

9. RECOVERY COSTS

Costs defined below are for Option 3 and are based on operating or material costs. Salaries are not estimated, but effort is given as person-day equivalents (bold). This is because some surveys and laboratory time are likely to be at no cost to the Department, individual staff costs vary, and some activities will be conducted whether or not this plan is implemented. The effort is given as "personnel time" where it involves people outside the Department and "staff time" where it is mainly provided in-house.

Year	1	2	3	4	5
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OBJECTIVE 1: Survey on Little Barrier Island¹

Personnel time (h)	50	50	50?		
Operating costs (includes some contract labour) (\$)	3500	3500	Third survey?		

OBJECTIVE 2: Determine habitat use on Little Barrier Island

Personnel time includes report writing (h)		60	60	30	
Field work (operating) (\$)		2500	2500		
Studies of moisture requirements (\$)		2000			

OBJECTIVE 3: Promote public interest and involvement

Staff time (h)	50	40	30	30	30
Transport and educational material (\$)	5000	3000	1500	1500	1500

OBJECTIVE 4: Partnerships with local authorities

Staff time (h)	10	10	5	5	5
Travel costs (\$)	750	750	500	500	500

OBJECTIVE 5: Pest prevention campaign

Staff time (h)	20	10	5	5	5
Signs and brochures (\$)	5000	2000	1000		

OBJECTIVE 6: Eradicate goats and pigs from Te Paparahi²

Personnel time (h)	50	250	200	120	80
Operating costs (\$)	2000	100 000	5000	2000	1000
Boundary fence (\$)			25 000		
Maintenance costs of fence(s) (\$)				1000	1000

OBJECTIVE 7: Define long term objectives

Staff time (h)	10	2	1		
Transport costs for meetings (\$)	750	750	750		

¹ Assumes transport costs not shared with other activities

² Excludes any existing control efforts; costings based on Rangitoto Island Pest Eradication Report, November 1990

CRITICAL PATH

Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Objective
1. Pest prevention campaign	High	Low	Low	Low	Low	1
1. Establish partnerships	High	Low				2
1. Survey on Little Barrier	High	High	Low			3
1. Determine habitat use		High	High	Low		4
2. Eradicate goats, pigs	High	High	Low	Low	Low	5
2. Promote public involvement	High	High	High	Low	Low	6
3. Long term objectives: Great Barrier	High					7

KEY: Level of effort:  High  Low

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APPENDIX 1: Biology of the Chevron Skink

Much of the information provided below is from unpublished data obtained during a study on Great Barrier Island (IM and DRT) conducted between October 1984 and April 1986.

Taxonomic Relationships

The genus *Leiopisma* has traditionally been regarded as confined to Australasia with a small number of species in Oceania and Mauritius (e.g. Hardy 1977, Cogger 1986). Recent immunological studies of Australian species assigned to *Leiopisma* resulted in removal of all Australian skinks from the genus (Hutchinson et al. 1990). This work concluded that species from New Caledonia, Lord Howe Island and New Zealand are distinct from the species in both Australia and Mauritius and that the New Zealand species should be in their own genus.

This recent assessment by Hutchinson et al. (1990) underlines the high endemism of the New Zealand lizards, and their possible antiquity (Towns et al. 1985, Hickson et al. 1992).

On Great Barrier Island chevron skinks (*Leiopisma homalonotum*) were often found with the ornate skink (*Cyclodina ornata*) and share with it unusual cryptic colouration and distinctive markings around the eye and lower jaw (fig. 44 in Towns 1988b). These similarities may be the result of convergence rather than taxonomic affinity. Comparable colour patterns are found in the unrelated burrowing skink *Geomyersia glabra* of the Solomon Islands (McCoy 1980).

On the basis of habits, habitat and morphology the chevron skink is a unique member of its genus. The relationships between New Zealand *Leiopisma* and those elsewhere are only now being unravelled. The place of chevron skinks in this fauna of endemic lizards is yet to be determined. However, there are strong morphological grounds for excluding chevron skinks from *Cyclodina* (Hardy 1977). The close association of chevron skinks with standing or running water is unique in New Zealand, although it is found in skinks elsewhere. Three species of *Sphenomorphus* in Australia are commonly called water skinks because they frequently occur along water courses and take to water when alarmed (Cogger 1986).

In New Zealand there appears to be a taxonomic relationship between *L. homalonotum* and *L. gracilicarpus* (Appendix 2). The possibility that the two forms are the same species, as proposed by McCann (1955) should be investigated further.

Other Amphibians and Reptiles that Occur with Chevron Skink

Native frogs and 13 lizard species have been recorded on Great Barrier Island. A very similar fauna is found on Little Barrier Island, with exceptions being the presence of tuatara and absence of frogs and striped skink (Appendix Table 1.1).

Habitats and Habits

The habits and habitat occupied by chevron skink is more similar to *Cyclodina* than to other *Leiolopisma*. Chevron skinks are only occasionally seen in the open during the day. On Great Barrier Island most observations of chevron skinks reported to us, and most animals we have captured, were near streams or stream beds. Mean distance from water out of 21 sightings (where distance from water was recorded) was 2.5 m (range 0-10 m). Four animals were found inside rotten logs near streams where the interior of the logs had degraded to wet pulp.

Most sightings and captures have been during summer, with the months of January, February and March producing almost 77% of all reports (Appendix Fig. 1.1).

Relevance of the low frequency of sightings, and the peculiar locations in which sightings have been made, may relate to physiological and metabolic characteristics of the species. Studies relating microhabitat use to physiological capabilities should receive priority. The relationship with watercourses requires investigation because of the restricted management options implied. The sporadic observation of animals implies a fossorial and/or arboreal existence which may be defined by physiological studies and/or radiotracking. Alternatively (or in addition), the species may feed intensively for short period and then become inactive, as snakes do, which would explain their infrequent appearance. Studies on metabolic requirements should investigate this.

Density

Capture rates of chevron skinks on Great Barrier Island cannot realistically be related to a numerical density because there were almost no recaptures (two out of 30 marked). Continuous trapping over one season (October 1985-April 1986) yielded 13 lizards over 9703 trap-days. This capture rate of 0.13/100 trap-days compares poorly with the 0.30/100 trap days recorded for Whitaker's skinks at Pukerua Bay. The latter capture rate was the lowest found for any of the Pukerua Bay lizards (Towns 1992b).

Food Requirements

Nothing is known of feeding habits or food of chevron skinks in the wild. The damp locations in which they forage provide a wide range of litter organisms. In captivity chevron skinks take a wide range of invertebrates including spiders, crickets and tree wetas.

Reproduction, Productivity and Growth Rate

Chevron skinks appear to be sexually dimorphic, with males smaller and more slender-bodied than females. They may produce up to eight offspring (Robb 1986), but seldom more than two survive in captivity. Frequency of litter production (productivity) is unknown. The few recaptures have not enabled the construction of growth curves. However, size classes that may relate to growth cohorts were apparent from the 30 captures on Great Barrier (Appendix Fig. 1.2). These data indicate that males may take

up to three years or more to reach sexual maturity and females may require at least four years. The largest lizard was 45 g, total length 25.4 cm, and apparently a female.

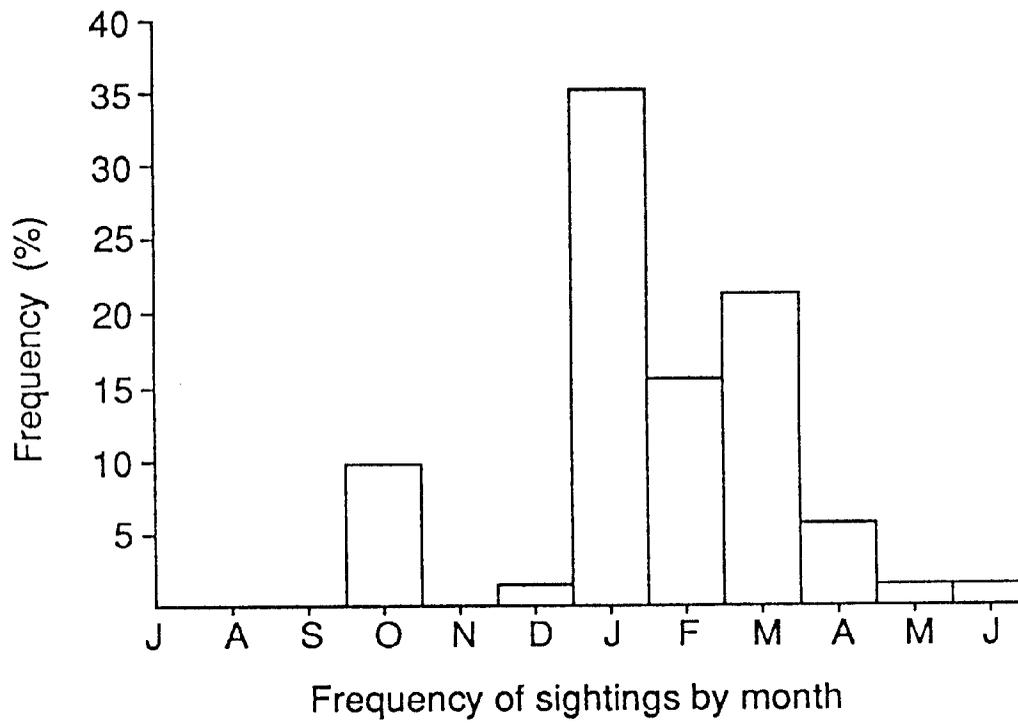
Relationships with Other New Zealand Lizards

Most New Zealand members of *Leiopisma* are sun-seeking species that bask quite prominently for at least part of the day. There are two notable exceptions, the chevron skink and the nocturnal, egg-laying Suter's skink. The chevron skink differs from all other members of the genus in a number of other respects: affinity with fresh water; sexual dimorphism; vocal behaviour when disturbed; and the very high litter size.

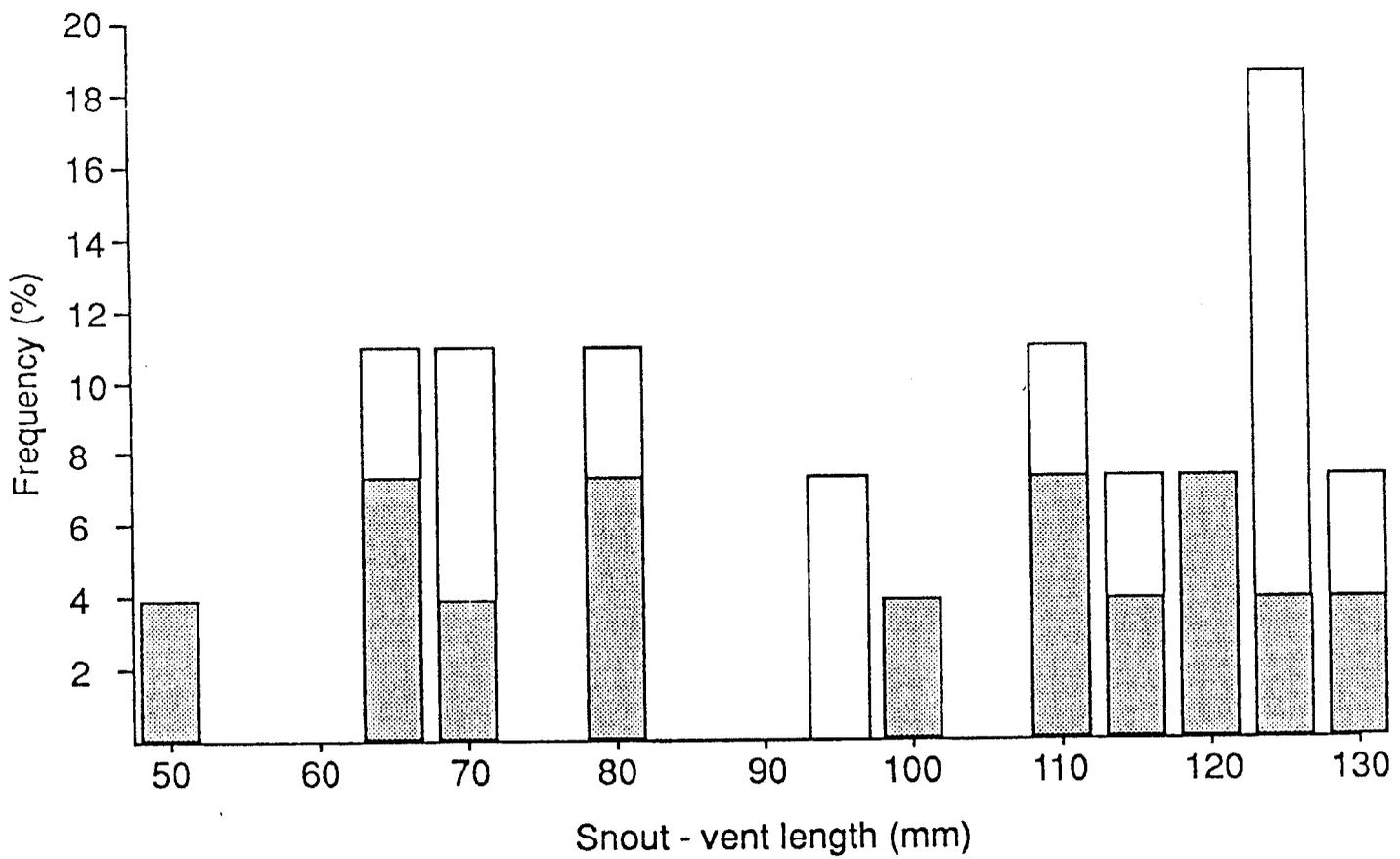
Scientific name	Common name	Great Barrier Island	Little Barrier Island
Leiopelmatidae (Native frogs)			
<i>Leiopelma hochstetteri</i>	Hochstetter's frog	+	
Sphenodontidae (Tuatara)			
<i>Sphenodon p. punctatus</i>	Northern tuatara		+
Gekkonidae (Geckos)			
<i>Hoplodactylus duvaucelii</i>	Duvaucel's gecko	?	+
<i>H. granulatus</i>	Forest gecko	+	+
<i>H. maculatus</i>	Common gecko	+	+
<i>H. pacificus</i>	Pacific gecko	+	+
<i>Naultinus e. elegans</i>	Northern green gecko	+	+
Scincidae (Skinks)			
<i>Cyclodina aenea</i>	Copper skink	+	+
<i>C. oliveri</i>	Marbled skink	+	+
<i>C. ornata</i>	Ornate skink	+	+
<i>Leiopisma homalonotum</i>	Chevron skink	+	+
<i>L. moco</i>	Moko skink	+	+
<i>L. smithi</i>	Shore skink	+	+
<i>L. striatum</i>	Striped skink	+	?
<i>L. suteri</i>	Suter's skink	+	+
Total		14	13

? Either not recorded in recent times or uncertain record

Appendix Table 1.1. Species of amphibians and reptiles found on Great Barrier and Little Barrier Islands from Newman and Towns (1985), McCallum and Darker (1982), Whitaker and Daugherty (1991).



Appendix Figure 1.1. Percentage frequency of sightings by month for 31 chevron skinks on Great Barrier Island between October 1984 and April 1986.



Appendix Figure 1.2. Length frequency distribution (snout-vent length) of 27 chevron skinks captured on Great Barrier Island between October 1984 and April 1986. Dark shaded bars, captures by hand; light bars, pitfall captures.

APPENDIX 2: Other Species Taxonomically Linked with the Chevron Skink

Cyclodina ornata

The ornate skink is smaller than the chevron skink, and more commonly encountered on Great Barrier Island (Newman and Towns 1985). Claims that chevron skinks are more common than usually recognised on Great Barrier Island (e.g. Dick 1981) have been refuted by Ogle (1981), who found only one of the locality records given to be reliable. Many reports most likely result from confusion between chevron and ornate skinks.

Leiopisma gracilicarpus

A relatively large skink of 97 mm snout-vent, which was described from a single specimen as *Leiopisma gracilicarpus* by Hardy (1977), was listed as indeterminate by Williams and Given (1981) and presumed extinct by Bell (1986). The specimen, which had been in the collection of the Auckland Institute and Museum for many years, had the locality (Hokianga) as the only accession data and had become bleached in preservative so that no distinguishing characteristics remained. McCann (1955) regarded the animal as a chevron skink, but Hardy (1977 p. 241) described it as *Leiopisma gracilicarpus* on the grounds that it "may be a juvenile" and is "of much more slender build" than the chevron skink. Apparently on the assumption that the specimen is a juvenile, Hardy (1977) proposed that "circumstantial evidence" could attribute it to the kawekaweau, a large ("two foot long") lizard alluded to in several early issues of *Transactions of the New Zealand Institute* (see references in Hardy 1977 p. 241). Hardy suggests that these reports support the existence of a large species of skink.

In their description of the previously unknown giant gecko, *Hoplodactylus delcourti*, Bauer and Russell (1986 p. 146) suggest that the collection site for the single unlabelled specimen could be New Zealand - also on the basis of early records of the kawekaweau. They considered that the report of the kawekaweau by Mair (1873) "matches extremely well with the size and colour" of *H. delcourti*. As a result, Hardy (1977) has assumed the kawekaweau to be a skink, whereas Bauer and Russell (1986), using the same anecdotal accounts, have assumed it to be a gecko. To add further confusion, some Maori-English dictionaries refer to kawekaweau as a synonym for tuatara.

The most credible and detailed report was of a large, rather amphibious lizard in the Waoku Plateau between Hokianga and Kaipara, especially around Waima and Wairari Creeks (Walsh 1905). This report closely resembles our observations of the habits and habitat of chevron skinks on Great Barrier Island, and is within the area from which the "kawekaweau skink" was obtained.

More recently the New Zealand Herpetological Society has been investigating records of large lizards in the northern North Island. In about 1985 they received a report of a large skink disturbed in Northland when a puriri tree was being split for logs. When presented with unlabelled colour photographs the observer picked the chevron skink as being the lizard which he had seen (John West, pers. comm.).

The single *L. gracilicorpus* specimen has been examined by DRT and Professor Joan Robb. The reproductive system appears to be that of a sexually mature male. This would place it within the size range of male chevron skinks. Scanning Electron Microscope analyses of scale surfaces, which usually reveal species-specific sculpturing (Robb 1986), have provided no structures which will distinguish the "kawekaweau skink" from the chevron skink (J. Robb pers. comm.).

There is no biogeographic reason why the chevron skink, which is a highly distinctive species, should be endemic to Great Barrier and Little Barrier Islands. As a measure of the secretive habits of the chevron skink, for about 60 years it was assumed to originate from the Mokohinau Islands, and was only positively identified from Great Barrier Island by Hardy in 1977.

In conclusion: there is anecdotal evidence that a lizard closely resembling the chevron skink once occurred in the Hokianga area, and recent observations indicate that it may still occur in Northland. It is very likely that McCann was correct in determining the Hokianga skink as a chevron skink, but because of the state of preservation of the specimen, it is not possible to completely support McCann's decision, or to completely refute Hardy's one of naming it as a separate species.

APPENDIX 3: Legislation Relating to Movements of Potential Pests to Great Barrier Island and Control of Pest Species Present

Written with help from Lester Blomfield, Auckland Conservancy solicitor

1. Mustelids

Covered under Farming of Protected Wildlife Regulations 1985: "...no person shall keep in captivity or liberate any unprotected wildlife on or convey any unprotected wildlife to, any of the following areas: ... (c) Great Barrier Island.

"Unprotected wildlife" means any wildlife specified in the Eighth Schedule of the Wildlife Act 1953. The Eighth Schedule lists ferrets, polecats, stoats and weasels.

2. Deer, chamois, possums, wallaby, goats and pigs

Covered under the Wild Animal Control Act 1977:

Restricts the liberation of wild animals defined under Section 2.

Wild animals are defined as species listed under Section 2 not fenced, farmed or restrained. The Act points out that while free-ranging these animals are the property of the Crown.

Section 11 states: "No person shall without the written authority of the Minister:

- (a) Capture or attempt to capture any wild animal or convey or have in his possession any wild animal, for the purpose of liberating it or turning it at large;
- or
- (b) Liberate any wild animal or turn it at large or allow it to go at large.

Deer are also covered under the Deer Farming Notice No. 4 1986, where deer farming is not permitted on... (f) all outlying islands ... except Kaikoura Island.

3. Weka

Covered under the provisions relating to possession in the Wildlife Act 1953.

4. Cats, rats and hedgehogs

Not defined as wild or noxious animals, but covered under the Reserves Act 1977 (below).

5. Any organism other than man

Under Section 94 (Offences on Reserves) of the Reserves Act 1977 an offense is committed by anyone who:

- "(a) Causes or allows any cattle, sheep, horses or other animals of any kind whatsoever to trespass on any reserve.
- (b) Liberates any animal on any reserve."

The legal position of a number of these provisions would be clarified if they were collected under Auckland City Council bylaws.