

# Tuatara recovery plan

2001-2011

THREATENED SPECIES RECOVERY PLAN 47



Department of Conservation  
*Te Papa Atawhai*

# Recovery plans

This is one of a series of recovery plans published by the Department of Conservation. Recovery plans are statements of the Department's intentions for the conservation of a particular species of plant or animal. Recovery plans focus on the goals and objectives of species management, guide the Department in its allocation of resources and are used to raise public awareness of the species recovery process.

A recovery group has been established for tuatara that consists of people with knowledge of the ecology and management needs of the species. The recovery group prepared this plan in conjunction with the people interested in, or with an expert knowledge of, the species. Drafts have been sent to relevant Conservation Boards for comment and to people interested in conservation management of tuatara. Minor changes to the plan were made as a result of that consultation.

The recovery group will now review progress in implementation of this plan and will recommend to the Department any changes that may be required in management. Comments and suggestions regarding conservation of tuatara are welcome and should be directed to the recovery group via any office of the Department or to the Biodiversity Recovery Unit.

The recovery planning process provides opportunities for further consultation between the Department and the tangata whenua and others over species management. Those interested in being more involved in species management or in receiving information should also contact the recovery group.

The Central Regional Office of the Department of Conservation formally approved this plan in May 2001. A review of the plan is due after 10 years (2011), or sooner if new information leads to proposals for a significant change in management direction. It will remain operative until a reviewed plan has been prepared and implemented.



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Cover: Cook Strait tuatara, an unnamed subspecies of *Sphenodon punctatus*, on Takapourewa (Stephens Island). Photograph by Paddy Ryan.

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# Abstract

This recovery plan succeeds the earlier plan (Cree and Butler 1993) which guided tuatara conservation during the past decade and saw major achievements that have placed the species in a far less vulnerable position. Rats have been eradicated from several island habitats, and tuatara have been translocated to other islands in the hope of establishing new wild populations. Research and enhanced animal husbandry techniques have led to successful incubation of eggs and raising of juveniles in captivity. This increased productivity has been used to augment relict populations and provide animals for new wild populations.

Future work will focus on advocating for the eradication of rats from Little Barrier (Hauturu), Mauitaha and Hen (Taranga) Islands and in maintaining the pest-free status of other island habitats. Further translocations are planned as part of the long-term objective of establishing wild populations of tuatara throughout their pre-human range.

The potential to use tuatara in education, to enhance public awareness of conservation issues, and for research are all promoted within the plan. All are seen as essential for long-term conservation of the species. The increased involvement of iwi is essential if the plan is to succeed.



# 1. Introduction

Tuatara are rare, medium-sized reptiles (adults ranging from about 300 g to 1000 g) found only in New Zealand. They are the only extant members of the Order Sphenodontia, which was well represented by many species during the age of the dinosaurs, some 200 million years ago. All species apart from the tuatara declined and eventually became extinct about 60 million years ago. Tuatara are therefore of huge international interest to biologists and are also recognised internationally and within New Zealand as species in need of active conservation management.

Tuatara once lived throughout the mainland of New Zealand but survived in the wild on 32 offshore islands. These islands were characteristically free of rodents and other introduced mammalian predators and occupied by breeding colonies of seabirds that contributed to the fertility and hence the richness of invertebrate and lizard fauna needed by tuatara. Tuatara have since been translocated to a further three islands that they presumably inhabited in the past (Figure 1).

Current taxonomy recognises two species of tuatara, and one of these is considered to comprise two subspecies. The northern tuatara (*Sphenodon punctatus punctatus*) is present on islands from the Bay of Plenty north and the Cook Strait tuatara (*S. punctatus*), an unnamed subspecies, is present on Takapourewa (Stephens Island) and the Trio Islands in Marlborough Sounds. The other species is the Brothers Island tuatara (*S. guntheri*) known naturally from one small island in the Marlborough Sounds.

According to the ranking system currently used by the Department of Conservation (Molloy and Davis 1994), Brothers Island tuatara is in Category 'A' (requiring urgent recovery work), and the northern and Cook Strait tuatara are in Category 'B' (requiring work in the short term). In view of conservation work over the past 10 years all tuatara are now in a slightly more secure position.

## 2. Distribution and population trends

Tuatara were once widely distributed over the North and South Islands. They declined during the last 1000–2000 years and probably became extinct there by the late 1700s (Newman 1878, Buller 1894). They now survive in the wild only on offshore islands in Cook Strait and to the east of the North Island from Bay of Plenty to Northland. During the past 100 years tuatara populations have become extinct on 10 of these islands (Cree and Butler 1993).

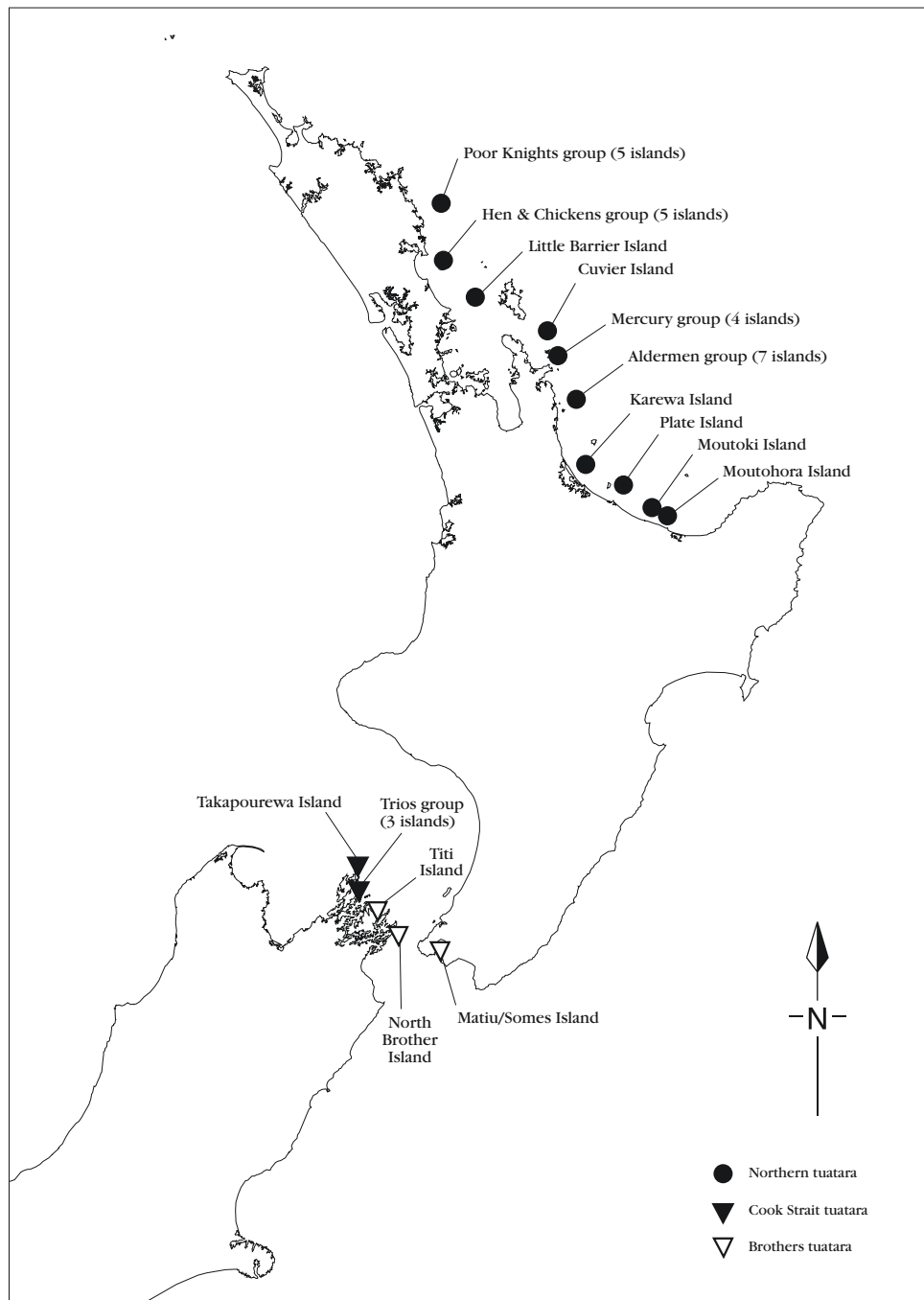
Tuatara are currently present on 35 islands ranging in size from 0.4–3100 ha (Appendix 1). Seven of these islands are in Cook Strait although two of these have only recently had tuatara introduced to them. All other islands are on the east coast of the North Island from Bay of Plenty to Northland, including one where tuatara

have recently been introduced. It is estimated that northern tuatara total some 10,000, Cook Strait tuatara consist of some 45,000 (of which at least 30,000 are on Takapourewa) and Brothers Island tuatara is the least numerous at some 400 adults.

The number of populations and the number of individual tuatara have been declining up until very recently. Only during the last decade has the threat of predation and competition by rats been removed from several islands, allowing for greater productivity in these populations. The eradication of rats on other islands has allowed tuatara to be introduced with the intention of establishing new populations and extending the range of the species.

In addition to these wild populations, tuatara are kept in captivity in New Zealand and overseas. Details of these animals and the protocols for their management are described in Blanchard (in press).

Figure 1. Present distribution of tuatara. More detail on each island is provided in Appendix 1.



### 3. Causes of decline and threats

There is good evidence to link the decline of tuatara with the presence of rats: Norway rat *Rattus norvegicus*, ship rat *R. rattus* and particularly the Pacific rat *R. exulans* (Crook 1973). A survey of most tuatara islands (Cree and Butler 1993) showed that in the presence of rats, tuatara numbers were low, some adults were in poor condition and there were few, if any, juveniles in the population. This effect is probably from the joint impacts of direct predation by rats on small tuatara and their eggs, and competition between tuatara and rats for food resources. Ten island populations of tuatara became extinct during the twentieth century (Cree and Butler 1993), and rats were present with each of these. Cats were also present on some islands. Indirect evidence of the impact of rats on tuatara comes from the observed ability for lizard populations to recover after rodent eradication (Towns 1996). Tuatara had gone from the mainland of New Zealand before the arrival of pakeha, so it is reasonable to assume again that the Pacific rat was a major impact.

While a primary cause of decline for an island population may be removed by the eradication of rats, other threats remain. Paramount amongst these is that rats could be accidentally re-introduced to the island. Change to the island habitat is also a risk, whether it is gradual or the result of a catastrophic event such as fire. Illegal capture of tuatara has occurred and poses a continual threat with the rising international demand for more animals.

All of these threats are greater on small islands that have less ability to buffer the impact of change. Also, small populations on small islands are vulnerable to loss of genetic variation and other random influences.

### 4. Species ecology and biology

While appearing superficially similar to some other reptiles, tuatara and other sphenodontians are characterised, in particular, by unique dentition in which a single row of lower teeth fits into a groove between two rows of upper teeth.

Among living reptiles, tuatara are also characterised by the following suite of features:

- a specialised jaw movement which allows the teeth to exert a shearing effect,
- small bony uncinat processes on the ribs,
- a complete lower temporal arch in the skull,
- the lack of a male intramittent organ.

Tuatara are now restricted to offshore islands where they live in burrows in coastal forest or scrub. They are most active at night but also bask in the sun during the day. Activity is greatest in warm wet weather (Walls 1983). Habitat requirements have been investigated by Crook (1973), Newman (1987), Carmichael *et al.* (1989) and others. Most information arises from work on Takapourewa but is consistent with what is known from other tuatara populations.

The following habitat features are considered favourable for long-term survival of a population:

- coastal forest or scrub with a relatively open understorey and little ground cover,
- friable soil for digging burrows,
- ambient air temperatures varying seasonally between 5° and 28°C,
- generally high relative humidity with regular heavy rain (although standing water is not necessary),
- a lack of introduced mammals,
- a diverse invertebrate fauna (preferably including tree weta and *Mimopeus* beetles), small lizards and small nesting seabirds (particularly fairy prions and diving petrels),
- areas suitable for nesting that are open and sunny, preferably with a northern aspect and with moist soil to a depth of c.0.5 m.

In addition to these ideal requirements there are significant advantages for tuatara on islands greater than 10 ha because these islands have the potential to support larger, and hence more resilient populations.

Studies on Takapourewa and elsewhere (Walls 1981, Moller 1985, Carmichael et al. 1989, Cree *et al.* 1999 and Ussher 1999) indicate that tuatara feed on small, moving prey such as insects, spiders, isopods, earthworms, lizards and seabird chicks. Research suggests that small birds may be beneficial (Cartland-Shaw *et al.* 1998) though not necessarily essential (Blair *et al.* 2000) in the diets of tuatara. The indirect benefits of being sympatric with seabird colonies (enhanced soil fertility and greater density of invertebrates) are more apparent.

Adult tuatara have few natural predators. The Australasian harrier and NZ falcon will prey on tuatara of all ages, the NZ kingfisher is known to prey on juvenile tuatara and it is possible that moreporks and black backed gulls also take some. The Pacific rat is still present on some tuatara islands prompting debate on the likely ill effect they may have. There is good evidence (Cree and Butler 1993) that Pacific rats severely restrict recruitment of young animals to the population, and their presence will lead to depauperate faunas of invertebrates, lizards and small petrels on which tuatara feed. Ussher (1999) has shown that the kiore have a greater competitive advantage over tuatara in seral forest and suggests that the adverse impacts on diet will be less as modified habitats mature. Pacific rats and tuatara are now sympatric only on Little Barrier, Mauitaha and Hen Islands.

Our understanding of the breeding biology of tuatara comes mainly from Takapourewa (e.g. Cree and Butler (1993), Cree (1994) and Newman *et al.* (1994)). Males become sexually mature when they reach a snout-vent length (SVL) of about 180 mm but may not get an opportunity to breed until they grow much larger. Mating occurs during January–March when the male holds a territory and will display to ward off intruders and to court receptive females. Females will breed at 13 years and a SVL of c.170 mm. The slow rate of egg yolk production (vitellogenesis) means that wild females do not breed annually, the average time between clutches being 4 years. In the year that breeding does occur, the female will ovulate within 1–2 months of mating and carries the eggs in her oviduct, where they will slowly become shelled, until laying in October–December.

Egg laying occurs in small excavated burrows at preferred sites that are characteristically in the open and exposed to the north. On average 9–10 eggs are

laid in the nest which is then back-filled and guarded for several days before being abandoned. During the 11-16 month incubation period many eggs are destroyed by other burrowing females or succumb to desiccation and insect predation. Hatching success is about 42%. During the first 2 months the hatchlings are diurnal, but within a year they begin to burrow and become nocturnal.

Incubation of tuatara eggs in a controlled environment has a greater hatching success rate and has also demonstrated that incubation temperature has an influence in determining sex (Cree *et al.* 1995).

## 5. Past conservation efforts

Significant progress has been made over the past decade in providing better security for tuatara (Towns *et al.* in press). This has been possible through:

- technical and operational advances in the ability to eradicate rodents from islands,
- developing expertise to induce egg-laying and artificial incubation,
- refined animal husbandry techniques to keep adults and raise juveniles in captivity,
- ability to transfer and release tuatara into new wild environments,
- co-operation of several iwi in endorsing various translocations of tuatara.

Specific conservation gains include the following:

1. In 1995 18 adult and 50 juvenile Brothers Island tuatara were transferred to Titi Island in Cook Strait where their establishment was monitored. Two years later more than half of the animals had been re-sighted and all had increased in weight except for one female which was suspected to have just laid eggs (Nelson 1998).
2. In 1998 an attempt was made to establish a third wild population of Brothers Island tuatara with the transfer to Matiu Island of 20 wild caught adults and 34 captive juveniles. The juveniles were from eggs previously induced from wild females. This move made tuatara more accessible for viewing by the public than ever before.
3. In 1990/91 tuatara were removed from Stanley, Red Mercury and Cuvier Islands and kept in captivity while Pacific rats were eradicated from those islands. The captive stock from each island was kept separate. Two of the Red Mercury females were induced to lay and these eggs gave rise to a further 26 juveniles. The animals from Cuvier and Stanley Islands also bred in captivity. The eradication operations were successful and the tuatara are being returned to their home islands, which are now capable of sustaining these populations.
4. In 1991/92 only eight tuatara could be found surviving on Little Barrier Island, and these adults were transferred into captivity on the island where they could breed, without predation of eggs, pending eradication of Pacific rats. Since then, eggs laid by the captive females have been incubated at Victoria University leading to an additional 42 offspring by mid 1999. These offspring have been returned to Little Barrier where they are being held in an enclosure.

5. Pacific rats were eradicated from, Whatupuke in 1993, Lady Alice Island in 1994 and Coppermine Island in 1997 (all within the Hen and Chickens group). Juvenile tuatara have since been seen for the first time on all of these islands, indicative of successful recruitment. This is in contrast to Hen Island where the rats are still present and no juvenile tuatara are seen. The three rat-free populations should now be sustainable without further direct management.
6. In 1992 Pacific rats were eradicated from Middle Chain Island in the Aldermen Islands to eliminate the risk of rats swimming to adjacent islands with tuatara populations.
7. In 1996 32 adult northern tuatara were transferred from Moutoki Island (in the Rurima group) to Moutohora (Owen 1998). This transfer has the potential to form a new population established on an island with a potential carrying capacity of *c.* 8500 and will eventually allow public access to tuatara in the wild because the island does not have the same legal restrictions as nature reserves.
8. In preparation for the establishment of new wild populations 432 young Cook Strait tuatara are being raised in captivity at Victoria University. The young animals will be available for settlement on a new island when they are about five years old (2004). In preparation for this, a rodent eradication operation has been conducted on the Rangitoto Islands east of D'Urville Island.

## 6. Long-term recovery goal

The genetic diversity of tuatara will be maintained by returning all existing populations to their natural levels and establishing new wild populations of tuatara throughout their pre-human range as components of healthy ecosystems.

## 7. Options for meeting the long-term recovery goal

### Option 1

*Do nothing.*

Work over the last decade has successfully enhanced existing habitat, re-introduced tuatara to several islands previously inhabited by rats and increased security for many populations. It could be argued that now is the time to stand back and allow the species to take advantage of these improved conditions. A lack of further active management will, however, see:

- the ultimate demise of populations on Little Barrier, Mauitaha and Hen Islands owing to the predatory and competitive effects of rats,
- restoration initiatives for other islands proceeding without tuatara included in the new suite of species,
- a decline in island security which will place existing populations under greater risk,
- a decline in the public knowledge and appreciation of the species and related conservation issues.

### Option 2

*Maintain existing initiatives, but do not establish new wild populations nor increase public accessibility to tuatara.*

It is likely that the three tuatara populations on rat-infested islands will still suffer if there is not a strong recovery plan mandate. The restoration of tuatara on other islands such as Stanley, Cuvier and Red Mercury will continue to be monitored as will the establishment of the three new wild populations. However, without a continued effort to return tuatara to suitable islands the species will remain relatively vulnerable to accidental misfortune.

### Option 3

*Maintain and pursue all current initiatives.*

Security of island populations is enhanced, rodents are eradicated where they co-exist with tuatara, captive management is used to raise (head-start) animals for new wild populations and the public is encouraged to learn and participate in this work. These techniques are known to work, and their active implementation will lead to a significantly less vulnerable status for all tuatara taxa within the term of this plan.

The management of captive tuatara is acknowledged as an essential element in the recovery of tuatara and as an aid in researching better knowledge of the species.

### Preferred Option

Option 3 has been chosen for the duration of this plan.

## 8. Objectives for the term of the plan

1. The genetic diversity of all existing tuatara stock is preserved.
2. Tuatara are reinstated as components of healthy ecosystems throughout their pre-human range.
3. Public awareness of tuatara and related conservation issues will be promoted through accessibility to captive animals and certain wild populations of tuatara.

## 9. The role of captive management of tuatara

Tuatara of all three taxa are held in a range of captive facilities throughout New Zealand. At one time these captive populations were regarded as an essential safeguard in case of disaster striking the wild populations. Given the success of conservation measures in the wild this is no longer a valid justification for holding these animals in captivity. Captive management of tuatara, however, still plays a vital role in increasing the productivity of threatened populations, raising young for wild releases, providing a resource for research purposes and providing an opportunity to raise public awareness of tuatara and associated conservation issues.



# 10. Workplan

## OBJECTIVE 1. THE GENETIC DIVERSITY OF ALL EXISTING TUATARA STOCK IS PRESERVED.

The aim is to maintain all existing wild populations of tuatara on their current islands. This requires stringent measures to minimise existing threats through such measures as rodent eradication where this is still necessary and, through effective management of island security, to reduce the chance of new threats becoming established.

### Action 1.1. Maintain the predator-free status of islands inhabited by tuatara.

Techniques used to keep predators off these islands must be practical and effective and executed to a consistent standard by conservancies. When this guidance has been provided it becomes the responsibility of each conservancy to incorporate these standards into their own island quarantine and contingency plans.

TABLE 1. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO MAINTAIN PREDATOR-FREE ISLANDS INHABITED BY TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Central Regional Office Northland, Auckland, Waikato, Bay of Plenty, Wellington, Nelson/Marlborough	High	Establish standard operating procedure for all visits to predator-free islands.	Documents completed.	Immediate
	High	Development and implementation of predator strategies for all islands that are consistent with best practice to prevent colonisation and which present effective contingency arrangements should these fail.	Procedures and resources in place to manage visitor quarantine and contingency planning and resources available in case of colonisation.	Immediate

### Action 1.2. The department will seek the support of iwi to eradicate Pacific rats from islands where they are present with tuatara.

Little Barrier Island is of immense significance for the conservation of northern tuatara because it is the only example of tuatara in kauri forest and it is one of the few islands with the potential to support a population of many thousands of this sub-species. The surviving tuatara from this island and their progeny are held in captivity on the island to keep them safe from competition for resources and predation.

Hen Island also has great potential for the conservation of northern tuatara given its size (500 ha). At present the population is at a vulnerably low level: less than 43 individuals seen in the last 16 years and no juveniles seen since 1989.

Tuatara have only recently been discovered on Mautaha. The size of this population is unknown but likely to be only a few individuals.

No juvenile tuatara have been observed on islands where rats are also present. It is presumed that the species has survived on these islands only because of the longevity of the adults.

TABLE 2. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO ERADICATE PACIFIC RATS FROM ISLANDS INHABITED BY TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Auckland	High	Obtain agreement from iwi and secure funding for rat eradication from at least Little Barrier and Hen Islands.	Eradication of rats recruitment of wild juveniles to these populations.	Operations completed by winter 2002.
Northland	Moderate			

**Action 1.3. Develop and maintain an appropriate security system to discourage illegal visitors to the islands, to indicate if animals are being poached and to lead to the apprehension of any poachers.**

While the incidence of poaching may be extremely low at present it is known to occur. This activity not only poses a direct threat to fragile populations, but also increases the risk to island habitats through fire or introduction of rodents. Apprehension of offenders is important in discouraging the activity.

TABLE 3. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO PREVENT POACHING OF TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Wildlife Enforcement Group and Conservancy law enforcement staff	High	Systems installed and operative where appropriate.	Greater confidence in security and knowledge of the level of risk.	Report on progress - available for each recovery group meeting.
		Follow-up action prompt and appropriate.		
		Reports available for recovery group to assess effectiveness of these actions.		

**Action 1.4. The legal status of all islands with tuatara will be reviewed.**

The legal status of tuatara islands varies and places different restrictions on public access. The legal status was often gazetted under circumstances quite different from those today, and it is appropriate to re-assess how relevant the legal status is for the current circumstances. Emphasis will be on those islands with lesser rank than nature reserve or wildlife sanctuary.

TABLE 4. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO REVIEW LEGAL STATUS OF ISLANDS INHABITED BY TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Northland, Auckland, Waikato, Bay of Plenty, Wellington, Nelson/Marlborough	Low	Reports on assessment to recovery group.	Recommended changes incorporated within 'best practice' manual.	Reports to recovery group by 2002 and action to follow.

**Action 1.5. Monitor trends in island populations or their habitats that may warrant management intervention.**

It is a difficult and lengthy research task to determine population parameters for tuatara, let alone trends in these over time. The need for a simple, effective and rapid survey technique has been identified as a research priority. Changes in habitat or potential changes in those factors most likely to cause a decline (weeds, pests, revegetation or modification owing to muttonbirding visits) are easier to detect and manage than tuatara populations themselves. Such 'monitoring' of island populations must be recorded and discussed in conservancy reports to the recovery group. Effective and efficient monitoring methods that become available will be described in the 'best practice' manual.

TABLE 5. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES FOR MONITORING ISLANDS INHABITED BY TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Northland, Auckland, Waikato, Bay of Plenty, Wellington, Nelson/Marlborough	High	Visit all islands as required to obtain early detection of threats/habitat changes.	Aware of population changes in time to take appropriate remedial action.	Report on this annually.
	Moderate	Population studies where threatened, e.g. habitat changes, small or with predators		Dependent on appropriate techniques.

**Action 1.6. Survey islands and stacks likely to hold unknown relict populations.**

It is possible that tuatara may be present on Archway (Poor Knights), Mokohinau Islands, Needles (north of Great Barrier) and also Whenuakuru and Hauturu (Clarke) Islands (near Whangamata). Some searching has occurred on these islands, but there is still the possibility of tuatara being present. Careful night-time searches may still reveal tuatara on other islands even though they have been visited regularly.

TABLE 6. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES FOR SURVEYING ISLANDS LIKELY TO HOLD UNKNOWN POPULATIONS OF TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Northland, Auckland, Waikato, Bay of Plenty, East Coast	Moderate	Identified islands should be searched by day and night.	Aware of all populations and able to take appropriate management.	Conclusive results for 2003 meeting.

**Action 1.7. Enhance the recovery of relict populations using captive breeding.**

Captive breeding has played an essential role in the recovery of several island populations already, and this work must continue. The ageing and declining population on Hen Island must be managed through the incubation of eggs and raising of juveniles in a predator-free environment. This could either be on the island, as is the case with Little Barrier or by a repeat of the captive management that occurred with tuatara from Red Mercury, Stanley and Cuvier. While captive breeding is an effective tool, it is expensive and is essentially a short-term measure only. Captive breeding must be used in conjunction with restoration of the original habitat.

TABLE 7. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO ENHANCE RECOVERY OF POPULATIONS USING CAPTIVE BREEDING.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Recovery Group, Auckland, Waikato Northland	High	Return captive-raised juveniles, as decided by recovery group.	Viable wild populations.	Ongoing
	High	Investigate safe breeding facilities for Hen Island tuatara either <i>in situ</i> or <i>ex situ</i> .		First eggs collected by November 2002.

**OBJECTIVE 2. TUATARA ARE REINSTATED AS COMPONENTS OF HEALTHY ECOSYSTEMS THROUGHOUT THEIR PRE-HUMAN RANGE**

Tuatara were a significant element of many ecosystems in New Zealand. An increasing variety of such habitats, not just on islands, is being restored by removal or reduction of alien species. The next step of restoration is to re-introduce elements which have been lost. In certain circumstances this should include tuatara. The techniques of incubation, head-starting and transfer have now been developed.

The holding of captive tuatara plays a vital role in this objective. The details are described in the management plan for captive tuatara.

**Action 2.1. Criteria are developed that define suitable new locations for the establishment of tuatara; and these locations identified.**

These criteria will relate to the size of the habitat, the extent to which it must be free of predators, invertebrate richness, presence of other key species, potential for conflict with other conservation goals, potential for public access and education and security from poaching. The approved criteria will be incorporated within a 'best practice' manual for tuatara conservation.

TABLE 8. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO DEVELOP CRITERIA THAT DEFINE SUITABLE NEW LOCATIONS FOR TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Recovery group	High	Criteria to be defined and listed in 'best practice' manual.	Sites to be managed in preparation of eventual transfer.	2002

**Action 2.2. Preservation of the historic and geographic patterns of tuatara distribution.**

As a guiding principle, tuatara should not be established in the wild outside their original range. In this regard East Island remains an enigma because it is not known which tuatara taxon once inhabited the island. Consultation with iwi is a vital early consideration for any translocation proposal.

TABLE 9. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO PRESERVE HISTORIC AND GEOGRAPHIC PATTERNS OF TUATARA DISTRIBUTION.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Waikato	High	Transfer of tuatara to Middle Chain from Aldermen Islands.	Animals transferred.	2003
Auckland	High	Transfer of tuatara to Tiritiri Matangi from Aldermen Islands.	Animals transferred.	2003
Nelson/Marlborough	Medium	Transfer of tuatara to Rangitoto Group from Takapourewa.	Animals transferred.	2004
Recovery group	Medium	Support of translocation of tuatara to the wild within the known range of the taxa.	At least six translocations to the wild attempted.	Continual
Recovery group	Medium	Assessment of previous transfers.	At least six translocations to the wild regarded as successful.	2010

### Action 2.3. Assess potential impacts on source populations prior to any transfer from the wild.

A thorough understanding of the source population, its size, structure and sex ratio, is necessary before harvesting from the wild. For example, a study on North Brother (Nelson 1998) has shown the population to be relatively small and with a skewed sex ratio. The findings provided cautionary advice for further harvesting of wild animals from this island. Nevertheless, these data must be balanced against the knowledge that small populations may be regulated by the restricted habitat. Removal of some animals from the population may allow increased opportunities for juveniles to become established.

TABLE 10. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO ASSESS IMPACTS OF TRANSFERS FROM WILD ON SOURCE POPULATIONS.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Northland, Auckland, Waikato, Bay of Plenty, Nelson/Marlborough	Medium	Provide documented evidence of the state of the population and the expected impact with any transfer proposal.	Retention of viability of donor population.	When appropriate.

**Action 2.4. Protocols for translocation of tuatara into the wild will be compiled and published within a ‘best practice’ manual.**

Details should include: head starting techniques, sex and age ratios for the founding population, total number of animals, requirements for supplementary transfers, time of year, packaging, introductory burrows as well as the need to monitor the success of the operation. The approved document will be included in the ‘best practice’ manual. The recovery group will encourage conservation managers to publish the results of all attempted translocations.

TABLE 11. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO DEVELOP ‘BEST PRACTICE’ FOR TRANSLOCATION OF TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Recovery group	Low	Protocols prepared and included in ‘best practice’ manual.	Protocols available.	2002

**Action 2.5. Establish sustainable captive populations of tuatara from existing stock.**

The technique of obtaining eggs from wild tuatara, artificial incubation of the eggs and captive raising of the young will be used as a tool in the establishment of new populations. This work relies heavily on the scientific expertise of universities, the husbandry skills of zoos and the willingness of these institutions to be actively involved in the conservation of tuatara. Advantages of captive raising of tuatara are that productivity in a controlled environment is much greater than in the wild. Caution must be exercised to ensure fitness and gender ratios of young tuatara raised in captivity.

TABLE 12. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO ESTABLISH SUSTAINABLE CAPTIVE POPULATIONS OF TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Recovery group	High	Sustain a healthy captive population of tuatara.	Viability and genetic diversity of captive stock is retained.	Ongoing
		Support institutions involved in approved ‘head-starting’ programmes.	Non-DOC agencies are encouraged and supported in this work.  New healthy wild populations.	

**OBJECTIVE 3. PUBLIC AWARENESS OF TUATARA AND RELATED CONSERVATION ISSUES WILL BE PROMOTED THROUGH ACCESSIBILITY TO CAPTIVE ANIMALS AND CERTAIN WILD POPULATIONS OF TUATARA.**

It is possible that tuatara, more than any other animal in New Zealand, has captured the public imagination through its ancient lineage and the fascinating story of its biology and conservation management. Unlike other large native vertebrates it can be approached closely, moved easily and even handled without impacting greatly on the individual or the conservation of the species. Close encounters with tuatara are captivating for both young and old people and have proven to be an effective medium for advocating conservation.

With the recent success of several initiatives for conservation of tuatara, the need to retain captive tuatara as an 'insurance' population is far less relevant. Meanwhile those tuatara that are held in captivity (see the full list in the plan for management of captive tuatara) are breeding and the survival of young is improving. The production of young from captive-raised animals is imminent. It is important that the captive tuatara stock is sustained through maximising the genetic diversity within each of the three taxa so that they might be retained for the greatest benefit to conservation, education and science.

**Action 3.1. Promote controlled public access to certain wild populations of tuatara.**

Wild populations of tuatara have now been introduced to islands where controlled visits by the public are permitted. Matiu Island in Wellington Harbour and Motouhora in Bay of Plenty are examples. The risk of poaching or accidental introduction of rodents may be increased on such islands, but where the risk can be well managed the benefits of public visits are significant. Good management involves high quality interpretive material and active discouragement of interference with the animals. Some future transfer proposals will endeavour to pursue this objective.

TABLE 13. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO PROMOTE PUBLIC ACCESS TO WILD TUATARA.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Bay of Plenty, Wellington, Nelson/Marlborough and possibly others	Medium	Manage access to tuatara islands with lower status than nature/scientific reserve to facilitate viewing opportunities without risk to tuatara health or security.	Active encouragement of public access to tuatara on at least two islands.	2002
All tuatara conservancies?	Medium	Establish tuatara in the wild where controlled public access is practical.	Introduction of tuatara to two other wild sites where public access is encouraged.	2006



**Action 3.2. Knowledge of tuatara and their conservation is promoted through the appropriate use of captive tuatara.**

The plan for management of captive tuatara provides guidelines on how captive tuatara can be managed as an educational exhibit while minimising stress to the animals. The tuatara roadshow has done this well, under the supervision of staff from Victoria University. Indeed, it is the reverence for the animal that enhances the impact of presentations. Any initiative to re-establish the roadshow should be fully supported.

TABLE 14. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO IMPROVE PUBLIC UNDERSTANDING OF TUATARA THROUGH USE OF CAPTIVE ANIMALS.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
Recovery group	Medium	Encourage the formation of travelling educational visits with tuatara.	A re-vamped tuatara roadshow is established.	Before 2005.
All conservancies		Encourage the use of captive tuatara to promote awareness of the species and its conservation.	Tuatara from >5 institutions are regularly used for educational visits to schools etc.	

**Action 3.3. High quality interpretation about tuatara and the issues relating to them is available to visitors where captive tuatara are on display and where there is public access to wild populations.**

The public has opportunities to see tuatara in captivity at several public institutions. These visits and the added value of good interpretative material is encouraged. Improved facilities need to be arranged with institution staff but may include display panels or contributions to audio-visual displays.

TABLE 15. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO PROVIDE TUATARA INTERPRETATION.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
All conservancies with captive tuatara	Medium	Information at existing public displays is up-dated and improved in quality.	All institutions with on-site public visits will be visited by conservancy staff and information provided for displays.	Before 2003.
			Substantial improvements at all public displays.	2005

**Action 3.4. Full use is made of the knowledge and skills available from iwi and other special interest groups when tuatara are managed for advocacy purposes.**

Involvement of iwi with any educational use of tuatara is important. The addition of cultural information adds value to the information normally presented on biology and conservation. Students and scientists have their own areas of expertise to contribute.

TABLE 9. PRIORITIES, TASKS, PERFORMANCE MEASURES AND RESPONSIBILITIES TO UTILISE KNOWLEDGE AND SKILLS OF IWI AND OTHER ASSOCIATES FOR TUATARA ADVOCACY.

CONSERVANCY	PRIORITY	TASK	PERFORMANCE MEASURE	TIMING
All conservancies	Medium	All public displays acknowledge significance to iwi as appropriate.	All displays meet this standard.	<2005
		Iwi are given the opportunity to be involved with live presentations.	Most public presentations have iwi involvement.	Immediate

## 11. Research priorities

### TO OBTAIN NEW KNOWLEDGE OF TUATARA THROUGH RESEARCH

The achievements made in conservation of tuatara over the past decade have been largely possible owing to the application of knowledge gained from scientific research. In particular, this includes: recognition of Brothers Island tuatara as a separate species, ability to induce egg laying and to incubate and head start in captivity, confirmation of existence of temperature dependent sex determination and better knowledge of populations still surviving in the presence of the Pacific rat. Further research will undoubtedly have similar benefits.

The useful application of research is not always apparent at the outset, and some research may never influence management of tuatara but will contribute to our knowledge and understanding of the animal. There is international interest in tuatara from many scientific disciplines, but access to the animals is almost entirely controlled by the Department of Conservation. The Department has international responsibilities to facilitate this research, provided the conservation of tuatara and obligations to iwi are not adversely affected.

The ethics of genetic research has recently become an issue, particularly for iwi. Some genetic research has been absolutely vital for the conservation of tuatara, for instance, the determination that Brothers Island tuatara were a different species and warranted a greater share of the resources to ensure their conservation. Other research raises concerns of manipulation, loss of whakapapa and perhaps even ownership. The issue of individual marking of tuatara is another that needs to be worked through carefully—fortunately all parties accept that tuatara welfare is paramount.

The following research topics have been identified as being useful in leading to better conservation management:

- To better understand taxonomic relationships, including confirmation of the subspecific status for tuatara in Cook Strait. This has relevance in the allocation of resources for the conservation of tuatara and also in deciding whether or not it is acceptable to use animals from several islands for translocation to a new island.
- To develop new methods for individual marking of tuatara. Individual marking is essential for many aspects of management and research. Passive transponders, inserted under the skin may have advantages over toe-clipping, but techniques are not well known and may not be suitable for all sizes of tuatara.
- To investigate sex ratios in wild populations and their implications for population viability.
- To better understand the determination of sex in tuatara.
- To better understand Maori knowledge of tuatara.
- To establish practical methods to census tuatara and to monitor population trends. At present this is only possible through intensive study and the use of mark/recapture techniques.
- To establish population models for some crucial islands where size of the population, loss of heterogeneity and biased sex ratios may pose a threat to its viability.
- To better understand the effects of stress on animals that are handled for display or management.
- To understand the impact of potential predators such as weka, takahe and kiwi.
- To investigate the existence and the role of commensal microorganisms. This has implications for the health of captive animals.
- To investigate social behaviour including mate selection.
- To study the diet of wild tuatara, including the interactions of juveniles with Pacific rats and the larger skinks.
- To investigate the effects of making tuatara more accessible to the public - effects for tuatara and the public.
- To investigate the characteristics of tuatara rookeries.
- To investigate changes in the population (including population size, class structure and density) after removal of introduced mammals.
- To better understand any adverse impacts of media and public interactions with tuatara so that the beneficial impacts may be safely maximised.

## 12. Review date

This plan, along with appended documents such as the captive management plan, is intended to guide management of tuatara until 2011. This process will be regularly reviewed through meetings of the Tuatara Recovery Group. Specific actions consistent with the plan and minor changes of direction as approved by the Regional General Manager (Central) will be recorded in the minutes of the group meetings. In addition, a complementary 'best practice' manual will be developed.

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# Appendix 1

## INVENTORY OF ISLANDS

### **Status of current tuatara populations**

ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
<b>Poor Knights</b>							
Tawhiti Rahi	163.0	Nature Reserve	DOC Northland, MSA (Maritime Safety Authority)	Maori occupation till early 1800s. Lighthouse beacon.	63	Hundreds or low thousands	Yes
Stack B	0.8	Nature Reserve	DOC Northland	None	2	Few tens	Yes
Aorangi	110.0	Nature Reserve	DOC Northland	Maori occupation till early 1800s. Pigs 1700s-1936.	26	Hundreds or low thousands	Yes
hAorangaia	6.3	Nature Reserve	DOC Northland	None	1	Few tens	None found
MSAu Kapiti	1.25	Nature Reserve	DOC Northland	None	2	Few tens	None found
<b>Hen and Chickens</b>							
Lady Alice (Marotiri)	155.0	Nature Reserve	DOC Northland	Once Maori-occupied. Kiore. Saddlebacks, introduced 1971.	About 250	Up to about 100	Yes
Whatupuke	101.9	Nature Reserve	DOC Northland	Once Maori-occupied. Kiore. Saddlebacks introduced 1964.	33	Low hundreds	One found 1979. None found in 1989

ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
Coppermine	79.5	Nature Reserve	DOC Northland/ MSA	Once Maori-occupied. Copper mining 1800s; prospecting 1960s. Lighthouse beacon. Kiore. Saddlebacks self-introduced from Whatupuke.	81	Low hundreds	"Small animals" seen in 1965, but no juveniles seen in surveys in 1968, 1979 or 1989
Mautaha	26	Nature Reserve	DOC Northland	Pacific rats - saddleback	0	<20	nil
Hen (Taranga)	500.0	Nature Reserve.	DOC Northland/ MSA	Once Maori-occupied. Lighthouse beacon. Stitchbirds introduced 1980 -1981. Little-spotted kiwi introduced 1988/1989.	29	Low hundreds	Two nests and two possible juveniles seen in 1984. No juveniles seen in 1989
Little Barrier (Hauturu)	3083.0	Nature Reserve	DOC Auckland	Once Maori-occupied. Logging in 1800s. Farmed extensively. Wildlife Officer 1897 to present. Pigs, dogs and cats eradicated. Pacific rat still present. Saddleback and kokako introduced.	-	Few tens? (8 removed to captivity). Captive population now about 60	None found during 1991 survey
Cuvier	170.0	Nature Reserve and Lighthouse Reserve	DOC Waikato, MSA	Lighthouse-keepers 1889 -1981. Sheep and cattle till 1960s. Goats eradicated 1961. Cats eradicated 1964. Saddlebacks introduced 1968. Stitchbirds introduced 1982. Parakeets re-introduced 1974.	-	Less than 10? (6 removed to captivity)	



ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
<b>Mercury Group</b>							
Middle	13.1	Scenic Reserve (but managed as if Nature Reserve)	DOC Waikato		34	Low thousands	Yes
Green	2.3	Scenic Reserve (but managed as if Nature Reserve)	DOC Waikato		41	Hundreds	Yes
Stanley (Kawhitihu)	99.5	Nature Reserve	DOC Waikato	Once Maori-occupied. Kiore. Rabbits. Saddlebacks introduced 1968.	17	Few tens (15 removed to captivity, at least 6 may be alive on island)	None found in surveys in 1989 or 1990
Red Mercury	225.0	Scenic Reserve (but managed as if Nature Reserve)	DOC Waikato	Once Maori-occupied. Kiore. Saddlebacks introduced 1966, little spotted kiwi 1983.	3	Few tens (11 removed to captivity, at least two may be alive on island)	None found in surveys in 1989, 1990 or 1991
<b>Aldermen Group</b>							
Ruamahua-nui	32.5	Nature Reserve	DOC Waikato	Once occupied or visited by Maori.	10	Hundreds	Yes

ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
Ruamahua -iti	25.0	Nature Reserve	DOC Waikato	Once occupied or visited by Maori.	17	Hundreds	Yes
Hongiora	16.3	Nature Reserve	DOC Waikato	Once occupied or visited by Maori.	5	Low hundreds	Yes
Nga Hora (previously known as Hernia)	3.4	Nature Reserve	DOC Waikato		3	Tens - low hundreds	None found in survey in 1989
Half	1.5	Nature Reserve	DOC Waikato		-	Tens - low hundreds	Yes
North Stack	0.7	Nature Reserve	DOC Waikato		-	Tens	Yes
Middle Chain Stack	0.4	Nature Reserve	DOC Waikato		-	Tens? (Presence of tuatara based on faeces only)	?
<b>Bay of Plenty</b>							
Karewa	5.0	Wildlife Sanctuary	DOC Bay of Plenty		31	Hundreds	Yes
Smaller northern part of Plate Island (Motunau)	0.8	Wildlife Sanctuary (Maori owned)	DOC Bay of Plenty plus Maori owners	Visited by Maori owners. Muttonbirding by owners still allowed with DOC permit.	-	Hundreds	Yes

ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
Larger southern part of Plate Island (Motunau)	2.8	Wildlife Sanctuary (Maori owned)	DOC Bay of Plenty plus Maori owners	Visited by Maori owners in past. Muttonbirding by owners still allowed with DOC permit.	18	Hundreds	Yes
Moutoki (Rurima Rocks)	0.8	Wildlife Refuge (Maori owned)	DOC Bay of Plenty plus Maori owners	Landing is legal without DOC permit, but requires permission of Maori owners. Owners can visit without permit.	30	150-180	Yes
Moutohora (Whale Island)	1.43	Wildlife Management Reserve, Wildlife Refuge	DOC Bay of Plenty	Norway rats, rabbits, goats and cats eradicated. Entry by permit for public parties. Tieke liberated 1999. Kiwi liberated 2001.	c.30	32 adults from Moutoki released in 1996, potential of many thousands	Yes
<b>Trios Group</b>							
Middle Trio	20	Wildlife Sanctuary (Maori-owned)	DOC Nelson-Marlborough plus Maori owners		59	Low thousands	Yes
North Trio	1	Wildlife Sanctuary (Maori-owned)	DOC Nelson-Marlborough plus Maori owners	None.	3	Few tens	Yes

ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
South Trio	2	Wildlife Sanctuary (Maori-owned)	DOC Nelson-Marlborough plus Maori owners	None	3	Few tens	Yes
Takapourewa	150	Wildlife Sanctuary, Lighthouse Reserve	DOC Nelson-Marlborough, MSA (subject to Maori land claim)	Lighthouse keepers 1894 -1989. DOC officer 1989 to present. Cats 1890s-1910. Yellow-crowned parakeet introduced 1970 (no longer present). Guinea fowl removed 1975; Antipodes Island. parakeet introduced 1986 (removed 1988). Stock grazed entire island 1890s -1951. One or more pigs once briefly present. Cattle removed 1988; dog removed 1989. Sheep still graze about 30% of the area above cliffs.	About 2000	At least 30,000 (Newman 1982a)	Yes
North Brother Island	4	Wildlife Sanctuary and Lighthouse Reserve	DOC Nelson/Marlborough, MSA	Lighthouse keepers 1877 -1990.	547	350+ adults	Yes
Titi Island	32	Nature Reserve	DOC Nelson/Marlborough	Periodic harvesting of titi. Norway rats eradicated in 1970s.	c.70	68 tutara from North Brother Island released in 1995, potential of several thousand	Not seen yet

ISLAND	AREA (HA)	RESERVE STATUS AND LAND TENURE	MANAGEMENT AUTHORITY	HUMAN ACTIVITIES AND INTRODUCED ANIMALS	NO. TOE-CLIPPED TUATARA	LIKELY POPULATION SIZE	PRESENCE OF TUATARA 180 MM SVL
Matiu/Somes Island	25	Scientific/historic	DOC Wellington	Intensively modified until post WW2. Active restoration including eradication of ship rats.	c.60	54 tuatara from North Brother Island released in 1998, potential of several thousand	Not seen yet

# Published recovery plans

NUMBER	SPECIES	YEAR APPROVED
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

Available from DOC Science Publications, Science & Research Unit, P.O. Box 10-420, Wellington.

\* Available from Otago Conservancy, Department of Conservation, P.O. Box 5244, Dunedin.