

6. Restoration of non-forest communities

While restoring forest cover to Mana Island is one of the key steps in the restoration programme, restoring forest to most or all of the island would jeopardise the survival of several resident threatened animal and plant species, and reduce the habitat available for some of the threatened animal and plant species proposed for translocation. Cook Strait giant weta are widely regarded as preferring low-growing shrubs and forest margins to the forest interior (Meads 1990), and since removal of stock and mice from Mana Island, giant weta have become abundant throughout the rank pasture. Giant weta are not found in the interior of the forest remnant on Mana Island, and it is likely that their numbers will decline on the island as the forest cover returns. Both of the threatened lizard species resident on Mana Island (McGregor's skink and goldstripe gecko) occur in non-forest habitats on the island. It is expected that both will spread into forest habitats, but possibly at lower densities to where they currently occur in coastal shrublands and flax respectively.

Many animal species proposed in this Restoration Plan for translocation to Mana Island prefer or require non-forest habitats: grassland (takahe, snipe, spotted skink), wetlands (brown teal, banded rail, fernbird), flax (flax weevil), shrublands (rock wren) or herbfields (speargrass weevil).

Four of the five threatened plant species that survived on Mana Island occur in non-forest communities (Cook's scurvy grass, *Meliccytus obovatus*, rengarenga, Jersey fern), and most of the threatened plants identified as suitable for planting on the island occur in coastal shrublands and herbfields rather than forest.

The retention and development of a variety of non-forested plant communities is an essential part of the Restoration Plan, with the aim of creating a mosaic of habitats all appropriate to the landforms on Mana island and supporting a diverse range of plants and animals representative of the eastern Cook Strait Ecological District.

6.1 CURRENT SITUATION

Less than one percent of Mana Island can be regarded as forest, although about 30 ha has recently been planted with forest-forming species. Mana Island is predominantly covered in rank grassland comprised almost entirely of naturalised species. More natural communities are found on the cliffs and shoreline (61 ha), where shrublands, grasslands and herbfields comprise a mix of native and alien species. The few small wetlands on the island are either highly modified or artificial, having been created to enhance habitat for takahe, provide irrigation water and/or to provide a water supply for fire fighting. Timmins *et al.* (1987a) recorded 17 species of native shrubs that are more typical of shrubland than forest, 10 species of native lianes, 10 species of native grasses, 19 species of native sedges and rushes, and 53 species of native herbs. These 100+ species provide the basis for restoring non-forest plant communities, though plantings of threatened plants (Section 7) may dominate some communities at selected sites.

6.2 FORMER DISTRIBUTION OF NON-FOREST PLANT COMMUNITIES

There is no historical record of the distribution of non-forest plant communities on Mana Island before forest clearance occurred. Chester & Raine (1990) concluded that a small wetland dominated by sedges existed continuously near the houses "until very recent times when it was drained". Shrublands and native grasses and herbs were likely to have dominated the thin soils on exposed coastal cliffs and on the shore platform, similar to their current distribution.

6.3 PROJECTED EXTENT AND DISTRIBUTION OF NON-FOREST PLANT COMMUNITIES

Completion of the current revegetation programme will recreate about 76 ha of coastal broadleaved forest, leaving about 57 ha of grassland on the plateau and in the valleys (Figure 5.2). The balance (84 ha) will be a mixture of flax/sedge dominated wetlands, and structurally complex shrub/grass/herbfields on the cliffs and shore platform.

6.4 RESTORING WETLANDS

The major non-forest community requiring active restoration on Mana Island is Waikoko wetland just inland from the buildings. This low-lying area is partially flooded in winter, but dries out in summer. A system of farm drains criss-cross the former swamp. A detailed contour map prepared by the Ministry of Works in 1973 reveals that the ground surface around the MAF research buildings was built up considerably before the buildings were erected, but there is still space to recreate several hectares of wetland. Restoring Waikoko wetland is likely to involve a combination of disrupting the drain system, recontouring to create a system of ponds and channels, installing control structures to hold water levels higher in summer months, and revegetation with sedges, flax, herbs and shrubs (Waugh *et al.* 1996).

Species likely to benefit from restoration of Waikoko wetland on Mana Island include regionally threatened wetland herbs and sedges (e.g., *Ranunculus macropus*, *Epilobium pallidiflorum*, *Galium trilobum*, swamp nettle, *Carex diandra*, *Sparganium subglobosum*), fernbird and brown teal. There are few comparable wetlands in the eastern Cook Strait Ecological District to guide restoration; perhaps the best examples are Taupo swamp and adjoining wetlands, Plimmerton (Ogle 1978; Bagnall & Ogle 1981; Clelland 1984) and Okupe Lagoon, Kapiti Island (Cockayne 1907; Bell & Atkinson 1975).

The species mix of wetlands is very dependent on physical parameters such as substrate type, water chemistry (salinity, pH, fertility), water depth, and timing and periodicity of submersion and exposure. While some parameters can be manipulated easily during construction (e.g., water depth and methods to control water levels), it will not be possible to predict which species are appropriate for planting in a restored wetland on Mana Island until the wetland has been formed

and water chemistry parameters can be measured. Wetland plants that may be suitable for planting on Mana Island are listed in Table 6.1 (from a list provided by Cohn Ogle, June 1992).

TABLE 6.1 WETLAND PLANT SPECIES THAT MAY BE SUITABLE FOR A RESTORED WETLAND ON MANA ISLAND (FROM COLIN OGLE IN LIT. JUNE 1992). NOTE THAT WATER CHEMISTRY WILL DICTATE THE MIX OF SPECIES THAT COULD BE PLANTED. FOR EXAMPLE, RAUPO AND *CAREX MAORICA* REQUIRE HIGH Ph AND HIGH FERTILITY, WHILE *DROSERA*, *UTRICULARIA* AND *LYCOPODIUM* REQUIRE LOW Ph AND LOW FERTILITY. SOME SPECIES GROW READILY IN MORE THAN ONE HABITAT, SO THE DIVISIONS BELOW ARE NOT CLEAR-CUT. ALL ARE SPECIES APPROPRIATE FOR THE ECOLOGICAL DISTRICT.

	BASIC SPECIES (TO GIVE COMMUNITY STRUCTURE)	THREATENED SPECIES
Brackish water	<i>Juncus maritimus</i> <i>Leptocarpus similis</i> <i>Bolboschoenus caldwellii</i> <i>Schoenoplectus pungens</i> shore ribbonwood	<i>Leptinella dioica</i> ssp. <i>monoica</i> <i>Mimulus repens</i> <i>Schoenus nitens</i> <i>Carex litorosa</i> <i>Baumea juncea</i>
Freshwater, constant water level	raupo harakeke <i>Carex secta</i> <i>Coprosma tenuicaulis</i> <i>Coprosma propinqua</i> Manuka (wetland ecotype) <i>Gahnia xanthocarpa</i> toetoe <i>Carex maorica</i>	<i>Ranunculus macropus</i> <i>Epilobium pallidiflorum</i> <i>Epilobium chionanthum</i> <i>Drosera binata</i> <i>Polygonum salicifolium</i> <i>Hypolepis distans</i> <i>Myriophyllum robustum</i> <i>Carex diandra</i> <i>Galium trilobum</i> <i>Hydrocotyle pterocarpa</i>
Freshwater, fluctuating water level	<i>Lilaeopsis novae-zelandiae</i> / <i>L. ruthiana</i> <i>Limosella lineata</i> <i>Myriophyllum propinquum</i>	<i>Ranunculus limosella</i> <i>Glossostigma dimorphum</i> <i>Potamogeton pectinatus</i> <i>Mazus novae-zelandiae</i> <i>Lepilaena bilocularis</i> <i>Elaine gratioloïdes</i> <i>Myriophyllum votschii</i> <i>Sebaea ovata</i>
Wet edge	coastal tree daisy <i>Coprosma rigida</i>	<i>Leptinella tenella</i> <i>Rorippa palustris</i> <i>Rumex flexuosa</i> <i>Callitriche muelleri</i> swamp nettle <i>Gleichenia microphylla</i> <i>Gahnia rigida</i> <i>Carex dipsacea</i> <i>Gratiola sexdentata</i> <i>Mentha cunninghamii</i> <i>Carex sinclairii</i> <i>Deparia petersenii</i> <i>Ophioglossum coriaceum</i> swamp maire <i>Gunnera prorepens</i>

Biotic factors such as interspecific competition, presence of herbivores and presence/absence of shade will also influence the final plant community structure.

Initial planning for the restoration of Waikoko wetland on Mana Island has been undertaken (Waugh *et al.* 1996), and advice has been sought from Ducks Unlimited.

Other small wetlands on Mana Island maintained for takahe should also provide habitat for fernbird, brown teal and some threatened plants. Further small wetlands should be developed on the plateau to improve habitat for takahe there as lower altitude territories become increasingly covered with woody vegetation. Plantings of toetoe and sedges around wetlands provide nesting cover for takahe, while corridors of flax linking wetlands along the valley floors will allow goldstripe geckos to colonise new areas of plantings.

6.5 RESTORING SHRUBLAND AND HERBFIELD COMMUNITIES

Sufficient elements of the coastal cliff and shoreline shrub and herbfield communities remain to allow natural succession to proceed without planting. One exception to this is an area to the east of Hole-in-the-Rock on the south coast where an historical map (Wilkinson 1873) shows a karaka grove that should be recreated. Ongoing weed control will be necessary, particularly of boxthorn. In areas that are heavily infested with boxthorn (e.g., the northern cliffs) some planting of *Coprosma propinqua*, tauhinu and prostrate taupata may be necessary following boxthorn control to prevent other weed species dominating shrub communities. Small scale plantings of speargrass will be made to prepare sites for liberations of Wellington speargrass weevils. Speargrass is already present at likely release sites, but the current density of plants does not match areas of preferred habitat on the Wellington south coast (Hunt 1996).

Most of the threatened plant species planned for establishment on Mana Island are coastal species. Specific habitat requirements will determine localities where plantings occur, but there are unlikely to be conflicts between small scale plantings of threatened plants and existing conservation values. Where conflicts over preferred planting sites do occur, establishment of further colonies of locally sourced Cook's scurvy grass and *Melicytus obovata* should have priority over non-local species.

6.6 MAINTAINING GRASSLANDS

Attempts to replace alien grass species with native grasses are considered futile, and so grasslands on the plateau and in the valleys will be dominated by alien grasses until eventually succeeded by bracken and shrubs. Natural succession outside areas to be planted is likely to be slow, but eventually (100 years plus) almost all of the island interior will be forested. Natural succession will not be hindered apart from on archaeological sites with surface and subsurface features that could be obscured or damaged by woody vegetation. There will be an inevitable decline in the area of grassland on the island, but the only threatened species likely to be adversely

affected by this is the takahe. Mana Island is too small to maintain a takahe population other than by intensive management; this should occur only if other conservation values are not unduly compromised. Given the long time frame involved (many decades), it is anticipated that there will be other large, predator-free sites available for self-sustaining takahe populations long before Mana Island grasslands have diminished to the extent that the island no longer has a role in takahe recovery.

7. Threatened plants

Nearly 160 species of indigenous terrestrial plants in the Wellington region are considered nationally or regionally threatened (Empson & Sawyer 1995; Department of Conservation 1996); of these, about 39% typically occur in coastal habitats, 47% occur in lowland areas, and 43% are classified as wetland species. The threatened plant database maintained by Wellington Conservancy lists 27 critical, endangered and vulnerable plant species from the eastern Cook Strait Ecological District, with a further 21 species from Wellington Ecological District (Table 7.1). Atkinson (1992) has argued that threatened plants from both eastern Cook Strait and Wellington Ecological Districts should be considered for introduction to Mana Island. As there are many other opportunities for threatened plant conservation, there is no need to compromise ecological restoration goals on Mana Island by introducing threatened plant species that were never known to occur in either eastern Cook Strait or Wellington Ecological Districts.

Habitat disturbance and browsing or seed predation by introduced mammals are major causes of local plant extinctions, and sites free of introduced mammals are likely to gain increasing importance as refugia for threatened plants. However, as plants do not need the large areas of land required by many threatened animal species, it is often possible to manage the threats posed by browsers in situ by techniques such as fencing, banding, shooting, trapping and poisoning. It is more difficult to improve the conservation status of threatened plants when their habitat has been destroyed and is no longer available for restoration. Over 90% of the wetlands in Wellington have been totally destroyed (Fuller 1993) and coastal habitats and flood-plain forests have been extensively modified (Ogle 1989b; Gabites 1993). Mana Island has enormous potential for establishing populations of regionally threatened coastal, forest and wetland plants in habitats free of browsing mammals and development threats.

Compared to animals, plants require only a very small area for establishment, and so there should be little conflict between threatened plant management and the main revegetation programme on Mana Island. The small number of plants required (perhaps less than a hundred per species for initial establishment) make propagation and introduction of threatened plants to Mana Island particularly suitable for community participation. Guidance on seed sources and propagation techniques can be provided by the Wellington Conservancy Plant Conservation Strategy (Empson & Sawyer 1995) and Department of Conservation staff. However, if threatened plants are being propagated by private individuals particular care must be taken against introduction of inappropriate organisms (including invertebrate pests, pathogens and weeds).

The main criterion for assessing the success of threatened plant introductions to Mana Island must be the establishment of self-sustaining populations, so that any further human intervention needed is minimal.

TABLE 7.1 CRITICAL, ENDANGERED AND VULNERABLE PLANT SPECIES OF THE EASTERN COOK STRAIT ECOLOGICAL DISTRICT AND WELLINGTON ECOLOGICAL DISTRICT LISTED IN THE THREATENED PLANT DATABASE MAINTAINED BY WELLINGTON CONSERVANCY. SPECIES MARKED WITH AN ASTERISK ARE ALREADY PRESENT ON MANA ISLAND.

SPECIES	NATIONAL STATUS	CONSERVANCY STATUS	ECOLOGICAL DISTRICT
<i>Adiantum hispidulum</i> (rosy maidenhair)		Vulnerable	Wellington
<i>Anogramma leptophylla</i> (Jersey fern)*	Endangered	Susceptible	Both
<i>Arthropodium cirratum</i> (rengarenga)*		Vulnerable	Both
<i>Atriplex billardierei</i>	Endangered	Extinct	Cook Strait
<i>Atriplex buchananii</i>		Endangered	Cook Strait
<i>Atriplex cinerea</i> (grey salt bush)	Endangered	Extinct	Wellington
<i>Botrychium australe</i> (parsley fern)		Vulnerable	Cook Strait
<i>Brachyglottis kirkii</i> s. s. (Kirk's tree daisy)		Endangered	Cook Strait
<i>Carex diandra</i>		Vulnerable	Wellington
<i>Coprosma acerosa</i> (sand coprosma)		Endangered	Wellington
<i>Coprosma virescens</i>		Endangered	Cook Strait
<i>Crassula peduncularis</i>	Vulnerable	?Extinct	Cook Strait
<i>Crassula ruamahunga</i>		Endangered	Wellington
<i>Dactylanthus taylorii</i> (wood rose)	Endangered	?Extinct	Wellington
<i>Deschampsia caespitosa</i> var. <i>macrantha</i>	Vulnerable	Extinct	Cook Strait
<i>Desmochoenus spiralis</i> (pingao)		Vulnerable	Cook Strait
<i>Discaria toumatou</i> (matagouri)		Vulnerable	Cook Strait
<i>Doodia squarrosa</i>		Critical	Both
<i>Entelea arborescens</i> (whau)		Vulnerable	Cook Strait
<i>Euphorbia glauca</i> (shore spurge)		Vulnerable	Cook Strait
<i>Gahnia rigida</i>		Critical	Wellington
<i>Ileostylus micranthus</i> (pirita)		Endangered	Cook Strait
<i>Juncus prismatocarpus</i>	Vulnerable	Indeterminate	Wellington

TABLE 7.1 CONTINUED

SPECIES	NATIONAL STATUS	CONSERVANCY STATUS	ECOLOGICAL DISTRICT
<i>Lepidium flexicaule</i>	Endangered	Extinct	Wellington
<i>Lepidium oleraceum</i> (Cook's survy gmss)*	Endangered	Endangered	Cook Strait
<i>Lepidium tenuicaule</i>	Vulnerable	Indeterminate	Cook Strait
<i>Leptinella dioica</i> ssp. <i>monoica</i>	Vulnerable	Endangered	Cook Strait
<i>Leptinella nana</i>	Endangered	Vulnerable	Wellington
<i>Leptinella pusilla</i>		Endangered	Wellington
<i>Libertia peregrinans</i>		Endangered	Wellington
<i>Lycopodium laterale</i>		Endangered	Wellington
<i>Mazus novaezeelandiae</i>	Vulnerable	Vulnerable	Cook Strait
<i>Melicytus obovatus</i> ssp. "coast"*		Susceptible	Cook Strait
<i>Muehlenbeckia astonii</i> (shrubby tororaro)	Endangered	Endangered	Cook Strait
<i>Peraxilla tetrapetala</i> (red-flowered mistletoe)	Vulnerable	Endangered	Wellington
<i>Pimelea aridula</i> var. "Cook Strait"		Critical	Cook Strait
<i>Pittosporum obcordatum</i> (heart-leaved kohuhu)		Endangered	Wellington
<i>Pleurosorus rutifolius</i> (blanket fern)		Vulnerable	Cook Strait
<i>Pseudopanaxferox</i> (fierce lancewood)		Vulnerable	Wellington
<i>Pterostylis micromega</i>	Critical	Endangered	Wellington
<i>Pterostylis puberula</i>	Critical	Critical	Wellington
<i>Rumax flexuosus</i>		Endangered	Cook Strait
<i>Scandia geniculata</i>		Vulnerable	Cook Strait
<i>Senecio sterquilinus</i>		Endangered	Wellington
<i>Streblus banksii</i> (large-leaved milk tree)*		Endangered	Cook Strait
<i>Suaeda novae-zelandiae</i>		Critical	Cook Strait
<i>Teucrium parvifolium</i>	Vulnerable	Endangered	Wellington
<i>Urtica linearifolia</i> (swamp nettle)	Vulnerable	Susceptible	Wellington

7.1 CURRENT SITUATION

Six threatened species of plants are recognised as occurring naturally on Mana Island: Cook's scurvy grass (nationally endangered), Jersey fern (nationally endangered), large-leaved milk tree (regionally endangered), Rengarenga (regionally vulnerable), *Melicytus obovatus* (regionally vulnerable) and *Hypolepis dicksonioides* (indeterminate). Cook's scurvy grass was reduced to fewer than ten plants on a single rock stack, although two plants have now established naturally on the shoreline at the base of the stack. Jersey fern is probably extinct on Mana Island following removal of stock, as rank grass is now covering the one site where it was known to occur (Colin Ogle pers. comm.). There are only four adult large-leaved milk trees on Mana Island (two male and two female). Two trees are isolated and are not producing viable seed, but the two trees in Forest Valley are reproducing, with abundant seedlings and a few saplings present. Rengarenga is abundant at a few sites around the coast of Mana, and in the lower sections of Tauhinu Valley. *M. obovatus* is represented by fewer than 30 shrubs on the cliffs. *H. dicksonioides* was first discovered on the island in 1994 and is spreading rapidly along the margins of the stream flowing out of Aston's Valley.

It is likely that many other threatened plant species were originally present on Mana Island, but were eliminated by over 150 years of grazing, seed and seedling destruction by mice, and periodic fires.

7.2 PROGRESS WITH THREATENED PLANT MANAGEMENT ON MANA ISLAND

Initial attempts at establishing some threatened plant species on Mana Island were made by Colin Ogle in November 1987: four plants of rohatu, three plants of *Pimelea aridula* and about 50 plants of the semi-prostrate Kapiti Island form of kowhai were planted. The rohatu were grown from seed from Pipinui Point, south of Titahi Bay, and were planted on the stream bank near the mouth of Forest Valley; two were alive in July 1988, but none was present in May 1994. The *Pimelea* were cutting-grown from Pipinui Point and were planted on a steep rock face at the lower end of Tauhinu Valley; two were alive in July 1988, but none was present in May 1994. The kowhai were planted on the hill slope above Hole-in-the-Rock on the south coast; at least ten were alive and flowering in May 1994, when ripe seed from the previous year was placed in suitable sites nearby.

Five potted plants of Cook's scurvy grass were planted on a rock stack near the island's only natural population in November 1987; they failed to survive. Plants have been maintained in the manager's garden on Mana Island since at least 1987; cuttings from these were grown on and 36 were planted out in 1994, mainly on the clifftop near the main sooty shearwater colony. Most of these plants were thriving and flowering in December 1994, but there is no evidence of new seedlings establishing to date. Seed collected from the wild plants on Hole-in-the-Rock in January 1995 produced over 900 seedlings, of which about 600 were planted out around Mana Island in September 1995 (Jason Christensen pers. comm.). Four hundred were planted in three mass plantings along the south coast to compare three different treatments: (a) direct planting among grass, (b) planting among grass with fertiliser added, and (c) grass physically removed, fertiliser added. The

remaining plants were planted near the main sooty shearwater colony, on the cliff top below the trig (70-80 plants; Cook's scurvy grass was present there in the 1970s), and on McGregor's Rock and two other stacks to the north of there.

About 150 locally sourced rengarenga were planted out on Mana Island in 1995, mainly around ponds and wetlands on the plateau. Abundant *Melicytus obovatus* seed has been collected for the same purpose, and about 40 seedlings were planted in 1996. A large quantity of seed was collected from the two adult large-leaved milk trees in Forest Valley in 1996, and about 100 wild seedlings were brought into cultivation in 1995 for growing on and planting out.

7.3 ESTABLISHING POPULATIONS OF THREATENED PLANTS ON MANA ISLAND

The following lists of potential threatened plant introductions to Mana Island (Tables 7.2, 7.3 & 7.4) are an amalgam of suggestions by Timmins *et al.* 1987b; Ogle 1989b and in lit. July 1992; Atkinson 1992; and Peter de Lange in lit. July 1992. All proposed introductions are consistent with recommendations in the Wellington Conservancy Conservation Management Strategy (Department of Conservation 1996) and the Wellington Conservancy Plant Conservation Strategy (Empson & Sawyer 1995).

The main criteria used in assessing whether a threatened plant species was appropriate for introduction to Mana Island were:

- (a) taxon recognised as a regionally or nationally threatened by Empson & Sawyer (1995)
- (b) evidence of past or present occurrence within either or both of eastern Cook Strait Ecological District and Wellington Ecological District
- (c) suitable habitat likely to be present on Mana Island

None of the species proposed for introduction was considered likely to compromise other conservation values on Mana Island through, e.g., hybridisation, parasitism, or competition. Inclusion in the lists does not in itself mean that a given plant species can be successfully established on Mana Island. Each introduction must be based on sound understanding of the ecological requirements of that species, and may require some site preparation and follow-up management until a self-sustaining population is established.

TABLE 7.2 THREATENED FOREST AND FOREST-EDGE PLANTS SUITABLE FOR INTRODUCTION TO MANA ISLAND, WITH POSSIBLE SOURCE LOCATIONS. SPECIES MARKED WITH AN ASTERISK ARE CONSIDERED HIGH PRIORITIES.

SPECIES	POSSIBLE SOURCE
Trees, shrubs and lianes	
<i>Dodonaea viscosa</i> (akeake)- <i>Entelea arborescens</i> (whau) <i>Ileostylus micranthus</i> (pirita)* <i>Korthalsella lindsayi</i> <i>Korthalsella salicornioides</i> <i>Lophomyrtus obcordata</i> (rohutu)* <i>Rhabdothamnus solandri</i> (waiuatua)* <i>Sophora microphylla</i> (kowhai) <i>Streblus banksii</i> (large-leaved milk tree)* <i>Tupeia antarctica</i> (tupia)*	Paekakariki Paekakariki Benge Park Kapiti Lookout (Paraparaumu) Kapiti Island Pipinui Point, Pukerua Bay Smith's Creek (Makart - southern limit) Papakowhai Mana Island Kapiti Island
Herbs	
<i>Acaena juvenca</i> *	Pukerua Bay
Ferns	
<i>Anogramma leptophylla</i> (Jersey fern)* <i>Blechnum</i> "Green Bay" <i>Doodia media</i> <i>Doodia squarrosa</i> <i>Hymenophyllum minimum</i> <i>Pellaea calidirupium</i> <i>Pteris saxatilis</i>	Carter Scenic Reserve Pukerua Bay Pukerua Bay Porirua East South Wellington Pukerua Bay ?

TABLE 7.3 THREATENED PLANT SPECIES SUITABLE FOR INTRODUCTION TO CLIFF AND SHORELINE HABITATS ON MANA ISLAND, WITH POSSIBLE SOURCE LOCATIONS. SPECIES MARKED WITH AN ASTERISK ARE CONSIDERED HIGH PRIORITIES.

SPECIES	POSSIBLE SOURCE
Trees, shrubs and lianes	
<i>Clematis afoliata</i> (leafless clematis)* <i>Convolvulus verecundus</i> * <i>Coprosma acerosa</i> (sand coprosma)* <i>Coriaria sarmatosa</i> (coastal tutu) <i>Discaria toumatou</i> (matagouri)* <i>Fuchsia perscandens</i> <i>Hebe elliptica</i> var. <i>crassifolia</i> * <i>Melicytus obovatus</i> * <i>Muehlenbeckia astonii</i> (shrubby tororaro)* <i>Muehlenbeckia ephedroides</i> * <i>Pimelea aridula</i> * <i>Rubus squarrosus</i> (leafless lawyer) <i>Scandia geniculata</i> * <i>Sophora microphylla</i> (kowhai - prostrate form)* <i>Tetragonia tetragonitodes</i> *	Spooky Gully Waipapa Stream ?Cape Palliser Paekakariki, Otari (ex Red Rocks) Pukerua Bay Kapiti Island Spooky Creek, Sinclair Head Titahi Bay Mana Island Sinclair Head Fitzroy Bay Pipinui Point Sinclair Head, Waipapa Stream Kapiti Island Kapiti Island (western cliffs) Petone Beach
Herbs	
<i>Acaena pallida</i> (giant bidibidi)* <i>Atriplex buchananii</i> * <i>Atriplex cinerea</i> (grey salt bush)* <i>Crassula peduncularis</i> <i>Daucus glochidiatus</i> (New Zealand carrot) <i>Fuphorbia glauca</i> (shore spurge)* <i>Lepidium oleraceum</i> (Cook's scurvy grass)* <i>Lepidium tenuicaule</i> * <i>Leptinella nana</i> * <i>Leptinella pusilla</i> * <i>Mentha cunninghamii</i> (New Zealand mint) <i>Rumex flexuosus</i> <i>Rumex neglectus</i> (shore dock)	Porirua Harbour, mouth of Long Gully Miramar Waimea Estuary Turakirae Head Pipinui Point Stack off Kapiti Island Mana Island ?Kapiti Island Whitireia Park Baring Head Mount Misery Te Ikaamaru Bay Cape Terawhiti
Grasses and sedges	
<i>Carex spinirostris</i> <i>Rytidosperma petrosum</i> * <i>Zoysia minima</i>	Kapiti Island (western cliffs) Titahi Bay
Ferns	
<i>Asplenium obtusatum</i> <i>Pleumsorus rutifolius</i>	Titahi Bay Palliser Bay

TABLE 7.4 THREATENED PLANT SPECIES THAT MAY BE SUITABLE FOR ESTABLISHING IN WETLAND HABITATS ON MANA ISLAND. SEE ALSO TABLE 6.1.

SPECIES	POSSIBLE SOURCE
Brackish wetland	
<i>Baumea juncea</i> <i>Carex litorosa</i> <i>Leptinella dioica</i> ssp. <i>monoica</i> <i>Ruppia polycarpa</i> <i>Schoenus nitens</i>	Taupo Swamp Waikanae River Makara Estuary Lake Kohangatera Pauatahanui
Freshwater wetland	
<i>Carex diandra</i> <i>Centipede minima</i> <i>Epilobium pallidiflorum</i> <i>Gabnia rigida</i> <i>Galium trilobum</i> <i>Gunnera prorepens</i> <i>Lepilaena bilocularis</i> <i>Leptinella dispersa</i> <i>Leptinella tenella</i> <i>Mazus novaezeelandiae</i> <i>Myriophyllum robustum</i> <i>Myriophyllum votschii</i> <i>Potamogeton pectinatus</i> <i>Pratia perpusilla</i> <i>Ranunculus macropus</i> <i>Rumex flexuosus</i> <i>Sebaea ovata</i> <i>Urtica linearifolia</i> (swamp nettle)	Taupo Swamp Kapiti Island Taupo Swamp, Kapiti Island Mangaroa Taupo Swamp, Kapiti Island Mount Kaukau, Otaihanga Lake Kohangapiripiri Whitireia Park Kakaho Stream (Pukerua Bay) ? ? Lake Wairarapa Lower Hutt Kapiti Island Taupo Swamp Kapiti Island ? Taupo Swamp

8. Birds

Designing a future avifaunal community on Mana Island required information on:

- what indigenous species are currently present or are likely to colonise naturally (not including species already introduced for conservation reasons)
- what species are likely to have been present historically
- what nationally threatened species require habitats free of introduced mammals to ensure their continued survival, and whether there are other more appropriate sites for their introduction
- potential conflicts between proposed introductions and resident species and/or other proposed introductions (including plants, invertebrates and reptiles), e.g., predation, competition, disease risk, hybridization.

The list of landbirds recorded from the entire Cook Strait Ecological District is not an appropriate model for guiding restoration of Mana Island's avifauna, as at least 18 landbird species were found on only one side of Cook Strait, and a further 14 pairs of subspecies were separated by Cook Strait (data from Turbott 1990). For example, both members of the following species or subspecies pairs could be considered for introduction to Mana on the basis of historic records from Cook Strait Ecological District: North Island kaka/South Island kaka, whitehead/yellowhead, and NI robin/S.I. robin. Ogle (1989) argued that faunistic differences either side of Cook Strait warrant an Ecological Region or District boundary dividing Cook Strait.

As a starting point, landbirds recorded from the southern North Island (south of Manawatu gorge) were considered as potential candidates for restoring the Mana Island avifauna. Some species were excluded if their known habitat or home range requirements indicated that it was unlikely that Mana Island would ever have supported a resident population (brown kiwi, blue duck, takahe, kakapo, North Island rifleman). However, Mana Island's predator-free status, accessibility and history of extreme modification make it one of the most suitable islands around the New Zealand coast for intensive management of critically endangered bird species as part of a national metapopulation (discussed below for brown kiwi, takahe and kakapo). Any such intensive management programmes to maintain species artificially on Mana must not compromise longer term conservation objectives on the island.

Landbird species were identified as being candidates for introduction if they met one of the following sets of criteria:

- (a) species recorded in middens on Mana Island that were likely to have had a resident population, and that are unlikely to have significant impacts on threatened plant or animal species that survived on Mana (9 species).
- (b) species known to have been present in the southern North Island (or their nearest living relative), that are unlikely to survive in the presence of mammalian predators, are likely to be able to establish a self-sustaining population on the island, and are not expected to compromise other conservation values on the island (5 species).

- (c) species that may require translocation to a predator-free island in the event of a catastrophe threatening the only remaining population, and that would not conflict with other conservation values during the short time present on Mana (i.e., until able to be restored to the original habitat) (1 species).
- (d) species known to have been present in the southern North island (or a close relative), that are unlikely to survive longterm on Mana without human intervention, but for which small predator-free islands have a role in a national recovery programme, and which would not unduly compromise other conservation values or objectives on the island (3 species).

8.1 CURRENT SITUATION

The following indigenous bird species have been recorded from Mana Island recently. The list does not include species deliberately introduced to the island, species known only as beach wrecks, or seabirds seen more than 100 metres offshore. Species known to breed are in bold lettering.

Sooty shearwater	about 100 pairs
Fluttering shearwater	common offshore
Common diving petrel	two caught ashore
Blue penguin	100s of pairs
Fiordland crested penguin	two records (K. Oates pers.comm.)
Australasian gannet	common offshore, 2 roosting Dec 1997
Black shag	always present around coast
Pied shag	vagrant
Little shag	large roost on dam, always present around coast
Spotted shag	vagrant
White-faced heron	usually present
Reef heron	1-4 birds usually present, 1 nest found
Royal spoonbill	vagrant
Paradise shelduck	about 10 pairs
Grey duck	occasionally with mallards on dams
Australasian harrier	always present, may breed
New Zealand falcon	one record
Pukeko	abundant breeder
Variable oystercatcher	10-15 pairs breed
Spur-winged plover	frequent visitor
Pied stilt	vagrant
Southern black-backed gull	c. 2500 pairs
Red-billed gull	about 150 pairs
Black-fronted tern	regular winter visitor in low numbers
Caspian tern	1-2 often feed along eastern shore
White-fronted tern	about 20 pairs

New Zealand pigeon	vagrant
Long-tailed cuckoo	one record (G.Timlin pers. comm.)
Shining cuckoo	occasional visitor
Morepork	occasional reports
New Zealand kingfisher	usually present, may breed
Welcome swallow	breeds around buildings and in sea cave
New Zealand pipit	often present, may breed
Grey warbler	present in Bush Valley and plantings
North Island fantail	abundant around coast, scrub and plantings
Silvereeye	abundant in scrub and plantings
Tui	occasional reports (P Todd pers.comm.)

8.2 WHAT WAS MANA ISLAND'S ORIGINAL AVIFAUNA?

There is no historical record of what bird species were present on Mana before the island was cleared. If we accept that Mana Island's original vegetation was predominantly mixed broadleaved forest (Timmins *et al.* 1987a), then it is likely that most forest birds of the southern North Island would have been present. This was partially confirmed following archaeological excavations on Mana Island in January 1990 (see Horwood 1991) that produced bones of at least 35 bird species (Table 8.1). This list is an invaluable resource to guide restoration of Mana Island's avifauna. However, the list must be used with caution, as it is likely that some species were captured away from the island; this is obviously the case for many of the seabirds, and may apply to some of the landbirds. For example, it is unlikely that moa would have survived on an island of 217 ha. It is hoped that further analysis of the bones collected (minimum number of individuals present; presence of different skeletal elements in relation to known preserving techniques) will shed light on which species were likely to have been caught locally. This is particularly important for weka, which is the only extant indigenous landbird listed that is not currently being considered for reintroduction (see below).

8.3 NATIONALLY THREATENED LANDBIRD SPECIES THAT MAY REQUIRE ISLANDS FREE OF MAMMALIAN PREDATORS

Two different groups of birds must be considered - those that evolved in isolation on the islands to which they are confined (Table 8.2), and mainland species that were formerly more widespread (Table 8.3). Where possible, forms that evolved in isolation should be conserved entirely within their natural range. Fortunately most of the taxa involved occur on more than one island within their respective island groups, and are unlikely to become extinct following a single predator colonization. Exceptions are landbirds endemic to the Poor Knights (1 subsp.), Codfish I. (1 subsp.), the Mangere Islands (1 subsp.), the Snares Islands (3 subsp.) and islands off Campbell I (1 species and 1 subspecies). Suggested recovery options for these taxa are given in Table 8.2. Two of these eight taxa can be used to replace extinct taxa

(Snares Island snipe/Stewart Island snipe, Snares Island fernbird/Chatham Island fernbird), as can three further taxa confined to single island groups (Three Kings bellbird/Chatham Island bellbird, Chatham Island snipe/Little Barrier snipe, Reischek's parakeet/Macquarie Island parakeet).

TABLE 8.1 BIRD SPECIES IDENTIFIED FROM MIDDENS ON MANA ISLAND (PHIL MILLENER IN LIT.). PRESENCE IN MIDDENS DOES NOT NECESSARILY MEAN THAT A BREEDING POPULATION WAS PRESENT ON MANA ISLAND. SPECIES IN BOLD ARE THOSE CONSIDERED APPROPRIATE FOR REINTRODUCTION TO MANA ISLAND AS DISCUSSED IN TEXT.

	BREEDING LOCALITY NEAREST TO MANA ISLAND
Seabirds	
Royal/wandering albatross (1) Shy mollymawk Fluttering/Hutton's shearwater Northern/southern giant petrel (1) ?Fairy prion ‡ ?Fulmar prion (2) ?Salvin's prion (2) ?Broad-billed prion (2) ?Cook's petrel (2) Common diving petrel Blue penguin ?Erect-crested penguin (2) Black shag Pied shag Southern black-backed gull	Otago Peninsula (royal albatross) Snares Islands Brothers Is (Cook Strait E.D. - fluttering shearwater) Chatham Islands (northern giant petrel) Brothers Islands (Cook Strait Ecological District) Snares Islands Crozet Islands, Indian Ocean Fiordland islands Little Barrier Island Brothers Islands (Cook Strait Ecological District) Mana Island Bounty Islands Kapiti Island (Cook Strait Ecological District) Makara (Cook Strait Ecological District) Mana Island
LANDBIRDS, WATERBIRDS AND WADERS	
Stout-legged moa Coastal moa Paradise shelduck Grey duck Australasian harrier New Zealand quail Domestic fowl Banded rail Weka ?Variable oystercatcher (2) ?Lesser knot/New Zealand dotterel(1) New Zealand pigeon Kaka Red-crowned/yellow-crowned parakeet New Zealand pipit Fernbird Whitehead New Zealand robin Bellbird Tui	Extinct Extinct Mana Island Cook Strait Ecological District ?Mana Island Extinct introduced poultry Marlborough Sounds (Sounds-Wellington Ecological Region) Gisborne Mana Island Kawhia (New Zealand dotterel) Cook Strait E.D. (especially Kapiti Island) Kapiti Island (Cook Strait Ecological District) Chetwode Is (Cook Strait E.D. - yellow-crowned parakeet) ?Mana Island Manawatu Estuary Kapiti Island (Cook Strait Ecological District) Kapiti Island (Cook Strait Ecological District) Kapiti Island (Cook Strait Ecological District) Cook Strait Ecological District (especially Kapiti Island)

(1)Species paired in this way cannot be reliably differentiated on the material available. The first species listed is the most likely option.

(2)Species listed in this way are difficult to distinguish from closely related species on the material available. The species listed are those that provide the "best fit"for the specimens compared with a wide range in the Museum of New Zealand collections.

TABLE 8.2 NEW ZEALAND LANDBIRDS, WADERS AND WATERFOWL ENDEMIC TO SINGLE ISLANDS OR ISLAND GROUPS, WITH SUGGESTED OPTIONS FOR CONSERVATION MANAGEMENT. NOTE THAT THE SHORE PLOVER IS INCLUDED IN TABLE 8.3, AS IT FORMERLY OCCURRED ON THE MAINLAND, THOUGH NOW CONFINED TO THE CHATHAM ISLANDS. SPECIES IN BOLD ARE DISCUSSED FURTHER IN TEXT.

SPECIES	RESTORATION OPTIONS AND COMMENTS
Kermadec parakeet	Conserve solely within Kermadecs. High risk of hybridization elsewhere.
Three Kings bellbird	Conserve within Three Kings. Introduce to Mangere Island to replace extinct Chatham Island bellbird. High risk of hybridization elsewhere.
Poor Knights bellbird	Conserve solely within Poor Knights. High risk of hybridization elsewhere.
Stewart Island fernbird	Conserve solely on Stewart Island and adjacent islands.
Stewart Island robin	Conserve solely on Stewart Island and adjacent islands.
Codfish Island fernbird	Conserve on Codfish Island, introduce to Solander Island if weka eradicated.
Chatham Island oystercatcher	Conserve solely within Chathams. Risk of hybridization on offshore islands,
Chatham Island snipe	Snipe formerly occurred throughout New Zealand. Conserve within Chathams and introduce to predator-free offshore islands around North Island.
Chatham Island pigeon	Conserve solely within Chathams. Risk of hybridization on offshore islands.
Chatham Island red-crowned parakeet	Conserve solely within Chathams. High risk of hybridization elsewhere.
Forbe's parakeet	Conserve solely within Chathams. High risk of hybridization elsewhere.
Chatham Island fantail	Conserve solely within Chathams. High risk of hybridization on offshore islands.
Chatham Island tomtit	Conserve solely within Chathams. Some risk of hybridization elsewhere.
Black robin	Conserve solely within Chathams.
Chatham Island warbler	Conserve solely within Chathams.
Chatham Island pipit	Conserve solely within Chathams. High risk of hybridization elsewhere.
Chatham Island tui	Conserve solely within Chathams. High risk of hybridization on offshore islands.
Snares Island snipe	Conserve within Snares. Introduce to predator-free islands off Stewart Island, especially those that formerly had extinct Stewart Island snipe.
Snares Island fernbird	Conserve within Snares. Introduce to Mangere Island (?and other islands) in Chathams group to replace extinct Chatham Island fernbird.
Snares Island tomtit	Conserve within Snares. Introduce to predator-free offshore islands only if Snares population under immediate threat of extinction. Risk of hybridization elsewhere, especially if resident tomtit population nearby.

TABLE 8.2 CONTINUED

SPECIES	RESTORATION OPTIONS AND COMMENTS
Antipodes Island snipe	Conserve solely within Antipodes Is.
Antipodes I. parakeet	Conserve solely within Antipodes Is.
Reischek's parakeet	Conserve within Antipodes Is. Could be introduced to Macquarie Island to replace extinct subspecies if cats and rats eradicated. High risk of hybridization elsewhere.
Antipodes Island pipit	Conserve solely within Antipodes Is. High risk of hybridization elsewhere.
Auckland Island teal	Conserve solely within Auckland Is. Risk of hybridization on most offshore islands, including Mana I.
Auckland Island rail	Conserve solely within Auckland Is.
Auckland Island banded dotterel	Conserve solely within Auckland Is. High risk of hybridization on offshore islands and Chathams Is.
Auckland Island snipe	Conserve solely within Auckland Is.
Auckland Island tomtit	Conserve solely within Auckland Is. Risk of hybridization elsewhere.
Campbell Island teal	Conserve within Campbell Is. Introduce to an island in Foveaux Strait until Campbell Island cleared of cats and rats as per Recovery Plan. Risk of hybridization on most offshore islands, including Mana.
Campbell Island snipe	Conserve solely within Campbell Is.

TABLE 8.3 THREATENED BIRDS OF THE NORTH AND SOUTH ISLANDS FOR WHICH TRANSFER TO (FURTHER) PREDATOR-FREE ISLANDS COULD ENHANCE THEIR CHANCES OF SURVIVAL. TAXA LISTED ARE THOSE IN CATEGORIES A, B, C AND X OF MOLLOY & DAVIS (1994). NOTE THAT SOME SPECIES ARE NO LONGER PRESENT ON THE MAINLAND. TAXA IN BOLD SHOULD BE INTRODUCED TO MANA; TAXA IN ITALICS COULD BE MANAGED ON THE ISLAND, BUT ARE UNLIKELY TO FORM SELF-SUSTAINING POPULATIONS.

	SUITABILITY OF MANA ISLAND
Little spotted kiwi	Could hold 50-100 pairs. Two birds present.
<i>Other kiwi spp</i>	<i>?Too small for self-sustaining population. May be suitable as "nursery" during intensive management of mainland populations in short/medium term.</i>
Brown teal	Habitat available, but would improve following restoration of wetland.
Weka (4 subspecies)	Introduction could endanger resident threatened species.
<i>Takahe</i>	<i>Insufficient habitat for self-sustaining population. Suitable for intensive management.</i>
Shore plover	Habitat should be suitable, but requires gull numbers to be reduced.
New Zealand pigeon	Habitat may be suitable in 5-10 years.
<i>Kakapo</i>	<i>Too small for self-sustaining population. Suitable for intensive management.</i>

TABLE 8.3 CONTINUED

	SUITABILITY OF MANA ISLAND
Kaka (2 subspecies)	Reintroduce North Island kaka when forest cover established.
Yellow-crowned parakeet	Suitable habitat present.
Orange-fronted parakeet	[May be colour morph of yellow-crowned parakeet]. Currently known only from beech forests. Southern islands more appropriate.
Rock wren	Habitat may be suitable now.
Yellowhead	Habitat not suitable. Southern islands more appropriate.
Stitchbird	Suitable habitat unlikely to be present for many years (review following trial introductions to other small islands).
Kokako (2 subspecies)	Suitable habitat unlikely to be present for many years (review following trial introductions to other small islands).
Saddleback (2 subspecies)	Introduction could threaten resident and introduced threatened invertebrates. Sufficient other predator-free islands available for both subspecies.

There are three taxa for which ex situ management on islands not previously inhabited by closely related extinct taxa may be necessary (without risking hybridization with related taxa): Codfish Island fernbird, Snares Island tomtit and Campbell Island teal. None of these taxa is recommended for release on Mana Island, although the tomtit niche on Mana could be left vacant so that there is a site available to move Snares Island tomtit to in an emergency. Recovery options for the two other taxa are given in Table 8.2.

The accessibility of Mana Island and its extensively modified habitats make it more suitable for intensive species management than most rodent-free islands (see Table 2.1). Most other rodent-free islands have largely intact forest cover, and so are not suitable for species that require grassland or wetland habitat (e.g., takahe, brown teal and fernbird). Islands with highly modified ecosystems (e.g., most of Mana, Maud and Tiritiri Matangi Islands) have more potential for experimental manipulation of habitats than do islands that have retained largely intact ecosystems, and so these few modified, permanently staffed islands are more likely to be used for intensive management of small populations of species such as takahe and kakapo. However, experimental habitat manipulation and intensive species management must not jeopardise the long-term survival of resident threatened animal and plant species.

8.4 A COMPARISON WITH KAPITI ISLAND

Mana Island is situated only 22 km south of Kapiti Island, one of New Zealand's three most important island sanctuaries for forest bird communities. Kapiti Island is nine times the size of Mana Island and has extensive forest cover with breeding populations of 21 species of native forest birds (cf. currently four on Mana Island). However, Kapiti Island may still have two species of rats (eradication attempted in

1996) and has an abundant weka population. The presence of weka makes Kapiti Island less suitable than Mana Island for restoring populations of small burrowing seabirds and some other species of ground-nesting birds (e.g., snipe, shore plover and banded rail). While many species of forest birds will be restored to Mana Island, Mana Island will eventually complement rather than replicate the forest bird community on Kapiti Island. Differences between the bird communities likely to be restored to the two islands are emphasised in Table 8.4

TABLE 8.4 BIRD SPECIES LIKELY TO BE CONFINED TO ONE OF EITHER MANA OR KAPITI ISLANDS FOLLOWING ECOLOGICAL RESTORATION OF BOTH ISLANDS. ABOUT THIRTY OTHER NATIVE BIRD SPECIES ARE LIKELY TO OCCUR ON BOTH ISLANDS.

MANA ISLAND ONLY	KAPITI ISLAND ONLY
Fluttering shearwater	Tokoeka
Common diving petrel	Weka
Fairy prion	Red-crowned parakeet
Australasian gannet	North Island rifleman
Banded rail	North Island tomtit
Shore plover	Stitchbird
Chatham Island snipe	North island kokako
Yellow-crowned parakeet	North Island saddleback
Rock wren	

8.5 RECREATING AN AVIFAUNAL COMMUNITY FOR MANA ISLAND

The following annotated list includes 20 species that currently breed (or occur regularly) on Mana, 17 species that should be introduced or attracted to the island, six species that may colonise the island naturally, three species that could only be maintained on the island by intensive management (considered necessary as part of national recovery programmes), one species that should be introduced only as a "last ditch" conservation measure, and five species that are not considered appropriate for introduction within the next 20 years even though formerly present in the southern North Island. The species recommended for establishment on Mana Island are based on the assumptions that (a) forest will be restored to at least a third of the island; (b) the island will be kept free of introduced mammals; (c) the wetland area near the houses will be restored; and (d) significant areas of grassland and shrubland will be retained. Beyond these broad habitat manipulations, it is assumed that the bird species to be introduced are ecological generalists that do not require plantings of specific plant species to ensure their survival. None of the species recommended for introduction in the next 20 years is likely to jeopardise the continued survival of resident threatened animal and plant species on Mana Island.

Species that should not be introduced in the next 20 years (unless new information is obtained on habitat requirements and/or impacts on other species) are listed in square brackets. Species to be introduced or deliberately attracted to the island are listed in bold lettering. Species that either require intensive management on the island or should only be introduced as a last ditch conservation measure are listed in italic lettering. Records of bones in middens at Paremata are from Davidson (1978), those from Mana are from Phil Millener (in lit.)

1. Little spotted kiwi (kiwi-pukupuku)

Criterion (b). Recorded from Cook Strait Ecological District (D'Urville & Kapiti Islands, bones at Paremata). Little spotted kiwi are apparently the kiwi most vulnerable to predation by introduced mammals, and may now be extinct on the mainland. Fortunately, little spotted kiwi can live at higher densities (about 0.5 pairs/ha) than other kiwi, and can tolerate the presence of rodents, and so there are several islands apparently suitable for little spotted kiwi. Little spotted kiwi from Kapiti Island have already been liberated on Long Island (Queen Charlotte Sound), Hen, Red Mercury and Tiritiri Matangi Islands.

The Kiwi Recovery Plan (Butler & McLennan 1991) identifies the need to establish further island populations of most kiwi taxa. As little spotted kiwi were found naturally within the Cook Strait Ecological District, Mana Island is an appropriate location to establish a population.

Mana Island is currently being used to attempt preservation of South Westland little spotted kiwi genes (one bird from Franz Josef paired with a bird from Kapiti Island). If this attempt fails, liberations of little spotted kiwi from Long Island (=D'Urville population) and/or Kapiti should be made to establish a self-maintaining population on Mana.

Conflicts between little spotted kiwi and other conservation values on Mana Island are likely to be minimal, especially while the kiwi are at a low population density. The presence of little spotted kiwi is unlikely to affect the establishment of those threatened invertebrates proposed for release on Mana Island, but kiwi should be fenced out of release sites for litter-dwelling species such as the giant pill millipede. Kiwi could potentially take giant weta nymphs, however giant weta are scarce or absent in forest habitats on Mana Island. Little spotted kiwi are not known to consume lizards.

Management action

Introduce further little spotted kiwi from mainland South Island, Kapiti Island and/or Long island as determined by the Kiwi Recovery Group. Monitor populations of threatened invertebrates and reptiles as the little spotted kiwi population increases, to ensure that populations of all species of conservation interest are stable or increasing.

2. Okarito brown kiwi

Criterion (d). Bones of brown kiwi found in middens at Paremata. Mana Island is probably too small to maintain a breeding population (typically require 5+ ha per pair). However, environments free of mammalian predators may be required in future to raise captive-hatched mainland kiwi until they are large enough to return

to mainland forests, as part of an intensive management programme. Such a programme is already underway for the endangered Okarito brown kiwi. Mana Island may be suitable as a "nursery" for other kiwi taxa, as long as there is no conflict with the main aim of establishing a little spotted kiwi population on the island.

Management action

Kiwi Recovery Group to determine whether Mana Island is suitable as a nursery for mainland kiwi taxa given the presence of one or more pairs of little spotted kiwi.

3. Sooty shearwater (titi)

Although widely distributed around New Zealand as a breeding species, most colonies north of Foveaux Strait number fewer than 100 pairs. If the small size of northern colonies is due to marine conditions, it may be unrealistic to expect the current population of about 100 pairs on Mana to increase greatly.

Management action

Continue monitoring burrow occupancy and breeding success of sooty shearwaters on Mana Island.

4-6. Fluttering shearwater (pakaha), common diving petrel (kuaka) & fairy prion (titi wainui)

All three species recorded from middens on Mana Island, and breed elsewhere in Cook Strait Ecological District. "Keystone species" with the potential to form large breeding colonies, importing large quantities of nutrients and thus supporting abundant invertebrate communities that, in turn, support abundant lizards. The top predator in a typical Cook Strait seabird/invertebrate/lizard ecosystem is the tuatara.

Trials are underway to attract all three species to an artificial colony, using a solar-powered tape deck that broadcasts their calls from dusk till dawn throughout the year. If successful, the same technique could be used to attract other petrels breeding in the Cook Strait region (flesh-footed shearwater and white-faced storm petrel).

There are few apparent conflicts between establishing further petrel colonies and other conservation objectives on Mana Island. However, any attempts to attract petrels to Mana Island should not occur close to archaeological sites (particularly the lighthouse and associated earthworks) as their burrowing activity may compromise the integrity of surface and subsurface features.

Management action

Continue trials to attract small petrels using acoustic stimuli. If unsuccessful within three breeding seasons, continue trial along with transfers of prebreeders from Cook Strait breeding islands. If necessary, transfer chicks before fledging as trialled with fluttering shearwaters on Maud Island (Bell 1994).

7. Blue penguin (korora)

Mana Island, along with other islands in the region, is an important breeding location for blue penguins, which are becoming increasingly scarce on the mainland.

Management action

None required.

8. Australasian gannet (takapu)

Gannets have increased markedly throughout New Zealand in the last fifty years (Wodzicki *et al.* 1984). However, the only colonies in the Cook Strait region are at Waimaru Bay, Pelorus Sound (29 nests in 1980/81; Wodzicki *et al.* 1984) and Farewell Spit (c.600 pairs in 1987/88; Hawkins 1988). It may be possible to attract gannets to a suitable site on Mana Island by the simple measure of putting out models of adult gannets to attract birds foraging offshore.

A gannet colony would result in total removal of plant cover within the area covered by the colony, but it would be a major nutrient source to support plant, invertebrate and reptile communities downslope. A gannet colony established by such a method would also be an important focus for interpretation, away from the more fragile petrel colonies.

Management action

Select suitable cliff-top site and install 50-100 model gannets (recommend painted concrete casts to withstand elements). Monitor by regular checks for presence of gannets and signs of visits (e.g., feathers, nests). If visual cues alone are unsuccessful in attracting gannets, investigate the use of acoustic stimuli as well.

9. Black shag (kawau)

Unlike most cormorants, black shags can nest on both trees and cliff ledges. However, they are very susceptible to human disturbance. The nearest known breeding colony is on Kapiti Island. Black shags are nearly always present around the coast of Mana, and may attempt to breed in future, particularly if little shags start breeding.

Management action

Keep human disturbance of areas where shags attempt to nest to a minimum.

10. Little shag (kawaupaka)

There is a little shag roost on trees around the dam at the base of House Valley. As little shags typically nest on trees overhanging water, it is possible that they will attempt to breed at this site. As for black shag, little shags are wary of humans, and most fly away when they see people on the vehicle track above the dam. This track is closed to the public, and will eventually be screened by plantings.

Management action

Keep human disturbance of areas where shags attempt to nest to a minimum.

11. White-faced heron

One or two white-faced herons are often present around the coast of Mana. Typical nest sites are in the tops of tall trees, though they occasionally nest on the ground. The most likely nest sites on Mana are the big old macrocarpas and pine trees, all of which will eventually be windthrown or cut down. As the white-faced heron is a recent immigrant to New Zealand, and is very abundant throughout the country, it is not considered necessary to retain potential nest sites on Mana.

Management action

None required.

12. Reef heron (matuku-moana)

One to four reef herons are often present around the coast of Mana, and breeding was first confirmed in December 1994. Typical breeding sites are in sea caves (there are few on Mana), on cliff ledges and in low vegetation.

Management action

Discourage people from walking along any sections of coasts where reef herons attempt to breed.

13. Paradise shelduck (putangitangi)

Several pairs are present on Mana, and broods of ducklings have been seen on some of the dams. With increasing tall vegetation around these dams they are likely to become less attractive to shelducks, which require all round vision from brood-rearing areas. However, restoring the Waikoko wetland should provide sufficient habitat to retain shelducks on Mana. The presence of paradise shelduck bones in middens on Mana suggests that they were part of the original avifauna.

Management action

Restore Waikoko wetland, keeping at least two hectares clear of tall woody vegetation.

14. Grey duck (parera)

Recorded from middens on Mana, but now all but replaced by the introduced mallard, with which grey ducks hybridize. Restoring the main wetland on Mana should improve habitat for dabbling ducks, but it would be difficult to develop habitat for grey ducks that would not attract mallards. Control of mallards is not feasible due to their abundance and mobility.

Management action

Restore Waikoko wetland.

15. Brown teal (pateke)

Criterion (b). Teal bones were found in middens at Paremata, and brown teal were recorded historically from Cook Strait Ecological District. The nearest population is on Kapiti Island (descended from captive-bred birds release in 1968). Mana Island

has been suggested as a possible site for releasing captive-bred Campbell Island teal, however this has been rejected by the Subantarctic Teal Recovery Group because of the risk of hybridization with brown teal dispersing from Kapiti Island. The brown teal is also nationally threatened, and may require habitats free of mammalian predators for its own survival. The draft Brown Teal Recovery Plan has a goal of establishing breeding populations of brown teal on at least five further small islands by 1999 (Dumbell & Williams 1994). Potential habitat already exists on Mana Island, but would be increased by the restoration of Waikoko wetland. Ducks Unlimited run a captive-breeding programme for brown teal (Operation Pateke) and should be able to provide advice on wetland restoration, as well as providing birds for release.

There is increasing evidence that, in the absence of mammalian predators, the brown teal was a terrestrial species, occurring under forest a long way from standing water (Worthy & Holdaway 1994). It is anticipated that once established on Mana Island, brown teal will occupy grassland and forest habitats as well as the wetlands.

There are no apparent conflicts between the release of brown teal and other conservation values on Mana Island.

Management action

Restore Waikoko wetland, liberate captive-bred brown teal (or wild-caught birds if recommended by the Brown Teal Recovery Group).

16. Australasian harrier (kahu)

Common on Mana, though not known to breed there. Also recorded in middens from Mana. Harriers are extremely mobile, and are often seen flying between Mana and the mainland. Although natural members of the Mana avifauna, harriers have the potential to disrupt conservation programmes by preying upon recently released "predator-naive" animals such as captive-reared teal and plover and translocated petrel chicks. Long term control of harriers on Mana is neither desirable nor practical, however short term control through trapping or shooting of problem individuals may be required during and after releases of vulnerable species.

Management action

Monitor harrier presence and behaviour during releases of species that may be vulnerable to harrier predation; remove or destroy any harriers that are considered to be jeopardising the success of releases.

17. New Zealand falcon (karearea)

A rare straggler to Mana Island. It is unlikely that falcons will become resident on Mana given the small size of the island, and the absence of resident falcons on the much larger, forested Kapiti Island nearby. Even more than harriers, falcons have the potential to jeopardise releases of other bird species on Mana.

Management action

Check for presence of falcons immediately before any planned release of any bird species on Mana. If considered necessary, live-trap falcons for release elsewhere.

18. [Banded rail (moho-pereru, mioweka)]

Criterion (a). Found in middens on Mana Island, not known elsewhere in Cook Strait Ecological District at present. Nearest populations are at the heads of Pelorus and Queen Charlotte Sounds where banded rails are confined to saltmarshes (Elliott 1989). Elsewhere in New Zealand banded rails also occur in freshwater wetlands; on a few islands free of mammalian predators (Three Kings Islands, Poor Knights Islands and at least five islands near Stewart Island) banded rails occur among forest, scrub and tussock grasslands. On mammal-free Mana island, banded rails could be expected to colonise most habitats.

Banded rails are secretive and rarely seen, yet are efficient colonists that have reached isolated islands throughout the Philippines, Indonesia, Melanesia, western Polynesia, Australia and New Zealand, including (formerly) Chatham Island and Macquarie Island. The New Zealand subspecies is endemic; whilst local in distribution, it is not considered threatened nationally. Banded rails are absent from the Wellington region, but there are two recent records from the Wairarapa. Restoring banded rails to Mana Island would achieve the dual goals of re-establishing a population in the region, and restoring a species presumed to have been part of the original Mana Island avifauna.

Although banded rails should eventually be returned to Mana Island, they are predators and could affect the establishment and expansion of reptiles, invertebrates and ground-nesting birds. Banded rails may recolonise the island naturally, but if they do not, their re-introduction should occur only once all planned releases of potential prey are complete and the new species are well established (i.e., in 20+ years).

Management action

Check for the presence of banded rails at five-yearly intervals by playing taped calls. Assuming that banded rails do not recolonise naturally in the interim, re-introduce them to Mana Island once all other restoration programmes involving reptiles, invertebrates and ground-nesting birds are complete and the target species well established.

19. Spotless crane (puweto)

Spotless cranes are rarely seen but widespread inhabitants of raupo dominated wetlands, including those in the Sounds-Wellington Ecological Region. On a few islands free of mammalian predators (e.g., Meyer Islets in Kermadec group, Three Kings and Poor Knights Islands) spotless cranes also inhabit forest and scrub. Spotless cranes are thought to have good powers of dispersal and may colonise Mana Island naturally, especially once Waikoko wetland is restored.

Management action

Restore Waikoko wetland. Check for the presence of spotless cranes at five-yearly intervals by playing taped calls.

20. [Weka]

Weka bones have been found in middens on Mana Island, and weka are present within the Marlborough Sounds (western weka) and on Kapiti Island (probably hybrid stock). North Island weka are now extinct in the Wellington region, but there are plans to reintroduce them to Karori Wildlife Sanctuary.

Weka have been introduced to many islands around the New Zealand coast, and at several sites are considered to have had severe impacts on indigenous fauna including reptiles, invertebrates, small petrels, shorebirds and some landbirds. Introduction of weka to Mana Island could endanger giant weta and McGregor's skink, as well as many of the species proposed for introduction. For this reason, weka should not be introduced to Mana Island unless (a) there is clear evidence that weka were part of the original avifauna on Mana, (b) there is new evidence indicating that past claims of the impacts of weka on other biota have been overstated, *and* (c) introduction of North Island weka to Mana is considered necessary to ensure their survival. Even if all these criteria are met, weka should not be introduced until all other species are well established. This stance is more moderate than that of Towns (1992b), Whitaker (1993) and Newman (1994) and who did not think weka should be considered at all for introduction to Mana.

Management action

Investigate weka bones from Mana Island middens to establish whether they were likely to have been obtained locally. Support research into the impacts of weka on other biota. Do not introduce weka to Mana Island unless criteria (a) to (c) above are met.

21. Pukeko

Pukeko are very abundant on Mana Island, and have caused problems by pulling out plantings and interfering with supplementary feeding stations for kakapo and takahe. Most of these problems can be overcome by modifying management practices, however, in some situations localised control of pukeko may be the only practical option to limit damage. There is also an unknown risk of disease or parasite transfer from the dense pukeko population to threatened bird species, especially the closely related takahe. Weighed against this is the potential to use pukeko to enhance takahe breeding success by cross-fostering takahe eggs to pukeko. It is possible that pukeko could hinder the establishment of, e.g., brown teal by predation of eggs and chicks.

Pukeko are likely to decline on Mana as the forest cover increases, but are expected to remain abundant in more open habitats.

Management action

Support research into the disease risk posed by the dense pukeko population on Mana. Monitor impacts of pukeko on plantings and on other animal species that are introduced to Mana, and undertake localised control if necessary.

22. Takahe

Criterion (d). The North Island takahe is extinct, though bones of it have been found in middens at Paremata. The South Island takahe population is reduced to a small wild population in the Murchison Mountains west of Lake Te Anau; birds from this source have been introduced to Kapiti, Mana, Maud and Tiritiri Matangi Islands and to the Stuart Mountains. There is also a small captive population. Although takahe survive well at low altitudes, there is currently a shortage of mammal-free non-forested lowland sites suitable for takahe. Of the 17 islands greater than 100 ha that are free of introduced mammals around the New Zealand mainland (Table 2.1) there are only four (Mana, Kapiti, Maud and Tiritiri Matangi) that have suitable habitat for takahe *and* where the presence of takahe is compatible with other management objectives. This situation is likely to change as further islands are cleared of introduced mammals, and as methods to keep mainland areas clear of predators improve. For the foreseeable future, however, Mana Island is expected to play a key role in the takahe recovery programme.

South Island takahe were first introduced to Mana Island in 1988; there are currently six pairs on the island. Intensive management is guided by the Takahe Recovery Group; this has included supplementary feeding, moving birds between the islands to minimise inbreeding, use of enclosures to aid pair-bonding and territory spacing, and egg transfers to ensure that as many pairs as possible have a fertile egg. Recent trials on Mana Island to determine whether takahe eggs/chicks can be reared by pukeko were inconclusive (Bunin & Jamieson 1996), and these trials are unlikely to resume in the near future.

Concerns have been raised over the potential impact of takahe on other threatened fauna on Mana Island, particularly McGregor's skink, goldstripe gecko and giant weta. Takahe are almost entirely herbivorous, rarely consuming large-bodied animal prey. In contrast, the closely related pukeko takes a larger proportion of animal prey in its diet. Pukeko have naturally colonised Mana island, and currently outnumber takahe there by over 40 to one. However, in the presence of both takahe and a dense pukeko population, McGregor's skinks and goldstripe gecko have apparently increased markedly in the last four years (Whitaker 1993; Newman 1994) and giant weta remain abundant. It is very unlikely that takahe are having any impact on other threatened fauna on Mana Island.

Mana Island could potentially hold up to 53 pairs of takahe if suitable ponds and plantings are provided on the plateau (Ryan & Jamieson 1998). However, if plantings and regeneration reduce the total area of grassland and shrubland on the plateau and valleys to 70 ha by the year 2030 as recommended in this plan, there would be sufficient habitat for about 25 pairs of takahe on Mana Island.

Takahe on Mana Island mainly have territories centred on the valley floors, usually around small artificial wetlands. Most territories include extensive areas of young plantings, but observations on Kapiti Island indicate that takahe are unlikely to live in mature forest. As the revegetation programme and natural regeneration will eventually produce tall forest on most valley floors and sides, it is likely that most current territories will not be suitable for takahe in 20 years time unless windows of open grass and shrubland are maintained within forest catchments. The Takahe Recovery Plan (Crouchley 1994) recommended that maintenance of grassland habitat be emphasised in the management plan for Mana Island. This will be

achieved by leaving unplanted windows of grassland on valley floors and lower slopes, and by leaving most of the plateau unplanted, apart from small areas of cover for nesting and roosting adjacent to ponds and depressions. In the short term, the Department does not intend preventing natural regeneration of forest and shrubland in order to maintain habitat for takahe, but this may become necessary if Mana Island remains a key site for takahe in 10 to 20 years time.

Takahe are unlikely to ever have a self-sustaining population on Mana Island (and may all eventually be moved to another island or mainland site), and so we must ensure that any habitat modifications made to provide for takahe do not unduly compromise other conservation values on the island. Maintaining small ponds on the island will provide habitat for other planned introductions (e.g., brown teal, fernbird) as well as takahe, but keeping large areas of the valley floors and sides clear of woody vegetation would conflict with the restoration of forest communities on Mana. If small windows of grassland are retained (or even maintained) within forest catchments, these will rapidly regenerate if takahe are ever removed from Mana Island.

In summary, Mana Island could support up to 25 pairs of takahe in the short to medium term if required by the Takahe Recovery Group. Takahe are not considered part of the long term restoration goal for Mana Island as it is unlikely that there will be sufficient habitat on the island to support a self-sustaining population.

Management action

Continue intensive management of takahe on Mana Island as long as required by the Takahe Recovery Group. Prepare habitat on the plateau by planting flax, toetoe, sedges and shrubs around ponds, and creating further small ponds if required. Retain windows of unplanted grassland on the valley floors and lower slopes of catchments that are otherwise forested. Ensure that any management actions taken to support the takahe recovery programme do not unduly compromise other conservation values and restoration goals on the island.

23. Variable oystercatcher (toreapango)

About 15 pairs of variable oystercatcher breed on Mana Island. Although variable oystercatchers are widely distributed around the Wellington coastline, there are very few sites where they are able to breed successfully. Fledging success in the presence of the large black-backed gull population on Mana has not been determined, but the island has the potential to be the main breeding site for variable oystercatchers in the entire Wellington region.

Management action

Monitor breeding success annually in relation to gull density. Colour-band adults and chicks to determine the importance of Mana Island in maintaining the variable oystercatcher population in the Wellington region.

24. Shore plover (tuturuatu)

Criterion (b). The shore plover is confined to a single wild population of about 130 birds on Rangatira (South East) Island in the Chatham Islands, but formerly occurred around the South Island and possibly the North Island (Dowding & Kennedy 1993). There are also about 30 captive-reared and captive-bred shore plover held at the

National Wildlife Centre (Mt Bruce) and Peacock Springs (Christchurch). The main purpose of the captive flock is to produce sufficient birds for release onto one or more predator-free islands, as described in the draft Shore Plover Recovery Plan (Kennedy 1993). Mana Island is within the presumed original distribution of shore plover, and is one of the top priority islands identified by the Shore Plover Recovery Group for a trial release.

Habitat suitability for shore plover on Mana Island has been assessed in preparation for release of shore plover there (Miskelly & Aikinan 1993). While the intertidal zone of Mana is not as extensive as the wave platforms and saltmarshes of Rangatira Island, there appears to be sufficient habitat and intertidal invertebrates to attempt a release of shore plover. The major barrier to establishing a breeding population of shore plover on Mana Island is the presence of a large colony of black-backed gulls. The very large number of gulls on Mana is thought to be the result of poor waste management in the Wellington region (see below). Gulls are known predators of shore plover chicks, and their numbers on Mana Island will have to be greatly reduced before a release of shore plover is attempted.

Apart from the need to control black-backed gulls, there are no apparent conflicts between releasing shore plover and other conservation values on Mana Island. The grass area behind the landing beach and the margins of any dams that shore plover frequent should be kept mown as bad-weather roost sites and feeding areas, but there is no justification for large-scale habitat manipulation for shore plover on Mana Island.

Management action

Reduce the black-backed gull population by at least 90% and maintain at that level. Introduce captive-reared and captive-bred shore plover to Mana Island. Following release, provide supplementary food as required, and control predatory birds (harriers, black-backed gulls) if necessary. Keep all areas currently mown as a low turf, and mow the margins of any dams the shore plover use.

25. Chatham Island snipe (tutukiwi)

Criterion (b). Snipe formerly occurred throughout New Zealand; the nearest known subfossil records to Mana Island are in the Wairarapa and at Marfell's Beach, Marlborough (Miskelly 1987), but this is probably due to the paucity of suitable sites for the preservation of small bird bones in the Wellington region. Snipe survived on offshore islands in the Hauraki Gulf and off Stewart Island until 1870 and 1964 respectively (Miskelly 1987 & 1988) but both these subspecies are now extinct due to introductions of cats, rats and weka. Snipe still occur on the Chatham Islands, Snares Islands, Antipodes Islands, Auckland Islands and Campbell Islands, with a distinct species or subspecies on each group.

Snipe should be reintroduced to offshore islands that are free of introduced mammals as part of their ecological restoration and to reduce the risk of snipe becoming extinct. The forms of snipe currently at greatest risk from extinction are the Campbell Island snipe, Snares Island snipe and Chatham Island snipe, due to their small total population size, small area of habitat available, low number of islands inhabited, and accessibility to fishing craft capable of mooring close offshore (Chatham Island snipe has the added risk of frequent expeditions to Mangere and Rangatira Islands, with increased opportunity for rodent invasion). In contrast, it is

unlikely that a single predator invasion would endanger Auckland Island and Antipodes Island snipes, each of which occurs on several widely spaced and infrequently visited islands within their respective archipelagos.

On biogeographical and morphological grounds, the most appropriate snipe to introduce to islands off the North Island is the Chatham Island snipe, while the Snares Island snipe should be introduced to islands off Stewart Island. Unfortunately all offshore islands known to have had snipe historically still have introduced mammals and/or weka. However, as snipe occurred on many offshore islands as well as the mainland, it is appropriate to attempt liberations on modified islands that are now free of introduced mammals, such as Mana, Moutohora, Cuvier and Tiritiri Matangi Islands.

Snipe occur throughout any habitat with dense ground cover, including grassland; there is abundant habitat and suitable prey for snipe on Mana Island. The liberation of snipe is unlikely to conflict with other conservation values on Mana Island.

Management action

Seek support from the Chatham Island community for transfer of Chatham Island snipe from Rangatira to Mana, either direct or via a captive breeding programme..

26. Southern black-backed gull (karoro)

Black-backed gulls are over abundant on Mana Island, with 2500-2600 pairs breeding around the coastal platform, cliffs and on the plateau adjacent to Tauhinu Valley (Empson 1994). Scavenging on anthropogenic wastes has led to such a huge increase in black-backed gulls in the Wellington region that the breeding population on Mana is at least two orders of magnitude greater than it would be if gulls were feeding solely on natural food sources. While black-backed gulls are a natural part of the Mana Island avian community, at current densities the gulls have the potential to severely compromise restoration programmes on Mana Island. Species that could be affected by black-backed gull predation include petrels, gannets, oystercatchers, shore plover, red-billed gulls and terns. Black-backed gulls are also a potential disease risk to threatened species on Mana; gulls are notorious as disease carriers, presumably because of their scavenging habits.

While a reduction in black-backed gull numbers should benefit many other bird species on Mana Island, gull control will reduce nutrient inputs to the coastal platform and cliff communities, which may impact on plant, invertebrate and reptile communities. Such effects, if they occur, should be temporary, i.e., until populations of other seabirds increase.

Management action

Reduce the breeding population of black-backed gulls on Mana island to about 100 pairs centred on the north-western cliffs, and maintain at this level. Monitor gull predation on vulnerable species, and adjust control programme accordingly. Advocate better management of landfills and other gull feeding sites in the Wellington region.

27. Red-billed gull (tarapunga)

Red-billed gulls breed in at least two discrete colonies on the northern cliffs and adjacent stacks of Mana Island, with a 1993/94 population of about 155 pairs (C. Miskelly pers. obs.). Red-billed gulls take a greater proportion of natural prey than black-backed gulls, feeding mainly on marine crustacea during the breeding season. Their current breeding distribution on Mana Island is away from areas where most species vulnerable to gull predation do or may breed; however, white-fronted terns nest among the red-billed gulls and are vulnerable to egg or chick loss to gulls if disturbed by people. Red-billed gulls may increase in numbers and breeding distribution on Mana following black-backed gull control. Any increase should be monitored to ensure that other species (especially shore plover) are not unduly threatened.

Management action

Discourage people from approaching mixed red-billed gull/white-fronted tern colonies. Monitor distribution and size of breeding colonies.

28. Caspian tern (taranui)

Caspian terns are frequent visitors to the eastern shoreline of Mana Island. The only breeding colony in Wellington Conservancy is on Onoke Spit, Wairarapa. Caspian terns are extremely vulnerable to human disturbance when nesting. It is possible that Caspian terns may attempt to breed on Shingle Point, particularly after black-backed gull numbers are decreased.

Management action

Monitor the presence of Caspian terns on Mana Island. Discourage people from walking around Shingle Point if Caspian terns begin roosting or nesting there.

29. White-fronted tern (tara)

White-fronted terns bred on two stacks (20 pairs) off the northern coast of Mana in 1993/94 (C. Miskelly pers. obs.). Both colonies were among breeding red-billed gulls. White-fronted terns are more wary of humans than gulls, leaving their nests when approached and exposing their eggs and chicks to the less timid gulls. The size and distribution of tern breeding colonies on Mana Island may increase following black-backed gull control.

Management action

Identify roosting and nesting sites of white-fronted terns on Mana, and discourage people from approaching closer than 50 metres.

30. New Zealand pigeon (kereru)

Criterion (a). New Zealand pigeon bones have been found in middens on Mana Island and individuals occasionally occur there as vagrants; it remains a conspicuous member of coastal forest ecosystems in Cook Strait Ecological District. The kereru is considered a keystone species of New Zealand forest ecosystems, as it is the most widely distributed New Zealand bird species capable of dispersing large seeds. Restoration of kereru to Mana Island would be a major step in the shift from an

artificially created forest to a forest with a structure that is modified and maintained by natural processes.

Kereru are strong fliers, and will probably colonise Mana Island naturally from Kapiti Island when the forest on Mana is well established. Conversely, if kereru are reintroduced to Mana too soon, they are likely to fly away. It is possible that kereru will become seasonal visitors to Mana initially until the forest is sufficiently diverse and mature to maintain them year round. If kereru do not begin visiting Mana when there appears to be abundant fruiting of favoured species, then a transfer of kereru to the island should be attempted.

There are no likely conflicts between the reintroduction of kereru and other conservation values on Mana, although kereru may damage some plantings when feeding on leaf and flowerbuds.

Management action

Continue revegetation programme. Record timing and duration of visits by kereru, and note diet. If kereru are not regular visitors when habitat appears suitable, conduct a trial release of kereru from Kapiti Island.

31. *Kakapo*

Criterion (d). The kakapo is the most critically endangered New Zealand bird. Bones have been found at Paremata, and it is recorded historically from the Tararua Ranges and Marlborough Sounds, but it is unlikely that an island as small as Mana would have held a kakapo population. However, as an accessible, modified, mammal-free island, Mana Island has potential for intensive management of kakapo as long as this does not unduly compromise other conservation values and objectives on the island.

Two male kakapo were introduced to Mana Island in May 1992, and one of these survived in good condition for 15 months. This trial provided sufficient encouragement to support further use of Mana Island as a site for close order management of kakapo in a semi-captive environment.

If further kakapo are to be brought to Mana Island, it may be necessary to provide favoured food plants. These should be locally sourced plants appropriate to the Ecological District wherever possible. If it is considered essential that exotic plants be used (e.g., garden vegetables) then care must be taken to ensure that they do not become established in the wild on the island. As there is never likely to be a self-sustaining kakapo population on Mana Island, any habitat modification undertaken for kakapo should not compromise the main restoration programme, and should be reversible.

Although there are unlikely to be any direct ecological conflicts between kakapo and other conservation values on the island, the high priority given to kakapo may create indirect conflicts through reallocation of resources from other tasks. Sufficient staff resources must be available on the island to ensure the continuation of the overall restoration programme, regardless of the presence of kakapo.

Management action

Recommence intensive management of kakapo on Mana Island as and when required by the National Kakapo Team. Ensure that any management actions taken do not unduly compromise other conservation values and restoration goals on the island.

32. North Island kaka

Criterion (a). Kaka bones have been found on Mana Island, and kaka are still present in Cook Strait Ecological District (most notably on Kapiti Island). Kaka are thought to require forest that contains large amounts of dead wood, as wood-boring insect larvae are an important protein source during the breeding season. Natural thinning of plantings may provide a source of dead wood once plantings are well established, but this is expected to take at least ten years. Kaka may colonise or visit Mana Island naturally from Kapiti Island. If this does not occur, juvenile kaka from Kapiti should be released on Mana when forest cover is well established.

There are few apparent conflicts between the reintroduction of kaka and other conservation objectives on Mana Island. Kaka may carry diseases that kakapo are susceptible to, but note that kakapo occur alongside dense kaka populations on Codfish and Little Barrier Islands.

Management action

Continue revegetation programme. Record sightings of kaka that reach Mana naturally. Reintroduce kaka from Kapiti Island if kaka have not colonised naturally by the time forest is well established on Mana. Erect suitable nest boxes.

33. Yellow-crowned parakeet (kakariki)

Criterion (a). Parakeet bones have been found on Mana; these are most likely of red-crowned parakeet, but may be of yellow-crowned parakeet or both species. Red-crowned parakeets are abundant on Kapiti Island, and yellow-crowned parakeets are abundant on the Chetwode Islands and Titi Island in outer Pelorus Sound (all within Cook Strait Ecological District). Yellow-crowned parakeets formerly occurred on Kapiti Island, and are still present in the Tararua Ranges.

All eight taxa of *Cyanoramphus* parakeets in New Zealand are rare and/or have restricted ranges. Five taxa (Kermadec parakeet, Chatham Island red-crowned parakeet, Forbe's parakeet, Antipodes parakeet and Reischek's parakeet) have evolved on isolated islands; all five of these taxa should be conserved within the island group where they occur naturally, as it is unlikely that any would become extinct following a single predator colonisation, and there is a high risk of hybridisation with local forms if they were introduced to offshore islands (Table 8.2).

Of the three "mainland" parakeets, the most threatened form is the orange-fronted parakeet. There is still debate over whether the orange-fronted parakeet is a distinct species or a colour morph of the yellow-crowned parakeet (Taylor *et al.* 1986; Daugherty & Triggs 1991). Regardless of this debate, all recent sightings of orange-fronted parakeets have been in South Island beech forests, and it is more appropriate for any releases to occur on predator-free islands in Fiordland or South Island lakes.

Of the two remaining New Zealand parakeets, the yellow-crowned parakeet is currently considered the most threatened species (Molloy & Davis 1994). Red-crowned parakeets occur on at least 18 island groups around the mainland and Auckland Islands, and yellow-crowned parakeets occur on at least nine (Taylor 1985; Miskelly pers. obs). Both species were sympatric on at least 11 island groups, but on islands where both occur red-crowned parakeets are usually much more

abundant. Indeed, yellow-crowned parakeets have apparently recently become extinct on Kapiti, Solander and Three Kings Islands, while red-crowned parakeets remain abundant. The only islands which have yellow-crowned parakeets but not red-crowned parakeets are the two Chetwode Islands and Titi Island.

It is possible that red-crowned parakeets will eventually colonise Mana Island naturally from Kapiti. While both species can coexist in some circumstances, it is important that a stable population of the (apparently) less competitive yellow-crowned parakeet be established on Mana Island as soon as possible. This could be achieved by direct transfer of birds from the Chetwode Islands, as yellow-crowned parakeets from the northern South Island are apparently genetically identical to those from the North Island (Triggs & Daugherty 1988; Daugherty & Triggs 1991). Habitats on Mana Island are more similar to those on the Chetwode islands (especially Te Kakaho) than they are to montane forest in the Tararua Ranges.

Parakeets should exploit the super abundance of exotic grass seed on Mana Island. It is unlikely that parakeets would have any major impact on threatened plants on Mana, as all plants in the Cook Strait Ecological District would have evolved in the presence of parakeets. There are no other apparent conflicts between the reintroduction of parakeets and other conservation objectives on Mana Island.

Management action

Discuss transfer of yellow-crowned parakeets from Chetwode Islands with Nelson/Marlborough Conservancy and relevant iwi. Seek support for transfer of 20-30 yellow-crowned parakeets from Te Kakaho to Mana Island. Erect nest boxes in the most established plantings and monitor their use. Monitor parakeet flocks for the presence of red-crowned parakeets.

34. Shining cuckoo (pipiwharuroa)

The shining cuckoo is a brood-parasite of the grey warbler. Both species are widespread on the mainland. Shining cuckoos are migratory, and well able to colonise Mana Island naturally. More shining cuckoos are likely to occur on Mana as the forest cover increases, and grey warblers become more abundant.

Management action

Continue revegetation programme. Record sightings of shining cuckoo adults and fledglings.

35. Long-tailed cuckoo (koekoea)

The long-tailed cuckoo is a brood parasite of the whitehead. Both species are widespread in forests of central and southern North Island. Long-tailed cuckoos are migratory, and well able to colonise Mana Island naturally; one was recorded there in March 1998 (G.Timlin pers. comm.) However, they will not breed successfully until whitehead are established.

Management action

Continue revegetation programme. Reintroduce whitehead. Record sightings of long-tailed cuckoo adults and fledglings.

36. Morepork (ruru)

Moreporks were regularly reported on Mana before mice were eradicated. Reports since the mouse eradication have been irregular, and morepork are not considered resident on the island. Moreporks are expected to recolonise Mana Island naturally; as they are the top nocturnal predator in New Zealand forest ecosystems, deliberate reintroduction of moreporks is not considered appropriate, at least until all nocturnal invertebrates and reptiles introduced as part of this restoration plan are well established. Note that moreporks are also potential predators of petrels, snipe, and roosting bushbirds, but are unlikely to limit established populations.

Management action

Check for presence of moreporks before any liberations of nocturnal reptiles and large bodied invertebrates. If necessary, construct exclosures to keep morepork out of liberation sites.

37. New Zealand kingfisher (kotare)

Kingfishers are present on Mana Island in low numbers, although there is no evidence of breeding. This may be due to a paucity of nest sites. In forest ecosystems kingfishers typically nest in holes in trees, but they also use holes in banks. Road cuttings may provide potential nest sites on Mana Island, but potential nest sites will increase with maturing forest cover.

Management action

Record evidence of breeding by kingfishers.

38. Rock wren

Criterion (b). New Zealand wrens form an endemic family that was formerly one of the most diverse groups of landbirds in New Zealand. Six species and three subspecies are recognised in Turbott (1991), and a seventh species has since been described (Millener & Worthy 1991). Three of these species are known only from subfossil remains, and a further two have become extinct in the last 100 years. It is likely that at least four species occurred in the Wellington region, but the only confirmed species are rifleman (still present in Tararua, Rimutaka and Aorangi Ranges), North Island bush wren (two specimens from Rimutaka Range, 1850) and North Island stout-legged wren (subfossil bones from Wairarapa).

The bush wren is considered to have become extinct following the invasion of Big South Cape Island by ship rats in the 1960s (Bell 1978), leaving the rock wren as the only surviving species in the genus *Xenicus*. Atkinson (1990) developed an argument for attempting to re-establish a lowland population of *Xenicus* by introducing rock wren to Matiu/Somes and Mana Islands. The hope is that this introduced population would become adapted to living in forest, thus restoring some of the ecological and evolutionary processes lost with the extinction of the bush wren. This proposed experiment is given even greater poignancy following the suggestion by Worthy & Holdaway (1993) that the rock wren and bush wren may be forms of the same species. If this is the case, then liberating rock wren on Matiu/Somes and Mana islands would be restoring a species to the Wellington region that has been absent for over 140 years.

Potential conflicts between rock wren and other conservation values on Matiu/Somes and Mana Islands are discussed by Atkinson (1990). The only apparent conflict is potential predation of giant weta nymphs by rock wren. This could be checked by introducing both giant wets and rock wren to Matiu/Somes Island initially, and only transferring rock wren to Mana if both species become established successfully.

Management action

Support introduction of Cook Strait giant wets and rock wren to Matiu/Somes Island. If giant weta become established in the presence of rock wren, and rock wren establish successfully, then transfer rock wren from Matiu to Mana Island.

39. Welcome swallow

Welcome swallows are common on Mana Island, breeding around the buildings and in sea caves.

Management action

None required.

40. New Zealand pipit (pihoihoi)

Pipits occur on Mana Island in low numbers. Breeding has not been recorded. Pipits are birds of open country, and remain widespread throughout New Zealand.

Management action

None required.

41. North island fernbird (matata)

Criterion (a). Fernbird bones have been found on Mana Island. The nearest surviving population of North Island fernbird is at the Manawatu Estuary.

Five taxa of fernbird are recognised. The Chatham Island fernbird is extinct. The Snares Island fernbird is naturally confined to a small archipelago, and could become extinct following a single predator introduction. The Codfish Island fernbird is naturally confined to a single island, and could also become extinct following a single predator introduction. The Stewart Island fernbird is scarce on Stewart Island, but occurs abundantly on at least nine islands around Stewart Island; it has recently been exterminated by ship rats, cats and/or weka on a further six islands. The South Island fernbird is widespread in Nelson, the West Coast (including Open Bay Islands), Otago and Southland. The North Island fernbird is widespread in Northland, but patchy in central North Island and scarce as far south as Manawatu and southern Hawkes Bay. It was found at Lake Wairarapa as recently as 1948 (Watt *et al.* 1949). The North Island fernbird is also found on Great Barrier Island, and formerly occurred on Great Island (Three Kings Is) and the Alderman Islands.

Of the extant fernbird taxa, Snares Island fernbird and Codfish Island fernbird are the forms that most urgently require transfer to further predator-free islands (Table 8.2). However, it is not necessary to move either taxa 840-1000 km north to Mana Island, which would have formerly held North Island fernbird. Snares island fernbirds could be translocated to Mangere (and other) Islands in the Chatham Islands to replace the extinct Chatham Island fernbird; Codfish Island fernbirds

could be translocated to nearby Solander Island if weka are eradicated. Reintroducing North Island fernbird to Mana Island would restore the fernbird taxon most likely to have been present, as well as restoring a species no longer present in Wellington Conservancy.

Fernbirds are usually thought of as inhabitants of densely vegetated wetlands or pakihi scrublands, as these are the habitats most often occupied on the three main islands, Great Barrier Island and Codfish Island. However, fernbirds inhabit tall scrub and tussock grasslands on the Snares Islands, islands off Stewart Island and on the Open Bay Islands; all these islands are free of introduced mammals. The implication is that fernbirds have broad habitat requirements, but are confined to densely vegetated wetlands in the presence of rats and other predators.

Habitat preferences by North island fernbirds on predator-free islands are poorly known. They became extinct on Great Island between 1887 and 1934, apparently due to vegetational changes caused by goats (Turbott 1948; Turbott & Buddle 1948). Fernbirds disappeared from the Alderman Islands between 1927 and 1950 (Sladden & Falla 1927 & 1928; Falla 1953). Fogarty & Douglas (1973) suggested that regeneration had destroyed fernbird habitat on the Alderman Islands. As any North Island fernbirds released on Mana Island are likely to have come from wetland habitats, it would be prudent to restore the wetland on the island beforehand, even if fernbirds subsequently utilise grass and shrubland habitats on the island.

There are no apparent conflicts between reintroducing North Island fernbirds and other conservation objectives on Mana Island.

Management action

Restore Waikoko wetland. Translocate North Island fernbirds from the nearest viable population (?Manawatu Estuary).

42. Whitehead (popokatea)

Criterion (a). Whitehead bones have been found on Mana Island, and whiteheads remain abundant on Kapiti Island in both seral and mature forest. A successful transfer of whiteheads to Tiritiri Matangi Island from Little Barrier Island occurred five years after the revegetation programme on Tiritiri Matangi was initiated (Allen 1990), however, Tiritiri Matangi had a larger area of existing forest than Mana Island does. Mana Island could probably support a small whitehead population now, but translocation should wait 5-10 years until the existing plantings have formed a closed canopy.

There are no apparent conflicts between the reintroduction of whiteheads and other conservation objectives on Mana Island.

Management action

Transfer whiteheads from Kapiti to Mana Island when there is at least 10 ha of closed canopy scrub.

43. Grey warbler (riroriro)

Grey warblers are common in scrub and the more established plantings on Mana Island.

Management action

None required.

44. North Island fantail (piwakawaka)

Fantails are abundant on Mana Island.

Management action

None required.

45. Snares Island tomtit

Criterion (c). There is no evidence that tomtits occurred on Mana, although this is possible given their presence on Kapiti Island. North Island tomtits are widespread in forested areas of the North Island, as well as on Hen and Chickens, Little and Great Barrier and Kapiti Islands; further island introductions are not required to ensure its survival. There is a slight chance that North Island tomtits will colonise Mana Island naturally.

Although it would be biogeographically and ecologically more appropriate to introduce North Island tomtits to Mana Island, it may be prudent to leave the tomtit niche vacant in case a transfer site for Snares Island tomtits is required in an emergency.

The Snares Islands are a small archipelago of about 350 ha. The two islands large enough to hold resident populations of the three endemic landbird species are separated by a channel of only 100 metres. If ship rats or some other terrestrial predator colonised either North East or Broughton Islands, there is a high probability that Snares Island snipe, Snares Island fernbird and Snares Island tomtit would all become extinct within a couple of years. There is potential to use the snipe and fernbird to replace extinct taxa (Stewart Island snipe and Chatham Island fernbird) as part of other island restoration programmes (Table 8.2); this should occur before Snares Island landbirds are placed under immediate threat of extinction. However, there is no apparent site where it would be appropriate to establish a new "permanent" population of the Snares Island tomtit. As a sufficiently large, highly modified, predator-free island that is accessible but reasonably remote from other tomtit populations, Mana fits many of the criteria for a "lifeboat" island that could be used to maintain Snares Island tomtits in an emergency, until the predator introduced to the Snares is eradicated, and tomtits (along with snipe and fernbird) can be reintroduced.

Management action

Do not introduce North Island tomtits to Mana Island. If rats or other mammalian predators colonise the Snares Islands, transfer Snares Island tomtits to Mana Island until they can be returned to the Snares Islands (i.e., following predator eradication). The fate of any Snares Islands tomtits remaining on Mana Island should be determined following reintroduction to Snares Islands, and assessment of risk of reinvasion by predators.

46. North island robin (toutouwai)

Criterion (a). Robin bones have been found on Mana, and robins remain abundant on Kapiti Island. Robins are no longer present elsewhere in Wellington Conservancy.

All three subspecies of New Zealand robin have patchy distributions on the three main islands, but each also occurs on two or more offshore islands. Successful translocations of North and South Island robins to predator-free islands have been carried out, and there are further opportunities to introduce all three subspecies to other islands within appropriate ecological districts. The closely related black robin of the Chatham Islands is now confined to two islands, with no prospect of range expansion until cats and weka are eradicated from large areas of Pitt Island. However, as two separate predator invasions would have to occur to seriously endanger the black robin, there is no pressing need to introduce black robins to an island outside the Chatham Islands.

Bait trials on Kapiti Island indicated that robins could be vulnerable to nontarget poisoning during a toxic airdrop to eradicate rats. As a precaution, two transfers of robins to Mana Island were made in 1995 and 1996, and robins are now well established there.

Robins are diurnal insectivores that mainly forage on or near the forest floor. While it is possible that robins could consume giant weta nymphs, there is unlikely to be much overlap in robin and giant weta distribution on Mana. The Cook Strait giant weta is active at night and is mainly found in grassland and at the shrubland/grassland interface, whereas robins prefer a closed canopy with little ground vegetation. None of the threatened invertebrates being considered for release on Mana are likely to be threatened by the presence of robins.

Management action

Monitor robin diet and distribution on Mana to ensure that giant weta or other threatened invertebrate populations are not being adversely affected.

47. Silvereeye (tauhou)

Silvereeyes are abundant on Mana Island.

Management action

None required.

48. [Stitchbird (hihi)]

Stitchbirds formerly occurred in the southern North Island and on Kapiti Island, but from about 1885 became confined to Little Barrier Island. Attempts to translocate stitchbird to other islands (including Kapiti Island) have not been particularly successful to date, although the reasons for this are unclear. Stitchbirds on Little Barrier Island are sympatric with New Zealand's two other honeyeater species (bellbird and tui). Of the three species, stitchbirds take the highest proportion of fruit (Table 8.5), but there is no obvious feature of their feeding ecology that predisposes them to local extinctions (Angehr 1986).

The forest on Kapiti Island has been regenerating for 100 years, but may still not be sufficiently diverse to support stitchbird. It may be unrealistic to expect Mana Island to provide suitable habitat for stitchbird in the short or medium term, but this should be reviewed if new information on the factors limiting stitchbird populations comes to light following further translocation attempts and pest eradications.

TABLE 8.5 DIET OF THREE HONEYEATER SPECIES ON LITTLE BARRIER ISLAND
 APRIL 1982 TO MARCH 1983 EXPRESSED AS PERCENTAGE OF FEEDING
 OBSERVATIONS (FROM ANGEHR 1986).

	NECTAR	INSECTS	FRUIT
Stitchbird	40	33	27
Bellbird (male)	32	66	2
Bellbird (female)	71	27	2
Tui	81	10	9

Management action

Do not introduce stitchbirds to Mana Island unless evidence from other island liberations and pest eradications suggest that suitable habitat is present on Mana.

49. Bellbird (korimako)

Criterion (a). Bellbird bones have been found on Mana, and bellbirds remain abundant on Kapiti Island. Bellbirds are the most insectivorous of the honeyeaters (Table 8.5) and it is expected that sufficient habitat will be created on Mana when the existing plantings form a closed canopy (5-10 years). While bellbirds may be able to fly to Mana Island naturally, evidence from Auckland and Northland shows that male bellbirds disperse much more than females (Craig & Douglas 1984), and so new breeding populations take many years to establish.

As pollinators, bellbirds play an important role in maintaining a natural forest ecosystem. For this reason, bellbirds should be reintroduced to Mana as soon as habitat there appears suitable. There are no apparent conflicts with other conservation objectives on the island, although the presence of bellbirds may reduce the suitability of Mana Island for stitchbirds if/when the forest is sufficiently diverse to support stitchbirds. However, as bellbirds are known to have occurred on Mana Island in the past, their reintroduction should remain a priority.

Management action

Reintroduce bellbirds to Mana Island from Kapiti Island as soon as there is sufficient forest/shrub cover on Mana Island.

50. Tui

Criterion (a). Tui bones were the most abundant bird bones in middens on Mana Island (Horwood 1991). Occasional birds visit Mana when flax is in flower (Phil Todd pers.comm.). It is not known whether both sexes visit the island, but there is a chance that tui will colonise Mana naturally when a sufficient diversity and abundance of nectar and berry producing plants is established. Tui take a greater proportion of nectar and fruit than do bellbirds (Table 8.5), and so it may take a few more years for the habitat on Mana to be sufficient to support a resident tui population.

Tui are important pollinators and seed dispersers of native trees and shrubs. The re-establishment of tui would be a significant step in restoring natural processes in the forest ecosystem on Mana. There are no apparent conflicts with other conservation objectives on the island.

Management action

Record the timing and duration of visits by tui on Mana Island, and note diet. If tui are no longer visiting Mana when habitat appears to be suitable for them, conduct a trial liberation of adults and juveniles from Kapiti Island.

51. [North Island kokako]

Kokako apparently were not numerous in the southern North Island during European colonisation. There is no direct evidence that they occurred on Mana Island, but South Island kokako were present on Stephens Island (Cook Strait Ecological District). Translocations of kokako have been attempted to two large islands with extensive forest cover: the initial liberations on Little Barrier were very successful, but it is too early to determine the success of liberations on Kapiti Island. Kokako are thought to require tall, multi-layered podocarp/broadleaved forest, as they are confined to such habitats on the North Island mainland and on the islands to which they have been introduced. It is doubtful that Mana Island would ever support sufficient podocarp forest to hold a resident kokako population. However, the former presence of kokako on Stephens Island (150 ha) suggests that in the absence of mammalian predators and competitors, South Island kokako (at least) could survive in low, windswept forest with few podocarps. Whether North Island kokako could survive in seral forest on a small island could be determined by a trial release on, e.g., Tiritiri Matangi Island, where the revegetation programme is more advanced than on Mana. The suitability (and necessity) of Mana Island for kokako should be assessed following such a trial.

Management action

Do not introduce kokako to Mana Island unless evidence from other island liberations suggests that suitable habitat is present on Mana.

52. [North Island saddleback (tieke)]

Saddlebacks formerly occurred throughout the North Island and on at least five offshore islands including (apparently) Kapiti Island. There is no evidence that saddleback occurred on Mana Island, and the absence of their bones from middens there seems surprising given the assemblage of other bushbirds present. Predation by introduced mammals eventually confined the North Island saddleback to Hen Island only. From this one population, North Island saddlebacks have been successfully introduced (or reintroduced) to eight islands that have (or had) kiore (Lovegrove 1996). On Kapiti Island reintroduced saddlebacks maintained a precarious toehold due to predation by Norway rats, but should become well established if rat eradication has been successful.

The South Island saddleback would be extinct but for a successful rescue operation following the invasion of Big South Cape Island by ship rats. South Island saddlebacks now occur on nine small islands around Stewart Island, and have recently been released on Breaksea Island (Fiordland) and Motuara Island (Queen

Charlotte Sound; Lovegrove 1996). With the increasing success of rat eradications on islands, the survival prospects for both subspecies of saddleback becomes more secure each year.

Saddlebacks are vigorous foragers that are capable of taking large-bodied invertebrates. Of all the New Zealand passerines, the saddleback is the species most likely to consume species such as giant weta and large weevils. Recent evidence from Breaksea Island indicates that two species of large weevil have successfully established in the presence of an expanding population of saddlebacks (Thomas *et al.* 1992; Bruce Thomas pers.comm.), but there is no need to expose threatened invertebrates on Mana Island to saddleback predation given the number of islands where saddlebacks are now found, and the absence of evidence for the former occurrence of saddlebacks on Mana. The long-term presence of saddlebacks on Mana (and the Wellington region) should be reassessed following the success or otherwise of rat eradication on Kapiti Island.

Management action

Do not introduce saddlebacks to Mana Island. Reassess the potential impacts of saddlebacks on Mana Island invertebrates if rat eradication on Kapiti Island is unsuccessful.

8.6 NON-INDIGENOUS BIRDS ON MANA ISLAND

Eighteen species of introduced birds have been recorded from Mana Island (Table 8.6). As the restoration goal for Mana Island is to restore the island to a state similar to what existed before human contact, the continued existence of populations of any introduced bird species conflicts with the overall restoration programme. Introduced birds could potentially compromise other conservation values on Mana Island by competing for food and nest sites, direct predation (especially magpie), seed destruction, and dispersal of weed seeds. Potential benefits of the presence of introduced bird species include seed dispersal of native plants, high nutrient inputs below starling roosts (possibly analogous to the high nutrient input occurring around petrel colonies), and control of introduced invertebrates. The mosaic of habitats that will be created on Mana Island by the restoration programme will undoubtedly provide suitable habitats for all the species in Table 8.6 (with the possible exceptions of black swan and sulphur-crested cockatoo). Most of these bird species are extremely mobile and will undoubtedly continue to recolonise Mana Island even if the local population dies out or is eradicated. The high costs of attempting to control most species of introduced birds on Mana Island are not justified by the conservation gains that would be achieved. Management of those species for which control (or eradication) is feasible is discussed under "Control of animal pests".

8.7 HABITAT CREATION FOR BIRDS

Suitable habitat is already present on Mana Island for nine of the bird species proposed for introduction or attraction (fluttering shearwater, fairy prion, diving petrel, gannet, banded rail, shore plover, Chatham Island snipe, yellow-crowned

parakeet and, possibly, rock wren). Completion of the planting programme will create sufficient forest habitat to support resident populations of little spotted kiwi, New Zealand pigeon, kaka, whitehead, robin, bellbird and tui within the next twenty years. Restoration of Waikoko wetland is regarded as necessary before brown teal and fernbird are reintroduced, and creation and maintenance of a network of small wetlands will provide habitat for takahe, brown teal and fernbird.

TABLE 8.6 INTRODUCED BIRD SPECIES RECORDED FROM MANA ISLAND. MAGPIES HAVE BEEN ERADICATED BY SHOOTING, AND BLACK SWAN, SULPHUR-CRESTED COCKATOO AND CIRL BUNTING ARE INFREQUENT VISITORS. THE SINGLE RED-RUMPED PARROT FOUND ON THE ISLAND IN MARCH 1996 WAS PROBABLY A CAGE ESCAPE, BUT ITS ORIGIN REMAINS A MYSTERY.

Black swan	Mallard	Rock pigeon
Sulphur-crested cockatoo	Red-rumped parrot	Skylark
Hedge sparrow	Blackbird	Song thrush
Yellowhammer	Cirl bunting	Chaffinch
Greenfinch	Goldfinch	Redpoll
House sparrow	Starling	Australian magpie

There is already suitable habitat on Mana Island for Snares Island tomtit if required, but further reforestation will enhance the suitability of Mana Island as a "nursery" for young brown kiwi. Many of the plant species used in the planting programme are eaten by kakapo, but it is anticipated that provision of supplementary food will be necessary as part of any future intensive management of kakapo on Mana Island.

Smaller scale habitat manipulation for birds on Mana Island will include: excavation of artificial burrows to aid attraction of burrowing seabirds, planting toetoe and sedges around ponds to provide takahe nest sites, keeping existing tracks and the beach ridge mown to provide some areas of low turf for shore plover, and providing nest boxes for parakeets and kaka.

8.8 ACTION PLAN

Assuming that the revegetation programme is completed in the next 15 years, and that the main wetland on Mana Island is restored, it should be possible to introduce one or two species of bird per year for the next ten years, while experiments to attract four species of seabird continue concurrently (Table 8.7). The sequence of introductions should be:

1999-2003 little spotted kiwi, shore plover, Chatham Island snipe, yellow-crowned parakeet

2000-2005 (assuming that Waikoko wetland is restored) brown teal, fernbird

2001-2005 New Zealand pigeon, whitehead, bellbird, tui

2006-2010 kaka

2006-2010 (assuming that initial introduction to Matiu/Somes Island has been successful) rock wren

TABLE 8.7 SUMMARY OF BIRD SPECIES RECOMMENDED FOR TRANSLOCATION OR ATTRACTION TO MANA ISLAND. TIMING IS BASED ON HOW SOON SUITABLE HABITAT IS EXPECTED TO BE AVAILABLE, AND THUS REPRESENTS HOW SOON A SPECIES COULD BE RELEASED RATHER THAN A WINDOW OF OPPORTUNITY THAT WOULD OTHERWISE BE MISSED. NOTE HOWEVER THAT THE TIMING OF INTRODUCTION OF BANDED RAIL (ESTIMATED AT 20+ YEARS) IS DEPENDENT ON THE SUCCESSFUL ESTABLISHMENT OF ALL OTHER SPECIES PROPOSED FOR INTRODUCTION (INCLUDING REPTILES AND INVERTEBRATES).

ESTABLISH SELF-SUSTAINING POPULATIONS	TIMING	SOURCE/COMMENT
Little spotted kiwi	Continuing	Franz Josef/Kapiti, 2 birds present
Fluttering shearwater	1-5 years	Cook Strait islands, trial underway
Fairy prion	1-5 years	Cook Strait islands, trial underway
Diving petrel	1-5 years	Cook Strait islands, trial underway
Australasian gannet	1-5 years	Attract birds foraging offshore, trial underway
Brown teal	1-5 years	Ducks Unlimited/Great Barrier I. Restore wetland first
Banded rail	20+ years	Marlborough Sounds/Tasman Bay/Golden Bay
Shore plover	1-5 years	Rangatira Island via National Wildlife Centre
Chatham Island snipe	1-5 years	Rangatira Island. Restore evolutionary potential
New Zealand pigeon	5-10 years	Kapiti Island. Important seed disperser
North Island kaka	10+ years	Kapiti Island. Needs extensive forest
Yellow-crowned parakeet	1-5 years	Chetwode Islands
Rock wren	1-5 years	?Fox Glacier. Restore evolutionary potential
North Island fernbird	1-5 years	?Manawatu Estuary. Restore wetland first
Whitehead	5-10 years	Kapiti Island. Await further revegetation
North Island robin	1995-96	Kapiti Island. Apparently established
Bellbird	5-10 years	Kapiti Island. Important pollinator
Tui	5-10 years	Kapiti Island. Important pollinator

TABLE 8.7 CONTINUED

INTENSIVE MANAGEMENT IN SHORT/MEDIUM TERM	COMMENT
Other kiwi sp.	?Nursery for captive-hatched Haast tokoeka until large enough to cope with suite of predators present on mainland.
Takahe	Supplementary feeding, ?cross-fostering to pukeko, and translocation of young between islands to reduce inbreeding.
Kakapo	Supplementary feeding, intensive management (if required by Kakapo Recovery Programme)
INTRODUCE ONLY IF UNDER IMMEDIATE THREAT OF EXTINCTION	COMMENT
Snares Island tomtit	Introduce only if rats or other predators colonise Snares, and if North Island tomtit has not colonised naturally in the interim.