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## CONSERVATION OPPORTUNITIES ON A HIGHLY MODIFIED ISLAND: MANA ISLAND, WELLINGTON, NEW ZEALAND

**Summary:** Mana Island (217 ha) provides opportunities for conservation despite over 150 years of farming. It is free from all introduced mammals except mice. It supports native coastal communities representative of the region and already has nationally threatened plants and animals. To take best advantage of these opportunities, it is suggested that: the present native plants, animals and communities are protected; part of the island is revegetated; selected species of threatened native plants and animals are introduced; and the island and its natural and human history are used for education, interpretation and recreational enjoyment. Attention is drawn to some unanswered questions and potential conflicts associated with these management proposals.

**Keywords:** Mana Island; revegetation; threatened species conservation; reserve management; mammal-free island.

### Introduction

Mana, a 217 ha island near Wellington, has been farmed for over 150 years and, although highly modified, has no introduced mammals except mice (*Mus musculus*). Reflecting a groundswell of opinion that Mana has considerable biological value and untapped conservation potential, numerous land use studies have been conducted over the last 15 years (for example, Department of Lands and Survey, 1980, 1981). A radical change in the management regime began in 1986 after farming ceased and the current management plan was adopted (Department of Lands and Survey, 1986).

In 1984 we were part of a study team which listed the vascular flora, described and mapped and vegetation (Timmins *et al.*, 1987) and detailed a management concept for Mana Island (Wellington Botanical Society, 1984). The concept was essentially incorporated in the management plan for the island. This paper describes both the opportunities and the scientific problems associated with managing the island.

### The Island

#### *Physical Features*

Mana Island's physical features are summarised in Timmins *et al.* (1987). The island lies 21 km north of Wellington city, 23 km south of Kapiti Island and about 4 km offshore west of Titahi Bay (Fig. 1). It is approximately 2.5 km long and 1-1.3 km wide rising to 121 m above sea level. It has a distinctive flat plateau fringed by steep 100 m high sea cliffs and is deeply dissected in parts by valleys and gullies (Fig. 2). In summer there is little or no fresh water at the surface.

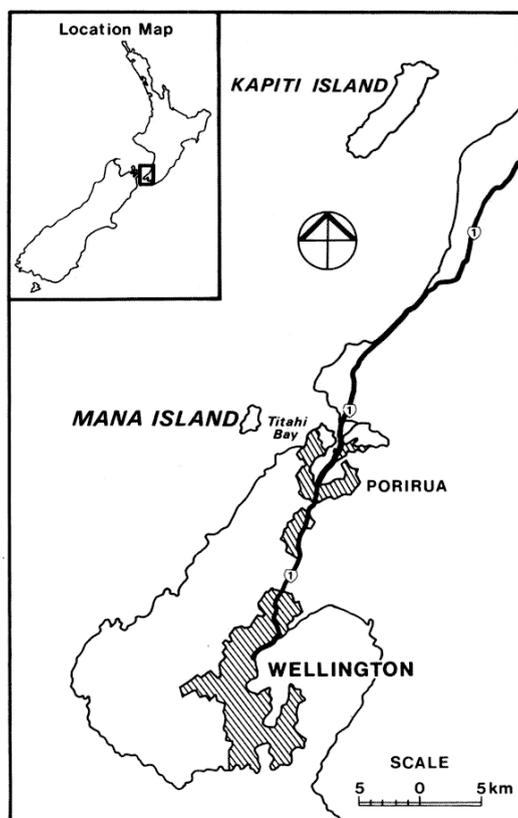


Figure 1: Location map of Mana Island



Figure 2: Aerial view of the southern part of Mana Island; steep southwestern coastal cliffs in the foreground, flat grassy plateau top in the middle ground, dissected by valleys in the background. The old farm buildings, manager's house and wharf can be seen in the top right of the photograph. Sheep are visible since the photograph dates from 1976. Photo: Lloyd Homer.

The soils are silt loam or fine sandy loam in texture, imperfectly drained on the plateau and well-drained elsewhere. Their low to moderate natural fertility has been evaluated by topdressing and use of the island by stock.

The island is swept both by prevailing north-westerly and by southerly winds. It has a relatively low rainfall and mild-cool climate (NZ Meteorological Service, 1983) and probably no frosts. Droughts occur in most summers.

#### *History*

The island was used by both Maori and Europeans.

Evidence of Maori occupation includes terraces, shell middens, kumara pits, and areas of soil modified for cultivation by addition of beach gravels (Jones, 1987). The island was farmed by Europeans from 1832, first privately and then by the Crown after 1865. At the time of the first European contact, the vegetation appears to have been a fire-induced grassland and shrubland (Department of Lands and Survey, 1981). A lighthouse was established on the summit of the island in 1865 but was later dismantled.

In the mid-1970s, Mana was used by the Ministry of Agriculture and Fisheries as a sheep quarantine and breeding station. Following a suspected scrapie

outbreak in 1978, the Department of Lands and Survey resumed control of the island and farmed cattle, principally to keep the grass short and minimise fire risk. In April 1986 the cattle were removed. The recent farming history, and particularly the quarantine station, has left a legacy of several buildings: houses, woolshed, an equipment shed, and an extended wharf (Fig. 2). The island now has a resident manager who is also responsible for its protection.

#### *Plants and Animals*

As a result of the long history of farming and fires, most of the island is highly modified. Exotic pasture dominates the plateau and adjacent slopes and basins (70% of the island). Previously the pasture was predominantly ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*), but since grazing ceased its composition is changing to cocksfoot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*) and prairie grass (*Bromus willdenowii*).

Despite its modification, the island still has some interesting botanical features. Some valleys support patches of tauhinu (*Cassinia leptophylla*) shrubland and kanuka-manuka (*Kunzea ericoides* -*Leptospermum scoparium*) scrub, which have increased in extent since stock were excluded by fencing. Kanuka forest grows in one valley with a few individuals of the broad-leaved species, karaka (*Corynocarpus laevigatus*), kohekohe (*Dysoxylum spectabile*), milk tree (*Paratrophis banksii*), akiraho (*Olearia paniculata*), and wharangi (*Melicope ternata*). Native coastal vegetation, comprising 25% of the total area, is present on the cliffs and shore and includes low shrublands of tauhinu, *Coprosma propinqua* and small-leaved pohuehue (*Muehlenbeckia complexa*). Over 217 species of vascular plants are present, 171 species are native; a few of them are uncommon or threatened regionally, and one nationally.

The island is a significant habitat for at least 3 threatened native animals: the Cook Strait giant weta (*Deinacrida rugosa*), McGregor's skink (*Cyclodina macgregori*) and the gold-striped gecko (*Hoplodactylus chrysosireticus*). Nesting birds include sooty shearwater (*Puffinus griseus*), little blue penguin (*Eudyptula minor*), variable oystercatcher (*Haematopus unicolor*), white-fronted tern (*Sterna striata*), red-billed gull (*Larus scopulinus*), southern black-backed gull (*L. dominicanus*) and some common land birds.

#### *Management Concept*

Although land use options considered for Mana included farming, forestry and various types of

reserve, many such options do not require an island and some would be unsuccessful because Mana is an island. Nature reserve status would protect the threatened plants and animals but much of the island does not warrant such a high level of protection. Future use of Mana should protect its valuable biological features and take advantage of opportunities that are not available elsewhere, either regionally or nationally.

The absence of all introduced mammals except mice is perhaps the most important feature. Of islands that exceed 200 ha and which lie within 50 km of mainland New Zealand, only 5 are known to be without rats (*Rattus* spp.): Blumine, Maud, Chalky, Secretary and Mana. Of these, Mana is the only one without stoats (*Mustela erminea*) or deer (Atkinson, unpub.) and it is beyond the swimming range of stoats (Taylor, 1984). This makes Mana nationally important as a potential refuge for threatened animals. It also has the potential to protect representative plant and animal communities now poorly protected in the Wellington region. Further, while the 2.5 km gap between Mana and the mainland at its closest distance has been sufficient to prevent unwanted mammals from swimming across, it is small enough to allow people easy access in suitable weather.

The underlying principle in the management plan is that the island's native species and communities are maintained in perpetuity while allowing compatible educational use and recreation enjoyment. This concept is similar to that for Tiritiri Matangi Island in the Hauraki Gulf (Mitchell, 1985). Tiritiri, like Mana Island, had been stripped of most of its original vegetation and turned into pasture but it is being revegetated to provide habitats for a greater variety of native animals and plants. It is envisaged that parts of Mana will also be revegetated and that selected native plants and animals will be introduced.

This management would take advantage of Mana's differences from nearby Kapiti Island, other islands, and from the mainland. This is consistent with one of the conclusions reached at the 1985 Council of Nature Conservation Ministers (CONCOM) workshop on island management in Australia: 'There should be an integrated approach to the use of islands so that proliferation of particular uses and facilities is avoided, ie, planning and use of one island should take into account other islands and the adjacent mainland' (McNamara, 1986).

Other sizeable but less modified mammal-free islands in New Zealand such as the Poor Knights Islands or Snares Islands are used to protect native plant and animal communities in their near-natural

condition. Mana is already highly modified so intervening to restore native communities and introducing threatened native plants and animals takes advantage of the island's near mammal-free state.

The proposed management will protect the following: 1) the threatened and uncommon plants and animals already on the island; 2) the coastal cliff and beach communities representative of those formerly common in the Wellington Ecological District; 3) archaeological sites; 4) selected threatened native plants and animals of the Sounds - Wellington Ecological Region, where suitable habitats exist or can be managed; and 5) a few nationally threatened animals, such as takahe (*Notornis mantelli*) or New Zealand shore plover (*Thinornis novaeseelandiae*), introduced from other parts of New Zealand, where suitable habitats exist or can be managed.

The management plan encourages compatible educational use, interpretation and recreational enjoyment of both the natural and human history of the island.

#### *Implementing the Management Plan*

Putting the management plan into practice requires a variety of activities, three of which are discussed.

#### *Revegetation*

Revegetating Mana is appropriate for many reasons. Most importantly, natural regeneration by itself will result in only slow development of vegetation of very low diversity because of the limited number of native woody plant species that remain. While we do not know exactly what that original vegetation of Mana Island was, we can infer its likely composition from adjacent coastal areas where some woody vegetation remains. Introducing appropriate species will result in a vegetation more representative of Wellington's coastal vegetation and which is presumably closer in composition to that originally present. Revegetation will also provide appropriate habitats for selected threatened species, reduce fire risk and improve the aesthetic appeal of the island.

#### *Constraints*

It is envisaged that only part of the island will be reforested initially so that some options for developing non-forest habitats are retained. Constraints on the revegetation programme, apart from cost, include a lack of sufficient suitable plants, the high exposure of planting sites to wind and salt, and the need to penetrate a thick grass sward without inducing weeds. Revegetation must not interfere with historic sites;

planting on some critical areas could obscure and even damage these sites (Hamel and Jones, 1982).

#### *Procedure*

Revegetation can begin on valley bottoms and sides where there is most moisture and shelter (Fig. 3). Wind breaks can be established with groups of plants, particularly those resilient to wind, eg, flax (*Phormium* spp.), ngaio (*Myoporum laetum*), taupata (*Coprosma repens*) and akeake (*Dodonaea viscosa*). These clumps will provide shelter and a seed source for further regeneration. Spot planting with kanuka, manuka, akeake and other early successional trees would provide further seed sources. Concurrently, some areas will be left to establish a woody cover from natural seed dispersal and such areas should be monitored. In addition, selected seed, appropriate for the stage of vegetation development, can be scattered at times to ensure best germination, for example, species such as karaka, kohekohe and tawa (*Beilschmiedia tawa*). Frugivorous birds and reptiles will also distribute seeds.



Figure 3: Kaikomako Valley bottom showing surface stones, extant kaikomako trees and occasional tauhinu shrubs; a probable site for initial revegetation (October 1986). Photo: Colin Ogle.

At all stages of revegetation, but particularly at the beginning, weed control will be important.

Adventive species such as boxthorn (*Lycium jeroicissimum*), gorse (*Ulex europaeus*), pampas (*Cortaderia selloana*, *C. jubata*) and, to a less extent, karo (*Pittosporum crassifolium*) are likely to seed on to bare areas.

From the foregoing, it is apparent that trials are necessary if an efficient method of restoring native vegetation to the island is to be identified. The soils of

the island are very variable and, given the prevailing climate, it will be necessary to use such trials to determine which species of plant are most appropriate for the different sites and which pre-treatments and methods of planting give greatest survival of plants.

#### *Suitable Plant Material*

This will be restricted to species growing naturally in the Sounds - Wellington Ecological Region and all propagating material should be collected from within this region (Timmins and Wassilieff, 1984). Sources of plant material will be centered on Mana Island. These will be supplemented by sources from the Wellington coast and more distant parts of the ecological region, preference being given to sites closest to the island. Table 1 lists species which would be suitable for propagation and planting on Mana.

#### *Labour*

Local groups and other interested people will play an important part in planting and other revegetation work. Work programmes will need to be carefully planned to make efficient use of, and give satisfaction to, volunteer labour. A temporary growing-on facility has been established on Mana to acclimatise plants and hold them until volunteers are available to plant them out.

#### *Future Vegetation*

It is envisaged that a substantial part of the island could return to young forest within 25 years. This

would leave about a third as scrub, shrubland or open communities on cliffs and along the shoreline where very little planting would be needed. The rest of the island could remain as grassland at least in the short term, but parts could be revegetated by woody plants in time. Maintaining some of the plateau in grassland will allow easy access across the island and will give time to evaluate this non-forested area as a habitat for threatened species.

Mixed forests of broad-leaved trees and podocarps can be established in the narrow valleys, containing such species as wharangi, karaka, ngaio, tawa, kohekohe, milk tree, rewarewa (*Knightia excelsa*), hinau (*Elaeocarpus dentatus*), pukatea (*Laurelia novae-zelandiae*), northern rata (*Metrosideros robusta*) and totara (*Podocarpus totara*), rimu (*Dacrydium cupressinum*) and kahikatea (*Dacrycarpus dacrydioides*). A greater proportion of podocarps, particularly totara, matai (*Prumnopitys taxifolia*) and kahikatea could be established in broader parts of valleys.

Although coastal cliff and beach communities are well represented on Mana their future is threatened by the further spread of boxthorn. A long history of grazing and fires has also depleted the island's coastal flora. Thus it would be desirable to introduce or re-establish native species of Wellington coastal cliff or beach communities, for example, *Coprosma acerosa*, *Scandia geniculata*, *Brachyglottis lagopus*, *Asplenium obtusatum*, *Coriaria sarmentosa*, and matagouri (*Discaria toumatou*).

Table 1: *Tree and shrub species suitable for propagation and planting on Mana Island* (list not exhaustive).

Initial Species	Secondary Species	Later Species
<i>Cassinia leptophylla</i> (tauhinu)	<i>Brachyglottis repanda</i> (rangiora)	<i>Beilschmiedia tawa</i> (tawa)
<i>Coprosma propinqua</i>	<i>Carpodetus serratus</i> (putaputaweta)	<i>Corynocarpus laevigatus</i> (karaka)
<i>C. repens</i> (taupata)	<i>Coprosma robusta</i> (karamu)	<i>Dacrycarpus dacrydioides</i> (kahikatea)
<i>Coriaria arborea</i> (tree tutu)	<i>Cordyline australis</i> (cabbage tree)	<i>Dacrydium cupressinum</i> (rimu)
<i>Dodonaea viscosa</i> (akeake)	<i>Hedycarya arborea</i> (pigeon wood)	<i>Dysoxylum spectabile</i> (kohekohe)
<i>Hebe</i> sp. (unnamed); <i>Veronica arboreal</i>	<i>Lophomyrtus obcordata</i> (rohutu)	<i>Elaeocarpus dentatus</i> (hinau)
<i>Kunzea ericoides</i> (kanuka)	<i>Macropiper excelsum</i> (kawakawa)	<i>Paratrophis banksii</i> (milk tree)
<i>Leptospermum scoparium</i> (manuka)	<i>Meliccytus ramiflorus</i> (mahoe)	
	<i>Olearia paniculata</i> (akiraho)	
	<i>Prumnopitys taxifolia</i> (matai)	
<i>Myoporum laetum</i> (ngaio)	<i>Olearia rani</i> (heketara)	
<i>Olearia paniculata</i> (akiraho)	<i>O. solandri</i>	
<i>O. solandri</i>	<i>Pennantia corymbosa</i> (kaikomako)	
<i>Podocarpus totara</i> (totara)	<i>Podocarpus totara</i> (totara)	
	<i>Pseudopanax anomalus</i>	
	<i>P. arboreus</i> (fivefinger)	

### *Conservation of threatened plants*

Mana provides an opportunity to secure protection for plants of the Sounds - Wellington Ecological Region that are regionally and nationally threatened.

Uncommon species of the region can also be protected on the island. Four categories of threatened or uncommon plants are recognised although the order of discussion does not imply priority.

#### *Nationally threatened plants*

At least one nationally threatened species, as defined by Given (1981), grows naturally on the island; the 'vulnerable' Cook's scurvy grass (*Lepidium oleraceum*). The Jersey fern (*Anogramma leptophylla*) is also present, listed by Given (1981) as 'local'. Both species should be propagated if possible. The following nationally threatened plants of the Sounds - Wellington Ecological Region could be introduced to coastal habitats on Mana: *Hebe speciosa* (rare), *Cotula nana* (endangered), *Lepidium tenuicaule* (indeterminate), *Hebe elliptica* var. *crassifolia* (vulnerable). Threatened species will be selected for introduction on the basis of their chances of survival, distribution in the ecological region and availability of suitable habitats on Mana.

#### *Regionally threatened plants*

In the period 1981-1984 the Wellington Botanical Society collated distribution records for native vascular plants that were possibly threatened in the Sounds - Wellington Ecological Region. The habitats of about 351110 of the species listed are coastal cliffs and beaches. The beaches and cliffs of Mana Island provide ideal sites for protecting some of these species. Several already grow on the island, eg, rengarenga (*Arthropodium cirratum*) (found in only 3 other sites in the Wellington area) and *Hymenanthera obovata* var. (found in 6-8 other sites in Wellington area but all except one site has 1 or 2 shrubs only). These species will be encouraged, or at the very least monitored to check their success. Other regionally threatened plants on Mana Island such as milk tree, whose foliage is palatable to stock and whose seeds are eaten by rats, are being monitored. Only 4 flowering plants (2 female and 2 male) of milk tree have been found on Mana although seedlings are present.

#### *Regionally uncommon plants*

Mana Island supports some species which, while not immediately threatened, are becoming increasingly uncommon in the Sounds - Wellington Ecological

Region. Plants such as *Peperomia urvilleana*, *Coriaria sarmentosa*, *Scandia geniculata*, *Brachyglottis lagopus* and yellow woollyhead (*Craspedia* sp. [c. *uniflora* var. *maritima*]) can be protected on Mana Island.

#### *Plants uncommon on Mana Island*

The survival of all the species that are presently natural to the island will be ensured, even if these species are common on the mainland. Special attention will be paid to protecting plants that are uncommon on Mana, eg, kaikomako (*Pennantia corymbosa*) and northern rata.

#### *Conserving threatened animals*

The virtual absence of mammalian predators makes Mana Island especially important for protecting threatened animals. Suitable habitat for most threatened plants can usually be established on the mainland, despite the activities of mammalian herbivores. Area requirements for viable populations of vertebrates, particularly birds, are generally greater than those for plants. Islands free of alien predators and herbivores are vital for the future survival of some animals. Notwithstanding the large number of offshore islands (< 50 km from the mainland) in New Zealand, a study by Atkinson (in press) shows that, of islands exceeding 100 ha, only the two main Poor Knights Islands, Stephens and Mana Islands are either without such introductions or have only mice as an alien mammal. Thus, in contrast to the regional context in which Mana can be seen as a refuge for threatened plants, the island should be considered of national importance for threatened vertebrates of coastal and lowland New Zealand.

Table 2 lists species that could be considered for introduction to Mana. With the exception of the Antipodes Island parakeet (*Cyanoramphus unicolor*), feasibility studies of the likely success of such introductions have yet to be made.

Decisions about species to be established on Mana should involve not only feasibility studies but also assessments of the likely effects of a proposed introduction on other species. Conflicts may arise between threatened animal and plant introductions, between such introductions and species already on the island, or between introductions and the revegetation programme. Unanswered questions are:

- i) Should endangered animals take priority over less threatened species?
- ii) Should threatened species that occur naturally in the ecological region take precedence over those from elsewhere?
- iii) Should species be considered only if appropriate

Table 2: Some threatened animals which could be considered for introduction to Mana Island. Key to symbols Conservation categories: E = endangered, V = vulnerable (IUCN definition), R = rare, C = regionally threatened (after Bell, 1986). Habitat: F=forest, S=scrub or shrubland, G=grassland, O=open, W=wetland.

Species	Conservation Category	Habitat	Comment
Brown teal <i>Anas aucklandica chlorotis</i>	E	G,S, W	Needs suitable areas of water with overhanging woody vegetation
Campbell Island teal <i>Anas aucklandica nesiotis</i>	E	G,S,W,	
Little spotted kiwi <i>Apteryx owenii</i>	E	F	Mana possibly not yet suitable; only one restricted viable population in the wild
Snares fernbird <i>Bowdleria punctata caudata</i>	V	F,S,G,O	Mana may be already suitable
North Island fernbird <i>Bowdleria punctata vealeae</i>	C	F,S,G,O	Mana may be already suitable
Snare Island snipe <i>Coenocorypha aucklandica huegeli</i>	V	F, S, G	Mana may be already suitable
Antipodes Island parakeet <i>Cyanoramphus unicolor</i>	R	G	Mana may be already suitable
Takahe <i>Notornis mantelli</i>	E	F, S, G	Dependent on how well species thrives on Maud Island
Black tit <i>Petroica macrocephala dannefaerdi</i>	V	F,S,G,O	As with other Snares birds, should introduction be made only in an emergency?
North Island saddleback <i>Philesturnus carunculatus rufusater</i>	R	F,S	Mana may be suitable if area of forest and tall scrub increased
NZ Shore plover <i>Thinornis novaeseelandiae</i>	R	G,W,O	Would require development of a salt marsh; threatened by its very restricted range (Chatham Islands)
Speargrass weevil <i>Lyperobius huttoni</i>	C	S, G	Requires tests to establish whether it can co-exist with mice.

habitat/plant species essential to their success already exist on the island?

iv) Should establishment of threatened animals take precedence over protection of threatened plants? Some examples will illustrate the types of conflict or decisions that are likely to arise. Takahe, which sometimes eat mice, may also eat lizards and thus have a negative effect on the McGregor's skink population of Mana. If North Island saddlebacks, efficient insectivores that eat tree wetas, were introduced to Mana they may endanger giant wetas. Introducing the endangered Campbell Island teal (*Anas aucklandica nesiotis*) would preclude the introduction of the brown teal (*A.a. chlorotis*) because

they might hybridize with each other. Brown teal may be less threatened at present but they are steadily declining and may not survive in the long term on the mainland (M.J. Williams, pers. comm.). Further, protecting the genetically more diverse mainland population may be of higher priority than protecting the small population of Campbell Island teal. This is especially so as the main population of brown teal is on Great Barrier, an island vulnerable to introduction of Norway rats (*Rattus norvegicus*) and mustelids.

Another example is the fern bird (*Bowdleria punctata*). Introducing the regional North Island fernbird (*B.p. vealeae*), which is approaching extinction in the southern North Island, would

preclude introduction of the fern bird endemic to the Snares Island (*B.p. caudata*). The latter subspecies is not immediately endangered but is nevertheless threatened because of human activity around the Snares group. Establishing a back-up population of Snares fernbird on Mana Island, for example, would be prudent.

The value of Mana Island as a habitat for threatened species of invertebrates may be restricted by mice; these rodents eat a wide range of invertebrates (Badan, 1986; Pickard, 1984). However, some invertebrates spend critical parts of their life cycle in places seemingly protected from mice. A species such as the speargrass weevil (Table 2) should be investigated for possible introduction to Mana.

Some species, such as takahe, use grassland or open habitat. If this bird were introduced, or any other that requires a similar habitat, some areas of the island would have to be retained in non-woody vegetation. Other species require specialised communities not present on the island. For example, brown teal or New Zealand shore plover both require wetland habitat. This could be engineered on the island if deemed appropriate.

Given such options, some of which are mutually exclusive, it is clear that decisions should be made on the choice of animal species to be introduced before the revegetation programme is too far advanced.

#### *Concept and practice*

As the section on threatened animals shows, implementing the management concept requires resolution of sometimes conflicting issues. The boat mooring policy is another example. Much of the present biological value and future potential of Mana Island hinges on the continued absence of mammalian predators, particularly rats. Present knowledge is inadequate to eradicate rats from an island the size of Mana, and other small mammals, if introduced, could be removed only with difficulty. Preventative measures recommended for the island include packaging of stores for the island to exclude rodents, carrying poison baits for rats on boats used to service the island, and provision for shipwrecks to be treated as possible rat invasions.

A further precaution would be to dismantle the Mana wharf because it and the Paremata wharf are two major danger points with respect to rat risk. But the wharf can facilitate the educational and recreational use of the island as well as the revegetation programme. The compromise adopted at present is to retain the wharf but with stringent

controls on its use (Department of Lands and Survey, 1986). This places a heavy responsibility on managers of the island and on visitors to scrupulously avoid introducing rats to Mana.

#### **Conclusion**

Mana Island presents the land manager with an unusual opportunity to restore a coastal and lowland community of native plants and animals even though its exact composition is unlikely to replicate what was originally present. Management of the island will combine conservation with education and recreation. This has seldom been tried on an island in New Zealand and we consider Mana has a significant contribution to make to the protected natural areas system.

To some extent the suggestions made here are comparable to the present management aims for Tiritiri Matangi Island in the Hauraki Gulf Maritime Park. However, the job of restoring Mana Island is magnified by the lack of diversity in its remaining seed sources as well as by the severe climate. In addition, the necessity to safeguard endangered species already on the island may place more restriction on future introductions than is the case for Tiritiri. In short, conservation problems associated with Mana are particularly challenging and as a result much may be learnt from tackling them.

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