

**THREATENED SPECIES RECOVERY PLAN NO.14**

**OTAGO SKINK AND GRAND SKINK  
RECOVERY PLAN**  
*(Leiopisma otagense and L. grande)*

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Cover illustrations: (top) Otago skink, (bottom) grand skink. Photos: Department of Conservation.

## FOREWORD

The recovery plan for the Otago skinks and grand skinks has taken a different path to recovery plans developed for other New Zealand threatened species. This acknowledges a fundamental difference between the species discussed in this plan and all other species recovery plans developed so far: all remaining habitats of the Otago skinks and grand skinks occur on freehold or Crown renewable leasehold land. Clearly, before proceeding with full public consultation over the recovery actions proposed for these species, it has been necessary to closely involve landowners in the development of the plan and to allay any concerns they may have about the actions proposed in the draft recovery plan.

The first draft of this plan was developed in 1990 and the prolonged consultation phase has delayed publication until 1995. By this time, many of the actions outlined in earlier drafts have already commenced or concluded. It was felt by recovery group members that it was better to complete the publication of this plan rather than begin an extensive revision of the plan at this time. This would then provide the wider public with a review of the goals, objectives and range of actions needed to recover these species. The current plan will be reviewed in the next two years and a revised recovery plan will be produced by 1997.

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## SUMMARY

The Otago skink and the grand skink are two of New Zealand's rarest lizards. They are known only from Otago, and both species are currently regarded as vulnerable by IUCN standards. They are amongst the largest of New Zealand lizards, up to 250-300 mm long. They mature in their third or fourth year and give birth to 2-4 young. They are strongly diurnal and eat a wide variety of invertebrates and fruit. These species are rock-dwelling and almost invariably occur on schist outcrops, their preferred habitat being large, well-creviced outcrops amidst tussock grassland or indigenous shrubland.

Formerly widespread in Central Otago at altitudes between 200 - 1000 m they are found over only about 8% of their past range. The two, widely-spaced population groups are: (in the east) between Hyde, Macraes Flat, Sutton and Pukerangi, but most common in the headwaters of the Waikouaiti River and Nenthorn Stream, and (in the west) in the Lindis catchment and at one site near Lake Hawea.

The reasons for concern are the lizards' diminished range and continually declining populations, and the fact that many populations are now extremely small and isolated. The causes for decline are not precisely known but include habitat degradation and destruction (primarily from agricultural development), predation by introduced mammals and birds, and pest control operations. All of these factors are still in effect and threaten the survival of the remaining populations. Changing fanning practices and new pest control methods increase the risks to lizards, particularly as there are no reserves in which their habitat is protected.

Several features of the biology of Otago skinks and grand skinks make them particularly vulnerable to extinction. These include late sexual maturity, low productivity, large size, highly specific habitat requirements, small and isolated populations, and the fact that their distribution is limited to the mainland. Nevertheless, the fact they occur over a wide geographic range, are still relatively numerous with high population densities at some localities, and are breeding in the wild suggests that *in situ* protection is feasible and could well increase their chances of survival. Captive maintenance and breeding is possible and could be implemented if necessary for the skinks' conservation.

The most favoured option for the conservation of Otago skinks and grand skinks is preservation *in situ* by protecting their habitat. This can be achieved through a two-tiered programme of habitat protection by the Department of Conservation and/or voluntary preservation agreements by landowners. Sites to be protected by the Department will be chosen either because they are core areas for the conservation of these species (on the basis of the quality and density of the lizard populations they contain and the potential for the maintenance or enhancement of these populations) or because the populations are near the limits of distribution. Sites for cooperative management with landowners should preferably fulfil the same criteria.

It has to be accepted that it is not physically or financially possible to protect all the remaining populations of Otago skinks and grand skinks and that, no matter how successful the conservation programme is, many will die out. Other problems for the recovery programme are the present lack of information on the ecology of the species, how their habitat may be maintained or enhanced, and on management of visitors to key sites.<sup>a</sup>

It is important, for success of the recovery programme, to implement a research programme as soon as possible. High priorities are: developing appropriate capture, marking and monitoring techniques; comparing the genetic status of the eastern and western populations; studying specified aspects of the species' ecology; and determining the effects different land management practices, pest control operations and predator control operations have on lizard populations. It is also important to investigate any reports of these species from beyond their known range.

Contact with all relevant landowners is to be made at the earliest opportunity to ensure they are fully informed of the recovery plan and its implications. Landowners' views will be sought throughout the programme, and appropriate management objectives will be set after this consultation.

## 1. INTRODUCTION

The grand skink *Leiopisma grande* (Gray) and the Otago skink *Leiopisma otagensense* (McCann) are two of New Zealand's largest and rarest lizards. They are known only from Otago. Appendix 1 contains details of their known biology.

The grand skink, named in 1845, was one of the earliest lizard species to be described from New Zealand. The Otago skink, although first recognised late last century, was not formally named until 1955.

Despite this long history, grand skinks and Otago skinks have proved particularly elusive. By the early 1960s fewer than 10 specimens of each had been collected and no extant populations of either species were known.

In 1962 Otago skinks were found on schist outcrops near Middlemarch in east Otago, and in the following decade a few other small populations were discovered nearby. During this period some grand skinks were seen in the same area but, because the significance of this was not realised, the precise localities were not documented. Eventually, in 1979, grand skinks were found living on schist tors near Macraes Flat.

By this time grave concerns for the conservation of these species were being expressed. They were regarded as amongst the rarest of the New Zealand lizards (Robb 1980), were listed in the New Zealand Red Data Book (Williams & Given 1981), and research into their ecology and conservation had been given the highest priority (Bell et al. 1983; Crawley 1981; Newman 1982).

Early in 1982 the Fauna Survey Unit of the New Zealand Wildlife Service recorded a few individuals of each species at widely scattered sites in the Macraes Flat - Middlemarch district and later found small populations in the vicinity of Lindis Pass and Lake Hawea. Detailed surveys then provided important information on habitat selection and behaviour and showed that localised population densities of both species could be quite high (Towns et al. 1984; Whitaker 1984; Towns 1985). As the actual population distribution and conservation status was still not clear, the Wildlife Service embarked on a research programme late in 1984, to cover these lizards throughout their potential range - an area of about 1.75 million hectares. The programme was continued by the Department of Conservation and completed in 1989, and has been documented in a series of internal reports (Whitaker 1985a & b, 1986a & b, 1987a & b, 1988a & b; Whitaker & Loh 1990).

The present recovery plan is a direct result of that research programme, which clearly showed that both species now occupy a greatly reduced range, have declining populations, and are at continued risk from a variety of environmental factors.

As presently defined, the species *Leiopisma otagensense* contains two forms (Hardy 1977). The northernmost of these forms (*waimatense*), the scree skink, occurs between Marlborough and north Otago and is now accepted as a separate species. This recovery plan is concerned solely with the grand skink and the Otago skink.

In this recovery plan, we are considering two species together because these two lizards have so much in common. Their former and present distributions are virtually the same, their habitats are very similar, at many localities they are broadly sympatric, and they appear to be equally at risk from the same threats. Conservation management for grand skinks and Otago skinks may be regarded as complementary and, with care, sites can be selected at which populations of both species could be reserved.

Although grand skinks and Otago skinks are not in immediate danger of extinction, their present conservation status is such that there is grave concern for their long-term survival. The recovery plan adopted here recognises that rapid intervention to halt the processes leading to the decline of at least some populations of these lizards, **before** they reach critically low levels, will be needed to ensure their survival.

Furthermore, we agree that it is far better to preserve species in their natural environment if at all possible and assume that such preservation in situ is more likely to be successful with the largest and least modified populations.

Central to this recovery plan for grand skinks and Otago skinks is the establishment of three major protected areas in the Macraes Flat - Middlemarch district. Protection of all these areas is regarded as the **minimum requirement** if the long-term future of these species is to be assured. All other conservation proposals in this plan are seen as additional, **not** alternative, to these protected areas and will maintain the genetic variation within the species over the greatest area of their known range.

Application of the recovery plan for grand skinks and Otago skinks will be under the guidance of a Recovery Group comprising the following:

- a Conservancy staff member responsible for related projects (DoC)
- a herpetologist from Science & Research Division (DoC)
- a staff member of the Threatened Species Unit (DoC)
- a representative of the Society for Research on Amphibians and Reptiles in New Zealand
- an invited landowner representative with an interest in reptile conservation

The Recovery Group will review progress on the recovery plan annually, or more frequently if circumstances dictate.

Throughout this document, 'Department' refers to the Department of Conservation. The scientific names of all species mentioned in the text are listed in Appendix 7.

## 2. DISTRIBUTION AND CAUSES OF DECLINE

### 2.1 Past Distribution

The distribution of extant populations (see map overleaf), notes accompanying museum specimens and historical records show that grand skinks and Otago skinks were once widespread in Central Otago east of the Alps in an area extending from Queenstown and Lindis Pass in the west to Macraes Flat and Sutton in the east. Otago skinks have been reported from the Hokonui Hills in Southland (Thomas 1982), but this requires confirmation.

The distributions of both species are virtually coincident with the broad band of metamorphic rock (chloritic quartzo-feldspathic schist) which crosses Central Otago. More specifically, the lithology at most localities for these lizards is schist in subzone IV (characterised by strong schistosity and strong foliation) while at a few it is schist in subzone III (strong schistosity but weak foliation).

The localities at which Otago skinks used to occur range from 200-950 m in elevation and those at which grand skinks occur from 335-915 m.

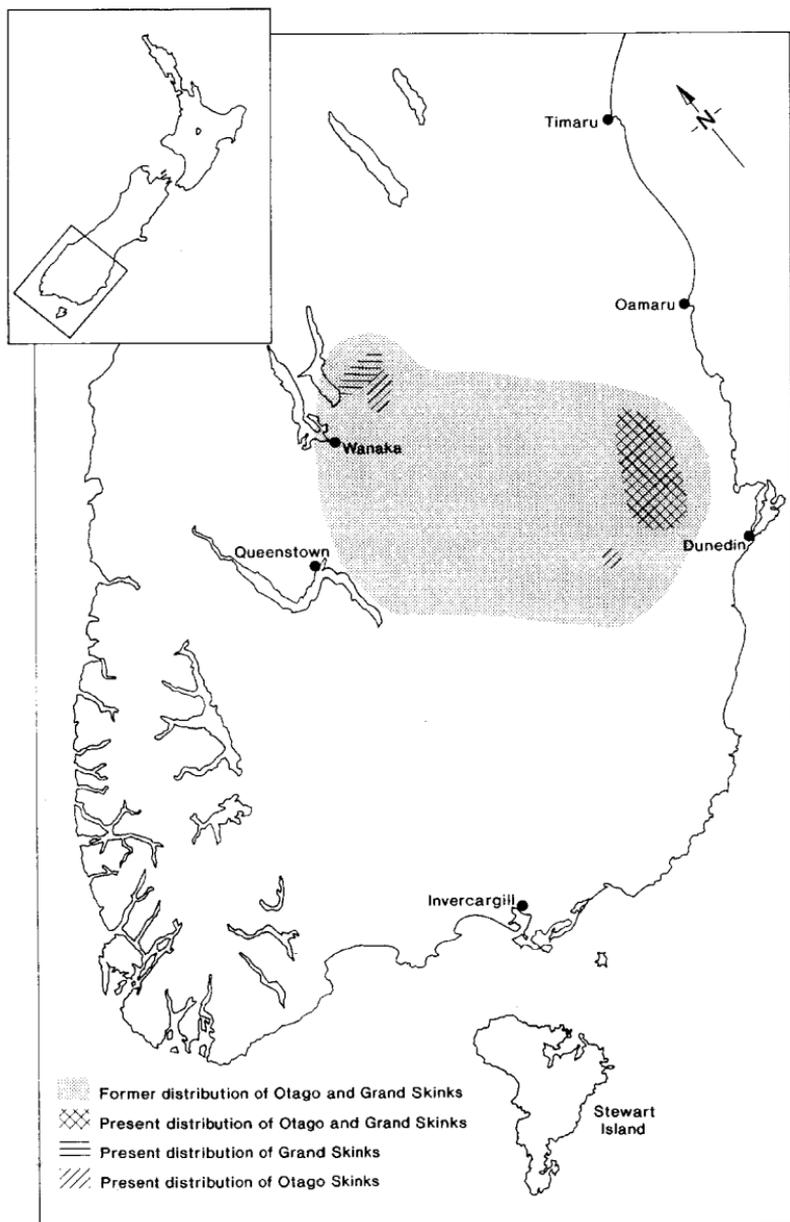
### 2.2 Present Distribution and Status

Extant populations of grand skinks and Otago skinks are known in only two areas. In eastern Central Otago both species are spread over a broad area extending from Hyde and Macraes Flat in the north to Sutton and Pukerangi in the south. Within this area both species are more numerous in the headwaters of Waikouaiti River and Nenthom Stream. In the west, grand skinks and Otago skinks are known from a few small, scattered populations in the Lindis River catchment, and grand skinks have been found at one site near Lake Hawea. There is no evidence that either species now survives in the central part of Central Otago. The Department of Conservation, Otago Conservancy, keeps a file of all sites where these species of skink have been reported or observed in recent years.

Grand skinks and Otago skinks no longer occur at many of the localities from which they have been reported in the past. More disturbing is that some of these populations appear to have died out very recently (within the last 5-25 years) indicating that localised extinction and consequent range reduction is a continuing process.

The current conservation status of the grand skink is **vulnerable** and that of the Otago skink is **regionally vulnerable** (Bell 1986), based on IUCN criteria. Populations of both are seriously depleted, are continuing to decline and, although still relatively numerous at some sites, are under continued threat from a variety of factors. Implicit in this designation is the belief that unless action is taken soon, the species will soon be **endangered** - in immediate danger of extinction.

It is fundamental to any recovery programme that a species be assigned the correct conservation status, as this permits realistic priorities to be set. The available evidence on the status of grand skinks and Otago skinks supports placing both in the vulnerable category. Otago skinks had been assigned regionally **vulnerable** status



(Bell 1986) because they were taxonomically linked to the more widespread and less threatened scree skink, which is now known to be a quite distinct species. Because the present situations of the Otago skink and grand skink are so similar it is recommended that the status of Otago skinks be elevated to that of "[nationally] threatened", the same as that accorded to grand skinks by Bell (1986). Both would thus be **vulnerable** by IUCN criteria.

If population monitoring were to show a continued decline in either species such that either the number of populations or the lizard density at the sites of largest population becomes halved, then that species should be immediately regarded as **endangered**. Even if present populations of both species are maintained, or enhanced within the proposed network of reserves, the conservation status of **vulnerable** must be retained because even in that situation the total number of lizards would not be high and the species would still occur on only a fraction of their former range.

Recognition of this status will ensure that protection of the lizards and protection of their habitat are considered when any activity requiring planning consent is proposed.

The Department of Conservation document 'Setting priorities for the conservation of New Zealand's threatened plants and animals' (Molloy and Davis 1994) places both species of skinks in Category A, the highest priority for conservation action.

### **2.3 Reasons for Decline**

The reasons for the decline in grand skink and Otago skink populations are not known with certainty. There is no indication that natural events have played anything but a minor role, and the changes are almost certainly the result of human activities, particularly over the last 150 years. The European settlers' demand for agricultural land has severely modified the Otago environment; the animals and plants they introduced have had a major effect on the indigenous biota, including the lizard fauna.

Many factors may have contributed to the decline of grand skinks and Otago skinks (Appendix 2), including:

- habitat modification - primarily the severe degradation or loss of indigenous tussock grassland or scrub between outcrops, but also the removal of indigenous vegetation from outcrops and the fouling of rock crevices
- habitat destruction - mining, quarrying, or forestry
- predation by introduced animal species
- competition from introduced species

- pest control operations - poisoning, particularly of rabbits, can lead to primary and secondary poisoning of lizards, depleted lizard food resources, and increased predation of lizards
- collection of lizards.

### 3. SPECIES ECOLOGY

Grand skinks and Otago skinks are found only on rock outcrops. The extant populations of both species are always on schist, although Otago skinks formerly lived in well-creviced basalt outcrops near Kyebum (Whitaker 1988a) and perhaps on conglomerate in the Hokonui Hills (Thomas 1982). The schist in these outcrops is usually in subzone III or IV, which fractures and weathers to form deep crevices and fissures that the lizards use as retreats.

Otago skinks have been found only on large outcrops or where there is extensive area of outcropping, generally in sheltered places along watercourses or steep-sided valleys. Although they have only been observed on the actual outcrops, they must occasionally forage off the rocks for some food items, for example tutu berries. Outcrops inhabited by Otago skinks are more likely to have a greater diversity of indigenous plants, especially berry-producing shrubs, than those occupied by grand skinks.

Although grand skinks do occur on large outcrops they are often found on smaller and/or more isolated outcrops, frequently those on ridge tops and sometimes in very exposed places. They are sometimes encountered foraging on the ground nearby, and at three sites were seen living beneath loose stones lying on soil.

Both species are more often found where the outcropping rock is surrounded by tussock grassland or native scrub than at sites highly modified by agricultural development.

Important habitat features are:

- outcrops big enough to support a reasonable population and/or close enough to other outcrops to allow movement between rocks.
- deep, secure crevices or fissures for shelter from predation or extremes of temperature.
- sites for basking safely, sheltered from the chilling wind and protected from predators.
- extensive rock surfaces over which they can forage; these are preferably encrusted with lichen to provide invertebrate prey and better camouflage against predators.

- surrounding vegetation of tall tussock grassland and associated subalpine plants to provide a food source of invertebrates and fleshy fruits, and good cover for safe dispersal between outcrops.

#### **4. WHY THESE SPECIES ARE THREATENED**

Concern for the future of grand skinks and Otago skinks arises from the fact that they now occur over a smaller area (approximately 8% of their past range) and in lower numbers than formerly, and they are still declining. Furthermore, several features of the biology of grand skinks and Otago skinks make them more vulnerable to extinction than other lizards in Otago (see Appendix 3). The small size and isolation of many populations only increases this risk, making recruitment almost impossible.

The threats to the continued survival of the remaining populations mainly arise from the fact that most of the presumed causes of their decline are still in effect.

##### **4.1 Continuation of Causes of Decline**

Habitat loss through farm development continues. To maintain economic viability farmers have to constantly improve their productivity, and the quickest way this can be achieved is through increasing the carrying capacity of the property. With the increased mechanisation of farms today ploughing and re-sowing of any slopes that can be worked with a tractor means there will be fewer and fewer extensive areas of relatively unmodified tussock grassland remaining at low elevations. Even on slopes too steep for tractors, over-sowing and fencing to smaller blocks to get greater control over grazing regimes are changing livestock densities.

The other likely causes of habitat degradation are also still occurring. Of the introduced herbivores affecting grand skink and Otago skink habitat, rabbits are more numerous now than at any time in the last 30 years; the distribution of feral goats is increasing rapidly. The impact of introduced predators may increase as the area of unimproved pasture decreases. Certainly, the currently high rabbit densities will lead to greater numbers of predators with a greater risk to lizard populations. The high rabbit densities at present and the damage they are doing to pastoral land mean pest control operations will probably increase.

The weed problem is also getting worse, particularly thyme which is spreading rapidly in the central part of Central Otago.

With the establishment of a large goldmine at Macraes Flat the destruction of grand skink and Otago skink habitat in that district, the last remaining stronghold for the species, may well become an issue in the near future. Already some populations are threatened by gold prospecting activities. Elsewhere the rate of habitat destruction is relatively unchanged - small pine plantations are being established but there is no large-scale move to forestry in Central Otago yet and the demand for decorative stone slabs is not increasing.

Levels of competition for food resources are also likely to increase as the area of unimproved pasture decreases.

Of all the possible reasons for the decline of grand skinks and Otago skinks, their collection as pets is the only one that has been reduced. The Wildlife Order 1981 gave these two species full protection under law and made it an offence to capture them or even disturb them. Sadly, this legislation has not been wholly successful and illegal collection does occur occasionally. More damaging is the impact on grand skink and Otago skink habitat of people moving loose stones to either see the rare lizards or capture the common, unprotected species.

#### **4.2 Lack of Protected Habitat**

Probably the greatest single threat to the survival of grand skinks and Otago skinks is that nowhere is their habitat protected by reserve status or covenant. This means that the prime cause of their decline - habitat degradation through agricultural development - can continue unabated and without legal recourse. [In 1993, the Redbank Conservation Area was purchased by the Department of Conservation. This reserve was purchased partly to protect grand skink habitat and partly as land to swap with the adjoining owner.]

#### **4.3 Changing Agricultural Practices**

The recent advent of goat farming for fibre production and/or weed control poses a special threat to grand skink and Otago skink habitat. Formerly, the habitat of these lizards was relatively inaccessible to sheep or cattle and the indigenous vegetation on the larger, steeper outcrops remained more or less intact. The natural agility of goats means they are able to get all over the outcrops and their predilection for woody plants means they are now destroying the remaining areas of scrub. Berry-producing shrubs (important in the diet of these lizards) are being eliminated and rock crevices are fouled with goat droppings. Goats are now widespread in Central Otago and are present in many districts for the first time. It is likely that goat farming will continue to spread and increase in the foreseeable future and will further degrade lizard habitat.

#### **4.4 Control of Agricultural Pests**

The currently high rabbit populations have led to greatly increased attention to the rabbit problem and the establishment of a special Rabbit Task Force to develop new ways to approach the control of rabbits. Because all the grand skink and Otago skink populations, but particularly those in the west, occur within the areas of high rabbit density, some rabbit control methods may increase the threat to lizard survival.

Reptiles are potentially at risk from poisons such as Compound 1080 (sodium monofluoroacetate) and anti-coagulants, eg. Talon. The former is restricted to licensed operators and the latter is not available for rabbit control on agricultural lands but can be used for the control of rodents and possums. The vulnerability of the giant skinks to these poisons would depend largely on which bait and lure is used to deliver the toxins. Dry pellets or diced carrot are unlikely to be attractive to these skinks but if fruit flavoured lures were used, this may increase the risks to the skinks. Compound 1080 is a powerful insecticide which may affect invertebrate populations in some

habitats. This could potentially reduce the invertebrate food resource (temporarily) for lizards or perhaps lead to secondary poisoning. Anticoagulant poisons are not known to kill insects directly. However, insects feeding on baits or scavenging on animal corpses killed by these toxins may be taken by the skinks and therefore increase the risk of secondary poisoning.

Amongst other rabbit control proposals are suggestions that the number of predators, particularly cats, should be increased and that scrub vegetation should be removed. By the increase of predators and the removal of habitat and forage, these actions would greatly increase the threat to grand skink and Otago skink populations.

Further conservation problems for the grand skinks and Otago skinks are outlined in Appendix 4.

## **5. POTENTIAL FOR RECOVERY**

There are several features of the remaining populations which suggest long-term survival is possible if remedial measures are implemented soon, whereas present trends - if continued unchanged - would suggest an uncertain future for both skink species.

### **(a) Wide Geographic Range**

The two districts where extant populations of grand skinks and Otago skinks are found (Macraes Flat-Middlemarch, Lindis) are widely separated, and within each the populations still occur over a relatively large area. This wide distribution means each species as a whole is buffered against any natural phenomena that might cause rapid and unexpected localised extinctions. Conservation measures should also recognise the security of this wide distribution and ensure that some protected populations are widely spaced.

### **(b) Total Population Still High**

Neither species is in immediate danger of becoming extinct. Total numbers are not known precisely, but there are clearly several thousand, perhaps up to 5000, of each. This high total population means there are still enough animals to ensure adequate founding populations for any recovery programme and that the total population will have a broad genetic base. [Note however that Patterson (1992) analysed transect data from past surveys and compared these results with the proportions of skinks he encountered in his census and monitoring study. He concluded that the wild populations may be as few as 1400 Otago skinks and 1800 grand skinks.]

### **(c) High Local Population Densities**

At many sites the localised population densities of both grand skinks and Otago skinks remain high. Provided the factors leading to the decline of these species elsewhere are controlled there is no reason to

presume these populations cannot be maintained with little further manipulation.

**(d) Breeding in the Wild**

Both grand skinks and Otago skinks are reproducing in the wild at nearly all sites, except perhaps those where population densities are very low. Control of the causes of mortality could well result in increased population densities at many localities.

**(e) In situ Protection Possible**

The long-term survival prospects are best for a species which can be retained in its natural environment. With locally high population densities of grand skinks and Otago skinks still surviving in relatively unmodified habitat at widely scattered sites in situ protection is a viable option, provided that the causes for decline are understood and addressed.

**(f) Captive Maintenance and Breeding Possible**

Otago skinks have been held in captivity for up to 20 years and with appropriate care can be maintained in good health. Captive Otago skinks will breed but, although there are second and third generation animals in captivity now, mortality rates amongst young are high. Grand skinks have been maintained in captivity for over 10 years, but successful reproduction has not been documented. The history of captive maintenance of these species shows that with care it would be possible to establish captive populations of these lizards should it ever become a conservation necessity.

## **6. OPTIONS FOR RECOVERY**

Conservation in the wild is seen as the most appropriate way of maintaining these species. The most-favoured option for achieving this is the protection and management of existing populations. The three major options for the conservation management of grand skinks and Otago skinks which have been considered are:

- Do nothing
- Conserve populations in the wild, either by (1) protecting the habitats of existing populations, or (2) transferring lizards into suitable existing reserves.
- Establish captive populations

### **6.1 Do Nothing**

All the available evidence shows grand skinks and Otago skinks now occur over a greatly reduced range and that populations of both species are continuing to decline

in the face of a wide variety of threats including habitat loss and degradation, and predation. The 'do nothing' option is therefore untenable as it will inevitably lead to the extinction of both species. If present trends continue it seems likely many populations will be lost within ten years and, perhaps, most of them within 50 years.

## **6.2 Conserve Populations in the Wild**

Either of the suboptions - protecting existing populations or transferring populations to reserved habitat - requires the Department to have control over the management of a small number of locations representing the species' geographical range, each of which with appropriate care would support a minimum population of several hundred (but preferably several thousand) grand skinks and/or Otago skinks. These could be sites where lizards already occur or those to which lizards are transferred.

### ***(a) Protect Existing Populations:***

Fundamental to the recovery of the species through preservation of existing populations is protecting their habitat. This can be achieved by the development of a two-tiered approach where:

- the primary management at the sites of greatest value is under the control of the Department of Conservation, and
- at less critical sites, management is a cooperative exercise with landowners.

Appendix 5 outlines mechanisms and key sites for achieving protection of existing populations.

### ***(b) Transfer Lizards to Suitable Reserved Habitat***

The establishment of new populations of grand skinks and Otago skinks in apparently suitable habitat that is already reserved and/or in Departmental control is regarded as neither a necessary nor viable option for the duration of this plan.

At present there are no reserves containing apparently suitable habitat within the known range of the species but some areas that do meet these criteria are currently under negotiation for protection. Because grand skinks and Otago skinks no longer occur at these sites the reasons for their disappearance would have to be precisely identified and rectified before the establishment of new populations could be considered.

The protocols and methodology for establishing new populations of grand skinks and Otago skinks have not been determined.

## **6.3 Establish Captive Populations**

The major reasons for establishing a captive population are that:

- it is essential for the survival of the species

- it will provide a source of animals for re-introduction to the wild, either at existing sites or at formerly occupied sites where conditions have now improved
- it will provide a source of animals for research
- it will provide an accessible group of animals for advocacy and education

Captive maintenance and breeding of grand skinks and Otago skinks has met with mixed success. With care it seems possible to maintain both species in captivity as adults but only Otago skinks have reproduced successfully and even then juvenile mortality is high.

At this stage the establishment of captive populations to ensure the survival of the species is not needed nor is it contemplated that animals should be re-introduced to the wild. Both these are, however, future options in case the status of wild populations dramatically worsens.

Existing captive populations do have a potential value in the production of animals for research or experimental studies *relevant to the conservation of the species in the wild*. They are also valuable for establishing the parameters required for successful captive maintenance and breeding of these species should it ever become necessary in the future. In the meantime the greatest role for captive populations is in advocacy, in making people aware of the significance of these animals and thus assisting their conservation.

At present only a few sites have large enough wild populations of both species to allow removing a few animals (to establish or enhance existing captive breeding populations) without jeopardising the survival of those remaining. These populations should not be those selected for wild management. Alternatively, animals could be taken into captivity from some of the very small, isolated populations threatened by continued habitat degradation and which have no chance of recovery. Captive populations of these skinks will only be held by recognised captive breeding institutions and herpetologists with a proven record of maintaining and breeding threatened reptiles. A captive breeding plan for grand skinks and Otago skinks will be produced separately.

**The preferred option, most likely to secure the long-term survival of the two species, is 2(a): To conserve populations in the wild by protecting existing populations.**

## 7. RECOVERY STRATEGY

**LONG-TERM GOAL:** To ensure the continued survival of wild populations of Otago skinks and grand skinks within their natural geographic range.

**SHORT-TERM GOAL:** To maintain or increase the population of both species by establishing a network of protected areas covering key habitats of the Otago skinks and grand skinks.

### OBJECTIVES

1. Preserve key populations of grand skinks and Otago skinks by protecting their habitat.

*Explanation:* Habitat protection is fundamental to recovery of the species. It can be achieved by a number of protection mechanisms ranging from purchase of the land by the Department to management of the sites on a cooperative basis with landowners. Mechanisms for protection should be negotiated between landowners and there should be no compulsion on the part of landowners to accept any particular mechanism (see Appendix 5 for criteria for selection of sites and mechanisms for protecting these sites).

2. Establish research priorities and set a research timetable.

*Explanation:* Little information is available on the natural history, ecology of the species nor the impact of management regimes. To ensure successful management of skink populations and their habitat it is essential that research is initiated as soon as practicable.

3. Investigate new reports of species distribution.

*Explanation:* Discovery of new populations, especially beyond their known range, could affect management priorities and are therefore important to investigate.

4. Monitor protected populations on an annual basis.

*Explanation:* To assess management success, protected populations need to be monitored to determine population trends.

## 8. WORK PLAN

### 8.1 Protection of Habitat

The success, or otherwise, of the recovery plan for grand skinks and Otago skinks is **absolutely dependent on the support and cooperation of the landowners or occupiers**. It is very important that all the landowners likely to be affected by the recovery plan are contacted and kept fully informed.

The sequence of actions/tasks in relation to the protection of habitat for grand skinks and Otago skinks should be:

- (a) gain agreement from landowner(s) that land is available for protection, that development will cease, and that present farm management will remain unchanged
- (b) survey site for grand skinks and Otago skinks to determine local distribution
- (c) get mutual agreement on the boundaries for the area to be protected, and on the type and length of tenure and land management or on the details for purchase by the Department
- (d) design fence and survey fence line
- (e) seek funding for fencing
- (f) erect fencing
- (g) initiate monitoring or other research
- (h) develop site-specific management plan
- (i) initiate management plan

#### 8.1.1 HABITAT PROTECTION WITH DEPARTMENTAL CONTROL

All sites chosen for management by the Department of Conservation *must be managed so that the conservation of grand skinks and Otago skinks is enhanced*.

Management of the habitat for the conservation of grand skinks and Otago skinks should start with immediate cessation of all development (burning, over-sowing, top-dressing, ploughing) and a staged removal of livestock. Subsequent management will vary and depend on how revegetation beyond this point affects the lizards. Some weed, herbivore and predator control may be necessary.

Three areas have been identified as **key sites** to achieve the conservation objectives for grand skinks and Otago skinks. These are:

Emerald Creek (+1500 ha) (grand skinks and Otago skinks numerous, exceptionally diverse lizard community)

Trig E, Ainges Road ( $\pm 225$  ha) (grand skinks numerous, some Otago skinks)

Deighton Creek ( $\pm 400$  ha) (Otago skinks numerous, some grand skinks)

Emerald Creek is the most important site, but all are essential for the preservation of these species in perpetuity.

To secure the future of grand skinks and Otago skinks at the western limit of their distribution, eight sites within the Lindis River catchment have been selected for habitat protection. These are:

Morven Hills ( $\pm 35$  ha) (six sites, Otago skinks)

Smiths Creek (+30 ha) (grand skinks)

Breast Creek ( $\pm 50$  ha) (grand skinks)

Several sites identified as important for the conservation of grand skinks and Otago skinks could be integrated into protected areas of broader scientific or conservation significance (RAP'S). These include:

Morven Hills (+28 ha) (five sites, Otago skinks)

Manuka Stream ( $\pm 600$  ha) (Otago skinks numerous, some grand skinks, diverse lizard community)

### **8.1.2 HABITAT PROTECTION WITH HIGH LANDOWNER INVOLVEMENT**

Six sites have been selected for preservation under cooperative agreements with landowners. Three of these are to protect the species at the south-eastern limits of their range; the other three are for management research plots. Two of the sites for research plots (Deighton Creek, Emerald Creek) lie within larger areas selected for habitat protection. The selected sites are:

Pukerangi Ridge (two sites, total  $\pm 2$  ha) (grand skinks; south-eastern limit of range)

Trig D, Pukerangi Ridge ( $\pm 1$  ha) (grand skinks; south-eastern limit of range)

Trig C, Pukerangi Ridge ( $\pm 3$  ha) (grand skinks, Otago skinks; south-eastern limit of range)

Hummock Runs Road ( $\pm 12$  ha) (grand skinks, Otago skinks; research plot)

Deighton Creek ( $\pm 40$  ha) (grand skinks, Otago skinks; research plot)

Emerald Creek (two sites, total  $\pm 5$  ha) (grand skinks, Otago skinks; research plots)

Action on these initiatives should begin within six months of the recovery plan's being accepted and be fully in progress within 18 months. [In 1993, the Redbank Conservation Area (1557 ha) was purchased by the Department of Conservation. This reserve, near Macraes Flat, includes an important habitat for grand skink but part of the land is also available to facilitate a land swap with the adjacent landowner. If successful, this will secure the protection of the largest remaining populations of both species of skink. Negotiations are still continuing.]

Key personnel: Protection staff, Otago Conservancy.

## 8.2 Research

The Recovery Group should more clearly **define research needs, establish priorities and set a research timetable** for presentation to the Department's Science and Research Division for approval and funding. The following projects are fundamental to meeting the objectives of this plan and are listed here in order of importance. A research timetable should be submitted as soon as possible. Details of these research priorities are outlined in Appendix 6.

- a) **Develop suitable capture and marking techniques**, essential for monitoring populations, hence measuring the success of conservation measures, and for most other research. This should be completed in the first summer field season; [see Patterson 1992 for recommended techniques].
- b) **Develop a non-disruptive population monitoring technique** alongside the development of the capture and marking techniques. As soon as a suitable technique is established, it should be implemented on all populations of highest priority for protection. This should be completed in the first summer field season; [see Patterson 1992 for recommended techniques].
- c) **Compare the genetic status** of the populations in the Lindis-Lake Hawea district with those in the Macraes Flat-Middlemarch district to determine whether they are sufficiently different to warrant special treatment in the recovery plan. This should be completed in the first summer field season.
- d) **Research aspects of the lizards' ecology**. For the proper management of the lizard populations and the areas in which they are to be protected knowledge of some aspects of the lizards' **ecology** is essential. Some ecological research will be short-term while other topics will take several seasons to obtain meaningful results; some can be done concurrently while others will require the

prior completion of other studies. These studies should start in the first summer field season and be completed within five years. The following sequence is envisaged:

- assessment of habitat requirements (year 1)
  - lizard population dynamics (years 2-4)
  - lizard population densities (year 2)
  - lizard behaviour (year 2)
  - impact of predation on lizards (years 2-3)
- e) **Assess the impact of different farm management practices** by using, in part, data from other studies, i.e., habitat requirements, population densities, population dynamics, and impact of predation. This should start in year 2 and be completed by year 4.
- f) **Determine the impact of pest control operations on lizard populations**. This research topic contains two discrete parts: (i) laboratory-based poison toxicity and bait palatability trials (complete within 18 months), and (ii) field studies on the effects of rabbit control operations on lizard populations (complete over the summer field seasons in years 2-3 after existing lizard population densities have been determined).
- g) **Assess the affects on skink populations of controlling lizard predators**, once the population densities and dynamics for grand skinks and Otago skinks have been determined. This should be undertaken in years 4-5.

### **8.3 Investigation of new reports of species distribution**

Because the discovery of new populations of either grand skinks or Otago skinks could affect the way that species is treated in the recovery plan all **reports of these species from beyond the two areas in which they are presently known should be investigated** as soon as possible after they are received.

### **8.4 Population monitoring**

As soon as a monitoring technique is developed, and certainly within 12 months of the formal protection of any habitat, population monitoring should begin and be continued on an annual basis thereafter.

### **8.5 Evaluation of progress**

The recovery group will meet at least once per year to evaluate progress of the recovery programme.

By 1997, the Department will undertake a major review of the recovery plan and progress of the recovery programme.

## 9. COSTS

The following table is laid out in the format presented below, with some allowance made for the work that has been completed.

**Time:** Given as person hours. Includes conservancy, field centre and head office.

**Operating:** Includes travel, material, wages or contract labour, specialist administrative costs such as legal.

**Capital:** Costs associated with habitat protection such as purchase, fencing, survey.

**Habitat Protection Acquisitions:** The costs are laid out for Emerald Stream, Trig E, Deighton Creek, and Manuka Stream, respectively.

**Research:** Most items are on the basis of research on contract, with some local practical support. The predation work is being done by a master's thesis project (Anita Middlemiss, Otago University) funded by Hellaby Trust.

## COSTS OF RECOVERY PROGRAMME FOR OTAGO AND GRAND SKINKS

	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Recovery Plan</b>					
Group Meetings (hr)	120	120	120	120	120
(\$)	600	600	600	600	600
Reassessment Time (hr)					400
(\$)					600
<b>Habitat Protection</b>					
Landowner consent & negotiation (hr)	120	120	120	120	120
(\$)	400	400	400	400	400
Implementation of covenants (hr)	800	800	800	800	800
(\$)	3000	3000	3000	3000	3000
Acquisitions (hr)		800	800	800	800
operating \$		800	800	800	800
capital \$		500,000	60,000	80,000	300,000
Management of land (hr)		400	800	800	800
(\$)		1,000	2,000	3,000	4,000
Population monitoring (hr)	800	50	50	50	50
(\$)		3,000	3,000	3,000	3,000
<b>Research</b>					
Define research (hr)					200
(\$)					200
Population dynamics (hr)		200	200	200	
(\$)		10,000	10,000	10,000	
Behaviour (hr)			200		
(\$)			10,000		
Predation impacts (hr)		200	200		
(\$)		600	600		
Land management impacts (hr)		250	250	250	
(\$)		16,000	16,000	16,000	
Pest control impacts (hr)		100	100		
(\$)		16,000	16,000		
Predator control (hr)				200	200
(\$)				5,000	5,000

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