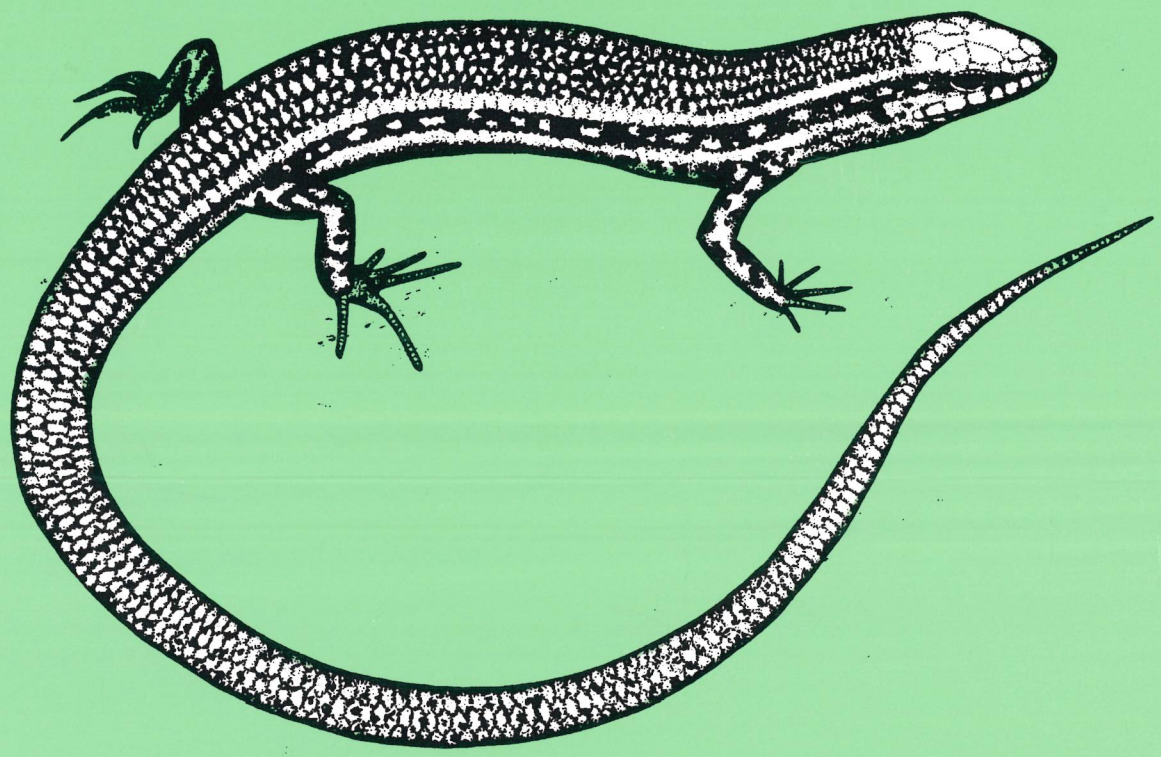
Lancelin Island Skink Recovery Plan

by David Pearson and Barbara Jones
for the Lancelin Island Skink Recovery Team



2000

Wildlife Management
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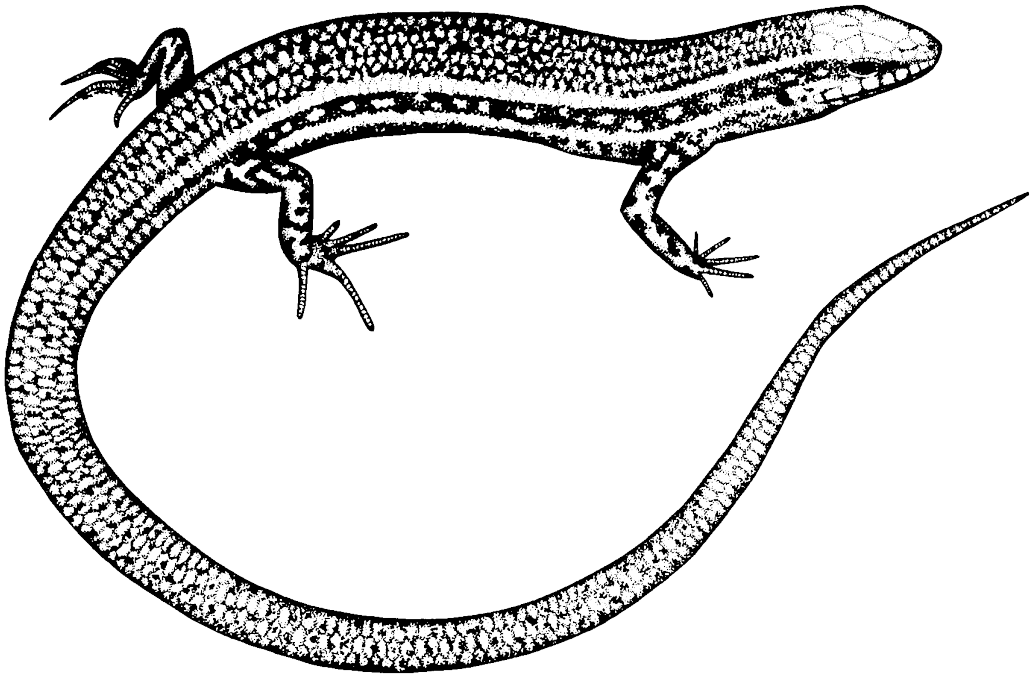

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WESTERN AUSTRALIAN WILDLIFE MANAGEMENT PROGRAM No. 22

LANCELIN ISLAND SKINK RECOVERY PLAN

by

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for the
Lancelin Island Skink Recovery Team

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2000

FOREWORD

The Western Australian Department of Conservation and Land Management (CALM) publishes Wildlife Management Programs to provide detailed information and management actions for the conservation of threatened or exploited species of flora and fauna.

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of threatened species and ecological communities. The attainment of objectives and the provision of funds is subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views nor the official positions of any individuals or agencies represented on the Recovery Team. This Recovery Plan has been approved by the Executive Director, Department of Conservation and Land Management, the National Parks and Nature Conservation Authority and the Minister for the Environment.

Approved Recovery Plans are subject to modification as dictated by new findings, changes in species' status and completion of recovery actions.

Information in the Plan is accurate at June 30 1999

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SUMMARY

CURRENT SPECIES STATUS: Threatened species (WA *Wildlife Conservation Act 1950),* Vulnerable, (Commonwealth *Endangered Species Protection Act 1992*), Endangered (Action Plan for Australian Reptiles, Cogger, Cameron, Sadlier and Eggler, 1993) and Vulnerable (IUCN 1996). One population of an estimated 3000 adults occurs on Lancelin Island. A population of unknown size, known only from one capture, has been located on the adjacent mainland. Perth Zoo holds a total of 45 adults and subadults.

HABITAT REQUIREMENTS AND LIMITING FACTORS: On Lancelin Island *Ctenotus lancelini* occupies shrubland with introduced annual grasses growing on sand dunes, swales and on limestone outcrops. Weeds have been expanding and perennial shrubs declining for about 20 years, and the future continuation of this trend may threaten *C. lancelini*. Wildfire or the introduction of vertebrate pests could have a major detrimental impact.

The species' range appears to have been historically small. The single mainland individual was found in coastal dunes with vegetation similar to habitat occupied on Lancelin Island. Trapping yielded no further captures, indicating that population density was very low on the mainland.

RECOVERY PLAN OBJECTIVES: To ensure the survival of the Lancelin Island population of *C. lancelini*; to survey for other populations; to increase the size of the captive population and investigate translocation options if required.

RECOVERY CRITERIA:

1. Resolution of the taxonomic status of allied taxa.
2. Monitor and maintain the Lancelin Island population so the population trend is stable or increasing.
3. Research and monitor habitat quality on Lancelin Island.
4. Management to exclude exotic animals and fire, and minimize visitor impacts.
5. Continue liaison with the public, government and developers over potential mainland habitat.
6. Survey for other populations.
7. Maintain the current captive population and increase its size to at least 50 adults.
8. Assess sites for translocation should this be required for the conservation of the species.

ACTIONS NEEDED: A Recovery Team was established in 1993 with members from Environment Australia, CALM, Perth Zoo, Shire of Gingin, WA Museum, WA Society of Amateur Herpetologists, and a wildlife research consultant. The Team will oversee proposed actions including:

1. Examination of the genetic and conservation status of *Ctenotus* taxa closely related to *C. lancelini*.
2. Monitoring of the *C. lancelini* population on Lancelin Island.
3. Research and monitoring of habitat on Lancelin Island.
4. Visitor and fire management on Lancelin Island.
5. Liaison with the local community and shire about the management of Lancelin Island.
6. Liaison and advice to government agencies and developers about potential mainland habitat.
7. Survey for other populations on the mainland and nearby islands.
8. Captive breeding with the maintenance of at least 50 adult individuals.
9. Evaluation of translocation options, if required.

ESTIMATED COST OF RECOVERY: 1999 prices.

Actions	Action 1	Action 2	Action 3	Action4 +5	Action 6	Action 7	Action 8	Action 9	TOTALS
1999	3.5	4.0	1.0	2.0	1.0		4.0		15.5
2000	5.0	4.0	1.0	1.0	1.0	5.0	4.0	1.0	22.0
2001		4.0	1.0	1.0	1.0	5.0	4.0		16.0
2002		4.0	1.0		1.0		4.0		10.0
2003		4.0	1.0		1.0		4.0		10.0
TOTAL	8.5	20.0	5.0	4.0	5.0	10.0	20.0	1.0	73.5

BIODIVERSITY BENEFITS: Despite their prominence in the Australian herpetofauna, the ecology of most *Ctenotus* species is little known, particularly those occurring in temperate climates. Lancelin Island is an important seabird breeding island (including Roseate and Bridled Terns and a southern nesting site of the Common Noddy).

1. INTRODUCTION

1.1 Description and taxonomic history of the species

The Lancelin Island Skink (*Ctenotus lancelini* Ford 1969) is a small lizard, with adults weighing up to 10 g and having a total body length of around 220 mm. The dorsal surface is grey-brown with several indistinct lines of black streaks running along the back from the neck to the base of the tail. The sides of the body between the legs have 3 prominent grey-white stripes; a dark brown area between the upper two stripes is adorned with grey-white dashes and dots. The tail is grey-brown with dappled black markings (Ford 1969, Ehmann 1992).

Ctenotus lancelini was first collected in October 1961 by Julian Ford on Lancelin Island. He considered it a subspecies of the widespread and variable *Ctenotus labillardieri*, but noted that the Lancelin Island specimens were readily distinguishable from individuals from other populations (Ford 1969). The general colouration of *C. lancelini* differed from *C. labillardieri* by being pale brown on the dorsal surface rather than bronze-brown to black; darker markings on the back resulted in a dappled appearance; and the hind legs were yellow, not reddish-brown. In addition, the five Lancelin Island specimens he used in his analysis had, on average, longer head-body and tail lengths than individuals from other locations (Ford 1969). Storr (1972) elevated the taxon to specific status on the basis of its colouration and its size relative to *C. labillardieri.*

The taxonomic relationships of *C. labillardieri* and *C. lancelini* have been examined by Dr. Mark Adams at the Evolutionary Biology Unit of the South Australian Museum. Tissue from four *C. lancelini* collected from Lancelin Island and from the only mainland capture were compared with *C. labillardieri* tissue from a range of sites in south-west WA. *Ctenotus lancelini* was found to constitute a distinct species with six fixed differences from *C. labillardieri* in 40 of the loci examined (15%). Of particular interest was the finding that two specimens of *C. labillardieri* from Meelup and near Pinjarra had only one fixed difference from *C. lancelini*, suggesting that it is the same species or a sister taxon. Further morphological and DNA characterisation work is required to resolve this situation.

1.2 Distribution and abundance

Until recently, *C. lancelini* was only known to occur on Lancelin Island (Ford 1963), which lies approximately 100 km north of Perth and is separated from the mainland and the town of Lancelin by 700 m of shallow water. In October 1994, a single individual was found in a Lancelin foreshore reserve, directly opposite the Island (Maryan and Browne-Cooper 1994). No further individuals have been recorded on the mainland. The current known range of *C. lancelini* (< 10 ha) remains one of the smallest known of any Australian reptile.

Between October 1991 and March 1993, several attempts to collect *C. lancelini* on Lancelin Island (Browne-Cooper and Maryan 1992, Rolfe 1993) resulted in the capture of just one individual. Previous visitors to the Island had collected three to six by hand during a single day search (Hanlon/Petersen collections in the Western Australian Museum; G. Connell, G. Harold, pers. comm.). These results indicated that the status of *C. lancelini* needed urgent clarification.

A detailed study was initiated by CALM with the financial support of Environment Australia. One of this document's authors (BJ) was contracted to undertake a two-year population/trapping program. This study was completed in December 1995 (Jones 1996). It showed that *C. lancelini* was not restricted to outcropping limestone as previously believed, but that it occurred on each of the 13 trapping grids used to sample the Island's main habitat types. The perceived decline of the species was probably due to the timing of previous visits and the use of rock-turning as the principal means of locating the skinks. However, it may be that numbers had declined locally under limestone slabs due to weed growth reducing exposed rock cover.

Between 1993 and 1995, several searches of mainland sites in the Lancelin area (Rolfe 1993, Jones 1996 and Pearson unpublished data) resulted in the hand collection of one *C. lancelini* (Maryan and Browne-Cooper

1994). In late 1995, trapping was undertaken at the mainland collection site to obtain capture rates which were
directly comparable to contemporaneous Island trapping, but no *C. lancelini* were captured. These data indicate that the species was very rare at the only known mainland locality.

The Lancelin Island *C. lancelini* population was estimated to consist of about 3000 adults in 1994-5. Relative capture rates for the different trapping grids varied by up to a factor of 40, showing that the population was not evenly dispersed throughout the Island's habitats. Population density was estimated to vary up to a maximum of about 800 *C. lancelini* per hectare in areas with the highest capture rates.

1.3 Habitat

On Lancelin Island *C. lancelini* used all of the main vegetated habitat types available. Substrates included sand, and shallow soil over limestone. The vegetation consists of low shrubs with a variable component of winter annuals, predominantly Rye Grass (*Lolium rigidum*) and Wild Oats (*Avena barbata*). The vegetation of the Island has been documented by Keighery and Alford (in prep.)

Favoured areas were identified by high capture rates, and were characterised by having nearby slopes facing north to north-east. Such areas were protected from prevailing southerly winds and received sunlight early in the day.

The vegetation at the single mainland collection site was structurally and floristically similar to vegetation on the eastern margin of Lancelin Island.

1.4 Life history and ecology

All available information on the species biology and population ecology outlined here is drawn from a recent study of the Lancelin Island population (Jones 1996). *Ctenotus lancelini* is morphologically adapted to forage within leaf litter (short limbs, heavy body relative to its length and a slender head with small eyes). On Lancelin Island its diet consisted almost entirely of insects associated with litter accumulations.

Adult *C. lancelini* were caught most frequently between September and late November. Although gravid females were caught in most parts of the Island, 56% were caught in only 7% of pits. This suggested that high-quality egg incubation sites were rare and shared by many females. The topography of small areas associated with the favoured pits appeared to offer the *most* protected, north-eastern slope available. Hatchlings were caught in other areas which showed that some gravid females used less popular, but still successful incubation sites.

Hatchlings were captured from mid-January onwards. High mortality within the first few months of life appeared to be associated with abnormally dry conditions between December and April inclusive. In 1994, no subadults were caught in spring, and rainfall (December-April) was only 6% of the average. In 1995, rainfall (December-April) was about 50% of the average and subadults were captured in spring. In early 1995 the body condition of young declined from hatching until several days after the first rainfall of the year (late March). Seasonally high mortality may severely limit recruitment into subsequent adult cohorts.

Some females first bred during their second summer, while others appeared to achieve breeding condition only in their third summer. Some adult females were known to be gravid in three subsequent years, suggesting that female longevity may exceed six years.

Male *C. lancelini* were smaller than females and less abundant, with about 70% of the population being female making up about 30% of total captures (recapture data indicated no significant difference in trappability of sexes). Sex ratios varied between years and areas, with males being exceptionally rare in areas with the highest densities of adult females.

1.5 Reasons for threatened status

The highly restricted distribution of the species makes it vulnerable to local perturbation.

Understanding of other threats to *C. lancelini* has changed substantially as more data have become available on its basic ecology. Burbidge (1993) suggested two possible threats: 1) an increase in introduced grass cover which may be degrading habitat for *C. lancelini* (by shading basking sites and altering prey communities), and 2) possible predation by Silver Gulls (*Larus novaehollandiae*). The role of weeds is examined further in Section 1.5.2. There is no evidence that Silver Gulls feed on *C. lancelini*. Given the cryptic foraging habits of *C. lancelini*, and that Gulls congregate on Lancelin Island for nesting during winter when the skinks are inactive, it is unlikely that predation occurs at any appreciable level.

1.5.1 Restricted distribution

Ctenotus lancelini is only known to occur on Lancelin Island (7.6 ha) and on an adjacent section of the mainland; a total area of less than 10 ha. Despite intensive trapping at the site of the mainland capture and survey work elsewhere from Wedge Island south to Guilderton, there have been no further mainland captures. This makes determination of the mainland distribution problematic: the taxon's status on the mainland is most appropriately considered as rare.

1.5.2 Habitat alteration

The vegetation of Lancelin Island has undergone considerable change over at least the last 30 years. Photographs taken by Nic Dunlop in 1976 show that some vegetation communities have altered substantially over short periods, and that the eastern beach and associated dune are periodically washed away. At present this small dune and swale behind the eastern beach has one of the highest densities of *C. lancelini*.

The dynamic characteristics of vegetation communities on Lancelin Island appear to be driven by at least three forces; the input of guano by nesting and roosting seabirds, increasing dominance of weed species and variable rainfall. Changes in vegetation on south-western Australian islands due to seabird and seal activity were studied by Gilham (1960, 1961). She found that bird guano in nesting areas changes the soil nutrient status, often killing existing plants and improving conditions for the growth of "coprophiles". While heavy guano deposits may kill all plants, lesser concentrations led to increasing soil fertility (through nitrogen and phosphorus inputs) which caused accelerated growth of some species and the loss or decline of others. Trampling and burrowing by seabirds may also impact upon the vegetation (Gilham 1961).

Instability in island vegetation communities where nesting birds are present, is further accentuated by fluctuations in bird numbers (and hence the rate of guano accumulation), storms or drought. The Mediterranean climate of Lancelin Island with hot dry summers, results in seasonal guano concentration in the soil and strong shifts in vegetation composition. Gilham (1961) noted that there was a general trend for "sclerophylls to become replaced by succulents, shrubs by trailing herbs, perennials by annuals and indigenous plants by aliens."

Jones (1996) noted that the major potential threat for *C. lancelini* on Lancelin Island was the disturbance of the small areas used by females for the incubation of eggs. Their exact location and characteristics have not been clearly identified. However, they tend to be situated on protected slopes with north to north-eastern aspects, suggesting that oviposition sites are chosen on the basis of substrate thermal characteristics. Jones (1996) estimated that these high quality incubation sites may have a total area of only 1000 m^2.

The surface of Lancelin Island has abundant seabird burrows. Most contain substantial amounts of organic matter (faeces, feathers and dead chicks) within a well-insulated and relatively humid micro-environment. As such, they may form an important resource for invertebrates. Lizards on the Island, including *C. lancelini*, were frequently seen to flee into the burrows. Since the burrows collapse readily underfoot, increasing tourist numbers may impact on these important microhabitats.

There is no evidence to support the hypothesis that the expansion of weeds was detrimental to *C. lancelini* during 1994-5 (Jones 1996). It occurred at high densities in some areas with abundant winter weeds, but also at very low densities in other areas with fewer weeds, suggesting that vegetation composition was not a major limiting factor on local abundance. Nevertheless, expansion of weed coverage and the associated decline of perennial shrubs, especially on shallow soils over limestone, may impact on the species over the next 10-20 years.

1.5.3 Impact of drought on recruitment

Drought limits recruitment of juveniles into the adult population (see section 1.4). A succession of dry years may result in a population decline and would be of concern only if it coincided other pernicious events (eg. storm removal of the eastern swale).

1.6 Existing conservation measures

1.6.1 Management of Lancelin Island

Lancelin Island is a Class A Nature Reserve and is managed by staff from the CALM Mid-West Region based in Lancelin and Moora. A Friends of Lancelin Island group was formed in 1997 through community interest in issues affecting the Island. Management to date has focussed on reducing the impacts of visitors. Nature reserve and pet/firearm prohibition signs have been erected on the eastern coast of the Island, There is also a similar sign on the town jetty. The Island is a very popular recreation site for local townsfolk and tourists during spring and summer. A boardwalk was erected in May 1999 across the northern end of the Island by CALM staff with the assistance of the Friends of Lancelin Island. This will reduce trampling of seabird burrows and wind erosion on the eastern dune.

A District Operations Officer based in Lancelin patrols the area regularly. Local Fisheries Western Australia staff and police officers at Lancelin monitor activities on the Island, typically in relation to illegal fishing and boating safety.

1.6.2 Recovery Team

Interim Wildlife Management Guidelines (IWMGs) written by Burbidge (1993) guided initial survey work on Lancelin Island. The IWMGs also provided for the establishment of a Recovery Team. The first Team meeting was held in December 1994. The Recovery Team has members from CALM (Moora District, CALMScience Division, WA Threatened Species and Communities Unit), Environment Australia (Threatened Species and Communities Section), Perth Zoo, Western Australian Museum, Shire of Gingin, WA Society of Amateur Herpetologists (WASAH) and wildlife research consultant, Barbara Jones. The IWMGs were further revised by Pearson (1994).

The Recovery Team has met on numerous occasions since its formation and produced annual reports between 1994 and 1998. It will continue to report annually on the implementation of this Plan to CALM's Corporate Executive and any funding agencies.

1.6.3 Ecological studies

The discovery of *C. lancelini* occurred during biogeographic research on insular avian and reptile faunas by Julian Ford from the WA Institute of Technology (now Curtin University). He described the taxon from five specimens and speculated on the thermal implications of its pale colouration.

A two year study of *C. lancelini* on Lancelin Island (Jones 1996), represents the first detailed study of the ecology of *C. lancelini*.

1.6.4 Herbicide toxicity trials

A rapid increase in the area covered by exotic grasses on Lancelin Island was thought to be detrimentally changing habitat conditions for *C. lancelini* (Burbidge 1993). A spraying trial was carried out on a small area of Lancelin Island using Fusilade® to determine its effectiveness for the control of weed grasses. Fusilade® (ICI Australia) is widely used and was recommended by the Kings Park and Botanic Garden staff for controlling Rye Grass.

Reports of Gould's Sand Goannas (*Varanus gouldii*) dying following weed-spraying (with a mixture of "Round-up" and "Glean") in Karrakatta Cemetery, Perth (G. Thompson, pers. comm.), prompted concern about potential impacts on *C. lancelini* should spraying of grasses be necessary on Lancelin Island.

Information on the bio-toxicity of Fusilade® was requested from ICI. They provided data on the properties and toxicology of fluazifop, the active ingredient in Fusilade®. It has not been tested on native Australian fauna, nor any reptiles. Oral LD_{50} tests have been carried out on rats, mice, guinea-pigs, mallard ducks, rabbits, dogs, ring-necked pheasants, rainbow trout, mirror carp, bluegill and honey bees.

Clearly, if widespread spraying of weeds was to take place on Lancelin Island, it is important that it will not have deleterious effects on *C. lancelini* and other fauna. To investigate the toxicology of Fusilade®, a series of oral dosing and direct spraying trials were carried out by Dr. Dennis King (AgricultureWA) during 1996. A total of 35 *Ctenotus labillardieri* were used as analogues for *C. lancelini* in these trials to determine the LD_{50} for the skinks. The results of this study are currently being written up, but it appears that *C. labillardieri* has a high tolerance to fluazifop if not administered in a hydrocarbon solvent. The latter caused considerable discomfort to skinks at high concentrations with some deaths (King and Pearson, in prep.)

1.6.5 Captive breeding

Concerns about the status of *C. lancelini* in 1993 led to the establishment of a *Ctenotus* captive breeding program involving Perth Zoo and CALMScience Division. Since the population of *C. lancelini* appeared very low on the basis of search data (Browne-Cooper and Maryan 1992) and trapping attempts (Rolfe 1993), the Red-legged Skink (*Ctenotus labillardieri*) was used as an analogue for initial captive breeding attempts.

Ctenotus labillardieri is a sibling species to C. *lancelini*, but is common and widespread in south-western WA. Skinks for captive breeding were captured by searching under granite slabs around a number of outcrops about 60 km south-east of Perth and near Waroona.

Captive breeding commenced in September 1994 with 34 *C. labillardieri* (15 males, 11 females and 8 unsexed juveniles), housed at Perth Zoo and the WA Wildlife Research Centre. They were housed in small aquaria in different combinations of animals (1 pair, 2 pairs, 3 pairs, and males and females kept separate except during the mating season). The skinks were fed with termites and mealworms, initially in measured quantities to prevent obesity, but latter *ad lib* when it became clear that obesity did not appear to be a problem.

In 1994, only three eggs were produced; two were desiccated when located and the remaining one (0.73g) was placed on vermiculite in a warm room (at $28\text{-}29^0$) and hatched after 35 days.

All *C. labillardieri* kept at Perth Zoo were moved to a purpose-built outdoor enclosure over the winter. Only one individual was unaccounted for at the end of this period. Gravid females were removed from the outdoor enclosure in early November 1995 and placed in small plastic boxes filled with moist vermiculite until they oviposited. The eggs were then artificially incubated on moist vermiculite at $28\text{-}29^0$ C.

Four clutches (2,3,3,4 eggs) were laid and incubated during November 1995. At oviposition, eggs weighed 0.55-0.71 g (mean 0.63 g). Four eggs hatched after 34-37 days (0.58-0.67 g; snout-vent length 26.0-32.5 mm). None of the four females held indoors at the WA Wildlife Research Centre reproduced during 1995.

Six gravid *C. lancelini* were collected on Lancelin Island in December 1995 and January 1996 for captive breeding purposes and kept at Perth Zoo. A male was collected in February 1996. Gravid females were maintained in small plastic boxes with moist vermiculite. Four females oviposited in December (12th, 14th, 14th and 27th) with clutch sizes of 2, 5, 3 and 3 respectively. The other two females produced clutches of 4 and 3 in January 1996 (14th and 20th).

The *C. lancelini* eggs were maintained on a 1:1 by weight vermiculite/water mix at 29 ^{0} C. At oviposition, eggs weighed 0.79-1.01 g (mean 0.91; standard deviation 0.086). Fifteen eggs hatched from the total of 20. Time from oviposition to hatching was 40-46 days (mean 42.3 days; standard deviation 1.6). Neonates weighed 0.49-0.89 g (mean 0.75 g; standard deviation 0.12) and had snout-vent lengths of 29-32.5 mm (mean 30.9 mm; standard deviation 1.4). All have been successfully maintained on a diet of termites.

The sex ratio of the neonates has not yet been determined. Juvenile *Ctenotus* discard their tails readily when handled, so sexing has been delayed until they are older.

1.7 Strategy for recovery

This Recovery Plan will run over a period of five years from 1999 to 2003 inclusive. Seven primary strategies will be followed during this period and are outlined below:

(i) Improve knowledge of the taxonomic and conservation status of *C. lancelini* and closely related taxa.

(ii) Monitor the Lancelin Island population of *C. lancelini.*

(iii) Establish a research/monitoring program to examine rates of vegetation change on Lancelin Island and techniques for the control of exotic plants should this be required for the conservation of *C. lancelini*.

(iv) Develop visitor management information signs and construct walkways to direct visitors on the Island and so minimise the trampling of vegetation.

(v) Expand public, local government and media awareness of the important nature conservation values of Lancelin Island.

(vi) Continue liaison with local government about developments along the coast and islands which may potentially impact on *C. lancelini* or its habitat.

(vii) Survey suitable habitat on the mainland in the coastal strip from Guilderton to Wedge Island, and various islands in the region for other populations.

(viii) Increase the captive population at Perth Zoo to a self-sustaining adult population of around 50 individuals, refine techniques and prepare a husbandry manual.

(ix) Investigate sites for translocation should survey work fail to locate other populations (in association with (vii)).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The downlisting of *C. lancelini* from "Vulnerable" to "Lower Risk" will not be possible during the life of this Plan, unless several other populations are located during survey work. The Plan seeks to ensure the survival of *C. lancelini* by maintaining existing habitat on Lancelin Island; increasing the size of the existing captive population; searching for other populations; and if none are located, investigating translocation to another site.

2.2 Criteria

The criteria for successfully achieving the objectives are:

1. Resolution of the taxonomic status of *Ctenotus* taxa closely related to *C. lancelini*, particularly populations at Meelup and near Pinjarra.

2. Annual monitoring of the *C. lancelini* population on Lancelin Island which indicates that the population trend is stable or increasing.

3. Research on, and monitoring of, habitat quality on Lancelin Island.

4. The implementation of management actions aimed at the prevention of fires, the exclusion of exotic animals and the minimisation of trampling damage by visitors.

5. Ongoing liaison and advice on survey needs to the Shire of Gingin, other authorities and developers if areas of potentially suitable habitat on the mainland are to be developed or disturbed.

6. Survey of suitable habitat on the mainland and nearby islands to locate any other populations if they exist.

7. An increase in the size of the captive population of *C. lancelini* to 50 adults, with the refinement of breeding techniques and the production of a husbandry manual.

8. Assessing sites for translocation should this be required urgently or in the event that no other populations are located.

9. Continued effective liaison with local government and the Lancelin community about the management of Lancelin Island and potential mainland habitat.

3. RECOVERY ACTIONS

The Lancelin Island Skink Recovery Team (section 1.6.2) will continue to meet regularly to oversee and co-ordinate the implementation of this Recovery Plan and will report annually to CALM's Corporate Executive. The costings of the recovery actions outlined below have been calculated based on 1997 prices. CALM's contributions include salaries.

3.1 Genetic status of Ctenotus lancelini *and associated taxa*

The genetic distinctiveness of *C. lancelini* relative to its closest sibling species, *C. labillardieri* and differences between the Lancelin Island animals and the sole mainland individual has been determined by Mark Adams. However, this work and allied morphological examinations by Dr Ken Aplin of the Western Australian Museum, have identified the existence of a taxon closely related or the same as *C. lancelini*. The taxonomic status of this species group needs morphological and perhaps DNA characterisation to resolve the number and distribution of various inbedded taxa. Examination of allozymes may be sufficient to distinguish individual taxa (costed at $3500 in 1998), but if this does not provide detailed resolution a study of mitochondrial DNA would be required ($5000 in 1998).

***Responsibility**: South Australian Museum, Western Australian Museum*

Cost:	*1997*	*1998*	*1999*	*2000*	*2001*
CALM			*3500*	*5000*	
Total Cost			***3500***	***5000***	

3.2 Population Monitoring on Lancelin Island

A monitoring program to track population trends, individual body condition and reproductive status, as well as abundance in various Island habitats will continue using a selection of the trapping sites established by Jones (1996). This will ensure continuity of this benchmark research on population distribution and dynamics.

Trapping will be undertaken on an annual basis for the life of the Plan. A minimum of 100 small pits with covers will be established at four sites on the Island. Seventy-five traps will sample the abundance and activity of breeding females on the Island's large central dune and adjoining swale, concentrating on northern and eastern aspects. The remaining 25 traps will be situated on the south-east slope of the central dune to sample males and sub-adults.

Two periods of trapping in the period from October 20 to December 1 are required, and each needs to include at least 3 days of "good" trapping weather (ie. morning sunshine with a daily maximum temperature $>22^0$ C). If dates are selected without regard to the predicted weather, it would be necessary to allow at least 12 days trapping to obtain these suitable conditions.

Trapping over each year of the Plan is required to establish baseline data to assess any future changes in the population, and so that seasonal effects on population size can be clarified. Based on existing data, fluctuations in capture rates of up to 20% could be considered normal variation (assuming suitable trapping weather). However, two successive monitoring sessions with declines of this magnitude would warrant the urgent transfer of more individuals into the captive population and research/management to identify the factor causing the decline.

***Responsibility:** CALMScience Division/Moora District*

Cost:	*1999*	*2000*	*2001*	*2002*	*2003*
CALM	*4000*	*4000*	*4000*	*4000*	*4000*
Total Cost	***4000***	***4000***	***4000***	***4000***	***4000***

3.3 Research and Monitoring of habitat on Lancelin Island

The vegetation communities on Lancelin Island are highly dynamic and affected by differences in annual

rainfall, nutrient inputs by nesting seabirds and the invasion of a range of weed species. The impact of these factors on overall habitat quality for *C. lancelini* is unknown. A monitoring program based on permanent quadrats and photo-points should be established to examine and document changes in the species composition, cover and structure of vegetation communities. Concurrent studies on seasonal changes in soil nutrients in undisturbed vegetation and areas utilised by nesting seabirds would be useful to interpret observed changes in vegetation characteristics. This would be a very suitable project for a post-graduate student.

The advance of weeds, particularly Wild Oats, Rye Grass and Iceplant (*Mesembryanthemum crystallinum*), has the potential to lead to dramatic shifts in species composition and dominance of some plant communities. Replicated experimental plots to examine different control techniques for these species will be established, if it becomes apparent that weeds are adversely affecting habitat quality for *C. lancelini*. Pending results of research on the impact of the herbicide Fusilade® on skinks (see Section 1.6.4), trials comparing the effectiveness of this herbicide with other techniques such as mechanical methods (removal by hand) will be conducted. The technique employed will depend on the growth and propagule characteristics of the weed species concerned.

Responsibility: *CALMScience Division/ Lancelin Office*

Cost:	*1999*	*2000*	*2001*	*2002*	*2003*
CALM	*1000*	*1000*	*1000*	*1000*	*1000*
Total Cost	***1000***	***1000***	***1000***	***1000***	***1000***

3.4 Visitor and fire management on Lancelin Island

The impact on *C. lancelini* of trampling of vegetation and the accidental collapse of seabird nesting burrows by visitors was believed to be significant. Given that visitation to Lancelin Island by local people and tourists is increasing, some pro-active management was required to ensure that visitor traffic was controlled before the situation became too serious. At present, most visitors land on the eastern beach and walk along one of two paths to the western side of the Island.

Interim management guidelines for Lancelin Island were prepared by Richard Hammond, Senior Landscape Architect/ Planner, CALM Parks Recreation, Planning and Tourism Division. These were prepared in July 1998. One outcome of this plan was the construction of a boardwalk on the northern end of the Island in May 1999.

Fires should be excluded from Lancelin Island. While the Island has probably burnt in the past, the impact of fire on *C. lancelini* is unknown and may be detrimental. The ban on all types of fires (including gas-fired barbecues) should remain. Signs indicating a total fire ban should be maintained at possible landing sites, particularly the eastern beach.

Total exclusion of visitors would obviously reduce the risk of fire, but this is impractical due to the Island's proximity to the townsite and important surfing and sail-boarding recreation areas. Nonetheless, the area should be for day use only with no allowance for camping.

Responsibility: *CALM Moora District/Parks, Recreation, Planning and Tourism Divison*

Cost:	*1999*	*2000*	*2001*	*2002*	*2003*
CALM	*2000*	*1000*	*1000*		
Total Cost	***2000***	***1000***	***1000***		

3.5 Liaison with the public, local government and the media

Ctenotus lancelini currently has a low public profile and this is desirable to prevent increased visitation on Lancelin Island. Nonetheless, it is appropriate to keep local people informed of research on the species through local media, whilst emphasising the need to avoid incompatible activities or the introduction of exotic animals onto the Island.

Local government needs to be kept informed and involved in research work on the Island and survey work elsewhere. The Shire of Gingin has been alerted to the presence of the species on the mainland and its co-operation sought to ensure that development proposals along the coastal strip between Guilderton and Wedge Island include surveys for *C. lancelini*.

Responsibility: *CALM Moora District/CALMScienceDivision*

***Cost*:** included in Section 3.4

3.6 Management of known mainland population

Despite the efforts of the CALM-WASAH surveys between Wedge Island and Guilderton and the intensive trapping by Barbara Jones in the foreshore reserve, the mainland population is still only known from a single individual. Trap results indicate that the mainland population must be at very low densities, making the determination of its distribution and the location of other populations very difficult.

The area where the sole mainland *C. lancelini* was located is a narrow foreshore reserve immediately opposite Lancelin Island. To the north, it is bordered by housing and a narrow strip of *Spinifex* grassland preserved behind the beach. To the east is a steep dune, the proposed site for a look-out. Further to the east, the eastern slope of the dune runs down into an area of degraded shrubland (the proposed site for a beachside resort-style development) and housing. To the south is a caravan park, the Lancelin Island Hotel and a narrow strip of vegetation that protects the foredune on the western side of Lancelin.

The foreshore area directly abutting the beach and the western side of the steep dune are Shire reserve. The remaining area is private property, although a land swap between the Shire of Gingin and the developers is proposed so that the crest of the dune is incorporated in the Shire reserve.

Further survey work should be carried out in this area to determine the size and distribution of the *C. lancelini* population (budget included in Section 3.7). Liaison with the Shire and the Environmental Protection Authority should continue to ensure that any developments in the area include surveys for the skink and minimise habitat destruction until its status in these areas is established.

Responsibility: *CALM Moora District/CALMScience Division*

Cost:	*1997*	*1998*	*1999*	*2000*	*2001*
CALM (salaries only)	*1000*	*1000*	*1000*	*1000*	*1000*

3.7 Survey for further populations

Some examination of potential habitat has been carried out on the mainland, but there is a need for further efforts. Survey work should also focus on local islands. Trapping results from Lancelin Island provide some general guidance as to the most likely habitats and times to capture *C. lancelini*. Trapping should be carried out using small "cover" pits during October and November and concentrate on sandy substrates or limestone

outcrops with northern and eastern aspects.

During the life of this Plan, survey work should concentrate on the area between Wedge Island and Guilderton to ensure a thorough investigation, although if suitable habitat is located elsewhere along the coast, then additional surveys may be warranted.

Responsibility: *CALMScience Division/ Lancelin Office*

Cost:	*1999*	*2000*	*2001*	*2002*	*2003*
CALM		*4000*	*4000*		
Other		*1000*	*1000*		
Total		***5000***	***5000***		

3.8 Captive breeding

Results of captive breeding efforts have been encouraging to date. Preliminary data suggest that growth and body condition of *C. labillardieri* kept in outdoor enclosures were superior to those maintained in indoor aquaria. Several captive *C. labillardieri* have completed their entire reproductive cycle at Perth Zoo, but oviposition in *C. lancelini* has been achieved only by removing gravid females from the Island population. During the life of this Plan, breeding techniques will be developed for *C. lancelini* to complete its entire reproductive cycle in captivity. The captive population will be increased to 50 adults through captive breeding and the occasional addition of wild-caught individuals.

Progeny of the captive breeding program, at the discretion of the Recovery Team could be used to establish other captive colonies or be used in translocations if these are required and approved by CALM's Director of Nature Conservation in accordance with Departmental policy.

Responsibility: *Perth Zoo/ CALMScience Division*

Cost:	*1999*	*2000*	*2001*	*2002*	*2003*
Perth Zoo	*3000*	*3000*	*3000*	*3000*	*3000*
CALM (salaries only)	*1000*	*1000*	*1000*	*1000*	*1000*
Total	***4000***	***4000***	***4000***	***4000***	***4000***

3.9 Evaluation of translocation options

If no other populations are located, or if *C. lancelini* is found to be declining on the mainland, it would be appropriate to consider translocation to another site. Potential sites should be investigated during the life of this Plan and can be accomplished during survey work (Section 3.7). A budget of $1000 is estimated to cover salary costs for a meeting/workshop to select suitable site/s.

Responsibility: *CALMScience and Information Division and Moora District*

Cost:	*1999*	*2000*	*2001*	*2002*	*2003*
CALM		***1000***			

IMPLEMENTATION SCHEDULE

	Task	Priority	Feasibility	Responsibility	Funding	Costs$					
						1999	2000	2001	2002	2003	Total
3.1	TAXONOMIC STATUS	1	100	SAM/ WAM	F	3500	5000				8500
3.2	POPULATION MONITORING	1	100	CALMSC	A	4000	4000	4000	4000	4000	20000
3.3	RESEARCH AND MONITORING OF HABITAT	1	100	CALMSC	A	1000	1000	1000	1000	1000	5000
3.4	VISITOR AND FIRE MANAGEMENT	2	100	CALM Lancelin/ Parks, Rec.	A	2000	1000	1000			4000
3.5	LIAISON	1	100	CALM Lancelin					costs incorporated in task 4		
3.6	MANAGEMENT OF KNOWN MAINLAND LOCATION	1	100	CALM Lancelin / CALMSC	A	1000	1000	1000	1000	1000	5000
3.7	SURVEY FOR OTHER POPULATIONS	1	100	CALMSC	A/F		5000	5000			10000
3.8	CAPTIVE BREEDING	1	90	Perth Zoo /CALMSC	P/A	4000	4000	4000	4000	4000	20000
3.9	TRANSLOCATION OPTIONS	2	100	CALMSC/ Lancelin	A		1000				1000
ANNUAL COST OF LANCELIN ISLAND SKINK RECOVERY PLAN											
				CALM		9000	13000	12000	7000	7000	48 000
				Perth Zoo		3000	3000	3000	3000	3000	15000
				Other Funds		3500	6000	1000			10500
				Total Cost $		15500	22000	16000	10000	10000	73500

Notes: A = CALM; CALMSC = CALMScience; P = Perth Zoo; F = other funds required

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REFERENCES

Browne-Cooper, R, and Maryan, B. (1992). Notes on the status of the skink lizard, *Ctenotus lancelini*, on Lancelin Island. *W.A. Naturalist* **19**: 63-65.

Burbidge, A..A. (1993) Interim Wildlife Management Guidelines for the Lancelin Island Skink (*Ctenotus lancelini*). Unpublished report, Department of Conservation and Land Management, Perth.

Cogger, H.G., Cameron, E.E., Sadlier, R.A. and Eggler, P. (1993). The Action Plan for Australian Reptiles. Australian Nature Conservation Agency, Canberra.

Commonwealth of Australia (1992). Endangered Species Protection Act 1992; Schedule 1.

Ehmann, H. (1992). Encyclopedia of Australian Animals: Reptiles. Angus and Robertson, Pymble, NSW.

Ford, J. (1963). The reptilian fauna of the islands between Dongara and Lancelin, Western Australia. *W.A. Naturalist* **8**: 135-142.

Ford, J. (1969). Distribution and variation of the skink *Ctenotus labillardieri* (Gray) of south-western Australia. *J. Roy. Soc. W.A.* **51**: 68-75.

Gilham, M.E. (1960). Destruction of indigenous heath vegetation in Victorian sea-bird colonies. *Aust. J. Bot.* **8**: 277-317.

Gilham, M.E. (1961). Alteration of the breeding habitat by sea-birds and seals in Western Australia. *J. Ecol*. **49**: 289-300.

IUCN (1996). "1996 IUCN Red List of Threatened Animals." Compiled and edited by J. Baillie and B. Groombridge. IUCN, Gland, Switzerland.

Jones, B. (1996, unpub.) A field study of the Lancelin Island Skink *Ctenotus lancelini.* Report for the Department of Conservation and Land Management, Perth, WA.

Keighery, G.J. and Alford, J.J. (in prep.) Vegetation and flora of the Lancelin to Dongara Islands.

Maryan, B. and Browne-Cooper, R. (1994).Discovery of the Lancelin Island Skink (*Ctenotus lancelini*) on the mainland. *Western Australian Naturalist* **20**: 13-14.

Pearson, D.J. (1994, unpub.). Revised Interim Wildlife Management Guidelines for the Lancelin Island Skink (*Ctenotus lancelini*). Unpublished report, Department of Conservation and Land Management, Perth.

Rolfe, J.K. (1993, unpub.). Report to the Western Australian Threatened Species and Communities Unit on a survey to determine the status of the Lancelin Island Skink *Ctenotus lancelini* (Ford, 1969). Unpublished report, Department of Conservation and Land Management, Perth.

Storr, G.M. (1972). The genus *Ctenotus* (Lacertilia, Scincidae) in the Eastern Division of Western Australia. *Journal of the Royal Society of Western Australia* **51**: 97-109.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1981). *Lizards of Western Australia. I. Skinks*. University of WA Press/WA Museum, Perth.