common members of the *T. pauciflora* complex found in New Zealand, and it has also been known here as *T. intermedia* (St George et al. 1996) which is a later synonym of *T. colensoi*. The taxonomy of New Zealand *Thelymitra* is complex and confused, so it may well be that later treatments might refer this species to yet another name. In any case *T. colensoi* is one of the more common of the New Zealand members of the *T. pauciflora* complex at Waikumete it is possibly the most common sun orchid. Like its close relative, the more robust *T. aff. pauciflora*, the leaves of *T. colensoi* are often heavily infested with the disfiguring orchid rust *Uromyctes thelymitrae*. Furthermore, in common with many other sun orchids the delicate sky-blue flowers of this species only open fully on very sunny days. In poor weather the flower buds of this species scarcely if ever open, seed set occurring irrespective of whether the flower opens or not. While not as common as the two *Microtis* species this sun orchid is widespread throughout open sites in gumland scrub, the older Burial Areas, only becoming scarce in heavily mowed grounds and where the surrounding vegetation is too dense. It is absent from all moderate to dense *Watsonia* infestations but was encountered where this weed had been previously cleared by spraying. It is locally common in the area administered by the Friends of Waikumete Cemetery, in the graves between Kowhai Road, Daffodil Drive, Acmena Avenue and *Watsonia* Way, and in suitable open ground along Amber Crescent. Etiolated specimens were also frequent under kanuka in the Anglican G Burial plot north of Eucalyptus Drive.

Management Options: As *Thelymitra colensoi* is one of the most common orchids of gumland scrub, clay pans and the old cemetery areas there is no reason to devise a specific management plan for it. Being an orchid of sunny, open-areas it is naturally absent from the forested gullies and the denser more shady tree plantings of the cemetery. However, during December 1999 *Thelymitra colensoi* was also uncommon within areas of dense *Watsonia*. At the conclusion of the first stage of *Watsonia* control, *Thelymitra colensoi* soon reappeared, or spread into the recently cleared/sprayed ground. By November 2000 it was sparsely distributed throughout the majority of the December 1999 *Watsonia* control sites. *Thelymitra colensoi* is also one of three orchids which have successfully colonised the intensively manicured lawns and gardens of the main cemetery area.

Thelymitra pulchella**sun orchid**

Threat Status: None.

Description: Robust, rush-like, tuberous, orchid, forming dense tufted colonies. Flowering plant c.50 - 70(-100 cm) tall. Leaf dark green, broadly lanceolate, c. 10 - 30 cm long, c.6 - 10(-20) mm wide, fleshy, channelled, basal portion of underside minutely rough to touch. Stem, dark green suffused with red, robust, fleshy, sheathed with 3-5 dark green leaf bracts. Flowers 6 - 10 per stem, these usually opening several at a time. Individual flowers 12 - 17 mm across, sepals, petals and labellum blue, pink, or white, these in turn striped with dark blue. Sepals and petals alike, rather broadly ovate, sometimes with subacute apices. Labellum distinctly more obovate. Column reddish-blue with darker stripes, post-anther lobe not hooded, reddish-brown with paler margins. Column-arms red or orange, variable some with coarse yellow fimbriae, or small kelp-like teeth.

Distribution within Waikumete Cemetery: Confined to the southern gumland vegetation

Peak Flowering Time: October - December.

Notes: As circumscribed here most Waikumete plants of *Thelymitra pulchella* match that formerly known as *T. fimbriata*. Current thought is that *T. pulchella* is a highly variable species, which shows a number of variants with regard to column are ornamentation. Evidence in support of this comes from the observation that different column arms types may be found in varying proportions within the same population. Nevertheless some orchid enthusiasts regard these variations as different species for which the names *T. caesia*, *T. concinna*, *T. fimbriata*, *T. pachyphylla* and *T. pulchella* are available. Until the taxonomic revision of the New Zealand orchids is complete we retain the current usage of the earliest available name, *T. pulchella* for all of these variants.

Management Options: see *Caladenia alata*.

Thelymitra tholiformis

sun orchid

Threat Status: Declining (de Lange et al. 1999a).

Description: Robust rush-like, tuberous, orchid, growing single or in small clonal patches. Flowering plant c.50 - 70(-100 cm) tall. Leaf green, broadly lanceolate, c. 10 - 30 cm long, c.5 - 10 mm wide, fleshy, channelled. Stem dark green, sometimes suffused with red, robust, fleshy, loosely sheathed with 2-3 dark green leaf bracts. Flowers 6 - 12 per stem, these usually opening several at a time, uniformly dark blue or mauve. Individual flowers 10 - 20 mm across, sepals, petals and labellum broadly elliptic with acuminate apices (sometimes narrow to a small apiculus). Column mauve or blue with a narrow brown and yellow band near apex, post-anther and side lobes arch markedly inwards, almost meeting to form a dome. Column-arms short copiously covered in fluffy white (or very rarely mauve) cilia.

Distribution within Waikumete Cemetery: Scarce. Known from several sites within gumland scrub west of Amber Crescent and within the southern part of the cemetery.

Peak Flowering Time: October - November.

Notes: Although believed to be an uncommon species *Thelymitra tholiformis* is now known to be locally common in some areas of gumland within the Auckland Region, especially those on Great Barrier Island. A distinctive, robust orchid, *Thelymitra tholiformis* usually grows with *T. aemula*, it may be distinguished from this and other related species of blue sun orchids by the dark blue, non-striped or unspotted sepals and petals, conspicuously domed golden yellow column, and column arms which possess dense fluffy tufted cilia.

Management Options: see *Caladenia alata*.

Thelymitra* aff. *ixioides

spotted sun orchid

Threat Status: None. However, this species is virtually restricted to gumland scrub, and is now considered very uncommon within the Auckland region.

Description: Rush-like, tuberous, solitary orchid. Flowering plant c.50 - 70(-100 cm) tall. Leaf green or yellow-green, often slightly glaucous, lanceolate, c. 10 - 20 cm long, c.5 - 12 mm wide, fleshy, channelled, basal portion of underside minutely rough to touch. Stem stout, green to yellow-green, somewhat glaucous or suffused with red. Flowers 10-20 per stem, these usually opening several at a time, pale blue with darker spots. Individual flowers 10 - 15 mm across. Sepals and petals rather broad. Labellum slightly more rounded. Column pale blue, with transverse violet band near the top. Post-anther lobe not hooded the upper margin bright yellow or red somewhat warty, side lobules distinctly higher. Column-arms within thin tufts of white or mauve cilia.

Distribution within Waikumete Cemetery: Scarce. Ten plants were seen during November 2000 in the southern gumland vegetation growing within open clay pans.

Peak Flowering Time: October - November.

Notes: *Thelymitra* aff. *ixioides* is a conspicuous sun orchid, on account of its large size, somewhat glaucous yellowish-green foliage that is basally suffused red, and large pale blue spotted flowers. Some Waikumete specimens were further distinguished by possessing additional sepals or petals. This orchid responds favourably to habitat disturbance and is often becomes temporarily abundant following road works, or fires which have traversed gumland scrub.

Management Options: See *Caladenia alata*.

Thelymitra* aff. *longifolia

sun orchid

Threat Status: None.

Description: Robust to medium-sized rush-like tuberous, orchids growing either as solitary specimens or in dense clonal masses. Flowering plant c.5 - 50(-100) cm tall. Leaf c. 5 - 40 cm long, c.5 - 20 mm wide, strap-shaped, prominently rigid, fleshy and flaccid, green to reddish-green, with ridges dark red, leaf sometimes blemished and/or distorted by rust spots. Stem stout, dark green to reddish-green. Flowers 1 - 10(-20) per stem, scented, white sometimes distally tinged pink, these fully expanding in sunny conditions, and opening several at a time. Individual flowers 10 - 15 mm across. Dorsal sepal slightly broader than laterals. Petals and labellum alike, ovate subacute. Column white or pale pink, apex dark brown or black with a conspicuous bright yellow margin, shallowly notched (horseshoe shaped from top). Column arms short terminated by dense, cottony white cilia.

Distribution within Waikumete Cemetery: Scarce. Locally common in the recently burned parts of the southern gumland vegetation, otherwise apparently only present under *Leptospermum polygalifolium* and *Melaleuca armillaris* plantings near the "Protestant C" burial ground, Amber Crescent (Burial Area 4).

Peak Flowering Time: October - December.

Notes: Although one of our most common sun orchids, this "species" seems to be genuinely scarce at Waikumete. It is not clear why this should be so. The form of *T. longifolia* present at Waikumete has the larger, white and pink-tinged, scented flowers of the insect pollinated race of *T. longifolia*. The taxonomic status of this variant is still to be resolved (B.P.J. Molloy pers. comm.).

Management Options: See *Caladenia alata*. However, the scarcity of what is usually a very common orchid of gumland habitats is puzzling. Further research into the problem may be needed. In the interim care needs to be taken that the population within the Protestant Burial Area off Amber Crescent is not destroyed by excessive mowing, weed control or other accidental misadventure.

Thelymitra* aff. *pauciflora

blue sun orchid

Threat Status: None.

Description: Robust to medium-sized rush-like tuberous, orchids growing either as solitary specimens or in dense clonal masses. Flowering plant c.10 - 80(-100) cm tall. Leaf c. 5 - 40 cm long, c.5 - 20 mm wide, fleshy, often prominently ribbed, channelled, and strongly keeled; green to reddish-green, with ribs dark red, entire leaf often blemished and/or distorted by rust spots. Stem stout, dark green to reddish-green often blemished by rust spots. Flowers 1 - 20 per stem, dark blue or cerise sometimes magenta, these fully expanding in sunny conditions, and opening several at a time,. Individual flowers 10 - 15 mm across. Sepals, petals, labellum alike, elliptic or lanceolate, apex acute. Column blue or cerise, apex blackish-purple with a conspicuous yellow margin deeply cleft, rather thin, and distinctly turned under. Column arms terete erect with fluffy white cilia.

Distribution within Waikumete Cemetery: Widespread throughout the cemetery in a variety of habitats, excluding only the main forested areas and those gravesites subjected to regular mowing.

Peak Flowering Time: September - January.

Notes: The taxon present at Waikumete Cemetery is the more common of the New Zealand members of the *T. pauciflora* complex. It is a robust species forming dense colonies. Vegetatively it may be distinguished from the majority of other sun orchids by its conspicuously ribbed, deeply channelled, dark green and red-striped leaves which are often heavily infested with the disfiguring orchid rust *Uromyctes thelymitrae*. From the closely related *T. colensoi* it differs by its greater size, and the flowers which open widely, are dark blue to cerise, and by the distinctive yellow-tipped column which is deeply cleft, thinner than *T. colensoi*, and prominently in rolled. However, unless the day is very sunny the flowers of this sun orchid scarcely open. Although sparsely distributed this sun orchid is locally common throughout the more open gumland scrub, and older Burial Areas only becoming scarce in heavily mowed grounds and where the surrounding vegetation is too dense. It is absent from all moderate to dense *Watsonia* infestations but was encountered where this weed had been previously cleared by spraying. It is locally common in the area administered by the Friends of Waikumete Cemetery, in the graves between Kowhai Road, Daffodil Drive, Acmena Avenue and *Watsonia* Way, and in suitable open ground along Amber Crescent.

Management Options: *Thelymitra* aff. *pauciflora* is one of the most common orchids of gumland scrub, clay pans and the old cemetery areas there is no reason to devise a specific management plan for it. Being an orchid of sunny, open-areas it is naturally absent from the forested gullies and the denser shadier tree plantings of the cemetery. However, during December 1999 *Thelymitra* aff. *pauciflora* was also uncommon within areas of dense

Watsonia. Following completion of the first stage of *Watsonia* control, *Thelymitra* aff. *pauciflora* soon reappeared, or spread into the recently cleared/sprayed ground. By November 2000 it was present throughout the majority of the December 1999 *Watsonia* control sites. *Thelymitra* aff. *pauciflora* is also one of three orchids which have successfully colonised the intensively manicured lawns and gardens of the main cemetery area.

Dicotyledonous Composite Herbs

Picris burbridgei

native oxtongue

Threat Status: Vulnerable (de Lange et al. 1999a).

Description: Annual to perennial herb up to 1 m tall. Stem stout, arising from a deep taproot, at first unbranched until flowering commences. All parts densely clad in stout bristles. Basal leaves in a rosette, lanceolate, up to 10 × 3 cm margins undulating, entire, crenate or toothed. Cauline leaves oblanceolate to lanceolate-oblong. Inflorescence a branched subcorymbose structure. Individual capitula (flowers) (flowering) 1 - 1.5 cm long and 1 cm diameter, cylindrical, subtended by 2 rows of 10 - 20 involucral bracts, these linear-lanceolate, with the central portion of the outer bracts with large teeth. Florets (petals) sulphur-yellow. Seed a black or brown 2.5 - 3 mm long cigar-shaped achene, subtended by an off white pappus.

Distribution within Waikumete Cemetery: Discovered in November 1999 on a clay bank near the junction between Kowhai Road and Daffodil Drive (Burial Area 2). Since then no further plants have been seen at this site or elsewhere within the cemetery.

Notes: Native oxtongue, although once widespread in the Auckland Region, had virtually vanished from all but the outer Hauraki Gulf Islands by the turn of the last century. Although the exact cause of this decline is unknown it is suspected that this weedy species succumbed to competition for space from other related northern hemisphere weeds such as catsear (*Hypochoeris radicata*), hawkbit (*Leontodon taraxacoides*) and oxtongue (*Helminthotheca (Picris) echioides*). Accordingly *Picris burbridgei* is now listed as nationally vulnerable (de Lange et al. 1999a). At Waikumete the main risk this species faces is further competition from introduced weeds, and being mistaken and sprayed as one of those weeds. This confusion can arise because our native oxtongue is rather weedy, and it resembles the introduced oxtongue *Helminthotheca*. Both species (and indeed genera) can be easily distinguished in a flowering condition because *Picris* flowers (capitula) possess an inner and outer whorl of many (> 10) narrowly lanceolate bracts, which collectively form the involucre. The involucre of *Helminthotheca* also consists of an inner whorl of bracts but the outer whorl is made up of 4 large, heart-shaped bracts. Seed from the plant was gathered and while some was scattered in the vicinity the rest was sent to the Auckland Regional Council Botanic Gardens as a safeguard. This proved prudent, as no further specimens have been located at this site or elsewhere within the cemetery.

Management Options: The only available option is to restore the species back to Waikumete. Several suitable locations for this purpose are available. Suitable sites include the clay track leading from Amber Crescent to the Water Tank, the gumland scrub remnant between Amber Crescent and the Dalmatian Mausoleums, sections of the Friends of Waikumete Cemetery wild flower area, as well as parts of the southern gumland vegetation. We

recommend that restoration of this nationally threatened species be undertaken as soon as possible. Restoration of this species is seen as a positive undertaking which can, and should involve the public.

Dicotyledonous Vines

Calystegia marginata

small-flowered bindweed

Threat Status: Declining (de Lange et al. 1999a).

Description: Long-trailing vine forming dense to somewhat diffuse leafy patches. Stems slender, without hairs, green to brown spotted red or black, twining readily on associated vegetation. Leaves on slender petioles up to c.5 cm long, leaf arrow-shaped (sagittate) acute to subacute, basal lobes divergent, acute, variously lobed or toothed. Flowers, solitary, white c. 12 mm diameter, borne on winged peduncles. Capsules globose, papery, bearing 4-6 black markedly rugose seeds.

Distribution within Waikumete Cemetery: Known from a single site within the southern gumland vegetation.

Notes: *Calystegia marginata* is an indigenous bindweed favouring low scrub and coastal habitats. Historically the species was known to grow as far south as Thames. Its discovery at Waikumete now constitutes the extant national southern limit. Discovered at Waikumete in September 2000, possibly only one vine is present, and by May 2001 this was at risk of being smothered by the surrounding gumland vegetation. Urgent action is needed to prevent its extinction at Waikumete.

Management Options: At present the first priority, to prevent the imminent loss of this species at Waikumete, is to clear away some of the surrounding vegetation. Some seed has also been collected and forwarded to the Auckland Regional Council Botanic Gardens, where it has been stored as a safeguard should the wild plant(s) die. It is recommended that some of this seed should be germinated and an attempt made to translocate the plants to other suitable locations at Waikumete. Recent translocation trials involving this species on Cuvier Island, suggest that translocations succeed best when plants are moved during autumn, and planted into very open, low scrub and rough pasture. Plenty of this habitat is available at Waikumete. However, education about this species and how to recognise it is even more crucial, because as a weedy bindweed this species is prone to accidental control. It is often confused with other introduced bindweed's, such as *C. sylvatica*, and at least some components of the *C. sepium* agg., which are often collectively referred to as "Convolvulus". In anticipation of this problem occurring elsewhere, the Department of Conservation has a fact sheet outlining key characters separating this species from other indigenous and exotic bindweeds. This may prove a useful guide at Waikumete.

Presumed Extinct Species

Phylloglossum drummondii

Threat Status: Endangered (de Lange et al. 1999a)

Description: Sterile leaves, bright green to yellow-green, produced annually in basal rosettes 1-2 cm long, linear, pointed, slightly fleshy. Fertile stem solitary, 1-4 cm high, bearing fertile leaves in a yellowish terminal cone 0.4 - 0.8 cm long.

Distribution within Waikumete Cemetery: Presumed extinct at Waikumete (see notes).

Growing Season: September - November.

Notes: This species formerly common in gumland scrub throughout the northern North Island (Braggins 1974) is dependant on frequent fires to maintain the open clay pans it requires (J.E. Braggins pers. comm.). It was last reported from Waikumete Cemetery in 1971 (de Lange et al. 1999b).

Management Options: If rediscovered this species will have the same management requirements as other fire/disturbance dependant species (see *Caladenia alata*). As a nationally threatened species (de Lange et al. 1999a) any management should be undertaken in consultation with the Department of Conservation.

Pterostylis puberula

Threat Status: Critically Endangered (de Lange et al. 1999a).

Description: An erect, pale green, solitary, tuberous orchid. Flowering plants up to 15 cm tall but usually much less. Stem silvery-grey, slender, minutely rough, covered in short stiff projecting hairs. Rosette leaves 4-6, c.7 × 5 mm, ovate, acute, petiole little shorter, narrowly winged. Cauline leaves smaller, sheathing. Flower (galea), usually solitary, remote from highest bract, c.10 - 15 mm, pale green, copiously striped silvery-white. Dorsal sepal, pale green suffused silvery-grey, at first erect then abruptly horizontal with a blunt apex. Lateral sepals partially fused, very long, diverging at a very wide angle and so broadly U-shaped in front view, with an in-turned median tooth, sharply contracted into a slender ± erect club-shaped tail standing well above galea. Petals equal to or longer than dorsal sepal, striped pale-green and silver-white, apex subacute. Labellum oblong, pale green, hidden within galea, apex blunt.

Distribution within Waikumete Cemetery: Presumed extinct at Waikumete (see notes).

Peak Flowering Time: Unknown for Waikumete. Elsewhere September - November.

Notes: Although this species has been reported from Waikumete we have been unable to confirm this. There are no herbarium specimens known from Waikumete Cemetery although there are old Matthews herbarium specimens from New Lynn at AKU (!) which may be the basis of the Waikumete record. In any case this species was known from gumland scrub in the Oratia Valley, and at Titirangi until the 1950's, so that it is not unlikely that it may have occurred at Waikumete. Currently very little is known about the ecology of *P. puberula*, available evidence suggests that plants can be flower from September to December, with a possible peak flowering time of November. Furthermore, the species is often found in association with *P. tasmanica*, and both species prefer very open, sparsely vegetated clay pans. Such habitat still exists at Waikumete, and as *P. tasmanica* is still known from there, further opportunistic survey for *P. puberula* may yet rediscover it.

Management Options: A preliminary study of the only known population of this species left, that within the Kauaeranga Valley, suggests that this species benefits from frequent "opening-up" of its gumland habitat. Past collections, also suggest this. As there is evidence that this orchid temporarily expanded its range as a consequence of kauri-logging, gold mining and the frequent burning of gumland scrub and kauri forest throughout Northland and Coromandel during the late 1800's early 1900's. As this species is rated nationally as "Critically Endangered" (de Lange et al. 1999a) if plants are rediscovered at Waikumete the best policy would be to contact the Department of Conservation.

Significant Habitats at Waikumete

With regard to the presence of threatened and/or uncommon indigenous plants, there are two main areas of significant gumland vegetation left at Waikumete. These are as follows:

Northern Gumland

The Northern gumland vegetation and gullies drain the hill top that forms the western boundary of Waikumete Cemetery (bordered by Sunnyside and Awaroa Roads). The ridge tops of this area are vegetated in dense manuka and kanuka, and, possibly because the vegetation is so dense it seems to provide little orchid habitat. Between these ridges are several deep gullies, which are vegetated by dense tree fern which also seems unsuitable habitat for orchids. However, occasional specimens of the orchids *Caladenia atradenia*, *Caladenia chlorostyla*, and *Pterostylis* aff. *graminea* have been found in this area, and these become more common within the southern portion of the area, between Amber Crescent, Waitakere View Road, and the dirt track leading to the water tower. In this area there are significant populations of *Caladenia atradenia*, *C. chlorostyla*, *Pterostylis* aff. *graminea*, *Thelymitra aemula*, *T. colensoi*, *T. aff. pauciflora*, and the occasional *T. tholiformis*, *T. tholiformis*, and *T. aff. ixioides*, all of which are, even more common in the southern gumland. Although this southern portion of the main northern gumland area is still in very good condition, weed species including pampas grass (*Cortaderia jubata* and *C. selloana*) and tall fescue (*Schedonorus phoenix*) are invading all along the dirt track from Amber Cres to the Water Tower. Control of these weeds, ideally in winter, when all these orchids are dormant is urgently needed within the next year or so, otherwise they will become too dense to permit easy spot control, and the orchids of this area will be lost. Although the rest of the gumland vegetation has few threatened/uncommon indigenous species, it remains significant as a sizeable regionally scarce vegetation type, which is relatively weed-free and reasonably intact.

Southern Gumland

Externally this area presents much the same visual appearance as the Northern Gumland. However, possibly because it has been more frequently disturbed by human traffic (the site is partially tracked) and fires it contains the most important populations of gumland orchids. In particular, two areas, corresponding to those sites most recently burned, support large populations of *Caladenia atradenia*, the largest numbers of *Thelymitra aemula*, *T. carnea*, *T. tholiformis*, *T. aff. ixioides*, and *T. aff. longifolia*, and the only known habitat for *Caladenia alata*, *C. bartlettii*, *Genoplesium pumilum*, and *Pterostylis tasmanica*. Much of the remaining gumland area comprises a diverse mosaic of vegetation at different stages of succession, as well as wattle (*Acacia* spp.) forest, and some large areas dominated by pampas grass. Aside from the dense pampas infestations, the taller scrub and *Acacia*-dominated forest provides the only known Waikumete habitat for *Corybas cheesemanii*, *C.*

oblongus, *Pterostylis agathicola*, *P. trullifolia*, and *Calystegia marginata*. It is also the main habitat for *Pterostylis* aff. *graminea*, and the saprophytic orchid *Gastrodia* aff. *sesamoides* in the cemetery. Weed issues remain the main management concern. The key areas are those two sites that have been burned in the last decade or so. Of these, gorse (*Ulex europaeus*) and pampas grass are progressively swamping the smaller burn area. However, it is the larger area that preserves the greatest diversity of uncommon plants, and this location, has minimal weed infestation. We suggest that to ensure it remain in good condition, spot-spraying of pampas grass, gorse, *Acacia*, hakea (*Hakea sericea*) and *Aristea ecklonii* is undertaken as soon as possible. Again, as an immediate short-term measure we advocate winter spraying, when the majority of the uncommon native plants are dormant. Furthermore, as a long-term measure, we suggest this area would be an ideal location to trial the use of fire, spot burns, of the type prescribed by Norton & de Lange (*in sub.*) provide a small scale, low-risk option, especially if undertaken in winter.

Discussion

Waikumete Cemetery is a diverse landscape preserving important natural and historical connections with Auckland's past. That many uncommon indigenous species persist there may appear remarkable but by world standards it is not. Cemeteries often preserve the last vestiges of indigenous ecosystems long after urbanisation has otherwise effaced them from the landscape. While the presence of indigenous gumland habitat at Waikumete may not be unique the challenges we face in ensuring that these remnants persist are. Currently the existing management regime at Waikumete will not ensure the survival of many of the uncommon plants this survey has discovered there. To prevent further declines and losses more proactive methods are called for. Accordingly, we recommend that research programs are undertaken to explore the ways whereby gumland vegetation with its attendant, often fire-dependant species can persist within a fully functioning cemetery.

Recommendations

1. Preparation of a Field Guide to the uncommon Native Plants of Waikumete.

During the surveys it was evident that the public users of the cemetery are interested in its biota (especially the flora). However, many people were also confused as to the need to manage weed species, and failed to understand the importance of some of the key indigenous vegetation types. Therefore we suggest that to assist with public advocacy of the importance of the cemetery, as well as an aid to cemetery workers, and weed contractors, that a small publication be prepared. This should briefly outline the key vegetation types/habitats, showing examples of the unusual plants, and animals, which are found there, and the kinds of management needed to prevent their loss.

This publication could be sold from the Crematorium, and could be made available to interested tour groups and the Friends of Waikumete Cemetery.

2. Research into the Ecology and Control of *Aristea ecklonii*.

While the management of some of the major weed species at Waikumete has been initiated there are several species which are either of lower priority, or which have previously not been identified as a threat to the indigenous character of the cemetery. Our surveys identified that the small, blue-flowered iridaceous *Aristea ecklonii* is serious threat to those native plants that require open clay pans, low bristle-grass turf and short scrub land. During the October 2000 field inspection, the significance of this weed was identified to the participants, all of whom acknowledged that they previously overlooked its weed potential. Appropriate control measures remain uncertain, and until the ecology of this weed has been properly researched, experimental control seems inadvisable. Accordingly we suggest that research into the ecology and weed potential of this species is needed.

3. Spot-spraying and hand weeding of minor weed infestations.

This report has identified key gumland habitats where urgent weed control is needed. Within these sites we suggest that spot-spraying and /or hand weeding of pampas grass, hakea, wattle, and tall fescue should be undertaken during winter.

4. Restoration of native oxtongue (*Picris burbidgei*), bindweed (*Calystegia marginata*) and native paspalum (*Paspalum orbiculare*).

The first two species are nearly extinct at Waikumete, whilst the last occurs in very low numbers. Seed and/or plants of all three are held at the University of Auckland, or Auckland Regional Council Botanic Gardens. We suggest that restoration plantings of all three species should be undertaken, perhaps within the area managed by the Friends of Waikumete Cemetery, and within suitable sites around Amber Crescent, and within the Southern Gumlands.

5. Research into developing long-term disturbance management regime/protocols.

With only the occasional exception all gumland scrub is a product of frequent fires. Therefore many of the indigenous species which are characteristic of gumland have adaptations for fire, e.g., tubers, deeply buried rhizomes, and either fire resistant seeds which possess long-term viability, or seed ideally suited to wind dispersal. Without regular fires, gumland scrub will eventually succeed to forest. This is happening at Waikumete, although the process is being enhanced by the spread of exotic trees such as wattle and *Eucalyptus*, suited to impoverished soils, pampas grass, and ground cover weeds such as wandering Jew (*Tradescantia fluminensis*).

Nutrient-poor wetlands have a similar suite of indigenous species to that seen in gumlands, and these habitats too, are partially controlled by fire periodicity.

Recent experimentation in one of these wetlands, the Whangamarino, using small spot burns, conducted during winter, dramatically reversed the decline of the "Critically Endangered" swamp helmet orchid (*Corybas carsei*), as well as many other orchids, ferns and grasses (Norton & de Lange *in sub.*). Similar protocols could, with some experimentation be adopted at Waikumete. We suggest that this option is explored further.

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APPENDIX 1. Waikumete Cemetery Vascular Plant List

The basis for this species list is Esler & Cameron (1990) and for *Eucalyptus* Wilcox (1998). In most instances only indigenous and naturalised (including casual) vascular plants are listed. Indigenous taxa may or may not include those, which have been planted, as a clear distinction is not always possible. Similarly, while it is doubtful that all *Eucalyptus* listed are naturalised, a clear distinction, particularly when dealing with seedlings and juveniles of this taxonomically difficult genus, is not always possible. While we have tried to prepare as comprehensive a list as possible, it is likely that further additional records are held at the Auckland Museum (AK) and Landcare (CHR) herbaria.

Abbreviations

*adventive species

** adventive/planted?

† additional records (2000/01 Survey - 42 records)

agg. aggregate

sp. species (singular)

ssp. subspecies

s.s. *sensu stricto*, in the narrow sense

var. variety

x hybrid

SPECIES	Common name
Ferns and fern allies	
<i>Adiantum aethiopicum</i> [†]	common maidenhair
<i>A. cunninghamii</i>	common maidenhair
<i>Asplenium flaccidum</i>	hanging spleenwort
<i>A. oblongifolium</i>	shining spleenwort
<i>A. polyodon</i>	sickle spleenwort
<i>Blechnum discolor</i>	crown fern
<i>Blechnum filiforme</i>	thread fern
<i>B. novaezelandiae</i>	kiokio
<i>Ctenopteris heterophylla</i>	
<i>Cyathea dealbata</i>	silverfern
<i>C. medullaris</i>	mamaku
<i>C. smithii</i>	soft treefern
<i>Dicksonia squarrosa</i>	wheki
<i>Gleichenia dicarpa</i>	tangle fern
<i>G. microphylla</i>	waewaekaka

SPECIES	Common name
<i>Hymenophyllum demissum</i>	filmy fern
<i>H. flabellatum</i>	filmy fern
<i>Hypolepis ambigua</i> [†]	
<i>Lindsaea linearis</i>	
<i>Lycopodium deuterodensum</i>	
<i>Lycopodiella lateralis</i> [†]	
<i>Microsorium pustulatum</i> ssp. <i>pustulatum</i>	hounds tongue fern
<i>M. scandens</i>	mokimoki
* <i>Nephrolepis cordifolia</i>	tuber ladder fern
<i>Paesia scaberula</i>	hard fern
<i>Phylloglossum drummondii</i> (last seen c.1971)	
<i>Pnematopteris pennigera</i>	
<i>Psilotum nudum</i>	
<i>Pteridium esculentum</i>	bracken
<i>Pteris tremula</i>	shaking brake
<i>Pyrrosia eleagnifolia</i>	
<i>Schizaea bifida</i>	
<i>S. fistulosa</i>	comb fern
* <i>Selaginella kraussiana</i>	
Gymnosperms	
<i>Agathis australis</i>	kauri
* <i>Chaemaecyparis lawsoniana</i>	Lawson's cypress
* <i>Cryptomeria japonica</i>	Japanese cedar
<i>Dacrycarpus dacrydioides</i>	kahikatea
<i>Dacrydium cupressinum</i>	rimu
<i>Libocedrus plumosa</i>	kawaka
* <i>Pinus pinaster</i>	maritime pine
* <i>P. radiata</i>	radiata pine
<i>Phyllocladus trichomanoides</i>	tanekaha
<i>Podocarpus cunninghamii</i>	Hall's totara
<i>P. totara</i>	totara
* <i>Taxodium distichum</i>	swamp cypress

SPECIES	Common name
Dicotyledons	
* <i>Acacia longifolia</i>	Sydney golden wattle
* <i>A. mearnsii</i>	black wattle
* <i>A. melanoxylon</i>	Tasmanian blackwood
* <i>A. prominens</i>	
* <i>Achillea millefolium</i>	yarrow
* <i>Acmena smithii</i>	monkey apple
* <i>Ageratina riparia</i>	mistflower
* <i>Anagallis arvensis</i> var. <i>arvensis</i>	scarlet pimpernel
* <i>A. arvensis</i> ssp. <i>arvensis</i> var. <i>coerulea</i>	blue pimpernel
* <i>A. minima</i>	chaffweed
* <i>Anthemis cotula</i>	stinking mayweed
* <i>Aphanes inexpectata</i>	parsley piert
* <i>Aptenia cordifolia</i>	
* <i>Arctotheca calendula</i>	cape weed
* <i>Araujia sericifera</i>	moth plant
* <i>Aster lanceolata</i> × <i>A. novi-belgii</i>	Michaelmas daisy
* <i>A. subulatus</i>	sea aster
* <i>Barbarea intermedia</i>	winter cress
* <i>Bellis perennis</i>	daisy
* <i>Betula pendula</i> ²	silver birch
<i>Brachglottis kirkii</i> var. <i>angustior</i>	Kirk's daisy
* <i>Brassica oleracea</i>	wild cabbage
* <i>B. rapa</i> ssp. <i>sylvestris</i>	wild turnip
* <i>Calendula officinalis</i>	marigold
* <i>Callistemon rigidus</i>	stiff bottlebrush
* <i>Callitriche stagnalis</i>	starwort
<i>Calystegia sepium</i> agg.	pink-flowered bindweed
<i>C. marginata</i> [†]	
<i>C. turguriorum</i>	powhiwhi
* <i>Cardamine flexuosa</i>	wavy bitter cress
* <i>Centaurium erythraea</i>	centaury