Trifolium dubium	FAB	suckling clover	pas
T. micranthum	FAB	lesser suckling clover	pas
T. pratense	FAB	red clover	pas
T. repens	FAB	white clover	pas
T. subterraneum	FAB	subterranean clover	pas
Valerianella carinata	VAL	corn salad	agr
Verbena litoralis	VER	blue vervain	rud
Verbascum creticum	SCR	Cretan mullein	rud
Veronica arvensis	PLA	field speedwell	agr
V. filiformis	PLA	creeping speedwell	pas
V. persica	PLA	scrambling speedwell	agr
V. serpyllifolia	PLA	turf speedwell	pas
Vicia disperma	FAB	French tare	rud
V. hirsuta	FAB	hairy vetch	rud
V. sativa	FAB	vetch	rud
V. teterasperma	FAB	smooth vetch	rud
Viola odora	VIO	garden violet	rud
Vulpia bromoides	POA	vulpia hairgrass	rud

A trip to the Kermadecs
Cyclone damage, tragedy and frustration

Maureen Young
Photographs by Kevin Mills & Lyn Wade

In November 1994 a party of 13 members of Auckland Botanical Society chartered the navy ship *Acheron* and sailed for Raoul Island in the Kermadec group. They spent six days ashore and camped in the staff quarters. Unfortunately there was no trip report produced for this expedition. I was working at the time and could not join the group, so when a chance came to sail with Heritage Expeditions on a ten day trip to the Kermadecs, I decided to make up for this lack.

From 7 – 17 April 2011 the 72 m Russian-registered icebreaker, *Spirit of Enderby*, was home for 58 people, nine of whom were Heritage Expedition staff (Fig. 1). The Russian crew added to the complement. The programme for the trip was as follows:

Day 1
Sailed from Tauranga Harbour at 12.30 pm.

Day 2
Sailed northwards.

Day 3
At 10 am we came to the most southerly of the Kermadec Islands, L'Esperance Rock (French Rock).

Fig. 1. The DoC team with some staff & passengers from the Spirit of Enderby, on Raoul Island. Photo: M L Wade. 13 Apr 2011.

This is a rugged volcanic rock that soars 30 m up out of the sea. Clinging to the rocks is low vegetation that appeared to be the ice plant, *Disphyma australe* subsp. *stricticaule*. A pod of bottle-nosed dolphins played in our bow wave for some time, and flying fish and tiny flying squid put on a dazzling display.

In mid-afternoon we passed Cheeseman and Curtis Islands, which are separated by a narrow passage. Cheeseman is smaller and more rugged than the flatter Curtis, which is an active volcano with steaming vents in the crater floor. The same low, bright green vegetation was seen on both islands, but Curtis was crowned with brownish looking plants that we surmised to be *Cyperus insularis*. The divers in the party had hoped to get into the water here, but the swell was too great. Again the local dolphin pod checked us out. We could see Macauley Island on the horizon, but consoled ourselves that we would be visiting there on the trip home.

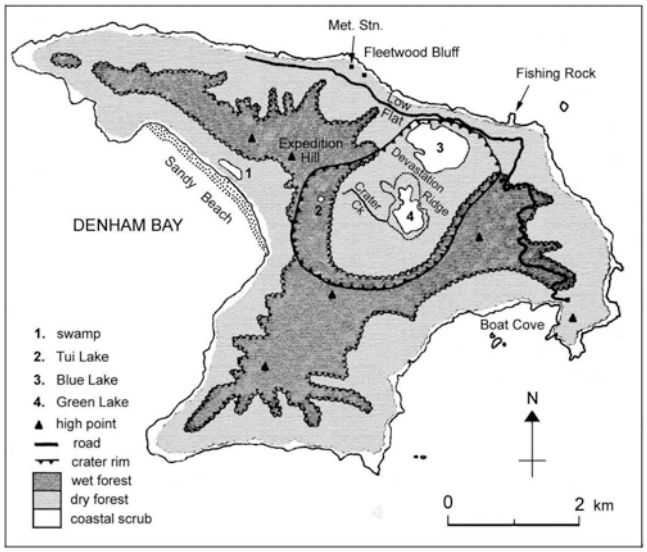

Fig. 2. Map of Raoul Island in the Kermadec Group. From a map by B. McCulloch, adapted by J. Salter.

Day 4

We woke in the morning to find that we were anchored with Raoul Island (Sunday Island) (Fig. 2, 3) to starboard and the Meyer Islets to port. We were now in the western hemisphere, at 29° 16′ S and 177° 57′ W, and 750 km NE of North Cape. Those who were going ashore were taken by Zodiac to Raoul, and had an exciting landing onto Fishing Rock (Fig. 4). Four dolphins escorted the Zodiac that I was in - a lovely welcome. The Zodiacs then headed back to spend the day working with the divers.

A 3 km walk took us along the ridge between the Blue Lake and the sea, past the Low Flat and on to the Department of Conservation (DoC) base at Fleetwood Bluff. On every few metres of this walk we would disturb a red-crowned parakeet, or kakariki, feeding on the grass seeds along the road edge. This is an amazing occurrence considering that kakariki had disappeared from Raoul Island for over 150 years until the rats were eradicated in 2002 (Veitch 2010). Ten tui were seen at one time feeding in the fruiting endemic *Coprosma acutifolia* shrubs. The party then broke up and did various short walks, with the botanists heading past the Orange Grove and a short way up the Denham Bay Track. We regretfully returned the way we had come, in time for the Zodiac trip back to the boat. An unfortunate accident happened as the Zodiacs were being winched aboard by the shipboard crane. A big swell at the wrong moment caused the dive master to trap his fingers in the equipment and lose the top joint of two of his fingers.

Fig. 3. Fishing Rock with the Meyer Islets in the background. Photo: K. Mills, 13 Apr 2011.

Day 5

During the night we had anchored off Denham Bay on the western side of Raoul Isand. The botanists were hoping for a calm day, as landing is difficult in big surf. Before breakfast the divers were taken to a spot near the coast for an early morning session, and after breakfast it was the turn of the snorkellers. This was where tragedy struck the expedition, as one of the participants took in some water, and despite the best efforts of the trip doctor, she died four hours later. Of course a pall was cast over the ship, and all thoughts of landing were forgotten in the ensuing activity.

Day 6

A force 5 earthquake was experienced during the night by those living on Raoul Island. A front with 35-40 knot SE winds was passing over and prevented any thoughts of landing, so we were taken on a circumnavigation of the island.

Fig. 4. Fishing Rock landing. Photo: K. Mills, 10 Apr 2011.

Day 7

Although there was still quite a swell, a landing was possible for those agile enough to leap ashore at exactly the right moment. All got onto Fishing Rock safely, except for the one who misjudged his leap and took the doctor in with him. It was proven that those lifejackets really do unzip and inflate automatically. The DoC staff kindly transported the four botanists (MEY, Anne Fraser, Lyn Wade and Dr Kevin Mills from Australia) to the beginning of the Denham Bay Track so we could get in a full day's botanising. The track circles the north-western side of the crater, and we could look down to the Blue and Green Lakes, the well-named Devastation Ridge, and the tiny Tui Lake (Fig. 5, 6).

Fig. 7. SE corner of Denham Bay. Photo: M.L. Wade, 13 Apr 2011.

At the top of the track (Expedition Hill) we clambered over some cyclone debris to get a view of a small corner of Denham Bay (Fig. 7). Our one regret was that we didn't succeed in reaching this bay, as the vegetation on the area of flat land and swamp behind the beach would have contrasted nicely with what we saw on the ridge. Again there was a hurried return to Fishing Rock and a spray-drenched shuttle back to the ship.

Day 8

The visit to Macauley Island was called off, and we were heading at full throttle back towards Tauranga. During the day a call was broadcast that sperm whales could be seen heading north, and in the distance we could see their water spouts as they surfaced.

Day 9

Sailed south in good seas passing close to the Mayor and Alderman Islands in the late afternoon, and docking at Tauranga 36 hours earlier than intended.

Day 10

For those who had an unplanned day to fill in, a bus trip to Rotorua to see Waimangu and Lake Rotomahana was offered by Heritage Expeditions.

Cyclone damage

On 28 March, just two weeks before our visit, Cyclone Bune hit Raoul Island with winds gusting to 160 kph and with 12 m swells crashing onto the shore. The eight people on the island took four days to clear the 3 km road from the DoC base to Fishing Rock, clearing something like 40 fallen trees. They also had to remake the track along the bottom of the cliff from the rock, and clear the Denham Bay Track for our benefit (T. Shanley, pers. comm.). As we circumnavigated the island in the ship it could be seen that the ridges and headlands had sustained the most damage. The ridge south of Denham Bay was the worst hit, with salt burn very evident and slip scars littered with smashed pohutukawa trunks. As we walked the tracks we could see many uprooted Kermadec pohutukawa trees (*Metrosideros kermadecensis*) throughout the forest (Fig. 8), and slips on the steep slopes. The workers on the island were downhearted at the thought of how much harder their weed survey work would be, as they are obliged to follow transects no matter what the slope or vegetation.

The vegetation

The dominant species on the island, making up almost 100% of the canopy, is the Kermadec pohutukawa. In New Zealand this is often planted because it is a smaller tree than our local pohutukawa (*M. excelsa*), but on Raoul Island the trees grow huge, gnarled trunks that soar over the understorey. On the lower slopes this understorey is largely composed of the Kermadec mapou (*Myrsine kermadecensis*), with kawakawa (*Macropiper excelsum* subsp. *psittacorum*) beneath that again, and the fern *Pteris comans* as a dominant feature of the ground cover. On the hill tops, often hidden as they are by mist-laden clouds, the wetter conditions encourage a more mixed understorey of hutu (*Ascarina lucida* var. *lanceolata*) (Fig. 9), mahoe (*Melicytus ramiflorus*), five finger (*Pseudopanax kermadecensis*) and nikau palm (*Rhopalostylis baueri*). The palms form dense stands of trees in some gullies on the higher, wetter slopes (Fig. 10). It is the same species as that found on Norfolk Island, and has shorter, more curved fronds than *R. sapida*. *Pseudopanax* grows into a large tree which occasionally overtops the pohutukawa.

While sailing around the island we could see that the surface, apart from the crater, is a series of narrow spurs separating deep ravines. We made educated guesses as to what plants we were seeing. We used the colour and height of the vegetation to assist us and concluded that the only canopy tree apart from the dark green pohutukawa was the lighter green ngaio (*Myoporum rapense* subsp. *kermadecensis*) in some coastal gullies. These graded down into a bright green prostrate cover of *Scaevola gracilis*, and then the darker green of *Coprosma petiolata* (similar in appearance to *C. repens*) growing in ice plant meadows.

On our walk from Fishing Rock to the DoC base we took the opportunity to sort out some pairs of similar looking species of ferns. Thus we found that *Nephrolepis hirsutula* has long, sickle shaped pinnae when compared to *N. flexuosa*; *Doodia milnei* also has much longer pinnae than *D. australis*, and shows none of the red coloration that is common in the latter; initially we had to carefully check *Macrothelypteris torresiana* and *Hypolepis dicksonioides* and found that *Macrothelypteris* has round sori away from the pinnae margins, whereas the *Hypolepis* sori are protected by a lamina flap. However, we soon got our eye in for the giant, hairy unfurling fronds of the latter, a very common fern around the inhabited area. We took careful note of the tree fern, *Cyathea milnei*, which grows throughout, though more commonly in the dry forest, and later compared it to *C. kermadecensis*, which grows at higher altitudes. We found that the trunk and the crown shape were the best features to tell them apart – *C. milnei* retaining the stipe bases on the trunk and with arching fronds and *C. kermadecensis* with a clean, scarred trunk and a chalice-shaped head.

As tiny fern spores disperse so easily on the winds to colonise new lands, ferns are a very important feature on the island. They were the only epiphytes that we saw, most commonly *Asplenium haurakiense*. The first fern to greet us as we landed on Fishing Rock was plentiful *A. northlandicum*. We saw only one plant of the finely divided *A. shuttleworthianum* (Fig. 11), but by the Hard Rock Café (a small cave in a rock face) we saw a hybrid with this fern obviously one of the parents. Great swathes of *Psilotum nudum* adorn roadside banks (Fig. 12). *Arachniodes aristata* and *Christella dentata*, both of which we saw on our 2010 trip to Norfolk Island, were commonly seen, as was *Blechnum norfolkianum*. Here, as on Norfolk and Little Barrier Islands, I found it hard to be convinced by this fern, looking as it does like very large *B. chambersii*. We carefully checked out the rhizome of the unnamed *Lastreopsis* species as requested by Leon Perrie from Te Papa, and were able to report to him that the rhizome was more or less erect. An unusual *Blechnum novae-zelandiae* intrigued the botanical party. It was smaller than the common *B. novae-zelandiae* but larger than our *B. procerum*, and with thinner, more pointed pinnae and bright red stipes and rachis (Fig. 13).

The exciting finds of our trip were both ferns. While checking out *Adiantum hispidulum*, which like that on Norfolk Island has soft fronds and pale hairs, we spotted a good patch of *A. diaphanum.* According to a folder held in the island headquarters to alert staff to rare plants, this small maiden hair fern had not been reported on Raoul Island since W.R.B. Oliver listed it in 1908. The second find was a species of *Hypolepis* (Fig. 14). It was not *H. dicksonioides,* the only species of that genus previously recorded on the island. *H. tenuifolia* is found on other Pacific Islands, so maybe that is what we found.

Three creepers were seen around the inhabited area: *Sicyos australis, Ipomoea cairica* and *Canavalia rosea*, this last with pinkish-mauve flowers and very stout green pods. Parapara, or bird-catcher tree (*Pisonia brunoniana*) grew mostly around the edge of the bush there, and we were shown very poor specimens of *Pouzolzia* (*Boehmeria*) *australis* (Fig. 15) (also found on Lord Howe and Norfolk Islands) and the endemic *Homalanthus polyandrus*. We later saw good saplings of this "Raoul poplar", mostly on old slip scars. It grew on Macauley Island before that was burnt and stocked with goats for shipwrecked mariners. Once the very large goat population was removed from the island one tree of this plant reappeared, and now that kiore have been eradicated there are many seedlings regenerating on bare ground (P.J. de Lange, pers. comm.). It has also been reported that trees of the Kermadec ngaio are advancing over Mt Haszard on Macauley, from the west side to the east, following the removal of the goats (W.R. Sykes, pers. comm.).

A very coarse, blue-green grass was commonly growing on the grassed area of the island, and this is the endemic *Imperata cheesemanii*. Unfortunately it had finished flowering for the year. The Raoul Island karo has yet to be named, being listed as *Pittosporum* aff. *crassifolium*. We mostly saw planted trees, but came across a few large ones that would have grown naturally (Fig. 16). The leaves lack the thick indumentum and were not as leathery as those of *P. crassifolium*. We were pleased to see the endemic *Hebe breviracemosa*, with the short racemes that its specific name suggests (Fig. 17). This was thought to be extinct before the goats were eliminated from Raoul Island, but after that event one shrub was found, and many have now been propagated and planted in suitable sites around the island. We didn't see *Peperomia urvilleana*, which grows epiphytically there, but we were so intrigued by reports of a hairy-leaved *Peperomia* that the staff showed us *P. blanda* growing in a pot in the shade house. It has very long flower spikes and softly hairy leaves.

Fig. 5. View of the crater with nikau palms. Photo: M.L. Wade, 13 Apr 2011.

Fig. 6. View of Blue Lake, Devastation Ridge and Green Lake. Photo: K. Mills, 13 Apr 2011.

Fig. 8. Cyclone damage to Kermadec pohutukawa. Photo: K. Mills, 10 Apr 2011.

Fig. 9. *Ascarina lucida* var. *lanceolata*. Photo: M.L. Wade, 13 Apr 2011.

Fig. 10. Nikau palm forest. Photo: K. Mills, 13 Apr 2011.

Fig. 11. *Asplenium shuttleworthianum.* Photo: M.L. Wade, 10 Apr 2011.

Fig. 12 *Psilotum nudum* and cyclone litter. Photo: M. L. Wade.,10 Apr 2011.

Fig. 13. Unusual *Blechnum novae-zelandiae*. Photo: K. Mills, 13 Apr 2011.

Fig. 14. *Hypolepis* sp. Photo: M.L. Wade, 13 Apr 2011.

Fig. 15. *Pouzolzia australis* seedling. Photo: M.L. Wade, 13 Apr 2011.

Fig. 16. *Pittosporum* aff. *crassifolium*. Photo: M.L. Wade, 13 Apr 2011.

Fig. 17. *Hebe breviracemosa.* Photo: K. Mills, 10 Apr 2011.

Weeds

One can't discuss the vegetation of Raoul Island without mentioning the weeds. From the early Polynesian voyagers, who brought, among other plants, the Pacific Island cabbage tree (*Cordyline fruticosa*), to the Bell family who lived, farmed and gardened on the island for almost 36 years, all settlers brought plants for food and ornamentation. In the mild climate many of these have naturalised and thrived and now prove a headache for DoC, charged as they are with caring for the island. A few species, such as radiata pine (*Pinus radiata*), loquat (*Eriobotrya japonica*), macadamia (*Macadamia tetraphylla*) and oleander (*Nerium oleander*) have been removed, and some 20-odd of the worst weeds are on the list to be eradicated. The very worst are: Mysore thorn (*Caesalpinia decapetala*), black passion fruit (*Passiflora edulis*), purple and yellow guava (*Psidium cattleianum* and *P. guajava*), buttercup bush (*Senna septemtrionalis*), peach (*Prunus persica*), nasturtium (*Tropaeolum majus*), African olive (*Olea europaea* subsp. *cuspidata*) and Madeira vine (*Anredera cordifolia*). Where Madeira vine grows on difficult cliff sites, as adjacent to Fishing Rock, the workers abseil down the cliff and remove the tubers to keep it from spreading.

Some garden ornamentals that have got out of hand are blue billy goat weed (*Ageratum houstonianum*), air plant (*Bryophyllum pinnatum*), Madagascar periwinkle (*Catharanthus roseus*) and the purple-flowered *Tibouchina urvilleana*. However, the colossus that towers over all the nuisance weeds is the aroid lily, or elephant's ear (*Alocasia brisbanensis*). This grows commonly in all habitats on the island from the coast to the summit, from gullies to ridge tops. So abundant is it that no attempt has been made to control it, as eradication would be impossible.

Discussion

Goats, rats and cats had a long history on Raoul Island - c.150 years for goats and cats, much longer for kiore, and since 1921 for the Norway rat. Goats were eradicated in 1984 and rats and cats in 2002/2003 (Veitch 2010) While these eradications have had positive benefits, such as the surprising appearance of land crabs once rats were removed, and the reappearance of nesting sea birds, the effects have been mixed as far as plants are concerned. Without the browsing of goats and the seed predation of rats, the understorey has thickened up, with plants such as the endemic *Hebe* starting to recover naturally, and the only saplings that we saw of *Pseudopanax kermadecensis* were of a size that suggested they had germinated post-eradication. The number of nikau seedlings in a vegetation plot changed from barely present in 2002 to nearly 4000 in 2005 (West et al. 2010).

However, the weeds have taken advantage of this lack of predation too. The number of weed seedlings has soared. Post-rat removal of passion fruit vines went from 2000 seedlings in 2003 to almost 14000 seedlings in 2004 (West et al. 2010). Orange tree (*Citrus sinensis*) seedlings are now proliferating where they hadn't previously, and Norfolk Island pines (*Araucaria heterophylla*) are increasing. These last two, the huge orange trees planted in the Orange Grove by the Bell family and the grove of Norfolk Island pines growing by the meteorological station, are considered to be historic plantings, and this illustrates a conflict between preserving historical plantings and controlling naturalising plants. *Tibouchina urvilleana* is another example. The decision has been made that where it grows at Denham Bay a ten metre square plot should be left, but this ideal has proven to be impossible to attain, and it now covers an area of c. 1 ha. Another unexpected result of the rat eradication has been the appearance of tropical army worms, which eat the leaves of the aroid lily. We saw the results of this defoliation in several places, but so far there is nothing to suggest that it will slow the growth of this pest plant, as much as that would be desired.

One wonders what plants will recolonise the bare soil exposed on new slips. Instead of native plants such as poroporo (*Solanum aviculare*), *Hebe breviracemosa, Homalanthus polyandrus* and *Blechnum novae-zelandiae*, there is more likely to be aroid lily, African olive, guava, *Ageratum* and even Norfolk Island pine, as the seeds can blow some distance in a strong wind.

The future of the now pest-free Macauley Island is a problem that engages the minds of DoC scientists. The past burning and the grazing by numerous goats left it covered with a turf of *Microlaena stipoides,* and that turf has since been invaded by the sedge, *Cyperus insularis* and the giant fern, *Hypolepis dicksonioides*. So should the island be planted with species from Raoul Island? Should it have seeds from Raoul Island. scattered over it? Or should it be left to the slow processes of nature and trust that birds will transport the occasional seed? Any intervention in such a remote area would prove to be difficult and expensive.

Despite the sadness engendered by tragic circumstances, this was an interesting and stimulating trip. Seeing a flora so closely related to that of New Zealand, yet with a Pacific element as well, reinforced the understanding that all indigenous plants arrived on the Kermadecs by long distance dispersal. Having recently visited Norfolk Island I was particularly taken with some similarities between the two floras, even to the weed problems common to the two subtropical islands. It is to be hoped that the effort currently being put into bio-security will be maintained despite hard economic times.

Acknowledgements
My thanks to botanical companions, Anne Fraser, Kevin Mills and Lyn Wade, and the latter two also for photographs; to Karen Baird for her companionship, for sharing her knowledge of the Kermadecs, and for discussion on the problems facing the islands; to Toby Shanley and Nicky Atkinson (DoC) for guiding us, and for answering my many questions about the weed problem; to Heritage Expeditions for the opportunity to visit this remote outpost of New Zealand. Peter de Lange and Bill Sykes have willingly answered my questions about current plant names and shared their observations on Macauley Island. Permission to reproduce the map of Raoul Island from *New Zealand DSIR Bulletin 219* was given by the author, and it was adapted by Josh Salter.

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Four Reserves and a River – Warkworth

Maureen Young

In 1987 a small booklet, "Scenic Reserves near Warkworth", compiled by A.E. Esler, W.M. Hamilton, F. Hudson and M. Young was published as a Lucy Moore memorial pamphlet by the Mid-North Branch of the Royal Forest and Bird Protection Society (Esler et al. 1987). The preface, in part, states: "Warkworth is a small town situated at the head of the navigable portion of the Mahurangi River, where the tidal waters meet the fresh. The once forested hills which surround the town were cleared of most of their timber in the 19th century – at first for kauri spars for the Admiralty and for timber for the Australian market, then later, to satisfy the demands of the rapidly growing city of Auckland. As settlers began to take up blocks for farming it became necessary to further clear the land for pasture. Fortunately this necessity did not preclude the retaining of some of the natural cover. Indeed, the early settlers seemed to have had a fondness for the bush, and many of them kept a patch on their properties. Much of the present charm of Warkworth and the Mahurangi district is due to the presence of these areas of bush."

Three of the reserves described in the pamphlet have boundaries on the eastern side of the Mahurangi River, or on a small tributary called Duck Creek. A fourth reserve sited further up Duck Creek has since been purchased. These four reserves make a continuous band of forest on the triangle of land formed by the river and creek (Fig. 1). Public access to all four is problematical. A short length of Duck Creek Road is a public road, and from this an ankle-deep stream crossing gives access to Glen Kowhai Reserve and hence to the other three. For locals an easier access to the two reserves on the Mahurangi River can be gained through the goodwill of a neighbouring farmer.

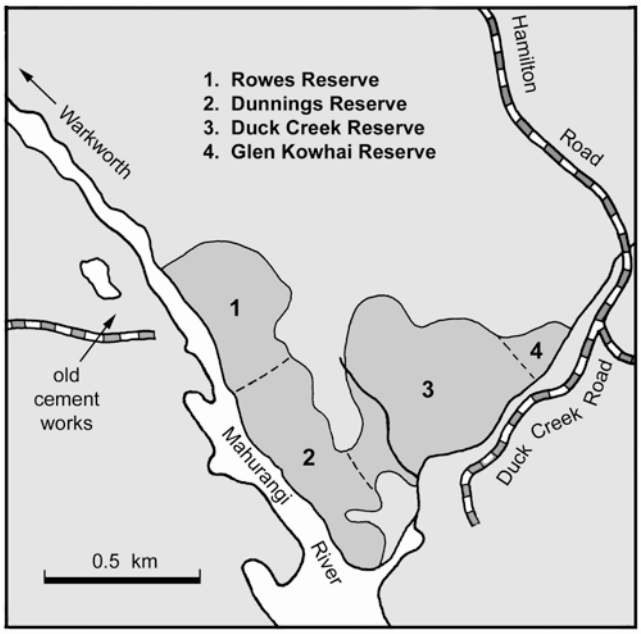

Fig. 1. Map showing the four reserves on the Mahurangi River and Duck Creek. Drawn by Maureen Young and Josh Salter.

Rowes Scenic Reserve and Dunnings Reserve

These two reserves run contiguously down the Mahurangi River, and as the boundary between the two is difficult to locate on the ground they will be described as one unit. Rowes Scenic Reserve (Fig. 2) is 2½ km downstream from Warkworth, opposite the old cement works. It was purchased by the Crown in 1979 and has an area of 9.35 ha.

In Dunnings Reserve the bush continues down the Mahurangi to the mouth of Duck Creek. This area of