# Flora and Vegetation of Pureora

**M. D. Wilcox**

The Auckland Botanical Society held an Easter Camp, 2-5 April 1999, based at Pureora Lodge in the northern block of Pureora Forest Park, 20 km east of Benneydale. Those who took part were:

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| Enid Asquith | Graeme Hambly | Helen Lyons | Stella Rowe | Mike Wilcox |
| Paul Asquith | John Hobbs | Morag Macdonald | Pat Seyb | Nancy Wilcox |
| Daphne Blackshaw | Val Hollard | Simon O'Connor | Shirley Smith | Pam Wilcox |
| Quentin Blackshaw | Marcel Horvath | Helen Preston Jones | Alison Wesley | David Wilson |
| Lisa Clapperton | Frank Hudson | Roslyn Prichard | Barbara White | Catherine Yong |
| Brian Cumber | Wyne Johns | Juliet Richmond | Bob White | Maureen Young |
| Colleen Foster | John Jordan | John Rowe | | |

## BOTANICAL PROGRAMME

Seven sites were visited and studied. These were :

- Frost flats and valley of the Karamarama Stream, a headwater of the Waipapa River, adjoining the Pureora Lodge
- Waipapa Ecological Area Forest Walk
- Mire complex of Waipapa Ecological Area
- Pureora Mountain
- Totara Walk
- Buried Forest and Pikiariki tower area
- Waimiha Stream bog pine reserve

## A BRIEF INTRODUCTION TO PUREORA

Pureora Forest Park is administered by the Department of Conservation (DOC) and covers an area of 78 000 hectares in the northern King Country. It is an amalgamation of the former Wharepuhunga, Pouakani, Pureora, Hurakia, Tihoi, Taringamotu, and Waituhi State Forests. Several Ecological Areas (Mangatutu, Waipapa, Pikiariki, Waimonoa, Ratanunui, Maramataha, Nga Morehu, Pureora Mountain, Waihaha, Whenuakura) have been designated within the Park, representative of all the major vegetation types (Nicholls 1978).

Logging of the dense podocarp forests in the former Pureora State Forest itself commenced in 1945 and ceased in 1978 when a moratorium was imposed on further logging, following protests. Local sawmills converted the logs into timber to meet the needs of the large state housing projects. Such was the density of the stands of rimu (*Dacrydium cupressinum*), matai (*Prumnopitys taxifolia*), and totara (*Podocarpus totara*) at Pureora, that the forest was more or less clearfelled during logging.

A form of selective logging took place in the early 1950s when peeler rimu logs for plywood manufacture were removed from what is now the Pikiariki Ecological Area. Much research was subsequently carried out at Pureora on forest regeneration and selection logging (Beveridge 1964, 1973, 1983; Herbert 1978, 1980, 1986; Smale et al. 1987, 1998). Selection logging was tried on a small scale at Tihoi and Pouakani for a short period before logging was finally stopped altogether.

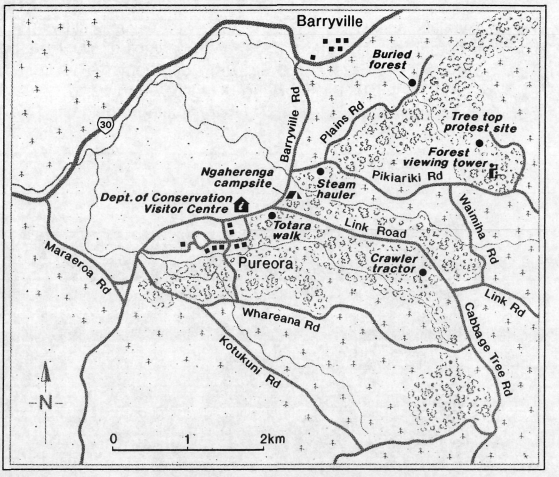
The main geographic features which have shaped the vegetation at Pureora are the inland, elevated locality with generally abundant moisture (180 rain days, 1850 mm per year) and with frequent frosts on flat or depressed sites, and the volcanic pumice deposits from the Taupo eruptions 1700 years ago (Druce 1952, McKelvey 1953, 1963). As pointed out by Hessell (1986), Pureora is about as far away from the sea as one can get in New Zealand. The climate at Pureora has evidently got milder in the last 40 years to the point that the regular harsh frosts of the past now rarely occur, allowing the accelerated encroachment of natural forest margins on to what were once frost-prone scrublands.

The Auckland Botanical Society has had at least three previous trips to Pureora, and valuable, brief accounts of these have been recorded in our Journal (Hynes 1969, Warren 1965, Mead 1972).

## EXOTIC FORESTS

From 1949, various exotic tree species were planted on the native forest cutovers, and these plantations adjoining the Forest Park are today licensed to Rayonier New Zealand Limited (25%) in a joint venture with UBS–Resource Investments International (75%) under a Crown Forestry Licence, or directly operated by the Department of Conservation or managed on behalf of Crown Forestry Management Ltd by New Zealand Forest Managers. In addition to the state-owned exotic forest lands at Pureora, Carter Holt Harvey Ltd manages radiata pine plantations on its own or leased Maori land, including Pouakani, and the Maraeroa C block (also known as the "KK" or Kokakotaia Block) comprising 5000 ha of radiata pine planted in 1975-76.

**Figure 1: Location of Pureora**






The New Zealand Native Forests Restoration Trust proposed to the Government in 1987 that the state-owned exotic plantations at Pureora be replanted in native trees once they had been harvested. In October 1990, the then Prime Minister, Mike Moore, agreed to this idea, and it was further supported in December 1991 by the new Prime Minister, Jim Bolger (New Zealand Native Forests Restoration Trust 1992).

The Pureora blocks are as follows:

### Pureora North Block

An area of 702 ha, at an altitude of 600-700 m, planted by the NZ Forest Service mainly 1970-1978 and now leased to the Rayonier-UBS joint venture. Under the condition of the Crown Forestry Licence, once these exotic plantations have been harvested, tenure reverts to the Crown, and they are supposedly to be re-established in native species by DOC, rather than replanted as exotic forest. The predominant species here is radiata pine (*Pinus radiata*), together with some Douglas-fir (*Pseudotsuga menziesii*) and muricata pine (*Pinus muricata*) adjoining Gully Road on the way to Pureora Lodge.

### Pureora Central Block

This is mainly flat to rolling terrain at an altitude of 550-800 m, covering c. 3000 ha. The predominant species are Douglas-fir and radiata pine, with small areas of Japanese cedar (*Cryptomeria japonica*), larch (*Larix europaea, L. kaempferi*), Sitka spruce (*Picea sitchensis*), western red cedar (*Thuja plicata*), and eucalypts (*Eucalyptus regnans, E. delegatensis*). It is managed by NZ Forest Managers (Turangi) on behalf of Crown Forestry Management Ltd. Again, when these stands are clearfelled, the intention is to promote regeneration back to native forest. Some areas of Douglas-fir were clearfelled recently, but the sites have quickly reverted to blackberry (*Rubus fruticosus*).

### Pureora Central Block (DOC areas)

Some 250 ha of plantations adjoining the Pikiariki Ecological Area are directly managed by DOC. These include blocks of Corsican pine (*Pinus nigra* ssp. *laricio*) and some *Eucalyptus regnans* near the Buried Forest, now viewed as valuable nurse crops for regenerating native forest. The New Zealand Native Forests Restoration Trust has undertaken planting of native trees to supplement natural regeneration.

This covers an area of 1056 ha, predominantly Douglas-fir planted 1965-75, at an altitude of 500-700 m, on the eastern side of the Hauhungaroa Range, with a rainfall of 1500 mm. This is also a Rayonier-UBS joint venture forest, which too is supposedly to be regenerated back to native forest when the exotic forest is eventually felled.

## KARAMARAMA FROST FLATS AND SCRUBLANDS NEAR PUREORA LODGE

The grassy flats and scrub near the lodge (Fig. 2), occupying a pumice terrace, provided convenient and absorbing botanising. The grass areas retain patches of silver tussock (*Poa cita*), mountain oat grass *(Deyeuxia avenoides*), patiti (*Microlaena stipoides*), danthonia (*Rytidosperma gracile*), and holy grass (*Hierochloe redolens*), together with the introduced grasses, browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*) and Yorkshire fog (*Holcus lanatus*), and purging flax (*Linum catharticum*).

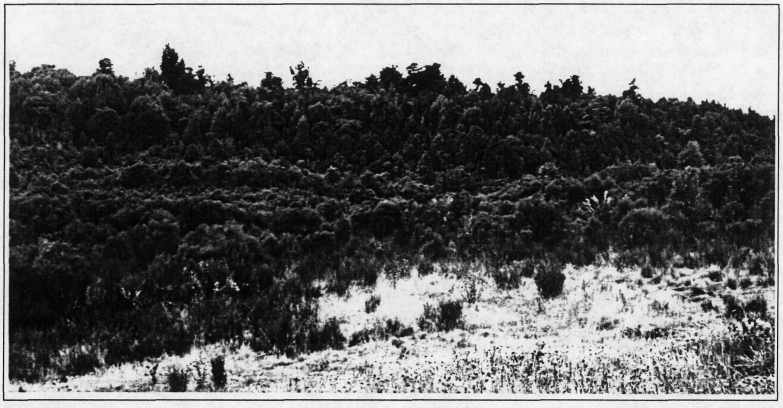


**Figure 2: Karamarama frost flats and scrublands near Pureora Lodge, merging into an ecotone of regenerating podocarps, and mixed tawa and podocarp forest of the Waipapa Ecological Area.**

Common small matted shrubs are *Pimelea prostrata, Leucopogon fraseri*, and less frequently, *Androstoma empetrifolia* and *Gaultheria macrostigma.* The introduced Spanish heath (*Erica lusitanica*) is well established. Prominent herbs are *Acaena novae-zelandiae, Celmisia gracilenta, Gentiana grisebachii. Gonocarpus micranthus* ssp. *micranthus, Geranium microphyllum, Helichrysum filicaule, Oreomyrrhis ramosa*, and the ubiquitous introduced catsear (*Hypochoeris radicata*). Damp spots often had *Viola cunninghamii, Nertera scapanioides, Pratia angulata, Gratiola sexdentata*, colonies of the four-square sedge, *Lepidosperma australe*, and cushions of *Oreobolus pectinatus.*

The most characteristic shrubs of these cold flats and hollows at 400-500 m altitude are monoao (*Dracophyllum subulatum*) and *Coprosma propinqua*, the latter attracting much attention by the spectacular crops of berries, ranging in colour from translucent white to wonderful shades of deep blue.

Associated shrubs were manuka *(Leptospermum scoparium*), *Olearia virgata* ssp. *centralis* (a characteristic small tree on alluvial terraces), *Coprosma* sp.(t), *Aristotelia fruticosa, Corokia cotoneaster, Leucopogon fas-ciculatus, Hebe stricta* var. *stricta, Raukaua anomalus, Pittosporum tenuifolium* ssp. *colensoi*, and *Gaultheria antipoda.* Beneath the shade of the taller shrubs could occasionally be found *Pimelea tomentosa*, and commonly, several ferns and lycopods including *Blechnum penna-marina, Sticherus cunninghamii, Hypolepis rufobarbata, Polystichum vestitum, Lycopodium volubile, L. scariosum, L. deuterodensum*, and *L. fastigiatum.* Under a mountain toatoa (*Phyllocladus alpinus*) was found an impressive patch of completely terrestrial *Tmesipteris elongata.*

The Pureora frost flats have been studied in detail by Smale (1990a, 1990b). Unfortunately, time did not permit us to visit the famous large frost flat in the Waipapa Ecological Area, known as the Taparoa Clearing.

## WAIPAPA FOREST WALK

This "1-hour" walk took us all morning, such was the diversity of plant life to be seen and studied. It is in the southern part of the Waipapa Ecological Area, which was the subject of a very intensive ecological study, reported by Leathwick (1987). Between the frost flats and high forest is a transition zone or ecotone (Bell 1976) of 6-9 m high pole stands in which lancewood (*Pseudopanax crassifolius*), mountain toatoa, *Melicope simplex*, *Pittosporum tenuifolium* ssp. *colensoi*, and broadleaf were dominant. The orange-fruited *Coprosma rigida* occurs on forest margins. The high forest has large emergent rimu, totara, miro, matai, and kahikatea, with a sub-canopy of tawa (*Beilschmiedia tawa*), hinau (*Elaeocarpus dentatus*) and occasional rewarewa (*Knightia excelsa*). There is one remarkable hollow totara which could serve as an overnight shelter. In the lower tier, tree ferns are abundant, the dominant ones being *Cyathea smithii*, *Dicksonia fibrosa*, and *D. squarrosa*, with mahoe (*Melicytus ramiflorus*), toro (*Myrsine salicina*), and kamahi (*Weinmannia racemosa*). Damp hollows commonly had *Coprosma rotundifolia*. A thicket of myrtle (*Neomyrtus pedunculata*) was encountered, with several plants bearing handsome orange, long-pedunculate fruits. Prominent ground plants were mountain horopito (*Pseudowintera colorata*), *Asplenium bulbiferum*, *Leptopteris hymenophylloides*, and carpets of *Hymenophyllum demissum*. Other filmy ferns noted were the epiphytic species, *Hymenophyllum bivalve*, *H. dilatatum*, and *H. scabrum*, and, on tree fern trunks, *H. ferrugineum*. The common epiphytic tank lily here was *Collospermum microspermum*.

Mosses to attract attention were the pendent *Weymouthia mollis* and *W. cochlearifolia*, the delicate fans of *Hypopterygium filiculaeforme* on the forest floor and fallen tree trunks, and the very abundant umbrella moss, *Hypnodendron comatum*. A few colonies of king moss (*Dawsonia superba*) were found, but it was not particularly common.

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## WAIPAPA MIRE

An objective in visiting this site was to see the large sedge, *Gahnia rigida* (Leathwick 1984b, Wallace 1984). It occurs here around the fringes of the bogs (Fig. 3), and apart from a location near Wellington, Waipapa and some occurrences in bogs on the Mamaku Plateau are the only other known sites for this species in the North Island. The mire is extensive (100 ha), and the source of the Waipa River. It is dominated by swamp umbrella fern (*Gleichenia dicarpa*) and *Lepidosperma australe*. In the wettest parts were stands of *Baumea rubiginosa*, star sedge (*Carex echinata*), and burr reed (*Sparganium subglobosum*). Other plants recorded were *Baumea teretifolia*, *Hierochloe redolens*, *Eleocharis gracilis*, patches of sphagnum moss (*Sphagnum cristatum*), the leafless *Clematis quadribracteola*, *Potamogeton suboblongus*, *Aporostylis bifolia*, *Phormium tenax*, *Schoenus maschalinus*, *Nertera scapanioides*, *Viola cunninghamii*, *Gonocarpus micranthus* ssp. *micranthus*, *Hydrocotyle pterocarpa*, *Juncus planifolius*, *Juncus articulatus*, and *Juncus gregiflorus*. A small damp depression (seasonal pond) had *Ranunculus flammula*, *Eragrostis brownii*, and *Pratia angulata*, and there were several individuals of the invasive grey willow (*Salix cinerea*), which probably should be removed as it is an undesirable environmental weed. A colony of the large orchid *Orthoceras strictum* occupied an eroded pumice site near the road, and examples of both *Drosera binata* and *D. spathulata* were found, but we did not see *Prasophyllum patens*, *Spiranthes sinensis*, *Centrolepis ciliata*, *Utricularia* sp., *Epacris pauciflora*, *Gunnera prorepens*, or *Empodisma*

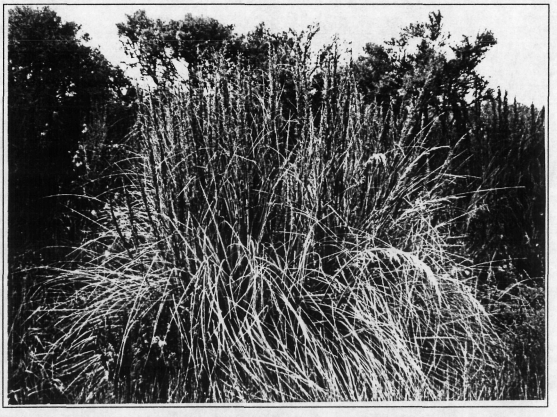

**Figure 3: *Gahnia rigida* 1999**

*minus*, previously recorded from this mire (Wallace 1984).

The elevated margins of the mire, and islands within it, support dense stands of monoao scrub, with manuka, *Coprosma* sp.(t) and *C. propinqua*, *Hebe stricta* var. *stricta*, and toetoe (*Cortaderia fulvida*), and with *Coprosma tenuicaulis* thickets near the margins. As elsewhere in Pureora, blackberries have invaded the disturbed roadside margins.

A side trip to native forest adjoining the southern end of the mire featured some spectacular groves of kamahi, with each tree epiphytic on the trunks of *Dicksonia fibrosa*. It was here that colonies were found of fine-leaved parsley fern (*Botrychium australe*). A planned return circuit via the Select Loop Road through selectively logged forest had to be aborted as a giant fallen rimu tree had blocked the road. Graeme Hambly and John Hobbs found *Brachyglottis kirkii* epiphytic on this tree.

## PUREORA MOUNTAIN

For many, the ascent of Pureora Mountain was the highlight of the trip, providing a rewarding physical challenge, and the opportunity to observe the sequence of vegetation from mixed podocarp forest to subalpine herbfield, as has been documented by Johnson (1978), Leathwick (1990), and Leathwick, Wallace & Williams (1988). Smale & Kimberley (1993) have reported on regeneration patterns.

The track from Link Road begins at an altitude of c. 800 m, and one of the first "finds" was the vegetable caterpillar, occurring in colonies on the forest floor. This intriguing object is the mummified caterpillar of the forest porina moth (*Dumbletonius* sp.), parasitised by the fungus *Cordyceps robertsii* (Relph 1991).

At first the forest has emergent rimu over a canopy of hinau and tawa, and with pigeonwood (*Hedycarya arborea*), raukawa (*Raukaua edgerleyi*), kamahi, miro, and toro. Hinau trees in this vicinity have been identified by the Department of Conservation as hosts of the mistletoe, *Ileostylus micranthus* (de Monchy 1998). Prominent plants in the understorey were *Cyathea smithii*, *Dicksonia squarrosa*, wineberry, broadleaf, tawheowheo (*Quintinia serrata*), putaputaweta, and pokaka (*Elaeocarpus hookerianus*)

**Figure 4: Forest of Hall's totara, kamahi and tawheowheo, Pureora Mountain, 1000 m altitude.**

Raukawa is particularly abundant and large here. Very prominent small shrubs were *Alseuosmia pusilla* and mountain horopito. Because of its low palatability to deer, this latter shrub has become more abundant over the last 40 years at the expense of palatable shrubs (e.g. *Pseudopanax* spp., *Coprosma tenuifolia*), which have been reduced by browsing (Williams 1991, Smale & Kimberley 1993). A seedling was found of what we took to be tawari (*Ixerba brexioides*), but this species is rare on the mountain.

In the subalpine "mossy" forest (Fig. 4), Hall's totara (*Podocarpus hallii*) is the main emergent tree, with the canopy variously comprising toro, kamahi, raukawa, and in places, pure tawheowheo (*Quintinia serrata*). Ferns abound, with good examples seen of *Phymatosorus novae-zelandiae*, *Hymenophyllum pulcherrimum*, and much *Leptopteris superba* and *L. hymenophylloides*. On the edge of the track and on banks were *Luzuriaga parviflora* and numerous clumps of the large moss, *Dendroligotrichon dendroides*. Attractive fungi in evidence on the forest floor were the blue toadstool, *Entoloma hochstetteri*, the pale blue pouch fungus, *Weraroa virescens*, and the red pouch fungus, *Weraroa erythrocephala*.

At c. 1000 m, there is a subalpine scrub forest of haumakaroa (*Raukaua simplex*), mountain five-finger (*Pseudopanax colensoi*), stinkwood (*Coprosma foetidissima*), *Coprosma* sp.(t), mountain holly (*Olearia ilicifolia*), broadleaf, Hall's totara, mountain toatoa, *Neomyrtus pedunculata*, and *Myrsine divaricata*. Prominent on the forest floor is the mountain tussock sedge, *Gahnia procera*, and *Blechnum procerum*. Bush lawyer (*Rubus cissoides*) is common here, as it is at lower elevations. On damp sites there were large clumps of *Astelia fragrans*. Only a few small examples were seen of mountain cabbage tree (*Cordyline indivisa*). *Brachyglottis rotundifolia* occurs in places (Hynes 1960) but we did not see it. The vegetation changes suddenly towards the summit to a low subalpine scrub (2 m) of bog pine (*Halocarpus bidwillii*), which was bearing an abundant fruit crop, broadleaf, mountain toatoa, a scrubby form of Hall's totara, *Gaultheria antipoda*, *Olearia arborescens*, mountain holly, *Ozothamnus vauvilliersii*, *Hebe corriganii*, mingimingi (*Leucopogon fasciculatus*), *Myrsine divaricata*, and *Blechnum montanum*. The lower stems of the low shrubs were clothed in filmy ferns (*Hymenophyllum sanguinolentum*, *H. multifidum*), and commonly *Grammitis magellanica* ssp. *nothofageti*.

The vegetation at the summit (1170 m) itself is a low shrubby mossfield (Fig. 5). Two alpine mosses, *Racomitrium pruinosum* and *Dicranoloma robustum*, are prominent, together with an assemblage of herbs and low shrubs, including *Coprosma cheesemanii* (sp."o"), *Gaultheria depressa* var. *novae-zelandiae*, *Kelleria laxa*, *Nertera scapanioides*, *Hypolepis millefolium*, *Blechnum pennamarina*, *Lycopodium fastigiatum*, *Uncinia uncinata*, *Oreobolus pectinatus*, *Pentachondra pumila*, *Androstoma empetrifolia*, *Celmisia gracilenta*, *Thelymitra venosa*, *Aporostylis bifolia*, *Hierochloe redolens*, *Deyeuxia aucklandica*, *Rytidosperma gracile*, and *Luzula picta*. Moist banks had colonies of *Ourisia macrophylla* var. *robusta*, commonly with *Anaphalioides alpina*.

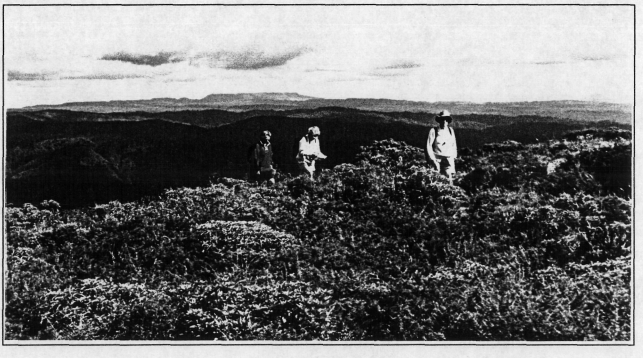

**Figure 5: Subalpine scrub on the summit of Pureora Mountain (1165 m), looking south along the crest of the Hauhungaroa Range. The flat-topped mountain is Tuhua (1042 m), and the cone to the far right is Hikurangi (770 m).**

A short distance below the summit, on the Toi Toi Track is a small mire containing bog pine, monoao, sphagnum, *Juncus novae-zelandiae*, and *Carpha alpina*. Interestingly, mountain neinei (*Dracophyllum traversii*) which is such a feature of the upper montane forests of the Ranginui Mountain just a twenty kilometres to the north-west, is completely absent from Pureora Mountain.

Pureora Mountain is at the northern end of the Hauhungaroa Range. It is an andesitic cone sitting on a greywacke basement. The view from the summit provided great panoramas of Lake Taupo (to the east), the Hauhungaroa Range stretching to the flat-topped Tuhua Mountain near Taumarunui (to the south), the Rangitoto Ranges (to the northwest), and Mt Titiraupenga (to the northeast).

## TOTARA WALK

The Totara Walk is through a dense virgin podocarp forest adjoining the Pureora Village. Just inside the forest, beside the track, was *Dactylanthus taylorii*, in flower (thanks to Sandra Jones for "finding" it). Some of us had earlier found *Dactylanthus,* protected from possums by wire cages (Ecroyd 1993) in a tall ecotonal pole stand of mountain toatoa beside Kotukunui Road. This has long been a known site for this species (Hynes 1960), but the Tuhua Plateau in the far south of Pureora Forest Park has perhaps the largest population (Whaley & Holzapfel 1997).

The Totara Walk forest is very tall, c. 40 m, with a mixture of totara, kahikatea, matai, and rimu. Broadleaved trees form a sparse lower canopy, the commonest trees being hinau, pokaka, kamahi, and tawa. Shrubs included *Melicope simplex*, horopito (*Pseudowintera axillaris*), and *Alseuosmia pusilla*. The dominant ground fern is *Asplenium bulbiferum.*

## THE BURIED FOREST

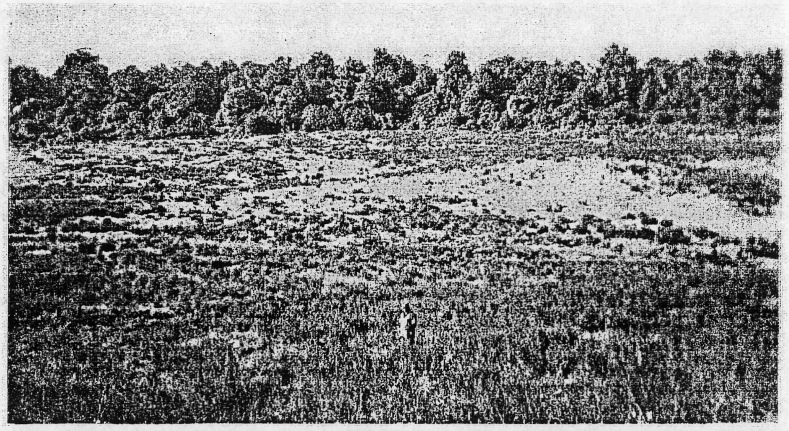

**Fig. 6: The open plains at Pureora in 1959, before pines were planted, with *Poa cita* and *Dracophyllum subulatum*. The Buried Forest lies beneath the wetlands in front of the high forest in the background, which later became part of the Pikiariki Ecological Area.**

This proved to be something of a disappointment, as only a small ditch with a few exposed logs is now open for public viewing. The saga of the buried forest has been well studied and documented (Clarkson 1989, Clarkson et al. 1988, 1995). Of interest is that several plant species (e.g., *Astelia grandis, Gahnia xanthocarpa, Phyllocladus trichomanoides, Freycinetia banksii, Libocedrus bidwillii*) found buried in the bog do not now occur in the nearby forest.

Before the open plains at the Buried Forest site were first planted up in *Pinus contorta* in 1958-59, (later converted to *Pinus radiata*, following the draining which lead to the discovery of the Buried Forest) the vegetation was a topographic mosaic of scrubland and bogs (Fig. 6, Wilcox 1959).

The hilly knolls had manuka and some *Carmichaelia australis*, the stream banks had *Olearia virgata* and *Coprosma propinqua*, there were areas of matted turf and tussock comprising *Poa cita, Oreomyrrhis ramosa, Acaena microphylla, Epilobium alsinoides*, and *Uncinia rubra*, there were frequent mires of *Gleichenia dicarpa, Sphagnum cristatum* and *Lepidosperma australe* draining into small streams, and monoao scrub throughout, but almost pure on the flatter, frostier microsites.

*Hebe stricta* var. *stricta* was commonly concentrated in damp, shaded hollows, and *Gunnera monoica* and *Viola cunninghamii* on the stream edges. Most of this vegetation disappeared with the planting of pines.

We examined a rather open stand of Corsican pine near the Buried Forest and were impressed by the regeneration of native trees and shrubs taking place under the pines. Some species noted were wineberry (*Aristotelia serrata*), five-finger (*Pseudopanax arboreus*), kohuhu, putaputaweta, lancewood, broadleaf, mahoe *(Melicytus ramiflorus*), narrow-leaved *mahoe (Melicytus lanceolatus),* karamu (*Coprosma robusta*), montane karamu (*Coprosma tenuifolia*), raurekau (*Coprosma grandifolia*), *Coprosma* sp.(t*), Coprosma* x *cunninghamii,* mapou (*Myrsine australis*), pate (*Schefflera digitata*), *lemonwood (Pittosporum eugenioides*), rangiora *(Brachyglottis repanda*), tree fuchsia (*Fuchsia excorticata*), all the podocarps (matai, kahikatea, totara, rimu, and miro) represented in the adjacent forest, bush lawyer (*Rubus cissoides*), cabbage trees (*Cordyline australis, C. banksii*), tree ferns (*Dicksonia squar-rosa. D. fibrosa, Cyathea dealbata*), *Polystichum vestitum, Astelia fragrans, Blechnum fluviatile, Blechnum discolor,* and *Blechnum novae-zelandiae.* There was unfortunately also much blackberry and broom (*Cytisus scoparius*). It appears that with appropriate nurse crop species (such as Corsican pine or scattered *Pittosporum tenuifolium* ssp. *colensoi*) that provide a sheltered microclimate with sufficient light, moisture, amelioration of severe frosts, and perches for seed-dispersing birds, native forest can regenerate itself on open sites at Pureora.

## PIKIARIKI ECOLOGICAL AREA AND FOREST TOWER

The Pikiariki Ecological Area (450 ha) has two main claims to fame. It was the place where the presence of kokako at Pureora was first brought to light and where important behavioural studies were made (Anon. 1981) during the 1978-81 logging moratorium. It was also where the protests against continued logging at Pureora took place, including Stephen King's famous tree "sit". During our walk in this area, a good-sized lacebark tree (*Hoheria populnea* var. *lanceolata*) and a huge black maire (*Nestegis cunninghamii*) were seen. Old logging tracks had regenerated into a pioneer scrub forest comprising wineberry, putaputaweta, pate, and *Coprosma tenuifolia.* The dominant large trees in the unlogged forest are matai, totara, rimu, and kahikatea.

## WAIMIHA STREAM BOG PINE COMMUNITY

It was of great interest to see this low elevation (500 m) community (a private Biological Reserve owned by Carter Holt Harvey Ltd) dominated by bog pine (Wilcox 1959, Hynes 1960, Warren 1965, Nicholls 1973, Gardner 1978, Johnson 1978) because we had seen bog pine the previous day on top of Pureora Mountain, as a diminutive shrub, heavily fruiting. This riparian low-elevation bog pine was a small tree 4-6 m in height, but evidently not fruiting here. Blackberry and broom have densely invaded the ground between the road and the stream, making access very difficult. In addition to bog pine, the community has mountain toatoa, some patches of *Pittosporum turneri,* and numerous other shrubs including *P. tenuifolium* ssp. *colensoi, Corokia cotoneaster, Aristotelia fruticosa, Dracophyllum subulatum, D. strictum, Coprosma propinqua, Gaultheria antipoda, G. paniculata, Hebe stricta* var. *stricta, Melicytus micranthus, Melicope simplex, Elaeocarpus hookerianus, Pimelea tomentosa, Raukaua anomalus, Carmichaelia australis* (the form previously known as *C. flagelliformis*), and *Olearia virgata.* Upstream on farmland, the curious almost leafless shrub *Melicytus flexuosus* can be found on the stream bank. Umbrella fern (*Sticherus cunninghamii*) is prominent on the ignimbrite gorge faces, near the stream, and the peculiar prostrate *Coprosma acerosa* ssp. "Central North Island" can be found on roadside banks.

## NOTE ON BIRDS AT PUREORA

Paul Asquith paid particular attention to the birdlife, and held an absorbing "listen" one night outside the lodge, where we heard the calls of morepork and kiwi (female). The kiwi record is of considerable interest as there was a release of kiwis at Cowan's Reserve northwest of Ranginui trig about 1995, but the Department of Conservation has otherwise had no previous reports of kiwi in Waipapa Ecological Area.

At this time of the year, the autumn fruit crops are conspicuous on trees and shrubs. Miro, kahikatea, horopito, toro, and the various coprosmas were especially noticeable. The forest was alive with birds, calling and chattering in the canopy. Tui, bellbird, whitehead, kakariki, robin, and tomtit were plentiful in the forest and ecotones. In scrub near the lodge and on the margins of the mire, fernbirds were commonly heard, but rarely seen, and we had a tame pipit at the lodge. Kokako had been heard near the Pikiariki forest tower by other birdwatchers, but we missed them. Our bird tally was as follows:

| | | | |
|---|---|---|---|
| bellbird | kaka | pigeon | spur-winged plover |
| blackbird | kakariki | pipit | starling |
| black swan | kingfisher | pukeko | thrush |
| chaffinch | kiwi | quail (Californian) | tomtit |
| fantail | magpie | rifleman | tui |
| fernbird | morepork | robin | welcome swallow |
| goldfinch | myna | rosella | whitehead |
| grey warbler | paradise duck | silvereye | white-faced heron |
| harrier | pied shag | sparrow | whitehead |
| | | | yellowhammer |

Other birds here, though not definitely recorded by us are kokako (Anon. 1981), falcon, and probably hedge sparrow, greenfinch, and redpoll.

## BIOLOGICAL CONSERVATION AT PUREORA

The Department of Conservation gives very high priority to controlling introduced animals at Pureora. Rats and possums are particularly targeted in giving general protection to the vegetation, and special protection to some of Pureora's feature species such as the kokako, *Dactylanthus taylorii*, and *Pittosporum turneri.*

Environmental weeds are also of concern as they disrupt the integrity of the natural vegetation. Troublesome are blackberry, broom, buddleia (*Buddleja davidii*), and grey willow. Spanish heath has long been very much part of the scrubland communities, and heather (*Calluna vulgaris*) too is now well established. There are also occurrences of Chilean flame creeper (*Tropaeolum speciosum*), *Cotoneaster franchetii, C. glaucophyllus, and C. simonsii*, while herb Robert (*Geranium robertianum*) is abundant on shady, disturbed forest margins.

## CONCLUDING REMARKS

The vegetation and flora at Pureora is of outstanding botanical interest, some noteworthy features being:

- the diversity of forest types, including dense stands of mature podocarps;
- the variety of divaricating shrub species on forest margins and in scrublands;
- the altitudinal belts of vegetation on Pureora Mountain;
- the natural forest margins with transitional ecotones between high forest and frost flats;
- mires dominated by monocotyledons and umbrella fern; and
- frost flats at 500-600 m containing several species otherwise only found on the top of Pureora Mountain, above 1100 m.

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**NATIVE VASCULAR PLANT SPECIES LIST: PUREORA FOREST PARK**

This list is based on previous ones by Wilcox (1959), Gardner (1978), Druce (1972, 1983), Druce, Clarkson & Clarkson (1984), Clarkson (1984), Shaw (1986a, 1986b), Leathwick (1987), Beadel (1988), Clarkson, B. R. *in* Leathwick, Wallace & Williams (1988), Clarkson (1989), and Smale (1990a), covering various sections of the forest park.

**1 Ferns and fern allies**

*Adiantum cunninghamii*
*Anarthropteris lanceolata*
*Asplenium bulbiferum*
*Asplenium flabellifolium*
*Asplenium flaccidum*
*Asplenium gracillimum*
*Asplenium hookerianum*
*Asplenium oblongifolium*
*Asplenium polyodon*
*Blechnum chambersii*
*Blechnum colensoi*
*Blechnum discolor*
*Blechnum filiforme*
*Blechnum fluviatile*
*Blechnum membranaceum*
*Blechnum montanum*
*Blechnum nigrum*
*Blechnum novae-zelandiae*
*Blechnum penna-marina*
*Blechnum procerum*
*Blechnum vulcanicum*
*Botrychium australe*
*Botrychium biforme*
*Ctenopteris heterophylla*
*Cyathea dealbata*
*Cyathea medullaris*
*Cyathea smithii*
*Dicksonia fibrosa*
*Dicksonia lanata*
*Dicksonia squarrosa*
*Diplazium australe*
*Gleichenia dicarpa*
*Gleichenia microphylla*
*Grammitis billardierei*
*Grammitis ciliata*
*Grammitis magellanica* ssp. *nothofageti*
*Histiopteris incisa*
*Hymenophyllum armstrongii*
*Hymenophyllum bivalve*
*Hymenophyllum demissum*
*Hymenophyllum dilatatum*
*Hymenophyllum ferrugineum*
*Hymenophyllum flabellatum*
*Hymenophyllum flexuosum*
*Hymenophyllum multifidum*
*Hymenophyllum pulcherrimum*
*Hymenophyllum rarum*
*Hymenophyllum revolutum*
*Hymenophyllum sanguinolentum*
*Hymenophyllum scabrum*
*Hypolepis ambigua*
*Hypolepis distans*
*Hypolepis millefolium*
*Hypolepis rufobarbata*
*Lastreopsis glabella*
*Lastreopsis hispida*
*Leptolepia novae-zelandiae*
*Leptopteris hymenophylloides*
*Leptopteris superba*
*Lindsaea linearis*
*Lindsaea trichomanoides*
*Lycopodium australianum*
*Lycopodium deuterodensum*
*Lycopodium fastigiatum*
*Lycopodium laterale*
*Lycopodium scariosum*
*Lycopodium varium*
*Lycopodium volubile*
*Ophioglossum coriaceum*
*Paesia scaberula*
*Pellaea rotundifolia*
*Phymatosorus novae-zelandiae*
*Phymatosorus pustulatus*
*Phymatosorus scandens*
*Pneumatopteris pennigera*
*Polystichum silvaticum*
*Polystichum vestitum*
*Pteridium aquilinum* ssp. *caudatum*
*Pteris macilenta*
*Pyrrosia eleagnifolia*
*Rumohra adiantiformis*
*Sticherus cunninghamii*
*Tmesipteris elongata*
*Tmesipteris sigmatifolia*
*Tmesipteris tannensis*
*Trichomanes endlicherianum*
*Trichomanes reniforme*
*Trichomanes venosum*

**2 Conifers**

*Dacrycarpus dacrydioides*
*Dacrydium cupressinum*
*Halocarpus bidwillii*
*Libocedrus bidwillii* (Whenuakura Clearing)
*Monoao colensoi* [Ref. Clarkson, Clarkson & McGlone 1986; McKelvey 1963]
*Phyllocladus alpinus*
*Phyllocladus toatoa*
*Phyllocladus trichomanoides*
*Podocarpus hallii*
*Podocarpus totara*
*Prumnopitys ferruginea*
*Prumnopitys taxifolia*

**3 Dicot trees and shrubs**

*Alseuosmia pusilla*
*Alseuosmia turneri*
*Androstoma empetrifolia*
*Aristotelia fruticosa*
*Aristotelia fruticosa* x *A. serrata*
*Aristotelia serrata*
*Beilschmiedia tawa*
*Brachyglottis kirkii* (= *Urostemon kirkii*)
*Brachyglottis repanda*
*Brachyglottis rotundifolia*
*Carmichaelia australis*
*Carpodetus serratus*
*Coprosma acerosa* ssp. ("Central North Island")
*Coprosma cheesemanii* (or sp. "o", Eagle 1982)
*Coprosma foetidissima*
*Coprosma grandifolia*
*Coprosma lucida*
*Coprosma propinqua*
*Coprosma propinqua* x *C. robusta*
*Coprosma rhamnoides*
*Coprosma rigida*
*Coprosma robusta*
*Coprosma rotundifolia*
*Coprosma rugosa*
*Coprosma* sp. (t) (of Eagle 1982)
*Coprosma tenuicaulis*
*Coprosma tenuifolia*
*Coriaria arborea*
*Coriaria pteridioides*
*Corokia buddleoides*
*Corokia cotoneaster*
*Cyathodes juniperina*
*Dracophyllum strictum*
*Dracophyllum subulatum*
*Dracophyllum traversii* (Ranginui Mt)
*Elaeocarpus dentatus*
*Elaeocarpus hookerianus*
*Epacris pauciflora*
*Fuchsia excorticata*
*Gaultheria antipoda*
*Gaultheria depressa* var. *novae-zelandiae*
*Gaultheria macrostigma*
*Gaultheria paniculata*
*Geniostoma rupestre* var. *ligustrifolium*
*Griselinia littoralis*
*Hebe corriganii*
*Hebe stricta* var. *stricta*
*Hedycarya arborea*
*Hoheria populnea* var. *lanceolata*
*Ixerba brexioides*
*Knightia excelsa*
*Kunzea ericoides*
*Laurelia novae-zelandiae*
*Leptospermum scoparium*
*Leucopogon fasciculatus*
*Leucopogon fraseri*
*Litsaea calicaris* (Mangatutu Ecological Area)
*Melicope simplex*
*Melicytus flexuosus*
*Melicytus lanceolatus*
*Melicytus ramiflorus*
*Metrosideros robusta* (Rata-nunui & Waimonoa Ecological Areas)
*Mida salicifolia*
*Myrsine australis*
*Myrsine divaricata*
*Myrsine salicina*
*Neomyrtus pedunculata*
*Nestegis cunninghamii*
*Nestegis lanceolata*
*Nestegis montana*
*Nothofagus menziesii* (Taringamotu River)
*Olearia arborescens*
*Olearia furfuracea*
*Olearia ilicifolia*
*Olearia rani*
*Olearia townsonii*
*Olearia virgata* ssp. *centralis*
*Ozothamnus vauvilliersii*
*Pennantia corymbosa*
*Pentachondra pumila*
*Pimelea prostrata*
*Pimelea tomentosa*
*Pittosporum eugenioides*
*Pittosporum kirkii*
*Pittosporum tenuifolium* ssp. *colensoi*
*Pittosporum turneri*
*Pomaderris ericifolia*
*Pseudopanax arboreus*
*Pseudopanax colensoi*
*Pseudopanax crassifolius*
*Pseudowintera axillaris*
*Pseudowintera colorata*
*Quintinia serrata*
*Raukaua anomalus*
*Raukaua edgerleyi*
*Raukaua* x *parvus*
*Raukaua simplex*
*Schefflera digitata*
*Solanum aviculare*
*Streblus heterophyllus*
*Weinmannia racemosa*

**4 Dicot lianes, epiphytes, parasites**

*Clematis cunninghamii* (= *Clematis parviflora*)
*Clematis foetida*
*Clematis forsteri*
*Clematis paniculata*
*Clematis quadribracteola*
*Dactylanthus taylorii*
*Griselinia lucida*
*Ileostylus micranthus*
*Metrosideros colensoi*
*Metrosideros diffusa*
*Metrosideros perforata*
*Muehlenbeckia australis*
*Muehlenbeckia axillaris*
*Parsonsia capsularis*
*Parsonsia heterophylla*
*Passiflora tetrandra*
*Rubus australis*
*Rubus cissoides*
*Rubus schmidelioides*

**5 Dicot herbs**

*Acaena anserinifolia*
*Acaena microphylla*
*Acaena novae-zelandiae*
*Anaphalioides alpina*
*Anaphalioides trinervis*
*Cardamine debilis*
*Celmisia gracilenta*
*Celmisia setacea*
*Centella uniflora*
*Craspedia* "Central North Is."
*Dichondra brevifolia*
*Drosera arcturi*
*Drosera binata*
*Drosera spathulata*
*Epilobium alsinoides*
*Epilobium cockayneanum*
*Epilobium insulare*
*Epilobium nerterioides*
*Epilobium pallidiflorum*
*Epilobium pedunculare*
*Epilobium rotundifolium*
*Galium propinquum*
*Gentiana grisebachii*
*Geranium microphyllum*
*Geranium potentilloides*
*Gnaphalium audax*
*Gnaphalium delicatum*
*Gnaphalium gymnocephalum*
*Gnaphalium involucratum*
*Gnaphalium limosum*
*Gnaphalium paludosum*
*Gnaphalium sphaericum*
*Gonocarpus aggregatus*
*Gonocarpus micranthus* ssp. *micranthus*
*Gratiola nana*
*Gratiola sexdentata*
*Gunnera prorepens*
*Haloragis erecta*
*Helichrysum filicaule*
*Hydrocotyle dissecta*
*Hydrocotyle elongata*
*Hydrocotyle heteromeria*
*Hydrocotyle microphylla*
*Hydrocotyle moschata*
*Hydrocotyle novae-zelandiae*
*Hydrocotyle pterocarpa*
*Hydrocotyle sulcata*
*Hypericum japonicum*
*Jovellana repens*
*Kelleria laxa*
*Lagenifera pumila*
*Lilaeopsis ruthiana*
*Liparophyllum gunnii*
*Mentha cunninghamii*
*Microseris scapigera*
*Myriophyllum propinquum*
*Myosotis forsteri*
*Myriophyllum pedunculatum* ssp. *novae-zelandiae*
*Myriophyllum robusta*
*Nertera ciliata* (= *Coprosma patrickii*)
*Nertera depressa* (=*C. nertera*)
*Nertera scapanioides* (= *C. scapanioides*)
*Nertera setulosa* (= *C. setulosa*)
*Oreomyrrhis ramosa*
*Ourisia macrophylla* var. *robusta*
*Oxalis exilis*
*Plantago triandra*
*Pratia angulata*
*Pseudognaphalium luteoalbum*
*Ranunculus amphitrichus*
*Ranunculus reflexus*
*Ranunculus rivularis*
*Raoulia albo-sericea*
*Raoulia glabra*
*Raoulia tenuicaulis*
*Senecio minimus*
*Senecio rufiglandulosus*
*Stackhousia minima*
*Stellaria decipiens*
*Urtica incisa*
*Utricularia monanthos*
*Viola cunninghamii*
*Viola filicaulis*
*Wahlenbergia violacea*

**6 Monocot trees and lianes**

*Cordyline australis*
*Cordyline banksii*
*Cordyline indivisa*
*Ripogonum scandens*

**7 Orchids**

*Aporostylis bifolia*
*Caladenia lyallii*
*Chiloglottis cornuta*
*Corybas acuminatus*
*Corybas iridescens* (D. Burstein)
*Corybas macranthus*
*Corybas oblongus*
*Corybas trilobus*
*Gastrodia* sp.
*Earina autumnalis*
*Earina mucronata*
*Microtis oligantha*
*Microtis unifolia*
*Orthoceras strictum*
*Prasophyllum colensoi*
*Prasophyllum patens*
*Pterostylis banksii*
*Pterostylis cardiostigma*
*Pterostylis graminea*
*Pterostylis patens*
*Pterostylis "montana"*
*Spiranthes sinensis* ssp. *australis*
*Thelymitra hatchii*
*Thelymitra longifolia*
*Thelymitra pauciflora*
*Thelymitra venosa*
*Winika cunninghamii* (= *Dendrobium cunninghamii*)

**8 Grasses**

*Chionochloa rubra* (Whenuakura Clearing)
*Cortaderia fulvida*
*Deyeuxia aucklandica*
*Deyeuxia avenoides*
*Dichelachne crinita*
*Echinopogon ovatus*
*Hierochloe redolens*
*Lachnagrostis filiformis* var. *semiglabra*
*Microlaena avenacea*
*Microlaena stipoides*
*Poa anceps*
*Poa breviglumis*
*Poa cita*
*Poa pusilla*
*Rytidosperma gracile*
*Stenostachys gracilis*

**9 Sedges**

*Baumea rubiginosa*
*Baumea tenax*
*Baumea teretifolia*
*Carex breviculmis*
*Carex dispacea*
*Carex dissita*
*Carex echinata*
*Carex geminata*
*Carex lessoniana*
*Carex maorica*
*Carex secta*
*Carex sinclairii*
*Carex solandri*
*Carex subdola*
*Carex testacea*
*Carex virgata*
*Carpha alpina*
*Eleocharis acuta*
*Eleocharis gracilis*
*Eleocharis sphacelata*
*Gahnia pauciflora*
*Gahnia procera*
*Gahnia rigida*
*Isolepis crassiusculus*
*Isolepis distigmatosa*
*Isolepis habra*
*Isolepis inundata*
*Isolepis pottsii*
*Isolepis reticularis*
*Isolepis subtilissima*
*Lepidosperma australe*
*Machaerina sinclairii* (Shaw 1986b)
*Morelotia affinis*
*Oreobolus pectinatus*
*Schoenus maschalinus*
*Uncinia banksii*
*Uncinia distans*
*Uncinia ferruginea*
*Uncinia filiformis*
*Uncinia gracilenta*
*Uncinia laxiflora*
*Uncinia rubra*
*Uncinia rupestris*
*Uncinia strictissima*
*Uncinia uncinata*
*Uncinia zotovii*

**10 Rushes and allied plants**

| | | | |
|---|---|---|---|
| *Centrolepis ciliata* | *Juncus acuminatus* | *Juncus gregiflorus* | |
| *Empodisma minus* | *Juncus antarcticus* | *Juncus novae-zelandiae* | *Luzula picta* |
| | *Juncus articulatus* | *Juncus planifolius* | *Luzula subclavata* |

**11 Other monocots**

| | | | |
|---|---|---|---|
| *Arthropodium candidum* | *Collospermum hastatum* | *Luzuriaga parviflora* | *Potamogeton suboblongus* |
| *Astelia fragrans* | *Collospermum microspermum* | *Phormium cookianum* | *Sparganium subglobosum* |
| *Astelia grandis* | *Dianella nigra* | *Phormium tenax* | *Triglochin striata* |
| *Astelia solandri* | *Herpolirion novae-zelandiae* | | |

# Botany of Whangapoua wetlands and dunes, north-eastern Great Barrier Island

**E. K. Cameron**

## Introduction

Great Barrier Island (Aotea) is recognised as a key conservation area by the Department of Conservation (DoC) mainly because: it is the largest island off the coast of the North Island of New Zealand, it contains extensive indigenous forest habitats of outstanding significance, a range and quality of freshwater and marine habitats, and contains two endemic flowering plants (*Kunzea sinclairii, Olearia allomii*) (DoC 1995). Greater than 60% of the island is formally protected and managed by DoC and the two large forested Scenic Reserves (Harataonga and Tryphena) are managed by Auckland City Council (see Fig. 1).

Little has been written specifically on the Whangapoua wetlands and dunes on the east coast of northern Great Barrier Island (see Fig. 1). Kirk (1869) was the first to publish something comprehensive on the botany of Great Barrier Island, including a species list of native and naturalised vascular plants. But there is nothing specific on Whangapoua apart from his occasional specimens collected there on 19 December 1867. Kirk does mention "On the eastern coast there is a considerable tract of sand-dunes and swamps, where a few peculiar plants may be found." "Most of the ordinary sand plants are found on the eastern coast: *Convolulus soldanella, Desmoschoenus spiralis, Spinifex sericeus* (as *S. hirsutus*), *Coprosma acerosa,* are abundant; as is the naturalised *Raphanus sativus*; *Atriplex billardieri (sic)*, and *Melicytus novae-zelandiae* (as an undescribed *Melicytus* sp.) are also found here." Four of these seven species were not recorded by this present survey for Whangapoua: *C. acerosa, R. sativus, A. billardierei* and *M. novae-zelandiae* (not a sand species!). Kirk also records 14 main wetland species from the east coast, which are probably based on the extensive Kaitoke wetland. There are various general and specific accounts on the island's botany since Kirk, including an updated native vascular plant list by Bartlett & Gardner (1983). The Whangapoua wetland is the only large estuarine habitat on Great Barrier Island. It includes mangroves *(Avicennia marina)*, salt-marsh, saltmeadow, shallow tidal flats, freshwater swamps, and is bounded on the eastern side by a sandspit and a magnificent, exposed sandy beach. The estuarine habitat harbours many uncommon bird species: fernbird, bittern, spotless crake, banded rail, and a large number of brown teal. Ogle (1980) regarded the whole estuarine system as one of the least modified in New Zealand and for its size one of the most valuable to wildlife. The Wildlife Service (Ogle 1980) found it contained the highest bird diversity of any area on Great Barrier. The Department of Lands and Survey bought Okiwi Station, the area surrounding the estuary (514.5 ha, containing some 450 ha of pasture), in 1984. Cameron (1985) made the case which fell on deaf ears for Whangapoua estuary and Okiwi Station along with four other natural areas on Great Barrier and the whole of Little Barrier to be considered for National Reserve status. Before Okiwi Station was gazetted as a Farm Park the Crown land carve up occurred and the "farmed" area of this outstanding conservation area was allocated to the newly formed Landcorp in 1987 (which was extremely contentious at the time). In 1992 the taxpayers of New Zealand, assisted by public subscription, bought the area "again" (costing nearly $1 million ) so that it could be managed for its conservation values as well as being farmed. DoC now manages the farm as the Okiwi Recreation Reserve (514.5 ha) and the estuary and sandspit as the Whangapoua Stewardship Area (390 ha). Hopefully the Whangapoua wetlands will be included in the proposed marine reserve DoC is attempting to establish in the north-eastern part of Great Barrier Island (DoC 1991, Jeffs & Irving 1993: 1.6-1.7, DoC 1995: table 9).

At the request of DoC I surveyed the wetland and dune vegetation of the Whangapoua estuary on