

**THREATENED SPECIES RECOVERY PLAN SERIES NO.5**

**CHEVRON SKINK  
RECOVERY PLAN**  
*(Leiopisma homalonotum)*

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Frontispiece: Chevron skink. Photo: Dick Veitch, Department of Conservation, Great Barrier Island, 1985.

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*(Leiopisma homalonotum)*

by

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**ABSTRACT**

Recovery options are provided for the endangered chevron skink (*Leiopisma homalonotum*), New Zealand's largest living endemic lizard. Chevron skinks are now confined to Little Barrier Island and Great Barrier Island, although early 20th century anecdotal reports indicate that they may once have occurred in the northern North Island. Status of the chevron skink on Little Barrier Island remains unknown because only one specimen has been found. Removal of cats from Little Barrier Island by 1980, combined with security of the island against threats associated with human activities, provides improved prospects for natural recovery of the species, but the extent of its useable habitat remains unknown. On Great Barrier Island chevron skinks are threatened by predation, habitat degradation, habitat destruction, accidental escape of additional predators, and intentional introduction of potential pest species. Because of this range of threats the plan focuses on habitat management on Great Barrier Island as a means of improving the conservation status of chevron skinks.

The preferred short-term (five-year) recovery option is based on a combination of survey, and research, on Little Barrier Island, and advocacy, wild animal control, and pest prevention to lessen threats on Great Barrier Island. The long-term option (ten-year) aims to couple success with short term objectives on Great Barrier Island with a programme of cat sterilization and control. In addition to chevron skinks, species such as Hochstetter's frog, striped skink, kokako, banded rail and brown teal would benefit either directly or indirectly from well targeted habitat management on Great Barrier Island.

**1. INTRODUCTION**

The New Zealand lizard fauna of geckos and skinks is probably the most diverse for any temperate archipelago. Lizard remains in caves and sand dunes indicate that the North Island fauna became greatly reduced in diversity at about the time humans arrived (about 1000 yr BP)(Davidson 1984, Worthy 1987, Towns 1992a). The most numerous populations of lizards are now found on relatively small islands free of introduced mammals (Towns 1991), but the most species-rich faunas are on the large Little Barrier and Great Barrier Islands (McCallum and Harker 1982, Newman and Towns 1985, Towns and Robb 1986, Whitaker and Daugherty 1991). These two islands provide the best examples of what mainland lizard faunas must once have been like. The following

recovery plan covers a species found only on Little Barrier and Great Barrier Islands: one of New Zealand's rarest lizards, the chevron skink (*Leiolopisma homalonotum*).

The chevron skink is the largest living lizard known from New Zealand, reaching 138 mm snout-vent and a total length of over 30 cm (Robb 1986). The species has distinctive brown and white markings formed into a teardrop under the eyes and alternating pale- and dark-brown markings down its back that are reflected in its common name. The species is unusual for its vocal chirps and grunts when disturbed or handled.

The chevron skink has been linked with accounts of a giant lizard (kawekaweau) of 19th-century Maori in the northern North Island (Hardy 1977), may be related to the only known specimen of another species (*Leiolopisma gracilicorpus*), and was "lost" from the fauna for over 60 years following its description in 1906 (Hardy 1977).

Until recently the species was thought to be confined to Great Barrier Island, but in early 1991 a joint DOC-Victoria University party searching for tuatara found a juvenile chevron skink on north-western Little Barrier Island (Whitaker and Daugherty 1991).

The chevron skink is listed in the *Red Data Book of New Zealand* as "vulnerable" (Williams and Given 1981), has been recommended for listing in the *IUCN Red Data Book* (the edition on lizards has yet to be published), and is listed by (Bell 1986) as endangered, with limited distribution. Justification for the endangered status was destruction of habitat on Great Barrier Island from development and browsing animals and threats of predation from introduced mammals and birds (e.g. weka *Gallirallus australis*). Status of the species on Little Barrier Island remains unknown.

On both Little and Great Barrier islands, the chevron skink is part of a fauna of amphibians and reptiles that is not only rich but also highly distinctive. Little Barrier is the only location where chevron skinks occur sympatrically with tuatara (*Sphenodon punctatus*), and Great Barrier is the only place where they occur sympatrically with Hochstetter's frog (*Leiopelma hochstetteri*). Tuatara and Hochstetter's frogs are both species that are highly sensitive to habitat disturbance and/or predation (Bell 1985, Cree in press), so conservation measures proposed for chevron skinks on the two islands are interlinked with those for tuatara and frogs. On Great Barrier Island management of chevron skinks is also linked both with management of land under Crown control (60% of the island) and future use of land outside Crown responsibility (Auckland Conservancy Conservation Management Strategy in prep., Auckland City Council District Plan: Great Barrier Island in review).

The opportunities and threats on Great Barrier are similar to those on the mainland, but there are some important differences. First, Great Barrier lacks some lizard predators present on the mainland: mustelids, Norway rats (*Rattus norvegicus*), and hedgehogs. The island also lacks several species responsible for forest habitat destruction elsewhere: deer, possums, wallabies and hares. In addition, opportunities to control pest species that are present (cats, dogs, pigs and goats) may be higher than on the mainland. There are also opportunities for protection and enhancement of a species with which a local community can identify.

Because of the conservation values of the amphibian and reptile faunas of Little Barrier and Great Barrier Islands and the role of the Department as a major land administrator on Great Barrier, this plan is directed more towards strong advocacy and effective habitat management and enhancement, rather than towards management of the chevron skinks as a species.

Preferred options for recovery are outlined below within a five-year timetable. Implementation of the recovery strategy will be assisted by a recovery team comprised of some or all of the following:

- Threatened Species Unit member - DOC, Wellington
- Field Centre Manager - DOC, Great Barrier Island
- CO - Species Protection - DOC, Auckland
- Other conservancy staff - (to be determined)
- Lizard expert(s) - outside organisation(s)
- Author(s) of plan - DOC, Science & Research, Auckland
- Captive breeding co-ordinator (New Zealand Herpetological Society; interim)
- Iwi representation - (to be determined)
- Local authority representation - (to be determined)

## **2. PAST AND PRESENT DISTRIBUTION**

### **2.1 Past Distribution**

The chevron skink was described by Boulenger (1906) from "Flat Is, Mokohinau Islands" but has never been located in the group since. The type specimens of the chevron skink and Suter's skink are held in the Wanganui Museum, and both McCann (1955) and Hardy (1977) noted that locality labels on the two specimens had been interchanged after the original description. The chevron skink had therefore been incorrectly attributed to the Mokohinau Islands. Until Hardy's revision the few specimens donated to the Auckland Museum from Great Barrier Island could not be assigned to any known species (Hardy 1977).

Chevron skinks were regarded by Towns and Robb (1986) as a "pseudoendemic" species confined to fragments of a previously wider distribution (Fig. 1). The discovery of chevron skinks on Little Barrier Island adds credibility to this view and casts new light on old northern North Island accounts of large skinks that could have been chevron skinks (Appendix 2)

### **2.2 Present Distribution**

#### **2.2.1 Wild Populations**

##### **GREAT BARRIER ISLAND**

Following general surveys for lizards and other vertebrates on Great Barrier (Ogle 1980, 1981, Dick 1981), searches specifically for the Great Barrier Island skink were conducted in northern and southern parts of the island (Newman and Towns 1983,1985),

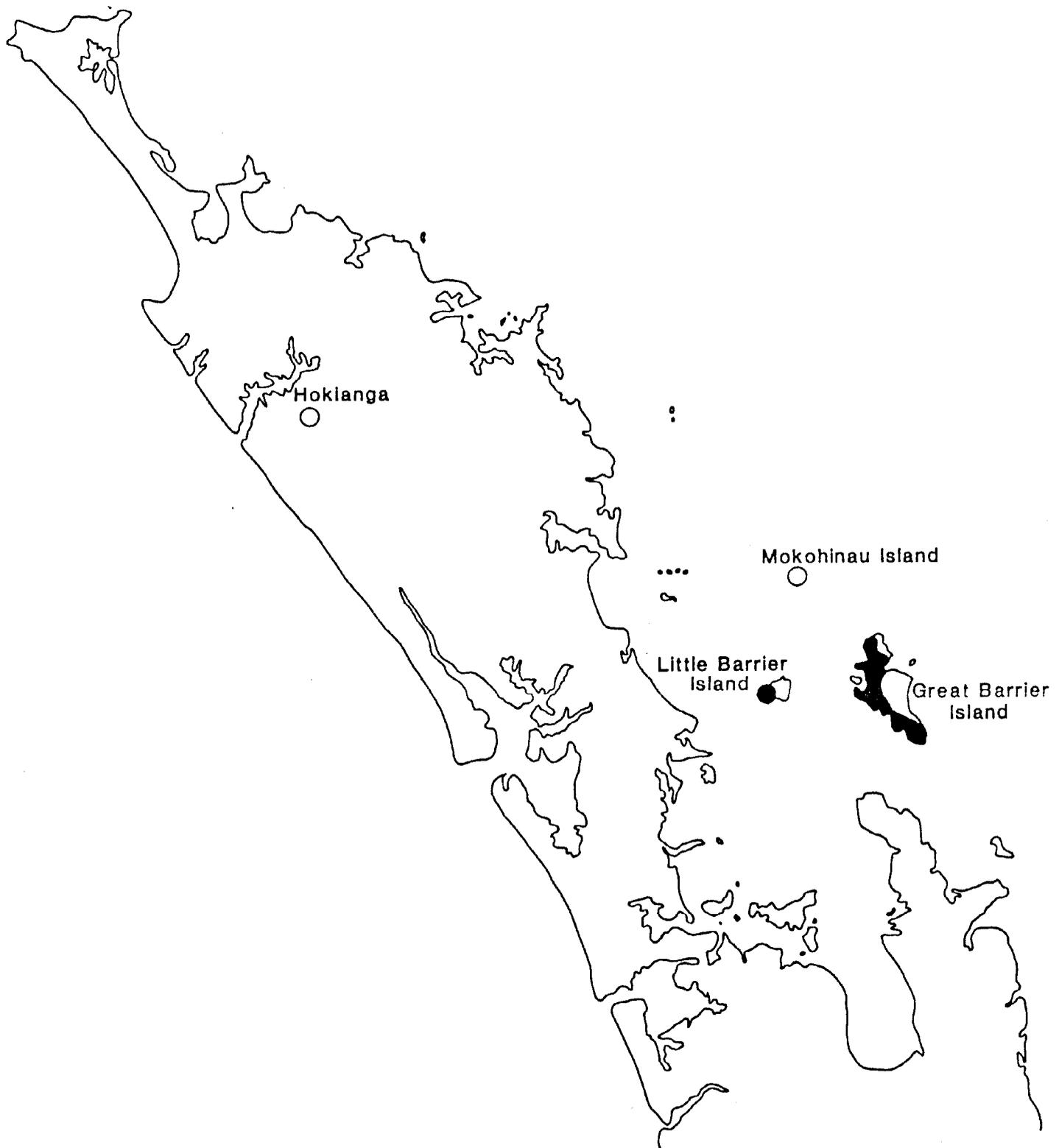


Figure 1. Localities mentioned in the text. Unconfirmed sightings that might be attributable to chevron skinks are shown in the Hokianga area (see Appendix 2), along with the report for the Mokohinau Islands ("Flat Island"), which is probably in error (open symbols). There is no "Flat Island" known in the Mokohinau Group, but it is the alternative name for Rangiahua Island. Confirmed reports are known only from Little Barrier and Great Barrier Islands (closed symbols).

preliminary habitat studies were carried out at Tryphena between January 1984 and April 1986 (DRT and IM), and a mail-based questionnaire on sightings was conducted in 1985 as part of the above study (IM).

Chevron skinks have been recorded at over 20 locations since the species was first described. The only confirmed reports of chevron skinks on Great Barrier Island before 1974 were the series from which it was described in 1906 and one specimen in 1952 (Auckland Institute and Museum records; Hardy 1977). Several confirmed sightings were made between 1974 and 1979, but most reports have been received since December 1979 (Ogle 1981, questionnaire records).

Sightings are concentrated on the western side of the island. No chevron skinks were found during a survey of the eastern side of Te Paparahi (the Northern Block) (Newman and Towns 1985) and none have been reported in Great Barrier Forest east of Mount Hobson (Fig. 2). At some locations there have been multiple sightings. The New Zealand Herpetological Society reported 21 sightings of an estimated 17 individuals along a stream in Tryphena (Ogle 1981), and four independent sightings reported by questionnaire were along a stream near Port Fitzroy. The most productive sites for chevron skinks near Tryphena show little evidence of disturbance by pigs and browsing by goats, both of which are uncommon in the more heavily populated areas.

#### LITTLE BARRIER ISLAND

The lizard found on Little Barrier was on the north-western side of the island. A concurrent survey on the eastern side did not locate the species and none were found during searches in October 1992 (A.H. Whitaker pers. comm. 1992).

In the absence of other information Great Barrier Island should still be considered the stronghold for chevron skink. Even if large populations of the species are present on Little Barrier, Great Barrier provides the widest range of habitats in which to support them.

#### **2.2.2 Captive Populations**

There are two populations of chevron skinks in captivity in Auckland. One group of less than ten animals has been held by a private breeder since 1978. The second group of four is housed at Auckland Zoo on behalf of the Department of Conservation. These originated from a collection held by a private breeder on Great Barrier Island, and included two lizards rescued from cats. Both groups of animals have bred while in captivity but survival of young has been low. In addition to these populations two individual chevron skinks are held separately, one of them on Little Barrier Island.

### **3. ECOLOGY OF CHEVRON SKINK**

The following information summarises more detailed accounts of the biology of the chevron skink (Appendix 1). There are no published detailed accounts of the ecology of this species.

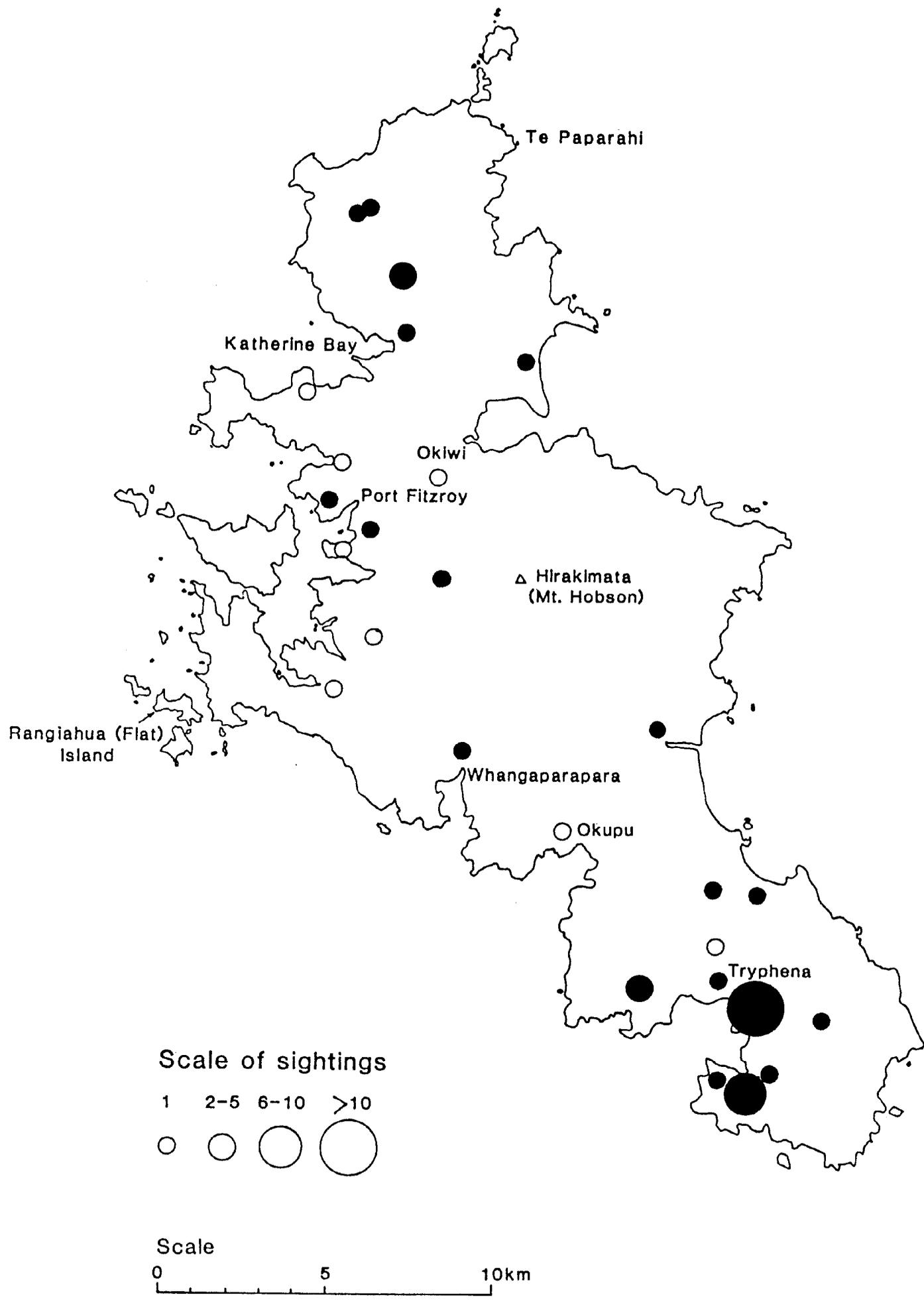


Figure 2. Map of Great Barrier Island, showing; distribution of confirmed reports of chevron skinks. The number of reports is shown by proportional circles; closed circles have precise locality data; open circles have general locality data. Information from Hardy (1977), Ogle (1981), Newman and Towns (1985), and Pickard and Towns (1988).

Chevron skinks are presumed to be diurnal. None have been seen during surveys at night with spotlights (Newman and Towns 1985). Animals in captivity have only been seen foraging during daytime (J. West pers. comm.). On Great Barrier Island the species has rarely been seen even following intensive searches of areas where they are known to occur.

Robb (1986) noted that chevron skinks are sometimes seen basking in patches of sun striking down through the foliage. However, the species is clearly not a heliothermic one (sun-seeking), otherwise, with a body mass of adults exceeding 50 g, considerable periods would need to be spent basking and observations would be more frequent (see Appendix 1).

Chevron skinks have been most frequently encountered in forested areas along water courses, often in very damp areas, including seepages, packs of damp leaf material and in wet, rotten logs. They have been found inhabiting burrows and even alkathene pipe in stream banks. The association with streams is such that juveniles at least are suggested to be semiaquatic (Towns and Robb 1986). The species is predicted to have a high rate of cutaneous water loss compared with other members of the genus (Cree et al in prep.)

Up to eight offspring may be produced in summer (Robb 1986) or early autumn. Young may take up to four years to reach sexual maturity (Appendix 1).

#### **4. THREATS TO LONG TERM SURVIVAL**

##### **4.1 Great Barrier Island**

The threats to chevron skinks on Great Barrier Island that led Bell (1986) to assign them endangered status remain, although these threats have been lessened by wild animal control in some areas. The species faces continued threats from predation, habitat degradation, habitat destruction, accidental escape of additional predators, and intentional introduction of potential pest species.

##### **4.1.1 Predation**

The only direct evidence of predation on chevron skinks by introduced mammals on Great Barrier comes from skinks reported as taken by cats. Live specimens of chevron skinks caught by cats are now in captivity at Auckland Zoo, and dead specimens were also reported through the questionnaire. Cats can be highly effective predators of lizards, with up to 14 lizards of three species reported from one cat shot in central Otago (Daugherty and Towns 1991). Potential rodent predators of chevron skinks on Great Barrier Island in decreasing order are ship rats, kiore (Towns 1991) and mice (Newman 1988, Towns 1992b). Trap interference by rodents (chewed through mesh and removal of baits) was recorded for all walk-through traps inside hollow tree trunks on Great Barrier. However, the vulnerability of chevron skinks to rodents remains unclear because so little is known of the lizards' ecology.

Pigs are almost certainly predators of chevron skinks on Great Barrier Island, and in some parts of the island their rootings are most extensive in likely lizard and native frog

habitats along streams. Evidence of predation of reptiles by pigs was found on Stephens Island where an escaped domestic pig was shot after feeding on tuatara and fairy prions (S. Bucknell pers comm. 1991). On the mainland feral pigs have been recorded eating geckos (Thomson and Challies 1988).

#### **4.1.2 Habitat Degradation**

Browsing by animals such as goats and feral cattle on Great Barrier Island has influenced the quality of forest habitats (Hay et al. 1985) and the species composition of the vegetation (Wright and Cameron 1985). Browsing by goats and pigs has caused accelerated erosion and silting of streams (Newman and Towns 1985, Towns 1987). The importance of goat control has been demonstrated by rapid changes to vegetation of Te Paparahi since control measures began in 1986 (A.E. Wright pers comm.).

Some of the best examples of lowland broadleaf forest containing chevron skinks are in Tryphena township, where pigs and goats are rare (R.E. Beever, pers comm. 1984).

#### **4.1.3 Habitat Destruction**

Most of Great Barrier has at some time been cleared for farming, firewood and timber, but low returns for farmers have led to much cleared land being abandoned. Over 50% of the land is now dominated by tea-tree (*Leptospermum*), ranging from manuka to tall kanuka (Cameron 1985). This reverting forest could form the basis for recovery of many rare species, including chevron skinks. However, increasing pressure to provide additional areas for residential subdivision and more sophisticated facilities for tourism, if not carefully planned, could cause destruction or degradation of key areas near existing settlements.

#### **4.1.4 Escape of Pest Species**

Escape onto the island of Norway rats or mustelids could be disastrous for chevron skinks. Because Norway rats (sometimes called water rats) frequent wet areas chevron skinks could be more vulnerable to these than to any other rodent. Mustelids are voracious predators of lizards and other small vertebrates (D.R. Towns, pers. obs., King 1990). There has been more than one attempt at landing pet ferrets on the island, although they are not permitted either under local bylaws or the Farming of Unprotected Wildlife Regulations 1985. Possums and deer could dramatically affect forest environments on Great Barrier. The escape of possums onto the island has been narrowly averted at least once (*New Zealand Herald* 13 January 1990). Both possums and deer are prohibited from liberation under the Wild Animal Control Act 1977 (see also Appendix 3).

The advent of fast ferry services to Great Barrier Island, the large vehicular ferry and numerous private vessels that visit during summer have increased the risk of pest species either escaping from boats or being unwittingly carried ashore in luggage or vehicles. The popularity of Great Barrier as a resort has added to the range of threats faced by chevron skinks and other species on the island.

#### **4.1.5 Deliberate Release of Pest Species**

Weka were unsuccessfully introduced to Great Barrier Island in the early 1980s. Fortunately the birds failed to establish, although several residents reported to us that

they were seen in the Tryphena area. Weka have greatly depleted lizard faunas on islands such as Arid (McCallum and Hitchmough 1982). On the Open Bay Islands lizards can only be found in areas protected from weka by wire netting (P. Carey, pers. comm.).

#### **4.2 Little Barrier Island**

The removal of cats from Little Barrier Island in 1980 (Veitch 1983) probably also removed the most significant predator of chevron skinks. Kiore (*Rattus exulans*) are known to have detrimental effects on diurnal skinks (Towns 1991). Whether these effects extend to chevron skinks is unknown. The future of chevron skinks on Little Barrier is now threatened by escape of additional rodent species ashore from shipwrecks or activities associated with management of the island. The threat of rodents escaping from stores landed on the island is now defined and minimised (draft Auckland Conservancy Rodent Contingency Plan). The only remaining threat is from ill-considered release of incompatible species. The danger of weka to lizard fauna has been outlined above, but other ground feeding birds can pose risks to island lizard populations. These risks have been examined, for example, by (Atkinson 1990) for takahe on Mana Island. Existing departmental translocation guidelines should deal with these potential threats.

### **5. ABILITY OF THE SPECIES TO RECOVER**

Predictions about the ability of chevron skinks to recover are complicated by the lack of information about historical distribution and ecology of the species. The following predictions must therefore be based on some assumptions:

1. The lack of reports on Little Barrier Island before 1991 reflects the effect of cats on the species. Their appearance during the 1991 survey, but not those previously (McCallum and Harker 1982), may represent the beginnings of a gradual recovery following the eradication of cats completed in 1980 (Veitch 1983).
2. The very few reports on Great Barrier Island prior to 1979 were the result of greatly reduced numbers of chevron skinks following forest clearance for farming and timber extraction. Increased sightings in the last 15 years have been the result of a partial recovery following 30 years of reversion of cleared land to forest (but may also be attributable to an increased number of observers on the island).
3. The predominance of sightings along water courses (Appendix 1) supports the physiological association with moist environments predicted by Cree et al. (in prep.). This may restrict the kind of locations in which the species can be managed.

#### **5.1 Little Barrier Island**

Chevron skinks on Little Barrier Island probably now have better prospects for recovery than at any time in the previous 100 years. Limits on the size of this expansion most

likely relate to the extent of suitable habitat. Little Barrier Island can be very dry in summer, when many streams carry little or no water (Kear 1961). Chevron skinks have been found in moist litter on dry stream beds on Great Barrier Island, but have not been found by us in very dry areas. Limits to expansion on Little Barrier Island could be set by the combined availability of moist and warm areas in summer. It is unclear whether the frequent cloud cap and higher rainfall above 650 m (Hamilton 1961) would provide more suitable habitat than the warmer, but drier areas nearer the coast.

## **5.2 Great Barrier Island**

Continued regeneration of seral vegetation may improve the quality of some forest areas occupied by chevron skinks on Great Barrier Island. In view of the array of factors leading to habitat degradation and destruction on the island (Section 4.1 above), it is unlikely that further recovery of the species will occur unaided.

## **6. OPTIONS FOR RECOVERY**

Four options for recovery are presented here. They are presented as points on a continuum, because viable alternatives to habitat protection and rehabilitation do not exist at present. Options 2-4 should therefore be regarded as cumulative, rather than exclusive. The options are presented on the assumption that surveys in forested parts of northern New Zealand will include searches for chevron skinks as the opportunities arise (see Appendix 2.)

Recovery targets either in terms of numbers of individuals or area occupied (e.g. Towns 1992a) cannot be provided because of the lack of definitive information on habitat use and status of the species in the wild. Habitat management away from Little Barrier and Great Barrier Island and translocation of chevron skinks to new locations is not advocated because of the current poor understanding of conditions in which the lizards live.

Uncommon species other than chevron skinks that could benefit from the various options are listed where possible.

### **OPTION 1: No management, research or advocacy on Little or Great Barrier targeted at chevron skinks and little habitat rehabilitation.**

The option has effectively been abandoned, because between 1986 and 1992 a goat control programme has greatly reduced the numbers of browsing animals in Te Paparahi. Unfortunately pig numbers appear to have risen greatly in the area (R. Delamore pers. comm.). If funds are not allocated to pig control on Great Barrier Island, to research on chevron skinks on Great Barrier or to surveys to determine the status of the species on Little Barrier the outcomes will be: (a) the status of the species on Little Barrier would remain unclear and (b) the threats of predation, habitat degradation, habitat destruction, and escape or introduction of pest species would lead to a decline of chevron skinks on Great Barrier.

The current low level of overall pest control, while highly effective against goats in Te Paparahi, will not by itself lead to decreased threats either to chevron skinks or to a wide range of other native fauna and flora, including several rare species.

**OPTION 2: Focus survey and research on the Little Barrier Island population and couple this with a moderate level of advocacy on Great Barrier Island.**

This should be regarded as a minimum-cost option. It would focus on establishing a clear view of status and habitat use by the species on Little Barrier. Information on habitat use could be applied on Great Barrier Island later. Wild animal management on Great Barrier would remain at a low level, but preventative measures (advocacy) against introduction of undesirable species would increase. These measures could include establishment and maintenance of bait stations against Norway rats at the main departure points of vessels for Great Barrier, on vessels regularly servicing the island, and on the wharves at Great Barrier. This should be coupled with warnings at departure and arrival points for aircraft regarding mammal species not wanted/prohibited from the island. Prohibited species such as mustelids are listed in the Farming of Unprotected Wildlife Regulations 1985 and should also be defined in local bylaws (see Appendix 3).

This option in part maintains a holding pattern for chevron skink habitats on Great Barrier Island, concedes some further deterioration of habitat quality due to browsing mammals, but allows for further control at a later date. There would be few direct benefits for other species from this option. Instead, gradual degradation of the stream habitats of Hochstetter's frogs will occur until effective control of habitat destruction by browsing mammals (especially pigs) is achieved.

**OPTION 2 SHOULD BE REGARDED AS AN ABSOLUTE MINIMUM REQUIREMENT FOR CONSERVATION OF CHEVRON SKINKS ON GREAT BARRIER ISLAND.**

**OPTION 3: Survey, research and preventative measures defined in Option 2, coupled with intensive wild animal control at key sites as well as a conservation action plan for Great Barrier Island.**

Under this option survey and research on chevron skinks would be focused on Little Barrier Island but could be extended to Great Barrier Island to obtain the most complete view of options for habitat management. Preventive measures would be implemented as in Option 2 above, but wild animal control would be focused on areas in which long-term (permanent) clearance of goats, pigs, cattle and feral dogs can be achieved. Examples would include Te Paparahi because of its high values for plants and animals (Towns 1988a) and some southern areas, because of their quality and high potential values. Both areas include land outside Crown control, so the campaigns would require effective advocacy, and partnerships with landowners, and the local and regional authorities. Such partnerships will only succeed if there are explicit statements provided by DOC on how its key land resources on the island should be managed (Conservation Management Strategy in prep). Evaluation of the prospects of a more formal status for

Great Barrier Island (e.g. National Reserve; Cameron 1985) should proceed in tandem with these partnerships.

**OPTION 3 IS THE PREFERRED REALISTIC AND ACHIEVABLE  
SHORT TERM GOAL.**

Achievement of this option would safeguard chevron skinks on Great Barrier Island and provide for further expansion in numbers. Other species that would likely benefit are five species of forest-inhabiting lizards including the only island population of the rare striped skink, as well as Hochstetter's frog (from improved catchment stability); and kokako (*Callaeas cinerea*), kaka (*Nestor meridionalis*), kakariki (*Cyanoramphus auriceps*) and other forest birds (from improved forest quality).

**OPTION 4. Survey, research and preventive measures defined in Option 2, intensive wild animal control at key sites, conservation action plan for Great Barrier Island as defined in Option 3, and a campaign of control and neutering of cats.**

The most serious predator of many vertebrates and invertebrates on Great Barrier Island is cats. At present it is unrealistic to propose the eradication of cats from Great Barrier Island. However, as the island becomes more populated, the number of domestic and feral cats will inevitably increase, and could reach beyond the levels of predation that some species can withstand.

In addition to the measures proposed under Option 3 above, there could be a long term aim at greatly reducing the effect of cats on native wildlife. This would need to be a five-phase operation involving

- (a) tests of the local effects of cat control on rodents and small vertebrates (best conducted in an uninhabited area such as Te Paparahi);
- (b) dependent on the results of (a), a cooperative campaign (possibly involving both the Auckland City Council and RNZSPCA) to have existing domestic cats spayed or neutered;
- (c) public education and requests for visitors and permanent residents not to take cats to the island;
- (d) concerted effort by DOC to control cats on Crown land at sites where they congregate (e.g. near huts and tracks); and
- (e) campaigns for local eradication of cats in concert with attempts at eradicating browsing mammals in selected areas.

**OPTION 4 SHOULD BE REGARDED AS THE PREFERRED  
LONG TERM OPTION.**

Species other than chevron skinks would also benefit from a combination of Options 3 and 4, including: Hochstetter's frogs (from improved catchment stability); kokako, kaka, kakariki and other forest birds (from improved forest quality and reduced predation); brown teal, banded rail, Cook's petrel and black petrel (from reduced predation); and

**3. SURVEY LITTLE BARRIER ISLAND FOR CHEVRON SKINKS.**

Undertake searches for chevron skinks in selected catchments on Little Barrier Island in order to assess status of the species on the island and to define locations for research on habitat use.

**4. DETERMINE HOW HABITATS ARE USED BY CHEVRON SKINKS AND IN WHAT WAYS THE SPECIES IS VULNERABLE TO HABITAT DISTURBANCE AND PREDATION.**

Conduct research that will define habitat use, the relevance of apparent associations with streams, and investigate whether the species has requirements for moist environments.

**SHORT TERM OBJECTIVES: PRIORITY 2**

**5. ERADICATE GOATS AND PIGS FROM SELECTED AREAS ON GREAT BARRIER ISLAND.**

Complete eradication of goats from Te Paparahi and start eradication of pigs before construction of a barrier fence across the northern isthmus.

**6. PROMOTE PUBLIC INTEREST AND INVOLVEMENT IN THE RECOVERY OF CHEVRON SKINK, IN HABITAT REHABILITATION, AND IN THE CONSERVATION VALUES OF GREAT BARRIER ISLAND.**

Keep the public informed of progress with recovery of chevron skinks, of success with control programmes, and of the rate of recovery of forest habitats. Involve interested groups as appropriate and provide for public participation in a cat control programme.

**SHORT TERM OBJECTIVES: PRIORITY 3**

**7. DEFINE LONG TERM OBJECTIVES FOR LAND MANAGEMENT ON GREAT BARRIER ISLAND.**

Initiate public debate and planning for an action plan for Great Barrier Island with the long term view of raising the status of parts of the island to National Reserve or equivalent.

**LONG TERM OBJECTIVES**

**8. DETERMINE HABITAT USE BY CHEVRON SKINKS ON BOTH LITTLE BARRIER AND GREAT BARRIER ISLANDS.**

Compare habitat use and numerical density on Little Barrier Island, where levels of predation have been greatly lowered, with Great Barrier Island, where they are still high.

**9. CONDUCT WILD ANIMAL CONTROL CAMPAIGNS AT KEY SITES ON SOUTHERN GREAT BARRIER ISLAND.**

Concentrate control campaigns in the southern isthmus south of Claris where there are known populations of chevron skinks along streams in regenerating coastal forest.

**10. INSTIGATE PROGRAMMES FOR THE STERILISATION AND CONTROL OF CATS.**

Undertake collaborative programmes with local authorities to discourage transport of cats to Great Barrier Island, sterilise domestic cats that are present, and control feral cats at key sites.

**8. RECOVERY WORK PLAN**

To meet each objective and fulfil the recovery goals the following actions are required:

**OBJECTIVE 1: ESTABLISH AND MAINTAIN A PEST PREVENTION CAMPAIGN**

**Explanation:**

The vulnerability of Great Barrier Island to the introduction of potential pest species should remain a constant concern. As visitor numbers grow risks are likely to increase.

**Plan:**

Publicise the need for measures to prevent the accidental introduction of Norway rats and possums, and the need to keep the island free of mustelids. This will require the following:

- \* A general campaign to raise public consciousness about the danger of harmful organisms on Great Larrier Island
- \* Signs at Ardmore, Auckland, Claris and Okiwi airports warning of the dangers of pest species
- \* Signs on vessels regularly visiting Little Barrier and Great Barrier and at departure points for vessels from Auckland and a : Tryphena, Whangaparapara and Port Fitzroy wharves
- \* Bait stations on vessels regularly servicing Great Barrier Island and on the main wharves
- \* Bylaws through the Auckland City Council that would prohibit the landing of unwanted organisms.

**Outcomes:**

The following outcomes should result from a high profile prevention campaign:

- \* Increased public awareness of the conservation values of Great Barrier Island and their vulnerability to pest species.
- \* Immediate reporting to DOC by a committed and concerned public should pest species escape or be released.
- \* Maintenance of the mustelid, possum and deer-free status of the island.

**Key Personnel:**

Auckland City Council  
 Shipping companies (Fullers, Pacifica, Gulf Trans)  
 Great Barrier Airlines  
 Fishing companies  
 Auckland Yachting Federation  
 Protection Manager - DOC, Auckland Conservancy  
 Field Centre Manager - DOC, Great Barrier Island

**OBJECTIVE 2: ESTABLISH PARTNERSHIPS WITH LOCAL AUTHORITIES AND LOCAL LANDOWNERS.**

**Explanation:**

On Great Barrier, there is a range of titles existing over land that borders land administered by the Crown. Land controlled by the Crown is also under a range of categories (see CMS). To avoid control of wild animals being complicated by these issues, effective partnerships will need to be established between DOC, the Great Barrier Island Community Board (GBICB), Auckland City Council (ACC), Maori tribal authorities and landowners.

**Plan:**

Foster close working relationships with the local community so that the problems of uncontrolled browsing mammals and the benefits of effective habitat management can be both implemented and demonstrated.

**Evaluation:**

The Auckland Conservation Board, DOC, GBICB and ACC in combination effectively promoting both the conservation values of Great Barrier Island and the projects required to safeguard and enhance those values.

**Outcomes:**

The key to success of any habitat management programme will be a well-informed local population that in large part understands and supports DOC's projects on the island.

**Key Personnel:**

Auckland City Council  
 Great Barrier Island Community Board  
 Public Relations staff - DOC, Auckland Conservancy  
 Field Centre Manager - DOC, Great Barrier Island

### **OBJECTIVE 3. SURVEY LITTLE BARRIER ISLAND FOR CHEVRON SKINKS.**

#### **Explanation:**

So far only one juvenile chevron skink has been found on Little Barrier Island. Surveys are required to assess the status of the chevron skink and to locate populations that would be suitable for studies of habitat use. These surveys should be concentrated on the western and southern sides of the island where water courses have a lower gradient than elsewhere.

#### **Plan:**

Undertake three surveys on selected parts of Little Barrier Island over three years. These surveys to be catchment based on the western and southern sides of the island. Once sufficient animals can be located tissue samples to be obtained to determine levels of divergence between the Little Barrier and Great Barrier populations.

#### **Outcomes:**

The surveys and samples of Little Barrier chevron skinks will:

- \* Identify areas where chevron skinks are most abundant
- \* Provide a means of assessing the status of the species on Little Barrier Island
- \* Identify whether the Little Barrier and Great Barrier Island populations of chevron skinks should be treated as one or two conservation units

Identify locations that could form the base for more intensive studies of habitat use by chevron skinks.

#### **Key Personnel:**

CO Species Protection - DOC, Auckland Conservancy  
Herpetologist (s) - DOC, Science & Research, Auckland  
CO - DOC, Little Barrier Island  
Geneticist - Contract

### **OBJECTIVE 4. DETERMINE HOW HABITATS ARE USED BY CHEVRON SKINKS ON BOTH LITTLE BARRIER AND GREAT BARRIER ISLANDS.**

#### **Explanation:**

Chevron skinks on Great Barrier Island have usually been observed along or in watercourses, or in very damp places, such as rotting logs. The single juvenile found on Little Barrier was in a stream bed. Because the levels of predation on Little Barrier are now lower than in the past, there should be fewer restraints on the range of habitats that can be used by the species. This is not the case on Great Barrier.

Cree et al. (in prep.) predict that chevron skinks will have unusually high moisture requirements, in line with those found for some other New Zealand lizards. These predictions should be tested using live animals.

**Plan:**

Undertake research to determine the range of habitats used by the chevron skinks on Little Barrier with application of these results to Great Barrier in the long term.

This work should be complemented by research on cutaneous water loss using animals at present in captivity.

**Outcomes:**

Research on habitat use and susceptibility to water loss will:

- \* Identify the kinds of habitats in which chevron skinks most frequently occur
- \* Identify the role of stream catchments in habitat use by chevron skinks
- \* Identify whether or not the use of moist environments by chevron skinks is a means of avoiding disturbance, predation or low invertebrate numbers in other areas
- \* Provide a basis for focusing habitat protection on Great Barrier Island.

**Key Personnel:**

Physiological Herpetologist - University of Otago, Dunedin  
Entomologist - DOC, Auckland Conservancy or outside agency  
Herpetologist(s) - DOC, Science & Research, Auckland

**OBJECTIVE 5. ERADICATE GOATS AND PIGS FROM SELECTED AREAS ON GREAT BARRIER ISLAND.****Explanation:**

One area, Te Paparahi, has been rated as having outstanding forest habitat (Ogle 1980, Towns 1988a), and has a particularly diverse fauna of lizards (including chevron skinks) as well as native frogs (Newman and Towns 1985) and kokako. The goat control campaign started in 1986 in Te Paparahi has eliminated all but a handful of goats on both Crown and Maori land (W. Murray pers comm. 1991).

**Plan:**

For effective completion of the campaign the following tasks should be undertaken:

- \* Complete eradication of the goats from Te Paparahi
- \* Negotiate with local landowners to find alternatives to maintaining free ranging pigs
- \* Install an effective barrier to reinvasion of the area by pigs and goats

**Evaluation:**

Successful removal of browsing mammals from the Te Paparahi will be reflected in:

- \* Rapid natural regeneration of lowland broadleaf and kauri forest (see Wright and Cameron 1985).
- \* Reduced frequency of landslips (Wright and Cameron 1985)
- \* Improved stream bed stability and lower silt loadings in streams (Newman and Towns 1985, Towns 1987).

**Outcomes:**

Reduced erosion and forest destruction following removal of goats, and reduced ground disturbance along streams and predation by pigs, will have the following outcomes:

- \* Improvements in habitat stability and therefore increases in numbers of native frogs
- \* Less frequent and less devastating flooding by streams and therefore improved quality of habitats used by chevron skinks with increased numbers of this species.

**Key Personnel:**

Aotea Maori community  
 Ngati Wai Trust Board  
 Operations Manager - DOC, Auckland Conservancy  
 Field Centre Manager - DOC, Great Barrier Island

**OBJECTIVE 6. PROMOTE PUBLIC INTEREST AND INVOLVEMENT IN THE RECOVERY OF CHEVRON SKINK IN HABITAT REHABILITATION AND IN THE CONSERVATION VALUES OF GREAT BARRIER ISLAND.**

**Explanation:**

Because of its size, restricted distribution, and distinctiveness, the chevron skink is an ideal flagship species for involving the Great Barrier Island community in conservation issues specific to their island. The experiences at Pukerua Bay near Wellington have demonstrated the considerable local interest that can be generated by having a nationally threatened species (Whitaker's skink), in their vicinity. The mail questionnaire for chevron skink sightings generated considerable interest on Great Barrier Island. A well-structured and directed campaign of advocacy and involvement centred on the chevron skink should raise the level of understanding of conservation values of Great Barrier Island as well as providing a foundation for any cat control programmes that might follow (see Objective 9). The conservation values of Great Barrier Island are of both local and regional interest; during the holiday periods the 800 local residents are outnumbered by an estimated 20 000 visitors per annum (E. Law pers comm. 1991).

**Plan:**

Advocacy for Great Barrier Island to be directed towards two audiences because of local and regional interests in the island. This should involve the following:

- \* Provide educational material for the community and schools on Great Barrier Island that outline the success of existing habitat rehabilitation programmes in Te

Paparahi, the importance of habitat restoration for chevron skink and the importance of the conservation values of Great Barrier Island in the national context.

- \* Establish a working relationship with the Auckland City Council and the Auckland Zoo to focus on breeding and display of chevron skinks currently held at the Zoo on the Department's behalf. These displays should exploit the opportunities to promote conservation on Great Barrier Island within the context of Auckland City using chevron skinks as a theme and demonstration animal.
- \* Promote a collaborative breeding programme for chevron skinks involving Auckland Zoo and the New Zealand Herpetological Society in order to expand existing stocks of chevron skinks for research and educational purposes. This programme to be based on a captive management plan drafted and co-ordinated by a captive breeding co-ordinator.
- \* Involve Auckland Zoo (Auckland City Council) in fundraising and promotional efforts for chevron skink conservation. Approach local businesses for assistance in the conservation of an endangered species now confined to the Auckland region.

**Evaluation:**

The success of advocacy directed towards issues on Great Barrier Island has implications for the economics of the Auckland area through tourism as well as commercial implications for Auckland Conservancy (expenditure and revenue). These implications should be investigated by trained economists and/or social scientists either through Auckland University or/and Science & Research Division of DOC. Understanding the issues that shape prevailing attitudes and the ways that these might change as a result of effective advocacy have implications for many DOC activities on Great Barrier Island.

**Outcomes:**

Well-targeted advocacy will provide:

- \* Effective partnerships between DOC and local authorities/businesses that tangibly support conservation activities on Great Barrier Island
- \* Public awareness and support for the recovery goals for chevron skinks defined in this plan
- \* Improved understanding of conservation issues on Great Barrier Island by the local community and support for the Department's endeavours on the island
- \* Appreciation in the Auckland community of the conservation values of Great Barrier Island and an awareness of the direct and indirect impacts of visitation on these values (especially with respect to pest prevention - Objective 5).

**Key Personnel:**

Auckland Conservation Board  
Public Relations staff - DOC, Auckland Conservancy

Senior Curator - Auckland Zoo  
New Zealand Herpetological Society  
Field Centre Manager - DOC, Great Barrier Island

**OBJECTIVE 7. DEFINE LONG TERM OBJECTIVES FOR LAND MANAGEMENT ON GREAT BARRIER ISLAND.**

**Explanation:**

Inevitable increases in the number of visitors to Great Barrier Island and the number of permanent residents on the island will place an increasing burden on its conservation values. This burden will have indirect detrimental effects on the chevron skinks through increased predation and habitat degradation or loss. On the other hand, appropriately managed tourism and residential areas on the island could be compatible with its conservation values, help raise awareness of them, and help generate revenue for both the local and regional communities.

For the potential benefits to be realised an action plan for Great Barrier Island is required. This could involve evaluation of proposals to raise the status of parts of the island to National Reserve or an equivalent (e.g. Cameron 1985).

**Plan:**

- \* As part of the CMS process investigate appropriate reserve status for all DOC and stewardship land on Great Barrier Island
- \* With agreement with local and regional authorities, and the Auckland Conservation Board outline options for a long term view of the status of Great Barrier Island.

**Key Personnel:**

Auckland City Council  
Auckland Conservation Board  
Great Barrier Island Community Board  
Strategic Planning Division - DOC, Auckland Conservancy

**LONG TERM OBJECTIVES:** The following three objectives are more strategic goals that could be aimed for following successful completion of Objectives 1-7. In view of their long-term nature, explicit details of plans, performance measures and key personnel are not provided here.

**OBJECTIVE 8. DETERMINE HABITAT USE BY CHEVRON SKINKS ON BOTH LITTLE BARRIER AND GREAT BARRIER ISLAND.**

**Explanation:**

Understanding the way habitats are used by chevron skinks will determine priorities set for many conservation activities. However, at present only a small amount of information is available on habitat use by the species on Great Barrier Island (Appendix 1). Information on habitat use on Little Barrier Island should provide one end of a use

spectrum that is likely to be more constrained on Great Barrier Island because of predation and human activities. This information will more clearly define whether distribution on Great Barrier is an artifact of predation or whether it reflects physiological constraints on habitat use.

Comparison between the two islands would provide the best measures on which to base habitat management on Great Barrier Island.

**OBJECTIVE 9. CONDUCT WILD ANIMAL CONTROL AT KEY SITES ON SOUTHERN GREAT BARRIER ISLAND.**

**Explanation:**

Success with the control/eradication campaign within the discrete area of Te Paparahi would open the way to apply a similar targeted approach to other parts of the island. Good quality lowland forest inhabited by chevron skink occurs south of Okupu and Claris. Given effective advocacy and strong public support generated by other successful activities on the island, the Department should be able to work through the complicated land ownership issues involved prior to effective wild animal control on the southern end of the island.

**OBJECTIVE 10. INSTIGATE PROGRAMMES FOR THE STERILISATION AND CONTROL OF CATS**

**Explanation:**

The largest and least easily controlled threat to vulnerable species of lizards and birds on Great Barrier Island is predation from feral and domestic cats. As the number of residents and visitors to the island continues to increase, the effects of predation by cats will become more apparent. Great Barrier is far too large for removal of cats, and promoting their removal would receive little sympathy from residents plagued by mice and rats. Trials on the effects of local control of cats should be conducted in an area away from settlements, possibly in Te Paparahi. Dependent on the ecological effects of cat control (such as predation of birds by rats), a wider campaign can be undertaken.

Effective control of cats could be achieved by having domestic cats sterilised along with targeted control of wild cats. In addition to these on-site measures visitors and new residents should be discouraged from landing cats on the island or landing only those ones already sterilised. This latter campaign would become a natural extension of the one against other pest species proposed in Objective 5.

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