

Recovery Plans

This is one of a series of recovery plans produced by the Department of Conservation (DOC). Recovery plans are statements of the Department's intentions for the conservation of particular plants and animals for a defined period. In focusing on goals and objectives for management, recovery plans serve to guide the Department in its allocation of resources and to promote discussion amongst a wider section of the interested public.

After preparing a technical report that was refined by scientists and managers, both within and outside the department, a draft of this document was sent to relevant Conservation Boards, Iwi, scientists, non-Government organisations, and DOC offices for comment. After further refinement, this plan was formally approved by the Regional General Manager (Northern) in July 2004. The life of this plan is suggested as 5 years (2009) or sooner if new information leads to proposals for a significant change in direction. This plan will remain operational until a reviewed plan is in place.

The Department acknowledges the need to take account of the views of the tangata whenua and the application of their values in the conservation of natural resources. While the expression of these values may vary, the recovery planning process provides opportunities for consultation between the Department and the tangata whenua. Departmental Conservancy Kaupapa Atawhai Managers are available to facilitate this dialogue.

A recovery group consisting of people with knowledge of hihi/stitchbird and with an interest in their conservation has been established. The purpose of the Recovery Group is to review progress in the implementation of this plan and to recommend to the Department any changes, which may be required as management proceeds. Comments and suggestions relating to the conservation of hihi are welcome and should be directed to the recovery group via any office of the Department or to the Biodiversity Recovery Unit.

Published Recovery Plans

NO.	SPECIES	YEAR APPROVED
53	New Zealand non-migratory galaxiid fishes	2004
52	Grassy plants of fertile sites	2004
51	Mudfish (<i>Neochanna</i> spp.)	2003
50	Kiwi (<i>Apteryx</i> sp.)	2003
49	<i>Powelliphanta</i> land snails	2003
48	North Island <i>Oligosoma</i> spp. skink	2002
47	Tuatara	2001
46	Chatham Island fantail, Chatham Island tomtit and Chatham Island warbler	2001
45	Forbes' parakeet and Chatham Island red-crowned parakeet	2001
44	New Zealand shore plover	2001
43	Chatham Island shag and Pitt Island shag	2001
42	Chatham Island mollymawk, northern royal albatross, Pacific mollymawk	2001
41	Chatham Island tui	2001
40	Black robin	2001
39	Parea	2001
38	Chatham Island oystercatcher	2001
37	Chatham petrel	2001
36	Chatham Island taiko	2001
35	Hoiho	2001
34	Pygmy button daisy	2001
33	<i>Hebe cupressoides</i>	2000
32*	Inland <i>Lepidium</i>	2000
31	<i>Muehlenbeckia astonii</i>	2000
30	North Island kokako	1999
29*	Weka	1999
28*	<i>Pittosporum patulum</i>	1999
27	<i>Cyclodina</i> skinks	1999
26	Coastal cresses	1999
25	Threatened weta	1998
24	Striped skink	1998
23*	Fairy tern	1997
22*	Blue duck	1997
21	Kakapo	1996
20	Stitchbird	1996
19*	Brown teal	1996
18*	Native frogs	1996
17*	New Zealand (Hooker's) sea lion	1995
16*	<i>Dactylanthus taylorii</i>	1995
15*	Bat (peka peka)	1995
14	Otago and grand skinks	1995
13*	Giant land snail	1995
12*	Takahe	1994
11*	South Island saddleback	1994
10*	New Zealand dotterel	1993
9*	Tuatara	1993
8*	Kowhai ngutukaka	1993
7*	Subantarctic teal	1993
6*	Mohua (yellowhead)	1993
5	Chevron skink	1993
4	Black stilt	1993
3*	Whitaker's and robust skinks	1992
2	Kiwi	1991
1*	North Island kokako	1991
—*	Yellow-eyed penguin	1991

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Hihi/stitchbird (*Notiomystis cincta*) recovery plan

2004-09

THREATENED SPECIES RECOVERY PLAN 54

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Abstract

The hihi/stitchbird (*Notiomystis cincta*) is a medium-sized forest-dwelling passerine that once occurred throughout the North Island of New Zealand. European colonisation, introduced predators, habitat loss and, possibly, disease reduced the distribution of hihi to Hauturu/Little Barrier Island in the Hauraki Gulf, where they have persisted to the present day. Recovery efforts first initiated in the 1980s have, to date, failed to establish further self-sustaining populations, although small populations remain at two of the translocation sites in the presence of supportive management. With the Hauturu population being the only population of reasonable size, hihi are currently still vulnerable to extinction. For this reason, establishing additional populations remains a core focus for hihi recovery. The likelihood of success of future translocations, however, cannot presently be fully evaluated because information on the factors limiting establishment is incomplete. Consequently, research into the requirements for establishing hihi populations is considered one of the highest priorities for hihi recovery. Future translocations of hihi will remain a central activity of the recovery programme but success of these cannot be guaranteed until such questions have been answered.

1. Introduction

The hihi/stitchbird (*Notiomystis cincta*) is a medium-sized (30–40 g) endemic forest-dwelling passerine. This species is currently categorised along with tui (*Prosthemadera novaeseelandiae*) and korimako/bellbird (*Anthornis melanura*) as a member of the honeyeater family (Meliphagidae). However, recent analysis of DNA has shown that hihi is not a honeyeater (Driskell 2001; Brian Gill pers. comm.). More work is required to clarify the phylogeny of hihi, but it is possible that hihi could be the sole representative of a new family endemic to New Zealand.

Hihi have a number of distinctive physical, behavioural, ecological and physiological attributes. For instance, they have relatively large eyes and long ‘whiskers’ around the base of the beak. Another distinguishing feature is their often upward-tilted tail. Hihi build their nests in tree cavities, a behavioural trait considered to exacerbate their susceptibility to the impacts of forest clearance and introduced mammalian predators.

Hihi are sexually dimorphic: male hihi are more colourful, with a jet-black head and white ‘ear’ tufts, bright yellow shoulder coverts and breast band, a white wing bar and a mottled tan to grey-brown body cover; females are smaller and have a more sombre olive to grey-brown body not unlike a female korimako (Fig. 1), but with a distinctive white wing bar similar to that of the male. The mating system is characterised by frequent forced copulation attempts by extra-male pairs, and can include various types of polygamy as well as social monogamy (Castro et al. 1996; Ewen et al. 1999).

Figure 1. Female hihi.
Photo: Rob Suisted.



Hihi seldom leave the cover of the forest. In dense forest, hihi are readily detected by their strident call, which Buller (1888) noted as ‘a fanciful resemblance to the word “stitch”’. Males also have a powerful ‘tiaora’ note, and both sexes have a low warbling song which may last several minutes. Hihi often give an alarm call when disturbed, not unlike that of the korimako, but higher in pitch (Higgins et al. 2001).

In pre-European times, hihi occurred throughout the North Island mainland and on Great Barrier Island (Aotea Island), Hauturu/Little Barrier Island and Kapiti Island. Introduced predators, habitat loss, and (possibly) disease, reduced the distribution to Hauturu. Despite attempts to establish self-sustaining¹ populations on Hen Island (in the Hen and Chicken Islands), Cuvier Island (Repanga Island), Kapiti, Mokoia and Tiritiri Matangi Islands; Hauturu remains the only place where a population persists in the absence of supportive management. There is a small captive population at the National Wildlife Centre at Mount Bruce; however, it cannot be considered insurance against loss in the wild.

Thus, despite recovery efforts, the fate of the hihi remains inextricably linked to Hauturu. While protection of the island in the nineteenth century undoubtedly saved the hihi from extinction, we cannot be complacent about its future. The Hauraki Gulf is subject to the highest recreational and commercial pressures of any marine area in New Zealand. The chance of fire, an invasion of ship rats (*Rattus rattus*) or the introduction of an avian disease to Hauturu is a real possibility. Any of these events could lead to the extinction of this endemic species.

The first hihi recovery plan (1996–2001) focused upon research, development of management techniques and translocation to improve the status of hihi. Much was learned during this period (Appendix 1) and a suite of management techniques is now available. However, the success of establishing new hihi populations has been variable. The present hihi recovery plan has a term of five years, operating over the period 2004–2009.

¹ A self-sustaining population is defined in this recovery plan as one that doesn’t require supplementary food or the intensive management of nest boxes to remain viable.

Under the Department of Conservation's (DOC's) 'Threat of Extinction' classification system, hihi are listed as Nationally Endangered, with the following qualifiers: Stable, Human Induced, and One Location (Hitchmough 2002). This ranking incorporates the high risk of extinction posed by an unusually high vulnerability to disease and the risk of predator invasions to the one self-sustaining population. The poor success of past translocations was also taken into account (Rod Hitchmough pers. comm.). This classification puts hihi into the category of species considered to be 'most at risk' (Molloy et al. 2002).

2. Past and present distribution and population trends

In pre-European times, hihi were found throughout the North Island mainland and on Great Barrier Island, Hauturu and Kapiti Island. By 1873, hihi were rare in the north of the North Island but were still relatively common in the south (Buller 1888). Hihi seemed to vanish from Great Barrier and Kapiti Islands at about this time (Oliver 1955). By the 1880s hihi were extinct everywhere except Hauturu; the last recorded sighting on the mainland being in the Tararua Ranges in the south of the North Island in 1883.

Hihi have been transferred from Hauturu to five other islands (see Section 5: Past Conservation Efforts); populations survive at only two translocation sites and supportive management is in place at these locations (Figs 2 & 3). Hihi translocated to Cuvier, Hen and Kapiti Islands in the 1980s did not establish (Angehr 1984; Lovegrove 1986; Rasch et al. 1996), while those translocated to Kapiti and Mokoia Islands in the 1990s declined without supportive management (Castro 1991, 1993; Empson 1992; Armstrong et al. 1997, 1999; Haxton 1999; Castro et al. 2003).

Supportive management techniques were developed between 1991 and 1994 as part of research carried out on the translocated populations on Kapiti and Mokoia Islands (Griffiths 2000; Taylor & Castro 2000a). Hihi were introduced to Tiritiri Matangi Island in 1995 and 1996. Supportive management was implemented soon after their introduction and has been maintained on the island since. Tiritiri Matangi is the only site where steady population growth has been attained (Fig. 3) (Ewen 1996; Wilson 1998; Taylor 1999, 2000; Stamp 2001; Fraser 2002). The remaining hihi on Mokoia Island were relocated to Kapiti Island in 2002, where ongoing supportive management was implemented in 2000 (Griffiths 2002; Owen 2003).

The number of hihi on Hauturu is unknown; estimates range from 600 to 6000 individuals. No information is available on population trends; consequently, population fluctuations and basic demographic parameters are unknown. The combined population from Tiritiri Matangi and Kapiti Islands is approximately 130 birds. A captive population (fluctuating between 5 and 12 birds) is maintained at Mt Bruce Wildlife Centre for research, breeding for release and advocacy purposes.

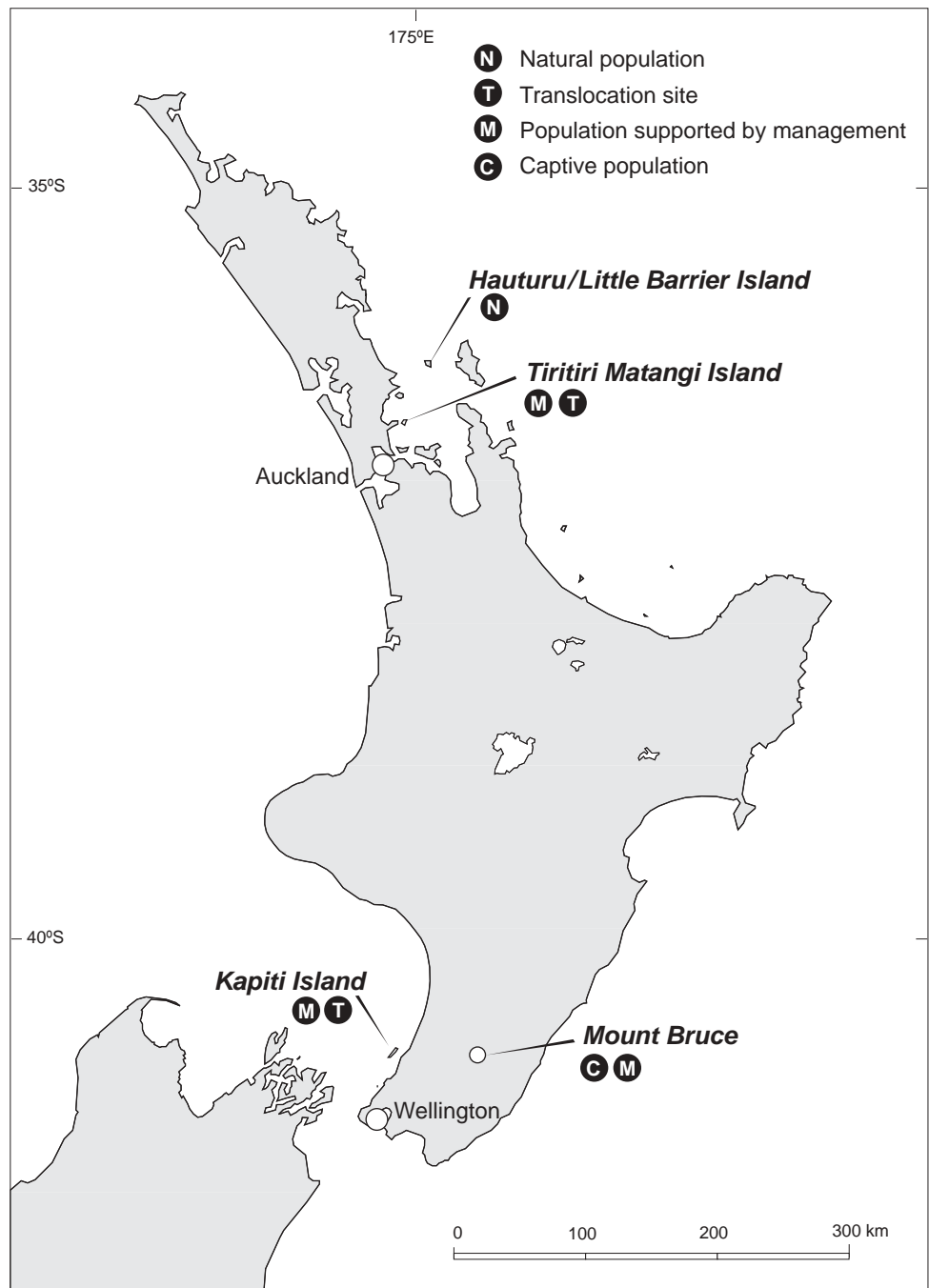


Figure 2. Current distribution of hihi. Historical records indicate that hihi formerly occurred throughout the North Island, as well as on Great Barrier Island, Hauturu/Little Barrier Island and Kapiti Island (Oliver 1955).

3. Agents of decline and threats

Loss of habitat, the introduction of mammalian predators and the arrival of new avian diseases have been postulated as the most likely causes of the extinction of hihi on the mainland. As a cavity nester, hihi are obligate inhabitants of mature forest and would have undergone a severe reduction in range following the clearance of lowland forest.

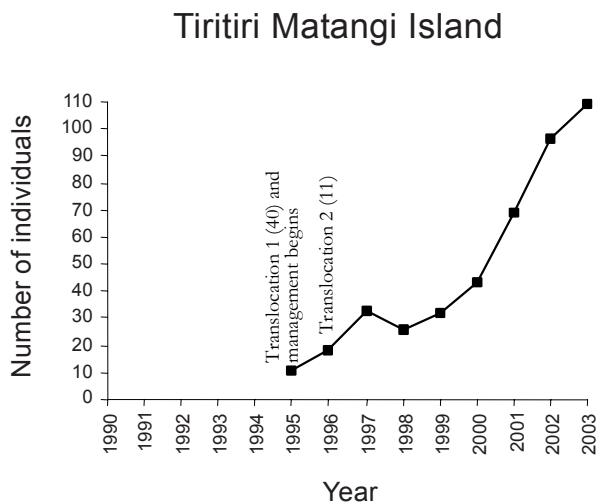
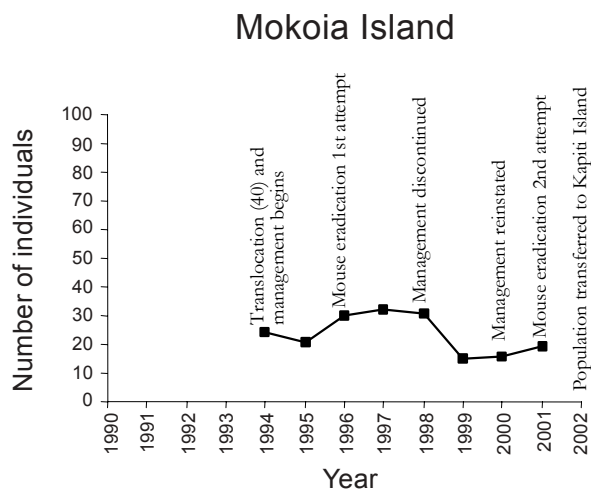
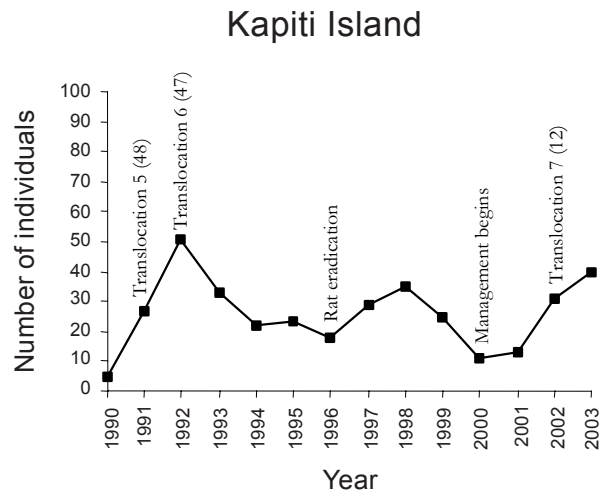


Figure 3. Population estimates of hihi at translocation sites from survey counts of birds during October–November. In parentheses are the numbers of birds that have been translocated. NB. No monitoring was carried out on Kapiti between 1983 and 1990. Four transfers, totaling 72 birds, took place during this period.

Of the introduced mammalian predators, ship rats are likely to have played the greatest role in the extinction of hihi on the mainland because of their ability to prey on eggs, chicks, roosting adults and, probably, incubating females during the breeding season. The habit of nesting and roosting in cavities makes hihi particularly susceptible to predation. Hihi persisted on the mainland and Hauturu in the presence of cats (*Felis catus*) (Veitch 1980) and kiore (*Rattus exulans*), and on Kapiti Island in the presence of both kiore and Norway rats (*R. norvegicus*). While mustelids (*Mustela* spp.) were not introduced into New Zealand until the late 1800s and are unlikely to have played a role in the extinction of hihi on the mainland, they are considered a potentially significant predator. Consequently, mustelids, particularly stoats (*M. erminea*), must be a major consideration for biosecurity on islands with hihi, and for any proposals to reintroduce hihi to the mainland.

The arrival of avian diseases to New Zealand has also been suggested as a factor contributing to the loss of hihi from the mainland. Evidence for this stems from the similar declines recorded in populations of tui and bellbird during the early 1800s. Reischek (1930) also found hihi on Hauturu (in the absence of ship rats) to be extremely rare during this period. Recent research has found hihi to be particularly susceptible to at least two avian diseases: aspergillosis² and coccidiosis³ (Alley et al. 1999).

Aspergillosis and coccidiosis are a major cause of mortality in the captive population at Mt Bruce, and coccidia have been found in wild hihi at translocation sites. A high level of mortality arising from aspergillosis was a key factor in the decline of hihi on Mokoia, or at least the population's failure to expand (Alley et al. 1999). The Mokoia population was found to be food limited during the breeding season, but this could be redressed by management.

The causes of decline on Hen and Cuvier Islands are unknown. The declines of Kapiti hihi in the past have been attributed to problems with food supply, lack of nest cavities and rats (now eradicated), but insufficient evidence exists. The Tiritiri Matangi population has also been shown to be food limited to some extent, but has expanded under management.

Currently, the major threats to the Hauturu population are the arrival of mammalian predators, disease or natural catastrophes. These threats could also affect the translocated populations.

² Aspergillosis arises as a consequence of the inhalation of the spores and, possibly, hyphae of *Aspergillus* spp. which, if not blocked by an individual's immune system, can lodge in the respiratory tract and germinate or grow (in the case of hyphae).

³ Coccidiosis results from the ingestion of oocysts and subsequent infestation of parasites within the intestine.

4. Species ecology and biology

Hihi feed on a variety of floral nectar sources, fruits and invertebrates. The percentage of each food type in the diet varies with availability and time of year (Rasch 1985a; Castro & Robertson 1997; Perrott & Armstrong 2000). Hihi are generally subordinate to tui and korimako, and their access to some food resources can be limited by local competition (Craig et al. 1981; Wilson 1997). Hihi often travel several kilometres a day between preferred feeding sites and are known to visit artificial feeders located up to 1.5 km apart in the same day.

Hihi nest in tree cavities, usually high up in live mature trees, although other types of cavities will be used (including artificial nest boxes) if mature forest is limited. Nests on Hauturu have been found mostly in puriri (*Vitex lucens*), tawa (*Beilschmiedia tawa*) and pohutukawa (*Metrosideros excelsa*) (Rasch 1985a). On Kapiti Island, hihi nest in pukatea (*Laurelia novae zelandiae*), hinau (*Elaeocarpus dentatus*), kamahi (*Weinmannia racemosa*) and rata (*Metrosideros robusta*) (Castro 1995). The nest is usually built above the level of the entrance hole and is constructed out of a platform of sticks with a cup on top. The cup is made of tree fern rhizomes and lined with tree fern scales often interwoven with lichen and feathers (Castro et al. 1996).

Male and female hihi maintain breeding territories together (approximately 0.5–1 ha) during the breeding season (Castro et al. 1996). Some males may defend a breeding territory that covers one or more female nesting sites (Matt Low pers. comm.). These territories break down somewhat during the breeding season outside the female's fertile period, and male birds will move over larger areas foraging or investigating further opportunities for copulation (Castro et al. 1996). Birds leave their territories during the winter to forage over wider areas, often moving in intraspecific groups, although hihi have also been recorded congregating with other species (Gravatt 1970; Rasch 1985b; Castro 1995).

Breeding takes place between September and March. Females typically produce two successful clutches of up to five eggs each, but may lay up to four replacement clutches if previous ones fail (Castro et al. 1996; Fraser 2002). Hihi usually form breeding pairs, but may also form polyandrous, polygynous or polygynandrous units, or females may breed alone (Castro et al. 1996). There are usually frequent forced copulation attempts: 80% of all clutches have been found to have extra-pair young with up to 40% of young in a clutch being the result of extra-pair copulations (Castro et al. 1996; Ewen et al. 1999).

5. Past conservation efforts

5.1 TRANSLOCATION HISTORY

Taylor & Castro (2000b) detailed the translocation history of hihi. A summary of this information, updated to include the most recent transfers, is provided in Table 1.

The captive population established at Mt Bruce has been used for research and advocacy. Details of hihi captive management can be found in the Stitchbird Husbandry Manual (Collen 2000).

5.2 SUPPORTIVE MANAGEMENT

Supportive management (first initiated in 1991) has evolved to the point that hihi survival, and even expansion, can be reasonably assured at certain translocation sites. Monitoring between 1991 and the present has demonstrated that hihi populations have declined at translocation sites when management is withdrawn. Provision of food and control of mites in nest boxes has allowed improved recruitment, enabling the Mokoia population to be maintained and the Tiritiri Matangi population to expand (Castro 1991, 1993; Empson 1992; Ewen 1996; Perrott 1997; Armstrong et al. 1999; Griffiths 1999, 2000; Haxton 1999; Taylor 1999, 2000; Hamill & Griffiths 2001; Stamp 2001; Dimond 2002; Fraser 2002; Castro et al. 2003).

Although a number of the underlying mechanisms limiting hihi populations are not well understood and the full consequences of management are unknown, food provisioning appears to enhance hihi survival or reproduction at all

TABLE 1. SUMMARY OF HIHI TRANSLOCATIONS (TRANSFERS).

LOCATION	AREA (ha)	No. OF TRANSFERS	TOTAL BIRDS TRANSFERRED	YEAR OF TRANSFERS	OUTCOME
Hen Island	500	2	46	1980, 1981	Did not establish.
Cuvier Island	195	2	66	1982, 1985	Did not establish.
Kapiti Island	1966	5	181	1983, 1985, 1990, 1991, 1992, 2002	Declined without management. Supportive management implemented in 2000.
Mokoia Island	135	1	40	1994	Population remained stable with management but declined when management withdrawn. Population transferred to Kapiti in 2002.
Tiritiri Matangi Island	220	2	51	1995, 1996	Consistent population growth with management. May reach carrying capacity in the near future.
Mt Bruce	N/A	4 (since 1990)	16	1995, 1999, 2001, 2002	Fluctuates between 5 and 12 birds.

translocation sites. The techniques employed to manage hihi at translocation sites are described in detail in the hihi standard operating procedure (Hihi SOP) (Taylor & Castro 2000a).

In situ management programmes are in place on Tiritiri Matangi and Kapiti Islands and involve a combination of measures including:

- provision of nest boxes allowing access for monitoring and nest manipulations.
- provision of feeders to enhance food supply and aid monitoring.
- banding of all fledglings for individual identification and measurement of demographic parameters.
- intensive management of mite infestations at nests.

Management of hihi in captivity at Mt Bruce has focused on developing effective captive management techniques (Collen 2000), improving methods to establish captive-bred birds in the wild and management of disease.

5.3 COMMUNITY RELATIONS

In addition to the Department of Conservation, conservation efforts have been undertaken and supported by a wide variety of interest and volunteer groups including colleges, research institutions, community groups, non-government organisations and iwi.

Iwi have been involved in translocations and ongoing management. The following iwi and hapu carried out kaitiakitanga: Ngatiwai, Kawerau a Maki, Ngati Paoa, Ngati Uenukukopako, Ngati Whakaue, Ngati Rangiwewehi, Ngati Rangiteaorere, and Te Ati Awa.

Research and management techniques have been developed by staff and students from Massey and Auckland universities and supported financially by the Marsden Fund, Massey University Research Fund, Auckland University Research Fund, World Wide Fund for Nature (NZ), Federation of University Women, Lottery Science Fund, Guardian Trust and the Department of Conservation.

The translocation of hihi to island sanctuaries that are easily visited has meant increased opportunities for New Zealanders to experience hihi: per annum, 9000 people visit Kapiti Island; 10 000 visit Mokoia Island; 30 000 visit Tiritiri Matangi; and 40 000 visit Mt Bruce Wildlife Centre.

6. Long-term recovery goal

The long-term recovery goal is to improve the conservation status of hihi by increasing the number of self-sustaining hihi populations to at least five.

6.1 PREFERRED OPTION FOR RECOVERY

The preferred option for recovery is to secure hihi populations at all existing sites as well as establishing populations elsewhere. This option aims to consolidate past recovery actions and make progress with hihi recovery towards achieving the long-term goal. Other options such as doing nothing or simply securing hihi at existing sites would not lead to improved security for the species and are rejected on this basis.

6.2 OBJECTIVES

The following objectives and actions are set out in order of priority.

Objective 1: Secure hihi populations at all existing sites.

Objective 2: Raise awareness and support for hihi recovery.

Objective 3: Establish a research programme on Hauturu.

Objective 4: Identify sites favourable to the establishment of self-sustaining hihi populations and introduce hihi to the most favourable of these.

Objective 5: Establish further managed populations.

Objective 6: Maintain a captive population of hihi.

7. Work plan

Objective 1: Secure hihi populations at all existing sites.

Performance measures

- Quarantine and contingency planning and implementation to DOC standard operating procedure (SOP) standards are in place at all island sites where hihi occur.
- Supportive management is carried out to Hihi SOP standards (Taylor & Castro 2000a) at all translocation sites.
- Trials of new management techniques are approved by the recovery group and are fully written up.

Explanation

All islands where hihi currently occur have high visitation rates, bringing a persistent threat of ship rats, disease and fire. Illegal and accidental landings are also possible. Hihi are particularly vulnerable to disease, but any of these threats could lead to the rapid decline and possible extinction of a population within a short period. Effective quarantine and contingency is therefore critical to ensuring the security of hihi populations.

Supportive management has been found necessary to maintain and bolster populations at translocation sites. These populations provide some degree of security should disaster befall the Hauturu population. They are also likely to be used as source populations for future translocation attempts. An ongoing commitment to providing supportive management is essential if these populations are to be maintained in as robust a state as possible.

The ultimate aim of all translocations is to establish self-sustaining populations, and management planning at translocation sites should be carried out with this aim in mind, even if it is a distant reality. Where concerted supportive management has failed to produce population growth, continued management must be reviewed.

Action 1.1

Within Year 1 of the plan, implement quarantine and contingency measures to SOP standard at all islands where hihi occur, if these are not already in place.

Responsibility: Biodiversity Programme Managers, Warkworth and Kapiti Area Offices.

Action 1.2

Throughout the life of the recovery plan, provide ongoing supportive management at current translocation sites using the techniques outlined in the Hihi SOP (Taylor & Castro 2000a). Any significant departures from the Hihi SOP must be approved by the Hihi Recovery Group before implementation.

Responsibility: Biodiversity Programme Managers, Warkworth and Kapiti Area Offices; Recovery Group.

Action 1.3

As directed by the Recovery Group, annually trial new techniques that may contribute to more effective supportive management and greater security for hihi populations; if these prove successful, immediately update existing protocols in the Hihi SOP.

Responsibility: Biodiversity Programme Managers, Warkworth, Mt Bruce and Kapiti Area Offices; Fauna Technical Support Officers, Auckland and Wellington Conservancies; Recovery Group.

Action 1.4

Carry out monitoring, data recording and collection on an annual basis at all sites where hihi occur to allow assessment of the viability of each population and measure the impacts of management.

Responsibility: Biodiversity Programme Managers, Warkworth and Kapiti Area Offices; Recovery Group.

Action 1.5

By Year 5 of the plan, undertake assessment of the viability of hihi populations at current (July 2004) translocation sites. Assessment should be similar to that of Griffiths (2002) and must include population viability analysis, the level of management required to sustain the hihi population at each site, and the existence and timing of viable alternative sites that will contribute to the conservation of hihi nationally. If populations at some sites are deemed to have limited long-term prognosis, include options for interim management of surviving hihi in the assessment.

Responsibility: Biodiversity Programme Managers, Warkworth and Kapiti Area Offices; Fauna Technical Support Officers, Auckland and Wellington Conservancies; Recovery Group.

Objective 2: Raise awareness and support for hihi recovery.

Performance measures

- Advocacy plan completed.
- Sufficient sponsorship funding is secured to enable Objective 3 to be implemented.
- Minimum targets for the publication of media releases and the creation of opportunities for public involvement are met.

Explanation

Securing an ongoing commitment to safeguard and support hihi populations will require the profile of hihi and the recovery programme to be raised. Increasing public awareness, empowerment of iwi, support from DOC, continued partnerships with research organisations and suitable sponsorship will all be integral to achieving long-term security for hihi and making progress towards attaining the long-term recovery goal.

Action 2.1

By the end of Year 1 of the plan, produce an advocacy document that outlines the steps to be taken toward raising the profile of hihi and gaining support for hihi recovery both within and outside DOC.

Responsibility: Recovery Group.

Action 2.2

Starting in Year 1 of the recovery plan, seek an organisation or organisations to sponsor the hihi recovery programme.

Responsibility: Recovery Group.

Action 2.3

As part of implementing the advocacy plan (Action 2.1), increase awareness of the importance of hihi recovery objectives both within and outside DOC by carrying out the following:

- As well as encouraging and facilitating media coverage, issue a minimum of eight media releases a year outlining key results of management and research.

Responsibility: Recovery Group; Biodiversity and Community Relations Programme Managers, Warkworth, Kapiti and Mt Bruce Area Offices.

- Provide, annually, at least five opportunities for local community, school and interest groups to be involved in hihi conservation, through active participation in translocations and breeding season management. Carry out at least one on-site interview with LERNZ every year.

Responsibility: Recovery Group; Biodiversity and Community Relations Programme Managers, Warkworth, Kapiti and Mt Bruce Area Offices.

- Provide annual reports to iwi and hapu actively interested in hihi and encourage iwi representatives to participate in hihi recovery. These annual reports should identify and set out priority tasks for the next 12 months.

Responsibility: Recovery Group; Biodiversity Programme Managers, Warkworth, Kapiti and Mt Bruce Area Offices.

- Publish results, along with key hihi conservation issues, within 12 months of management and research being completed, in both internal and external publications. If possible, scientific papers and reports should refer to the research needs of the hihi recovery programme.

Responsibility: Biodiversity Programme Managers, Warkworth, Mt Bruce and Kapiti Area Offices; Fauna Technical Support Officers, Auckland and Wellington Conservancies; Recovery Group.

- Update senior management on hihi recovery issues through the monthly operating review process.

Responsibility: Biodiversity Programme Manager, Warkworth; Fauna Technical Support Officer, Auckland Conservancy; Recovery Group.

Action 2.4

Identify, solicit and support research and management initiatives that contribute toward priority hihi recovery programme objectives by implementing the following:

- List research and management priorities annually and distribute the list to conservancies, universities and conservation organisations.

Responsibility: Recovery Group; Conservancy Advisory Scientists, North Island.

- Submit internal proposals for research during annual science planning rounds.

Responsibility: Conservancy Advisory Scientists, North Island; Recovery Group.

- Identify, annually, possible external avenues for obtaining research funding and submit proposals for research.

Responsibility: Conservancy Advisory Scientists, North Island; Recovery Group.

Objective 3: Establish a research programme on Hauturu/Little Barrier Island.

The key research questions relating to Objective 3 are outlined in Section 8 (Research Priorities).

Performance measures

- Research contract established in Year 2 of the plan.
- Updated reports are submitted to the Recovery Group at annual meetings from Area Offices involved in hihi management and monitoring.
- Comparative analysis of results from Hauturu and translocated populations is undertaken annually.

Explanation

Hauturu/Little Barrier Island is crucial to the long-term security of hihi, yet little information exists about the status of the island's population. Research at this site is vital to determine the long-term viability and threats to this population, and to identify the necessary actions to ensure its security. Information gained from this research will aid the selection of future translocation sites and will improve management techniques aimed at establishing self-sustaining populations elsewhere. Research on Hauturu will reduce the risk of repeating past failures and allow the limited resources available to hihi recovery to be used more efficiently.

A comparative study between the proposed Hauturu research programme and information currently obtained from translocation sites will increase our understanding of the factors limiting translocated populations. Furthermore, it will allow improved selection of future translocation sites, or enable techniques to be developed to overcome obstacles to hihi establishment.

Action 3.1

All communication as stated in Actions 2.3 and 2.4 should be used as an opportunity to raise awareness of the need for research on Hauturu.

Responsibility: Recovery Group; Biodiversity and Community Relations Programme Managers, Warkworth, Kapiti and Mt Bruce Area Offices.

Action 3.2

As soon as funding is secured, undertake a 3-5-year research programme focused on hihi on Hauturu.

Responsibility: Researchers; Conservancy Advisory Scientist, Auckland; Recovery Group.

Action 3.3

Compare, on an annual basis, information gained from the Hauturu research programme with information about translocation sites.

Responsibility: Researchers; Conservancy Advisory Scientist, Auckland; Recovery Group.

Objective 4: Identify sites favourable to the establishment of self-sustaining hihi populations and introduce hihi to the most favourable of these.

Performance measures

- Approval gained for translocation proposals to sites meeting the criteria established in Appendix 2 by Year 1 of the plan.
- An understanding of the effects of the removal of hihi from a population is gained from post-transfer monitoring.

Explanation

Several geographically-spread sites will be needed to achieve the long-term objective of this recovery plan. Island and mainland sites will be considered where predator-free status or year-round mammalian predator control is in place. Potential locations will be assessed against the criteria outlined in Appendix 2.

Action 4.1

By Year 1 of the plan, distribute the essential and desirable criteria for translocation sites (as outlined in Appendix 2) to North Island conservancies and community conservation organisations and seek feedback on sites favourable to establishing self-sustaining hihi populations.

Responsibility: Recovery Group.

Action 4.2

Within 6 months of the receipt of feedback (Action 4.1), identify sites conducive to the establishment of self-sustaining hihi populations.

Responsibility: Recovery Group.

Action 4.3

By Year 3 of the plan, develop translocation proposals for sites identified for hihi introduction (Action 4.2).

Responsibility: Recovery Group; Fauna Technical Support Officers, North Island; Biodiversity Programme Managers, North Island.

Action 4.4

By Year 3 of the plan, begin translocations of hihi from Tiritiri Matangi Island to approved sites.

Responsibility: Recovery Group; Biodiversity Programme Manager, Warkworth; Fauna Technical Support Officer, Auckland.

Action 4.5

Following the removal of hihi from Tiritiri Matangi Island (Action 4.4), immediately assess the density-dependence on this island and determine the extent to which harvesting of this population can occur. This will be achieved by recording the effects of harvesting on population dynamics and incorporating the results into a population model.

Responsibility: Recovery Group; Biodiversity Programme Manager, Warkworth; Fauna Technical Support Officer, Auckland.

Objective 5: Establish further managed populations.

Performance measure

- Hihi are released and managed according to Hihi SOP standards (Taylor & Castro 2000a) at a minimum of one new site by Year 2 of the plan.

Explanation

Until additional self-sustaining hihi populations are successfully established, a minimum of three populations maintained by supportive management, such as the provision of nest boxes and supplementary food, is required. While these hihi populations are not self-supporting, they provide an important insurance should the Hauturu population be compromised.

Implementing supportive management to maintain hihi populations is a significant commitment (c. 1800 hours (labour) and \$5000 (field supplies) per annum). However, these costs are moderate when compared with those for some other species' recovery programmes, and may be reduced by use of volunteers for some tasks.

Birds for translocation should be sourced initially from successful translocation sites, devolving failed sites or birds that are captive-reared for release. The Hauturu population will not be used as a source for translocated birds until research determines the impact of removal of birds from the population.

Action 5.1

By Year 1 of the plan, on the basis of the criteria outlined in Appendix 2, select and approve translocation sites where ongoing management can be provided.

Responsibility: Recovery Group.

Action 5.2

By Year 2 of the plan, begin introducing hihi to sites approved by the Recovery Group (Action 5.1).

Responsibility: Recovery Group; Fauna Technical Support Officers, North Island; Biodiversity Programme Managers, North Island.

Objective 6: Maintain a captive population of hihi.

Performance measure

- Hihi are managed to standards set out in the hihi husbandry manual (Collen 2000).
- Information relevant and useful to the hihi recovery programme is obtained.

Explanation

Captive breeding for release is likely to provide another method for supplementing and sourcing translocated populations. Priorities for captive management have been to perfect captive management techniques, improve survival of captive-bred birds released into the wild and improve current methods of disease management. However, because of the low numbers of birds able to be kept in captivity, the development of effective husbandry and management techniques has been a slow process. Captive management of hihi is intensive, especially during the breeding season. Advocacy has been an added benefit from holding birds in captivity.

Action 6.1

By Year 3 of the plan, assess the value of maintaining a captive population at Mt Bruce by weighing up the investment of resources against the advances being made in captive management techniques and survival of birds post-release.

Responsibility: Recovery Group.

Action 6.2

Depending on the outcome of Action 5.1, maintain a captive population at Mt Bruce for the principal purpose of breeding for release and approved research programmes.

Responsibility: Biodiversity Programme Manager, Mt Bruce.

Action 6.3

Investigate, annually, new methods of stress and disease control in captive hihi populations.

Responsibility: Biodiversity Programme Manager, Mt Bruce; Fauna Technical Support Officer Wellington; Conservancy Advisory Scientist, Wellington.

Action 6.4

Develop techniques that maximise the potential for captive-reared birds to establish in the wild.

Responsibility: Biodiversity Programme Manager, Mt Bruce; Fauna Technical Support Officer, Wellington.

8. Research priorities

This section outlines the key research priorities for the hihi recovery programme. The focus of this work is to obtain information that will facilitate the eventual attainment of the recovery plan's long-term goal, while at the same time consolidating and building upon information already available.

8.1 HAUTURU/LITTLE BARRIER ISLAND

Establishing a research programme on Hauturu is a major priority for the hihi recovery programme. In order to secure what is the only sizeable and self-sustaining population of hihi, information is urgently required on the viability of this population, and the threats to it. Information from the Hauturu population would be useful in improving hihi management techniques, as well as providing a better understanding of the requirements for establishing self-sustaining hihi populations elsewhere. Examples of relevant questions are:

- What is the status of the Hauturu hihi population in terms of its viability?
- What is the best method for assessing the ongoing status of hihi on Hauturu?
- What population parameters (i.e. breeding success, adult and juvenile survival) allow the Hauturu population to remain viable in the absence of supportive management?
- What are the differences in interspecific competition for resources between Hauturu and the translocation sites?
- What are the patterns of hihi habitat use on Hauturu, and what does this predict about their habitat requirements elsewhere and the ability of other sites to support hihi?
- What are the significant causes of mortality to hihi on Hauturu?
- What diseases are present or absent in the Hauturu population? Which diseases pose the biggest threat?
- What are the most significant threats to hihi on Hauturu? How can these threats be eliminated or minimised?

8.2 EFFECTS OF RESOURCE AVAILABILITY

The role of resource quantity and quality and the effect of interspecific competition on hihi survival and population establishment following translocation. Examples of relevant questions are:

- What is the effect of food quality on female hihi reproductive output (number of eggs and chicks fledged), and on chick developmental rate and survival to breeding age?
- What are the differences in plant phenology, energetic needs and feeder-use between translocation sites and Hauturu?
- What is the importance of the presence and/or abundance of natural foods on female hihi deciding to desert late clutches in translocated populations?

8.3 DISEASE, ECTOPARASITES AND STRESS

Impacts of disease and ectoparasites have been observed in hihi at all of the translocation sites (Cork 1994; Alley et al. 1999). Key questions are:

- What is the prevalence of *Aspergillus fumigatus* at potential mainland translocation sites in comparison with Mokoia Island, Tiritiri Matangi Island and Hauturu?
- How do habitat or micro-environmental conditions affect prevalence of nest mites, and how should this affect our choice of sites for translocation or nest boxes?
- How can mite infestations be suppressed in a cost-effective and efficient way, without having a negative effect on chicks and nesting hihi?

9. Review date

This recovery plan should be reviewed by September 2009.

10. Acknowledgements

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Appendix 1

KEY RESEARCH AND MANAGEMENT RESULTS ACHIEVED DURING THE COURSE OF THE FIRST HIHI RECOVERY PLAN

- Hihi survive translocation better if released immediately into areas where there are no conspecifics present (Castro et al. 1994a).
- Artificial nest boxes have been successfully used in supporting hihi breeding in regenerating habitats (Armstrong et al. 1999; Taylor & Castro 2000a).
- Management of nest mite infestations in artificial nest boxes has been necessary to improve the number of young fledged at translocation sites (Armstrong et al. 1999).
- Both feeders and nest boxes have greatly improved assisted management, research and monitoring of translocated populations (Castro et al. 1994b; Armstrong et al. 1999).
- Food supplementation experiments showed that:
 1. Supplementation improved hihi survival on Tiritiri Matangi Island, but not on Mokoia Island (Armstrong & Perrot 2000; Armstrong & Ewen 2001).
 2. Mokoia hihi fledged more young in years that supplementary food was provided compared with the one year when it was not.
 3. Mokoia females with ad libitum access to supplementary food did not fledge significantly more young compared with females that occasionally accessed distant feeders (Armstrong et al. 1997).
 4. Mokoia hihi did not produce significantly more young when a complete nutritional supplement was provided compared with times when just sugar or jam water was supplied.
 5. Food supplementation influenced female survival and behaviour during incubation and brooding.
- Hihi are susceptible to aspergillosis and coccidiosis (Alley et al. 1999).
- *Aspergillus fumigatus* is highly prevalent on Mokoia, less prevalent on Tiritiri Matangi and scarce on Hauturu, possibly accounting for different survival rates among these islands (Perrott 2001). *Aspergillus fumigatus* is promoted by clearance of vegetation (even leaves) and other forms of disturbance.
- Hihi populations are not deleteriously affected by the aerial distribution of cereal baits containing 20 ppm brodifacoum to eradicate rodents (Empson & Miskelly 1999; Armstrong et al. 2001; Griffiths & Wilson 2002).
- The distribution of nest boxes and feeders appears to have an effect on hihi mating systems and, possibly, on the degree of paternal investment.
- Survival of captive-bred birds released into the wild has, to date, been poor.

Appendix 2

CRITERIA FOR ASSESSING SITE SUITABILITY FOR THE REINTRODUCTION OF HIHI

Essential attributes of a site being considered for the reintroduction of hihi:

1. A year-round supply of suitable food exists in sufficient quantity to preclude the possibility of gaps in nectar and fruit availability.

A year-round supply of suitable food constitutes a diverse range (no less than eight species), flowering or fruiting at any particular time of the year.

Species could include hinau, kohekohe, puriri, rata, pohutukawa, kowhai, rewarewa, karo, fivefinger, pate, mahoe, kotukutuku/tree fuchsia, harakeke/flax, nikau and *Pittosporum*, *Coprosma* and *Alseuosmia* spp.

Food sources such as those listed must be present in sufficient quantity to allow hihi ready access despite the presence of dominant competitors such as korimako/bellbird and tui.

A diverse and abundant invertebrate community is also desirable.

NB: This requirement may be offset by the provision of supplementary food as per the protocols set out in the Hihi SOP (Taylor & Castro 2000a).

2. Tree cavities are abundant and opportunities for nesting are available despite the presence of nest site competitors such as kakariki, kotare/kingfisher and kaka.

Tree cavities are most likely to occur in old growth forest that includes tree species such as puriri, hinau, rata, kohekohe, tawa, pukatea, taraire, kahikatea and *Nothofagus* spp.

NB: This requirement may be offset by the provision and maintenance of nest boxes as per the protocols set out in the Hihi SOP.

3. An extensive area of habitat (> 200 ha) where mammalian predators and competitors are either absent or are consistently controlled to levels at 1% or less; or, alternatively, where the failure of passerine nesting attempts due to mammalian predation is less than 1%.

Of New Zealand's suite of introduced mammals, ship rats and stoats are suspected to be the most significant threat to hihi, but other potential predators and competitors include possums, goats, deer, pigs, cats, weasels, Norway rats, and kiore.

4. *Aspergillus* spp. spore counts within the soil are low (< 100 000 Colony Forming Units per gram of soil (CFU/g)).

5. Monitoring of the translocation and population establishment phase is undertaken to a level determined by the hihi recovery group.

Monitoring is vital to determine the success of a translocation but can also be used to answer specific management or research questions important to hihi recovery. Intensive monitoring of breeding success for a number of years will be required to confirm levels of recruitment and mortality. Monitoring

may necessitate radio-tracking individuals, banding and measuring birds, monitoring nesting attempts, maintaining and watching feeders, and carrying out periodic surveys of the population.

Additional desirable attributes of a site being considered for the reintroduction of hihi:

- 6. The forest understorey is complex, diverse and unmodified by introduced browsers.**
- 7. There is potential for the enhancement of habitats for hihi through management.**