LANCELIN ISLAND SKINK

RECOVERY TEAM

ANNUAL REPORT

1994

by

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for

The Lancelin Island Skink Recovery Team

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SUMMARY

This report summarises work carried out during 1994 for the conservation of the Lancelin Island Skink, *Ctenotus lancelini*. The Lancelin Island Skink Recovery Team met for the first time in December 1993. A further two meetings were held during 1994. The Recovery Team, consisting of representatives from CALM, ANCA, WA Museum, Perth Zoo, Shire of Gingin, WA Society of Amateur Herpetologists and a consultant researcher, co-ordinated the implementation of Interim Wildlife Management Guidelines for the species. ANCA provided the majority of funds to carry out the required actions.

A field ecological study of *C. lancelini* by Barbara Jones commenced in November 1993 and continued throughout 1994. She found that *C. lancelini* was abundant on Lancelin Island and distributed across all major habitats, in contrast to recent survey findings. The difference in results reflects the emphasis on rock-turning by earlier workers, restricted activity periods of the skink, its cryptic habits, and the use of more appropriate trapping techniques. The skinks were found to be breeding on the Island despite dry conditions during 1993-4. Considerable data on the basic ecology of the species have now been obtained.

Preliminary results of the ecological study suggest that factors thought to have caused the apparent decline in *C. lancelini*, namely Silver Gulls and weed invasion, were not as important as previously believed. Silver Gulls were most abundant on the Island when the skinks were inactive and the skink's cryptic behaviour suggests predation by gulls would not occur, or be very rare. Habitat modification by nesting gulls does not appear to be a major disturbance on the Island at this time. The nesting activities of other seabirds are probably having a greater impact on vegetation composition and structure.

A survey of presumed suitable habitat on the mainland by CALM and the WA Society of Amateur Herpetologists, was successful in locating *C. lancelini* in a foreshore reserve at Lancelin, the first record of the taxon on the mainland. Ongoing survey along the stretch of coast from Lancelin to Ledge Point has failed to locate any further populations.

The captive breeding program has developed suitable techniques for the captive maintenance of *Ctenotus* skinks. Two eggs were produced during in December 1994 from the analogue species, *Ctenotus labillardieri*, used for the initial trials of this program. One was desiccated when found, but the other has been successfully incubated and hatched 35 days after laying.

Information on the Lancelin Island Skink and the actions being taken to improve its conservation status have been disseminated in the local printed press, popular magazines, in radio interviews and through talks to school groups in Lancelin.

1. INTRODUCTION

The Lancelin Island Skink, *Ctenotus lancelini*, has one of the most restricted known distributions of any reptile, and until recently, had only been recorded on Lancelin Island, an area of just 7.6 hectares. It is declared threatened fauna under Section 14 (2)(ba) of the WA Wildlife Conservation Act. On the ANZECC list of Australian Endangered Vertebrates it is listed as 'Vulnerable', but the Department of Conservation and Land Management (WA) has recommended that its status be altered to 'Endangered' (Burbidge 1993, unpub.).

The first specimens of the Lancelin Island Skink, *Ctenotus lancelini*, were collected by Julian Ford in October 1961 during biogeographic research on the fauna of islands from Dongara south to Lancelin, Western Australia. He referred to them as *Ctenotus labillardieri* (the Red-legged Skink), but noted that they were readily distinguishable from mainland animals (Ford 1963).

Later, Ford (1969) described the Lancelin Island specimens of *C. labillardieri* as a distinct subspecies on the basis of differences in body dimensions and colouration. Storr *et al.* (1981) elevated the taxon to full species status. Early searches for *C. lancelini* suggested it was confined to small areas of outcropping and loose limestone boulders on the Island (see Rolfe 1993; unpub. for a summary of previous surveys).

Most searches for *C. lancelini* on Lancelin Island have relied on hand collection. The observations of Ford and other people who visited the Island to study its reptile assemblage indicated that the species was relatively common and could be obtained rock-turning (Rolfe 1993; unpub.).

However, in 1991 Perth herpetologists Brad Maryan and Robert Browne-Cooper visited the Island, and despite many hours of searching were unable to locate any *C. lancelini*. This result was in stark contrast to their previous visits in 1981 and 1983 when in excess of 10 individuals were captured on each occasion. They drew attention to the apparent plight of the species (Browne-Cooper and Maryan 1992). This prompted the WA Department of Conservation and Land Management (CALM) to search and trap on the island in January 1992. Only a single individual was captured.

Further trapping was conducted in November 1992 and March 1993 resulting in the capture of another individual. This appeared to confirm that the abundance of *C. lancelini* had declined dramatically. More survey work was recommended to locate and monitor the population, and the control of weeds was suggested (Rolfe 1993, unpub.).

Burbidge (1993, unpub.) prepared Interim Wildlife Management Guidelines (hereafter referred to as IWMGs) for the Lancelin Island Skink to initiate immediate actions on the Island to avert the threat of its extinction (Appendix 1). He identified two factors which were possible causes for the apparent decline of the *C. lancelini* population. Firstly, invasion of open areas on the Island by the introduced grasses, Rye Grass (*Lolium rigidum*) and Wild Oats (*Avena barbata*) may have affected foraging behaviour, reduced available basking sites, and limited reproduction or recruitment. Secondly, an apparent increase in Silver Gull (*Larus novaehollandiae*) numbers may have caused degradation of its habitat or led to the loss of skinks by direct predation (Burbidge 1993, unpub.).

In the IWMGs, Burbidge (1993, unpub.) proposed immediate spraying of exotic grasses with "Fusilade" (distributed by ICI Australia) and the reduction of gull numbers by baiting with alpha-chloralose or shooting. The formation of a Recovery Team, an ecological study of the

skink, captive breeding and translocation of *C. lancelini* to other islands were other proposed actions. An application was forwarded to the Australian Nature Conservation Agency (ANCA) to support this project and funds became available in November 1993 to commence work.

2. RECOVERY TEAM

2.1 Formation and composition of the Recovery Team

The establishment of a Lancelin Island Skink Recovery Team (hereafter referred to as the Recovery Team) was proposed by Burbidge (1993, unpub.) to further develop and implement the IWMGs. Membership of the Recovery Team was to consist initially of:

- Andrew Burbidge - WA Threatened Species and Communities Unit, CALM
- David Rose - CALM Moora District
- Jim Rolfe - CALM Science and Information Division
- a representative from the Perth Zoological Gardens
- a representative from the Shire of Gingin

Additional members could be added as deemed appropriate by the Recovery Team.

The Recovery Team expanded over the several months between its proposal and the first meeting held on December 13 1993. During 1994, there were some changes to the membership of the Recovery Team. Robert Browne-Cooper of the WA Amateur Herpetological Society joined the Recovery Team, and John Arlidge replaced Darryl Miller as the Perth Zoological Gardens representative. The composition of the Recovery Team on December 31 1994 was :

- Andrew Burbidge - WA Threatened Species and Communities Unit, CALM
- David Rose - CALM Moora District
- Russell Bone - CALM Moora District
- Jim Rolfe - CALM Science and Information Division
- David Pearson - CALM Science and Information Division
- Barbara Jones - private wildlife consultant
- John Arlidge - Perth Zoological Gardens
- Anita Jarvis - Shire of Gingin
- Ken Aplin - Western Australian Museum
- Sally Stephens - Australian Nature Conservation Agency
- Brad Maryan - Western Australian Amateur Herpetological Society
- Robert Browne-Cooper - Western Australian Amateur Herpetological Society

2.2 Recovery Team meetings

Three Recovery Team meetings have been held to date.

- December 13 1993 - WA Wildlife Research Centre, Woodvale
- April 11 1994 - Lancelin Island and St John Ambulance Hall, Lancelin
- September 26 1994 - WA Wildlife Research Centre, Woodvale

There were comprehensive summary records taken during each meeting and these may be obtained from CALM on request.

3. REVISION OF INTERIM WILDLIFE MANAGEMENT GUIDELINES

Preliminary results from research work on the Island (see section 4) increased the Recovery Team's understanding of the threats to *C. lancelini*, and the management of its habitat on Lancelin Island. As a consequence, the IWMGs drafted by Andrew Burbidge in June 1993 were revised by David Pearson in April 1994 (Appendix 2).

Several changes in emphasis were required. Concerns about the likely impact of herbicide spraying on *C. lancelini* and its apparent ineffectiveness to control exotic grasses at the time of year when applied (Rolfe 1993; unpub), resulted in the deferment of proposed spraying operations until impacts could be researched.

The numbers of Silver Gulls on Lancelin Island appeared comparatively low during the early months of research on the skink, and the distribution of *C. lancelini* across all the Island's major habitats suggested gulls were not a significant threat at that time. Control of gulls was thus deferred until there was evidence available on their possible impacts on *C. lancelini*.

Since *C. lancelini* had been found by Barb Jones to occupy a range of habitats other than areas of outcropping limestone, consideration of more potential islands for translocations was noted. However, any translocations were deferred pending the results of the ecological study on Lancelin Island, since this would help identify habitat preferences.

A proposed study of the genetic relationships of *C. lancelini* to sibling species was outlined. This was needed to determine the distinctiveness of the taxon relative to *C. labillardieri*.

Earlier surveys for the presence of *C. lancelini* on the mainland had assumed that their preferred shelter was limestone slabs. However, following Barb Jones' initial trapping results and observations, it was apparent that seemingly suitable habitat occurred along much of the coast near Lancelin. Some searches on the mainland in such areas were proposed for 1994.

4. FIELD STUDY OF *C. LANCELINI* ON LANCELIN ISLAND

In accordance with the IWMGs, a wildlife consultant (Barbara Jones) was contracted to conduct field studies of *C. lancelini* population parameters, and to investigate habitat factors considered to have the potential to limit abundance (including weed invasion and Silver Gull activity).

The first 12 months of trapping resulted in 242 *C. lancelini* captures (233 captures of 210 adults and 19 captures of young). Results showed that *C. lancelini* occurred in each of the three main habitat types, and that abundance varied within habitat types. An estimate of *C. lancelini* population density of 250-500 per hectare was derived using November 1994 recapture rates, giving an estimated population on Lancelin Island of 1750 to 3500.

Anecdotal evidence (old photographs and interviews with earlier workers) showed that areas of vegetation had changed substantially during the last 20 years , and indicated a general trend of exotic grass expansion (principally Rye Grass) and a decline in the abundance of woody perennials. This process of change was most extensive on shallow soil over limestone. Comparison of recent observations of the abundance of Silver Gulls and several other seabirds common on the Island, with those of other workers suggested that there has been an increase in the overall usage of the Island's habitats by breeding seabirds. Work by Gilham (1961) concluded that the pattern of guano accumulation and release into the soil was a major factor affecting the vegetation of south-west islands. Hence, changes to the Island's vegetation appear to be a response to a general increase in nesting seabird activity. Gilham's (1961) model for the process of change to vegetation has important implications for management planning aimed at eradicating weeds or re-establishing "original" vegetation.

5. SILVER GULL CONTROL

The impact of Silver Gulls on *C. lancelini* is unknown, but research results so far (Appendix 3) strongly suggest that gull nests are not in sufficient numbers or density to cause major habitat changes. The greatest numbers of gulls were recorded on the Island in winter when *C. lancelini* was inactive, so direct predation is unlikely at this time.

During the warmer months, predation is possible but given the cryptic nature of *C. lancelini*, its close association with cover and the presence of more abundant lizards, it appears unlikely that it would restrict the abundance of *C. lancelini*. Silver Gulls are not known to be predators of lizards.

The uncertainty of the impact of gulls on the skinks led to the deferment of control operations unless a deleterious impact can be demonstrated in the future.

6. WEED CONTROL AND THE IMPACT OF FUSILADE ON LIZARDS

Reports of Gould's Sand Goannas (*Varanus gouldii*) dying following weed-spraying in Karrakatta Cemetery, Perth (G. Thompson, pers. comm.), prompted concern about the possible impact on *C. lancelini* of spraying exotic grasses on Lancelin Island. The herbicide recommended by the Kings Park Board for controlling rye grasses was "Fusilade" (ICI Australia) and this had been used in early trials on Lancelin Island (Rolfe 1993, unpub.).

Information on the toxicity of Fusilade to reptiles was requested from ICI. They provided a sheet summarising the properties and toxicology of fluazifop, the active ingredient in Fusilade. It had not been tested on Australian fauna, nor any reptiles. Oral LD_{50} tests had 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 is 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 are planned for early 1995 to be carried out by Dr. Dennis King of the Agricultural Protection Board. *Ctenotus labillardieri* would be used as an analogue for *C. lancelini* in these trials.

Until the results of this study are known, no further weed spraying on Lancelin Island will be undertaken.

7. TRANSLOCATION TO OTHER ISLANDS

Translocation of *C. lancelini* to other islands was suggested as an important management option to reduce the risks associated with the entire population being located on one island. However, the recent discovery of *C. lancelini* on the mainland, may mean that translocation is no longer required. Until the size and distribution of the mainland population or populations is known, translocation should be deferred, although possible islands for this purpose could still be investigated if there was a suitable opportunity.

8. CAPTIVE BREEDING PROGRAM

8.1 Background

When it appeared that the population of *C. lancelini* had been declining for some time, captive breeding was seen as an important mechanism to conserve genetic diversity and provide stock for translocation operations. There are no published papers on the captive care and breeding of *Ctenotus* skinks, despite their abundance and numerically dominant position in the Australian lizard fauna (80+ species). Several zoos and private herpetologists were contacted to find anyone who had bred *Ctenotus* in captivity. Several people had found gravid individuals in the field and kept them until they laid eggs, but no-one had routinely kept large numbers, observed mating and successfully reared young in captivity.

Therefore, the captive breeding program was designed to gather as much data as possible on the care and maintenance of *Ctenotus* in captivity, particularly functional housing, suitable sex and number ratios in cages, dietary preferences and behaviour. In addition, the observation of mating, the testing of suitable egg-laying medium, egg incubation and the care of juveniles were all techniques and skills which needed to be developed.

The program is being run jointly by the Perth Zoological Gardens and CALM staff at Woodvale.

8.2 Selection of an analogue species

When the Lancelin Island Skink project commenced, it was thought that there were probably very few *C. lancelini* remaining on Lancelin Island, so the removal of a large number for a captive breeding program was neither possible, nor indeed, desirable. A suitable analogue species was required to trial different maintenance techniques and to develop expertise in breeding and incubating eggs. The Red-legged Skink, *Ctenotus labillardieri*, was selected because it is thought to be the closest sibling species to *C. lancelini*, occurs in a similar climatic zone, is a similar size and could be readily captured close to Perth.

Skinks were obtained for the captive breeding program from State Forest sites near Waroona and at Mt. Cooke, south of Perth. They were captured by CALM, members of the WA Amateur Herpetological society, Perth Zoo staff and volunteers by rock-turning on cool mornings around the base and sides of granite outcrops.

8.3 Captive maintenance

Skinks were housed indoors in glass aquaria at the Perth Zoo and at the CALM office at Woodvale. Two locations were used so that the skills and expertise gained from the program would be shared between both institutions, and to prevent the loss of all skinks if there was an outbreak of disease or equipment malfunction. In addition, the involvement of numerous people increased the chances that important behaviour would be observed. A roster of volunteers to observe and record skink behaviour at the Perth Zoo was established and co-ordinated by Perth Zoo docent, Lesley Cobb.

Skinks were housed in a number of different combinations to determine suitable housing arrangements. These were:
- single pair
- two pairs
- three pairs
- two males
- two females

The latter two groupings were to keep males and females separate most of the time, with occasional pairings of a male and female. This has been found to increase reproductive success in some reptiles (Weigel 1988). Each combination was trialed at the Zoo and at Woodvale, providing some duplication for comparison. However, the lack of mature females caught, meant that it was not possible to have a three pair grouping at both locations.

Different foods were trialed, but the only food items which could be supplied in sufficient quantities were mealworms and termites. Mealworms are known to be high in fat and lack various nutrients, so are not suitable as the sole food for lizards. Two vitamin supplements, "Rep-Cal Herptivite" and "Rep-Cal Calcium with Vitamin D_3, were dusted over mealworms fed to Woodvale skinks to overcome this vitamin deficiency. Wherever possible, meals of mealworms were alternated with termite meals.

No problems were encountered with the housing arrangements, and although fighting amongst males was observed frequently, no serious injuries were recorded. Two of the program's 42

captive skinks died during the year; one developed a necrotic wound on the leg and was found dead a short time later, and another was accidentally crushed during routine cleaning of its aquarium.

An outdoor enclosure has been constructed at the Perth Zoo to test whether captive maintenance and breeding is more successful than in indoor situations. It was completed after the main breeding period and when the skinks were difficult to capture, so it has not yet been used. It will be stocked with skinks over the next year.

8.4 *Ctenotus* behavioural study

Rostered volunteers have made extensive behavioural observations on skinks housed at Perth Zoo. Data they collected will be analysed thoroughly at the completion of this breeding season. Mating was observed on several occasions, and aggressive and courtship behaviour not previously reported for *Ctenotus* has been documented.

8.5 Breeding results

Only two eggs from a single female (housed in a 3 pair arrangement) have been produced to date. One was found during cage cleaning and immediately put onto moist vermiculite. The second was found some time after its deposition. It had dehydrated and the embryo was dead.

The viable egg was successfully incubated in a sealed container of moist vermiculite (1:1 ratio with water) in a temperature-controlled room at the Zoo. The egg weighed 0.73 g when initially found on December 9. Its size increased substantially during development. Hatching occurred on January 13; 35 days since laying. The neonate weighed 0.64 g, with a snout-vent length of 27 mm, about half adult length.

In a field study of *Ctenotus* in central Australia, James (1991) found that reproductive output varied greatly depending on rainfall. In dry to average years, reproductive success was very low. This may, in part, explain the poor breeding success so far. South-western WA had dry conditions over many months prior to the capture of the founder stock. As a consequence, their overall body condition is likely to be poor and reproductive output restricted. James (1991) noted that oviposition of *Ctenotus* occurred during two months in spring and two in summer so that at any particular time, the proportion of reproductive females was low. Thus, it is possible that further eggs may be produced during the coming months.

9. SURVEY FOR *C. LANCELINI* ON THE MAINLAND

Once the approximate habitat requirements of *C. lancelini* had been established from preliminary research carried out by Barb Jones, a survey of potential sites on the mainland was organised. Funding was provided from proceeds of the "Bankwest Landscope Conservation Visa Card". A small proportion of each purchase made with these cards goes to conservation, and $ 1 500 was earmarked during 1994 for a mainland survey for *C. lancelini*.

Seemingly suitable habitat along the coastal fringe from Lancelin to nearby Ledge Point were surveyed by hand-searching, raking leaf litter and pitfall-trapping. Three sampling trips of 2-4 days duration have now been carried out. Five sites were sampled with pitfall traps and many others were searched by hand or by raking leaf litter. A diverse range of reptiles have been captured and voucher specimens lodged with the Western Australian Museum.

The most significant result of this survey was the capture of a *C. lancelini* on the mainland, the first record of its occurrence off Lancelin Island. A single animal was collected by hand on October 3 1993 from under a clump of *Spinifex* in a foreshore reserve at Lancelin, directly opposite Lancelin Island. A grid arrangement of 40 pitfall traps has been established in this area, but no further individuals have been captured despite considerable effort. The specimen has been lodged with the WA Museum and tissue samples taken for genetic analysis.

10. GENETIC RELATIONSHIPS OF *C. LANCELINI*

The relationship of *C. lancelini* to its sibling species *C. labillardieri* is unclear, and is reflected in the changes to its taxonomic position over the twenty years since its original description. Comparison of genetic material from *C. labillardieri* from several south-west populations with material from *C. lancelini* from Lancelin Island and the mainland should resolve any uncertainty. Samples from the mainland specimen of *C. lancelini* have been collected, samples from Island animals will be collected in the coming year and testing will be conducted by the WA Museum (Ken Aplin), in conjunction with the South Australian Museum (Steve Donnellan).

11. MEDIA REPORTS

Articles on *C. lancelini* and the importance of Lancelin Island for conservation have been published in local newspapers (Gingin Times, Coastal Courier) and in the CALM magazine "Landscope". Examples of these are attached in Appendix 4. David Rose (CALM, Moora) was also interviewed on regional ABC radio.

Herpetologist Brian Bush visited the Lancelin Island Primary School and spoke to the students about *C. lancelini* and other reptiles in the area.

12. CONCLUSIONS

This report summarises the results of the first year of funding of the Lancelin Island Skink project. The results-to-date have been extremely encouraging and have expanded our understanding of its conservation status, habitat preferences, population size and the likely impact of various agents of disturbance on the Island.

The captive breeding program has developed the skills necessary to maintain *Ctenotus* skinks in captivity and breed them, although improved breeding rates would be required if restocking or translocation were to be attempted.

The discovery of *C. lancelini* on the mainland directly adjacent to Lancelin Island was an exciting development during the year. However, *C. lancelini* still has a very restricted known distribution and an expansion of the mainland survey during 1995 is required to clarify its distribution and conservation status.

13. ACKNOWLEDGMENTS

The members of the Lancelin Island Skink Recovery Team have been extremely supportive throughout the study, and their input into all aspects of this work have been most beneficial. For assistance and advice on visits to Lancelin Island, we thank Jim Rolfe, Russell Bone, Greg Keighery and Nick Dunlop.

Members of the WA Amateur Herpetologist Society (Brian Bush and Robert Browne-Cooper), Perth Zoo staff (Brad Maryan) and volunteers (Jacquie Richards, Louise Kuchel) assisted with the capture of lizards for the captive breeding program.

At Perth Zoo, Graham Hall has been very supportive of the project. John Arlidge, Greg Burford and Kellee Dearn have done a great job tending to the needs of the skinks. Volunteers Don Day, Linda Hooser, Melanie Kilpatrick, Michelle McGovern, Pat Mock, Alison Oddy, Arthur Sandford and Kelly Waters have kindly provided their time and patience to undertake behavioural studies of *Ctenotus* at Perth Zoo. Lesley Cobb has done a magnificent job rostering "the watchers".

During the mainland survey, Brian Cooper of Lancelin generously checked pitfall traps and removed animals, sometimes for many days by himself, so that the trapping could span a variety of weather conditions. Thanks also to members of the WA Society of Amateur Herpetologists; Robert Browne-Cooper, Brian Bush, Bruce George and Brad Maryan, who contributed their time, expertise and enthusiasm to undertake the mainland survey.

ANCA have provided funds for the ecological study on Lancelin Island and the captive breeding program. Bankwest through the Landscope Conservation Visa card provided funds for the mainland survey for *C. lancelini*.

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APPENDIX 1: INTERIM WILDLIFE MANAGEMENT GUIDELINES PREPARED BY BURBIDGE (1993, unpub.)

INTERIM WILDLIFE MANAGEMENT GUIDELINES FOR THE LANCELIN ISLAND SKINK (*CTENOTUS LANCELINI*)

Prepared by Andrew Burbidge
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June 1993

1. INTRODUCTION

1.1 Taxonomy and relationships

The Lancelin Island Skink, *Ctenotus lancelini*, known only from the 7.6 ha Lancelin Island, was described by Ford (1969), as a subspecies of the more widespread *C. labillardieri*. Storr (1973) raised it to a full species. As its original taxonomic designation suggests, it is closely related to *C. labillardieri*, which occurs from near Perth southwards and eastwards to near Esperance and has a total geographic range in the millions of hectares.

1.2 Discovery and status

The Lancelin Island Skink was first collected by Julian Ford between 1959 and 1961, during biogeographic research on islands between Lancelin and Dongara (Ford 1963). There has been no systematic research to establish its abundance; however, Rolfe (1993) has tabulated available information on attempts to observe and/or capture it since its discovery (Table 1).

Table 1. Capture rates of *Ctenotus lancelini* (from Rolfe 1993)

Year	No. observed	Person-hours
1963	`not uncommon'	unknown
1981	10+	unknown
1983	10+	unknown
1987	3-4	1.5
1991	0	10
1992	1	8

For five days during each of November 1992 and March 1993, Rolfe and colleagues attempted to capture Lancelin Island Skinks with pitfall and Elliott traps and, during the November trip, by lifting limestone rocks. Only one skink was captured, in a pitfall trap, during the November visit.

These data suggest that the Lancelin Island Skink has declined in abundance and may be extremely rare and critically threatened.

The Lancelin Island Skink is declared "threatened" under Section 14(2)(ba) of the Wildlife Conservation Act. It is listed as 'Vulnerable' in the ANZECC list of Australian Endangered Vertebrates. Current data suggest that it should be listed by ANZECC as 'Endangered" and that it meets draft IUCN criteria for the new category of 'Critical' (Mace and Lande 1991, Mace *et al.* 1992). CALM has requested the ANZECC Threatened Fauna Network to recommend this change to ANZECC.

1.3 Habitat and ecological relationships

Up until 1992, all skinks captured were located under limestone slabs. There are three small areas of limestone on the island, in all totalling about 20% of the island, ie, about 1.5 ha. These areas are vegetated with a herbfield with low emergent shrubs (Keighery and Alford, in prep.), while most of the remainder of the island is covered with an open heath (*Nitraria billardieri, Scaevola crassifolia, Acacia cyclops, Helichrysum cordatum* and *Atriplex isatidea*). The 1992 specimen was captured in a pitfall trap located in the ecotone between the northern limestone area and the adjacent heath.

Nothing is known about the ecology of the Lancelin Island Skink. It is a member of the *Ctenotus labillardieri* group and is closely related to *C. labillardieri*. This species occurs in heathlands and forests of the south-west and is particularly common around granite rock outcrops. It excavates shallow burrows beneath slabs of rock and logs. In its feeding behaviour it ventures into the open more than most other *Ctenotus* spp. and is often relatively easy to approach (Wilson and Knowles 1988).

Five other lizard species occur on Lancelin Island: *Ctenotus fallens, Cyclodomorphus branchialis, Egernia bos, Morethia obscura* and *Diplodactylus spinigerus* (and possibly *Morethia lineoocellata*). There is no evidence to suggest that any of these have become rarer over the past few decades, but there are no quantitative abundance data on any species.

Limiting factors and causes of threatened status

Because of the lack of information it is only possible to speculate about limiting factors and the reasons for the species current status. Possible reasons for its decline are:

1. **Weed invasion.** Almost all open areas of the island are now covered by dense stands of an exotic grass (mainly Rye Grass *Lolium rigidum* and Wild Oats *Avena barbata*). As *C. lancelini* probably feeds by darting out from cover into open areas, the reduction in such areas may have affected its ability to feed and hence to reproduce and recruit. Thermoregulation may also be affected by a reduction in basking sites.

2. **Increase in numbers of Silver Gulls.** In common with many gull colonies near human habitation, Silver Gull numbers on Lancelin Island appear to be increasing. The gulls breed almost entirely on the more open limestone areas of the island, the areas from which all records of *C. lancelini* have come. Gulls

may be degrading the habitat, reducing the abundance of food or directly predating the skinks. Direct predation seems likely.

2. MANAGEMENT GUIDELINES

2.1 Aim

The aim of these Interim Guidelines is to immediately introduce weed and gull control and to carry out preliminary research into the ecology of the Lancelin Island Skink. Captive breeding will be implemented if deemed necessary and if sufficient skinks can be captured. Translocation will also be investigated and implemented if sufficient skinks are available, either from the wild or from captive breeding.

2.2 Options

Options for management include:

2.2.1 Weed control

Reduction in cover by grass could be achieved by spraying with "fusilade" (active ingredient 212 g/L fluazifop-p, manufactured by ICI), a selective grass-controlling herbicide. Research in Kings Park has shown that this herbicide is effective in controlling veldt grass (*Ehrharta calycina*) at rates of 2 to 4 litres per hectare in 300 to 400 litres of water plus wetting agent, eg, Agral 60 @ 1:1 000, and that it causes no apparent damage to native plants except native grasses. Spraying will carried out while the weed is actively growing, during winter 1993 and 1994, and will be the responsibility of CALM's Moora District staff, in consultation with relevant Science and Information staff and Safety Branch.

2.2.2 Control of gulls

Research into Silver Gull control in New South Wales (Smith and Carlile 1993) has shown that the most effective method of immediate reduction of gull numbers at breeding colonies was to cull breeding adults. Pricking or removing eggs had little effect. Habitat modification, eg mowing, can reduce breeding, but is not a consideration in this case.

To reduce gull numbers and reduce possible gull predation, all Silver Gull nests, eggs and non-flying young found on Lancelin Island will be destroyed. Limited data available suggests that, on Lancelin Island, gulls mainly breed in spring and early summer, although autumn breeding may occur. This will necessitate visits to the island weekly during the peak of breeding and every two weeks either side of this period. Culling can be achieved by baiting. The method used in NSW was to mix 10 g of alpha-chloralose in 60 g of margarine and spread the mixture on six slices of bread. Two slices were placed on each nest, to give about 100 mg per bait or 200 mg per nest. Baiting in the NSW tests was not entirely effective, so shooting adult birds with a low-powered shotgun, eg, a .410, should also be considered. Dead gulls are to be removed from the island and buried.

The Silver Gull Action Plan for the Perth Metropolitan Area (CALM, 1993) proposed control of gull numbers by landfill site management, minimising the food supply in public open space and commercial areas and an education program. It does not envisage killing gulls or destroying nests and eggs. The gull control proposed in this IWMG must be preceded by permission from the Executive Director of CALM and the Minister for the Environment, and after a public education program. Liaison with the Shire of Gingin to ensure that the gull food supply in and near Lancelin is minimised will also take place.

2.2.3 Captive breeding

As far as is known, Lancelin Island Skinks have not been kept in captivity, let alone bred in captivity. Nevertheless, because of the urgency of conservation action, captive breeding should be considered. Perth Zoo advice is that captive breeding should be relatively simple, using aquaria, heat lamps and small insect food such as meal worms. It is desirable that an analogue, non-threatened species, be tested under these conditions first - the sibling species *Ctenotus labillardieri* would be ideal.

2.2.4 Translocation

Translocation should be considered, either direct from the existing single wild population, or using animals bred in captivity.

Four islands could be considered.

1. Wedge Island.

Wedge Island is about 20 km north of Lancelin Island. The southern end of the island consists of a herbfield dominated by the introduced *Mesembryanthemum crystallinum*. As the soils deepen towards the north, an open heath of *Olearia axillaris*, *Scaevola crassifolia* and *Spyridium globulosum* develops, with creepers of *Zygophyllum billardieri* (Keighery and Alford, unpublished). A search for Lancelin Island Skinks on Wedge Island in March 1993 was not successful.

Wedge Island does not appear to contain much suitable habitat for Lancelin Island Slinks at present. It has areas of limestone, but there are few limestone slabs and habitat modification would probably have to take place to make it suitable for the skinks. Reptiles known from Wedge Island are *Ctenotus fallens* and *Phyllodactylus marmoratus* (Williams 1986).There are no Silver Gull colonies.

In the recent past, Wedge Island has been joined to the mainland by a tombolo; during the past 25 years this has led to the local extinction of a colony of Wedge-tailed Shearwaters, apparently due to predation by foxes. In early summer 1992, Wedge Island was separated from the mainland by about 500 m of often rough ocean, but by June 1993 the tombolo had re-emerged. This makes Wedge Island unsuitable for translocation, because fox and cat predation would occur and there would be a significant degree of human interference.

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Green Islets are island nature reserves located about 40 km north of Lancelin Island. They comprise two separate small islands.

South Green Islet of 3.4 ha has a plateau of limestone with low dense heath with *Scaevola crassifolia, Atriplex cinerea, Rhagodia baccata, Frankenia pauciflora* and *Olearia axillaris.*

North Green Islet of 1.6 ha has two beaches and a central plateau of limestone, covered by sand to variable depth. It is vegetated with a mixed closed heath dominated by combinations of *Nitraria billardieri, Atriplex cinerea, Frankenia pauciflora, Scaevola crassifolia* and the creeper *Zygophyllum billardieri* (Keighery and Alford, unpublished).

3. Edward Island

Edward Island of 0.16 ha is situated close to the town of Lancelin. It is small and has little vegetation and seems unsuitable as a translocation site.

4. North Cervantes Island.

The 3.2 ha North Cervantes Island, also a nature reserve, is located about 55 km north of Lancelin Island. The island has an extensive beach on the eastern side and a limestone plateau, which is covered by an open heath of variable composition depending on soil depth. Major species are *Rhagodia baccata, Olearia axillaris* and *Frankenia pauciflora*. There are bare rock outcrops scattered through the plateau (Keighery and Alford, unpublished).

2.2.5 Research

Research into the biology and ecology of the Lancelin Island Skink is urgent (see below).

2.3 Strategies

Options 2.2.1, 2.2.2, 2.2.3 and 2.2.5 will be pursued as soon as funds become available. Option 2.2.4 will be investigated further during research into the species.

3. RESEARCH REQUIREMENTS

Research will be carried out into aspects of the biology and ecology of the Lancelin Island Skink, concentrating on its conservation biology. This will require the employment of a scientist for at least two years, plus support for vehicle running, travelling allowances, etc. Detailed, intensive research is necessary to establish the status of the skink before animals can be taken from the wild for captive breeding

or translocation, and to ensure that weed and gull control are benefiting the species.

The contract research scientist or postgraduate student should be appointed by October 1993. Technical support and assistance will be provided by CALM's Science and Information Division.

4. ESTABLISHMENT OF A RECOVERY TEAM

A Recovery Team to further develop and implement these Interim Guidelines will be appointed with membership as follows:

- CALM WATSCU: Andrew Burbidge
- CALM Moora District: David Rose
- CALM Science & Information Division: Jim Rolfe
- Perth Zoo
- Shire of Gingin
- ANCA

The Recovery Team may co-opt additional members as appropriate.

5. BUDGET FOR 1993/94

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Application (vehicle running, TA)	1 000
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Boat use	200
Travelling allowance	600
Ammunition	500
Action 2.2.3 Captive breeding (initial trials with *Ctenotus labillardieri*), aquaria, heat lamps, food	5 000
Zoo staff costs (travelling to Lancelin I)	500
Action 2.2.5, Research	
Contract scientist, 6 months	15 000
administration costs	1 000
equipment	1 000
vehicle running, boat use	2 000
travelling allowances	2 900
overtime (CALM staff)	800
supervision	10 000
TOTAL BUDGET 1993/94	**44 000**

Budgets for future years will be worked out during the first half of 1994.

ACKNOWLEDGMENTS

I thank Darryl Miller, Jim Rolfe and David Rose for help in compiling these Interim Guidelines.

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APPENDIX 2: INTERIM WILDLIFE MANAGEMENT GUIDELINES REVISED BY PEARSON (1994, unpub.)

INTERIM WILDLIFE MANAGEMENT GUIDELINES FOR THE LANCELIN ISLAND SKINK (*CTENOTUS LANCELINI*)

Prepared by Andrew Burbidge
Western Australian Threatened Species and Communities Unit
Department of Conservation and Land Management
June 1993

Revised by David Pearson
Science and Information Division
Department of Conservation and Land Management
April 1994

1. INTRODUCTION

1.1 Taxonomy and relationships

The Lancelin Island Skink, *Ctenotus lancelini*, known only from the 7.6 ha Lancelin Island, was described by Ford (1969), as a subspecies of the more widespread *C. labillardieri*. Storr (1973) raised it to a full species. As its original taxonomic designation suggests, it is closely related to *C. labillardieri*, which occurs from near Perth southwards and eastwards to near Esperance and has a total geographic range in the millions of hectares.

1.2 Discovery and status

The Lancelin Island Skink was first collected by Julian Ford between 1959 and 1961, during biogeographic research on islands between Lancelin and Dongara (Ford 1963). Until recent work by consultant Barbara Jones, there had been no systematic research to establish its abundance. Rolfe (1993) tabulated available information on previous attempts to observe and/or capture it since its discovery (Table 1).

Table 1. Capture rates of *Ctenotus lancelini* (from Rolfe 1993)

Year	No. observed	Person-hours
1963	`not uncommon'	unknown
1981	10+	unknown
1983	10+	unknown
1987	3-4	1.5
1991	0	10
1992	1	8

For five days during each of November 1992 and March 1993, Rolfe and colleagues attempted to capture Lancelin Island Skinks with pitfall and Elliott traps and, during the November trip, by lifting limestone rocks. Only one skink was captured, in a pitfall trap, during the November visit.

These data suggested that the Lancelin Island Skink had declined in abundance and might be extremely rare and critically threatened. The Australian Nature Conservation Agency provided funds to undertake an ecological study of the species in late 1993. This field study commenced in December 1993 and has substantially improved our understanding of the distribution of *C. lancelini* on the Island, as well as altering earlier suppositions about its preferred habitat.

The Lancelin Island Skink is declared "threatened" under Section 14(2)(ba) of the Wildlife Conservation Act. It is listed as 'Vulnerable' in the ANZECC list of Australian Endangered Vertebrates. Current data suggest that it should be listed by ANZECC as 'Endangered" and that it meets draft IUCN criteria for the new category of 'Critical' (Mace and Lande 1991, Mace *et al.* 1992). CALM has requested the ANZECC Threatened Fauna Network to recommend this change to ANZECC.

1.3 Habitat and ecological relationships

Up until 1992, all skinks captured were located under limestone slabs. There are three small areas of limestone on the island, in all totalling about 20% of the island, ie, about 1.5 ha. These areas are vegetated with a herbfield with low emergent shrubs (Keighery and Alford, in prep.), while most of the remainder of the island is covered with an open heath (*Nitraria billardieri, Scaevola crassifolia, Acacia cyclops, Helichrysum cordatum* and *Atriplex isatidea*). The 1992 specimen was captured in a pitfall trap located in the ecotone between the northern limestone area and the adjacent heath.

The work undertaken by Barbara Jones over the period December 1993 to April 1994, has resulted in the capture of 60 individual *C. lancelini* from all of the major habitat types on the Island. It is now clear that the species is not confined to limestone boulder areas, and as such, earlier suppositions about the reasons for its apparent decline and proposed management actions need to be revised.

Surveys of the Island have been undertaken using 11 grids of pitfall traps (9 in each grid). Drift fences have not been used to minimize vegetation disturbance, and to prevent interference with seabird nesting activities. A small "roof" of plywood was placed over each trap to prevent seabirds falling in, and reduce exposure to direct sunlight and any possible predation by birds. Five grids were established on rocky areas, 4 on a large dune and 2 on an eastern foredune. Trapping periods lasted 2-4 days.

Adult *C. lancelini* were captured on 9 of the grids, and recent hatchlings on 5 grids. One of the grids on the eastern foredune stood out as having the greatest number of captures, and was characterised by relatively dense shrubby vegetation and a protected north-eastern aspect. Temporal variation in capture rates was pronounced with the number of adults caught as a function of trapping effort declining after

early January. This corresponded with an observed decline in the number of invertebrates fallling into pits. There may prove to be another peak activity period in early autumn.

The first hatchlings were recorded on Janurary 20 and appeared to remain active during the hotter weather in contrast to the decline in presumed adult activity (based on capture rates). There appears to be some indication of sexual dimorphism in relation to body size, with adult females attaining greater snout-vent lengths than males.

The size of the population of *C. lancelini* is still unknown and will require further trapping data for an estimate to be made. To date, there has only been a single recapture. The lack of sightings of *C. lancelini* on the surface suggests that the species is cryptic and may be partially fossorial. Little else is currently known about its ecology.

Five other lizard species occur on Lancelin Island: *Ctenotus fallens, Cyclodomorphus branchialis, Egernia bos, Morethia lineoocellata* and *Diplodactylus spinigerus* (and possibly *Morethia obscura*). There is no evidence to suggest that any of these have become rarer over the past few decades, but there are no quantitative abundance data on any species.

Limiting factors and causes of threatened status

As outlined above, preliminary surveys suggested that *C. lancelini* was confined to a few small areas of limestone outcrop. The factors which appeared to have most potential to impact upon *C. lancelini* in these areas was the proliferation of exotic grasses and predation by Silver Gulls. Because of the lack of information it is still only possible to speculate about limiting factors and the reasons for the species apparent decline in numbers in the rocky habitat:

1. **Weed invasion.** Almost all open areas of the island are now covered by dense stands of an exotic grass (mainly Rye Grass *Lolium rigidum* and Wild Oats *Avena barbata*). As *C. lancelini* probably feeds by darting out from cover into open areas, the reduction in such areas may have affected its ability to feed and hence to reproduce and recruit. Thermoregulation may also be affected by a reduction in basking sites.

2. **Increase in numbers of Silver Gulls.** In common with many gull colonies near human habitation, Silver Gull numbers on Lancelin Island may be increasing. The gulls breed almost entirely on the more open limestone areas of the island. Gulls may be degrading the habitat, reducing the abundance of food or directly predating the skinks. Direct predation would appear to be most likely if gulls are having an impact. However, there are no available data to indicate that Silver Gulls are competing with or eating lizards on the Island.

2. MANAGEMENT GUIDELINES

2.1 Aim

The aim of these Interim Guidelines is to proceed with research into the ecology of the Lancelin Island Skink and determine the suitability of possible management actions to ensure its long-term conservation. Habitat quality (particularly weed growth and gull numbers) will be monitored. Captive maintenance and breeding will commence with a sibling species *C. labillardieri,* and then with *C. lancelini* as soon as practicable. The toxicology of herbicides on skinks will be determined and potential sites for translocation considered.

2.2 Options

Options for management include:

2.2.1 Weed control

Exotic grasses and other weeds appear to be spreading on the Island and may result in a decline in habitat quality for *C. lancelini* as well as other fauna. Control of weeds will probably be necessary in the short-term, but will be deferred for the next year to allow toxicology trials on Fusilade to be conducted. Consideration of other mechanisms to encourage the regeneration of native species in weed-affected areas will also be investigated.

Reduction in cover of grass could be achieved by spraying with "Fusilade" (active ingredient 212 g/L fluazifop-p, manufactured by ICI), a selective grass-controlling herbicide. Research in Kings Park has shown that this herbicide is effective in controlling veldt grass (*Ehrharta calycina*) at rates of 2 to 4 litres per hectare in 300 to 400 litres of water plus wetting agent, eg, Agral 60 @ 1:1 000, and that it causes no apparent damage to native plants except native grasses.

2.2.2 Control of gulls

Silver Gull numbers are increasing along the coast and probably in the Lancelin area. Their possible (if any) impact on *C. lancelini* is unknown. Gull numbers on the Island vary considerably during the year and numbers and breeding activity will be monitored to
assess the times when they are most likely to pose a threat to *C. lancelini*. Any control of gulls will be deferred until there is further evidence available of their impacts. Nonetheless, gull control may still be required, and approval from the Executvie Director of CALM and the Minister for Conservaton was sought and granted to carry out control operations if deemed necessary. A public education program was commenced with articles in local newspapers about the skink and the potential need to cull gulls.

Research into Silver Gull control in New South Wales (Smith and Carlile 1993) has shown that the most effective method of immediate reduction of gull numbers at breeding colonies was to cull breeding adults. Pricking or removing eggs had little effect. Habitat modification, eg mowing, can reduce breeding, but is not a consideration in this case.

Culling can be achieved by baiting. The method used in NSW was to mix 10 g of alpha-chloralose in 60 g of margarine and spread the mixture on six slices of bread. Two slices were placed on each nest, to give about 100 mg per bait or 200 mg per nest. Baiting in the NSW tests was not entirely effective, so shooting adult birds with a low-powered shotgun, eg, a .410, could also be considered. Dead gulls would be removed from the island and buried.

The Silver Gull Action Plan for the Perth Metropolitan Area (CALM, 1993) proposed control of gull numbers by landfill site management, minimising the food supply in public open space and commercial areas and an education program. It does not envisage killing gulls or destroying nests and eggs. Liaison with the Shire of Gingin has been ongoing and has resulted in changes to the management of the Lancelin tip.

2.2.3 Captive breeding

As far as is known, Lancelin Island Skinks have not been kept in captivity, let alone bred in captivity. Due to the urgency of conservation action, captive breeding should be considered. Perth Zoo advice is that captive breeding should be relatively simple, using aquaria, heat lamps and small insect food such as meal worms. It is desirable that an analogue, non-threatened species, be tested under these conditions first - the sibling species *Ctenotus labillardieri* would be ideal.

2.2.4 Translocation

Translocation should be considered, either direct from the existing single wild population, or using animals bred in captivity.

Four islands could be considered.

1. Wedge Island.

Wedge Island is about 20 km north of Lancelin Island. The southern end of the island consists of a herbfield dominated by the introduced *Mesembryanthemum crystallinum*. As the soils deepen towards the north, an open heath of *Olearia axillaris*, *Scaevola crassifolia* and *Spyridium globulosum* develops, with creepers of *Zygophyllum billardieri* (Keighery and Alford, unpublished). A search for Lancelin Island Skinks on Wedge Island in March 1993 was not successful.

Wedge Island does not appear to contain much suitable habitat for Lancelin Island Slinks at present. It has areas of limestone, but there are few limestone slabs and habitat modification would probably have to take place to make it suitable for the skinks. Reptiles known from Wedge Island are *Ctenotus fallens* and *Phyllodactylus marmoratus* (Williams 1986).There are no Silver Gull colonies.

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2. Green Islets.

Green Islets are island nature reserves located about 40 km north of Lancelin Island. They comprise two separate small islands.

South Green Islet of 3.4 ha has a plateau of limestone with low dense heath with *Scaevola crassifolia*, *Atriplex cinerea*, *Rhagodia baccata*, *Frankenia pauciflora* and *Olearia axillaris*.

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3. Edward Island

Edward Island of 0.16 ha is situated close to the town of Lancelin. It is small and has little vegetation and seems unsuitable as a translocation site.

4. North Cervantes Island.

The 3.2 ha North Cervantes Island, also a nature reserve, is located about 55 km north of Lancelin Island. The island has an extensive beach on the eastern side and a limestone plateau, which is covered by an open heath of variable composition depending on soil depth. Major species are *Rhagodia baccata*, *Olearia axillaris* and *Frankenia pauciflora*. There are bare rock outcrops scattered through the plateau (Keighery and Alford, unpublished).

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Research into the biology and ecology of the Lancelin Island Skink is urgent (see below).

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Options 2.2.1, 2.2.2, 2.2.3 and 2.2.5 will be pursued as soon as funds become available. Option 2.2.4 will be investigated further during research into the species.

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Research will be carried out into aspects of the biology and ecology of the Lancelin Island Skink, concentrating on its conservation biology. This will require the employment of a scientist for at least two years, plus support for vehicle running, travelling allowances, etc. Detailed, intensive research is necessary to establish the status of the skink before animals can be taken from the wild for captive breeding or translocation, and to ensure that weed and gull control are benefiting the species.

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APPENDIX 3: FIELD STUDY OF *CTENOTUS LANCELINI* ON LANCELIN ISLAND (BARB JONES)

Field study of *Ctenotus lancelini* on Lancelin Island

Barbara Jones
December 1994

Introduction

Previous work on the Island indicated that *Ctenotus lancelini* had only been found in or adjacent to rocky areas, (which constitute about 20 % of the Island's 7 ha), and indicated that the species may have suffered major decline in the past decade (Browne-Cooper and Maryan 1992, Burbidge 1993). Initially, the most immediate requirements of the Island work were to test two hypotheses:

1. *C. lancelini* is restricted to rocky areas and their margins
2. The number of *C. lancelini* on the Island is very low

For the sake of prudence these two hypotheses had been assumed to be valid when the initial Interim Guidelines (Burbidge 1993) were prepared. These Guidelines also proposed hypotheses relating to potential causes of decline:

1. An increase in the abundance of rye grass (*Lolium rigidum*) had led to a decrease in habitat quality for *C. lancelini*
2. An increase in numbers of Silver Gulls (*Larus novaehollandiae*) had led to a decrease in habitat quality for *C. lancelini*

Hence, the fieldwork also needed to evaluate these two proposals with respect to results indicating the likely size and distribution of the *C. lancelini* population.

A trapping programme was initiated in early December 1993 to determine the distribution and relative abundance of *C. lancelini* in a range of Island habitats. Comparison of population estimates (or capture rates) for different areas or pits with scored habitat variables relating to vegetation, rock or seagull abundance could then provide some insight into habitat parameters with the potential to limit *C. lancelini* abundance. A prerequisite for such an analysis is an understanding of seasonal variation in capture rates, and also of patterns of seasonal variation in the Island habitats. The results of the first year of the trapping programme are summarised in this report. The habitat analysis is scheduled for 1995.

The suggestion of changes to lizard abundances, vegetation patterns or seabird populations on the Island are all of a qualitative of inferential nature. There is no hard data to evaluate the extent of such changes. When the 'scientific' process is thus limited, the approach of the natural historian remains available. Hence, attempts to understand the extent and timing of changes has relied on anecdotal evidence, on qualitative field observations, and on intuitive analysis of these 'results'.

Field methods

Methods: Lizards

Figure 1 shows the positions of thirteen grids, each of which consists of 9 traps on a 20 x 20m square. Traps consist of a small plastic tub (19 cm deep, 18 cm wide) with a square timber cover (30 x 30 cm) above it. The covers are always in place, whether the pits are open or closed. On Grid zero (G0) five additional pits were placed within the main grid, at points considered to 'look like good spots'.

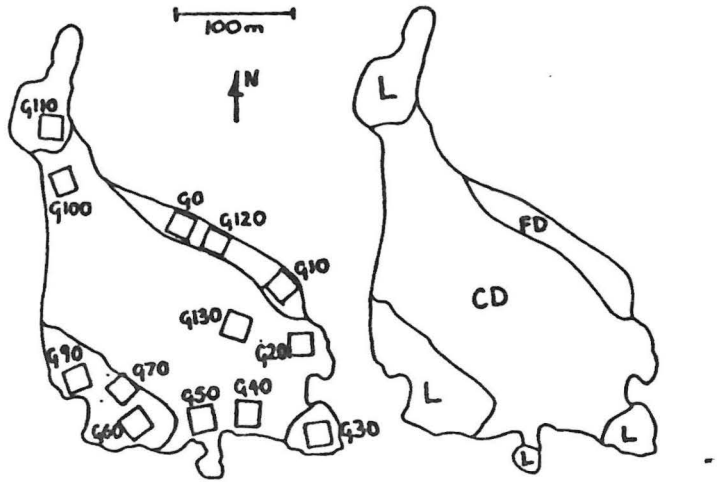

Figure 1. Map of Lancelin Island showing the three main habitat types (CD: central dune; L: shallow soil over limestone; FD: eastern foredune) and the position of the 13 trapping grids.

Twenty-five trapping periods of 2-5 days undertaken between December 1993 and November 1994 form the basis for results presented herein. The dates of trapping periods are as follows: **Trip 1**: 22-23 Dec, 1993; **Trip 2**: 17-20 Jan 94; **Trip 3**: 29-31 Jan; **Trip 4**: 4-6 Feb; **Trip 5**: 14-16 Feb; **Trip 6**: 25-27 Feb; **Trip 7**: 9-11 Mar; **Trip 8**: 29-31 Mar; **Trip 9**: 9-12 Apr; **Trip 10**: 19-21 Apr; **Trip 11**: 27-29 Apr; **Trip 12**: 12-13 May; **Trip 13**: 27-28 May; **Trip 14**: 5-6 Jun; **Trip 15**: 3-4 Jul; **Trip 16**: 16-18 Jul; **Trip 17**: 7-8 Aug; **Trip 18**: 16-18 Aug; **Trip 19**: 3-5 Sep; **Trip 20**: 18-22 Sep; **Trip 21**: 8-12 Oct; **Trip 22**: 18-19 Oct; **Trip 23**: 29-31 Oct; **Trip 24**: 12-15 Nov; **Trip 25**:26-30 Nov.

During summer months, when lizard activity was higher, traps were cleared two or more times per day. During winter traps were cleared daily. Lizards were individually marked using toeclip numbering as shown in Figure 2. Some groups of *Ctenotus fallens* were bulk numbered (this was the most frequently caught species). Weight, snout-to-vent length (SVL), tail length and gender were recorded for all lizards. Gender of the *Ctenotus* species and *Morethia lineocellata* was determined by applying gentle pressure to slide the vent scales towards the head and expose the soft tissue of the vent: males were characterised by the anus

being dorsally displaced from the most ventral soft tissue, while in females the anus was revealed as a typical sphincter, which appeared flush with the surrounding tissue. The gender of *Egernia bos* and *Cyclodomorphus branchialis* was determined by applying sufficient pressure to evert a hemepene just enough to be sure it was there. Gender was not always able to be determined with confidence, especially in small, young individuals.

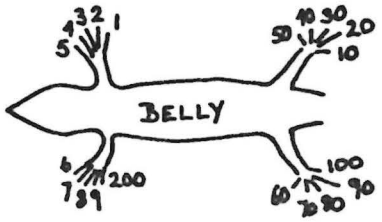

Figure 2. Diagram showing the numbering system used to individually mark lizards.

Methods: Silver Gull counts

The numbers of silver gulls which could be seen perching or sitting was counted regularly for three views. The three areas were selected because birds could be counted from a distance. From the southern peak of the central dune (near G130) the view of the southern limestone areas was very good, with over 90% of the vegetated, rocky areas visible, and a visible boundary which was the junction of the differing vegetation of the central dune and the rocky areas. The silver gull counts were for the areas associated with grid numbers, not for the area enclosed within the traps. The third area was a view from between G40 and G50, looking northwards towards the southern slopes of the central dune.

Other counts were collected earlier in the season, including a count of the number of gulls seen perching on a grid as it was approached, but, after several trips, this indicator was judged unlikely to be numerically reliable because the view of some grids at approach was far better than on those with the poorest view on approach.

An attempt to record nesting activity on all grids also provided numerically unreliable data. Where gull nesting activity was intense the shrubby vegetation was relatively rare and this provided excellent visibility of nests. In areas of denser vegetation nest visibility was low enough to require intensive searching and nesting activity was also low (judged by the relative intensity of birds doing aerial defence activity). Reliable nesting records are available for two areas (G30 and G60-90) used most intensively by nesting gulls. Nesting activity was recorded within a 30m x 30m square centered on the grid. Nests were tagged on the first occasion eggs were seen in them.

Results: *Ctenotus lancelini* on Lancelin Island

Monthly capture rates for the four lizards frequently caught are shown in Figure 3. *Cyclodomorphus branchialis* was rarely trapped, although during October and November some were sighted or caught from under the wooden covers when opening traps in the early morning.

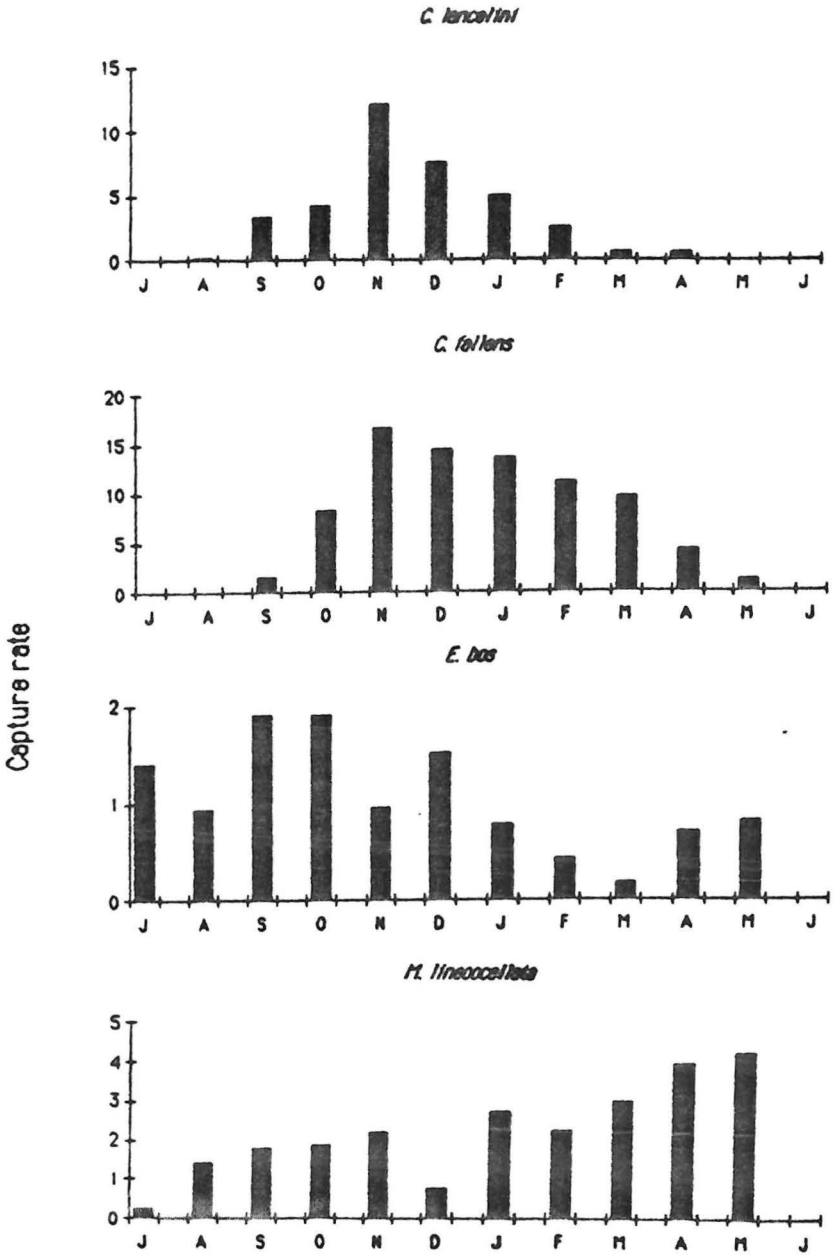

Figure 3. Monthly capture rates (number of captures per hundred trapdays) for the four commonly caught species. Rates were derived using by summing all captures (both adults and juveniles) on all grids.

Capture rates for *E.bos* and *M.lineocellata* suggest that these species may be active throughout the year, and this pattern contrasts with the *Ctenotus* species which appear to be inactive throughout winter. (The June and December results may be somewhat spurious: in June no trapping could be arranged to include sunny days; the December results are based on a single trapping period in December 1993.)

The patterns of seasonal activity of *Ctenotus* (Figure 4) shows young *C.lancelini* were caught between mid-January and late April (when they weighed 0.5-1.0 g) and young *C.fallens* were caught between early February and late May (when they weighed 0.8-3.0 g). For both species adult capture rates declined as capture rates of young increased. Comparison of the pattern of captures of the two *Ctenotus* suggest that *C.lancelini* activity tends to occur earlier in the spring-autumn period, and *C.fallens* later in the season. Comparison of the relative capture rates of *Ctenotus* adults and juveniles for early 1994 prompts the suspicion that captures of young *C.lancelini* seem relatively rare.

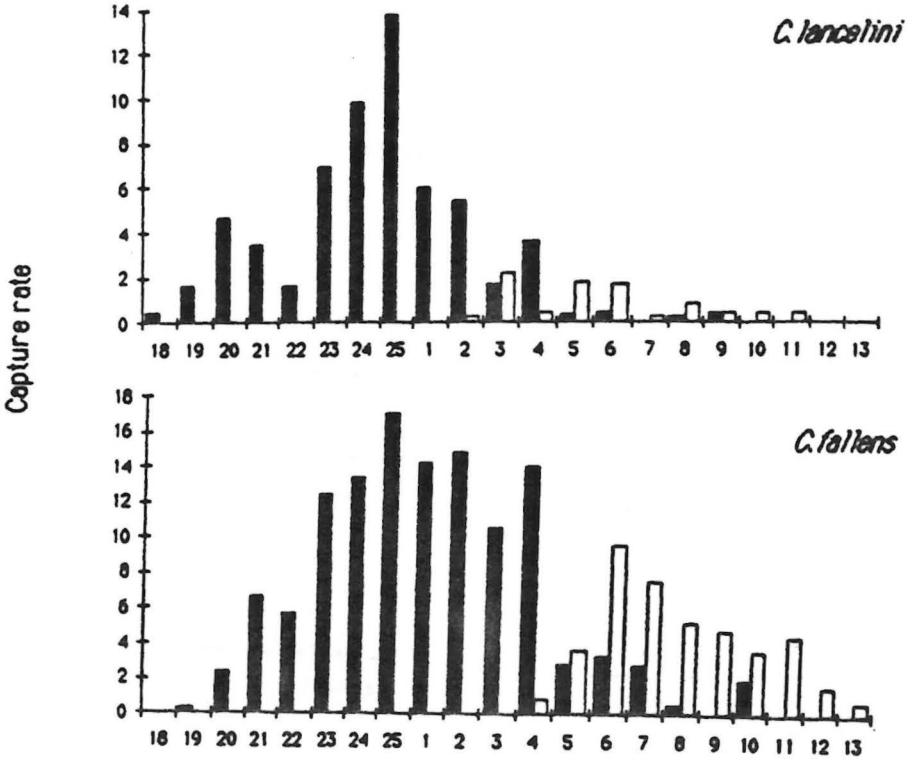

Figure 4. Seasonal pattern in capture rates (number of captures per hundred trapdays) of *C. lancelini* and *C. fallens* for adults (solid bars) and juveniles (open bars) for trips between December 1993 and November 1994.

Two of the seven *C. lancelini* collected by Petersen and Hanlon in April 1975 were small animals: one had an SVL of 38 mm and another was larger, with an SVL of 56 mm. During this study no *C. lancelini* collected had an SVL between 36mm and 65 mm. These data suggest that young *C. lancelini* can reach 65 mm by the summer after hatching.

Spring capture rates for male and female *C. lancelini* (on T19-T25) indicated activity levels differed for the sexes (Figure 5).

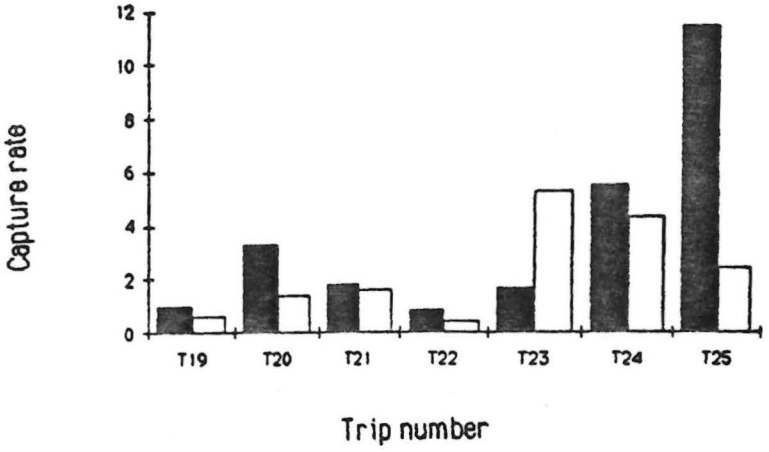

Figure 5. Capture rates (number of captures per hundred trapdays) of *C. lancelini* females (solid bars) and males (open bars) on spring trips in 1994.

The higher activity of males on T23 and T24 was presumably associated with mating activity (copulation observed for a pair in a pit on T24). The higher activity of females on T24 and T25 was interpreted to be due to the increased foraging activity of gravid females. Females caught earlier in spring tended to have lower weights than those caught later in spring (Figure 6).

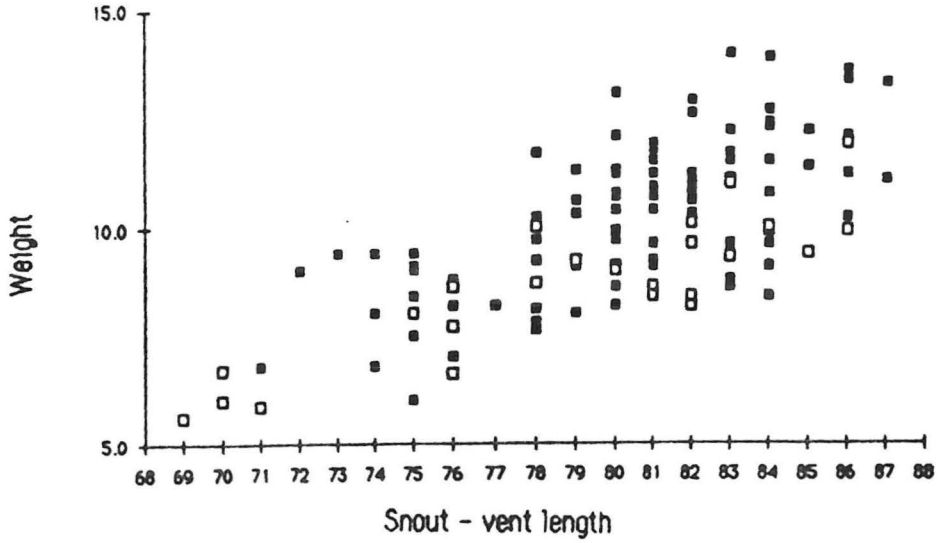

Figure 6. Plot of SVL against weight for female *C. lancelini* caught during spring 1994. Open squares represent females caught earlier in spring (3.9.94 - 11.10.94) and later in spring (19.10.94 -31.11.94)

solid sqs for those caught.

Sexual dimorphism appears to be dominated by differences in body size, with few males attaining an SVL > 80mm (Figure 7). Over the spring a total of 68 male and 119 female *C. lancelini* were caught.

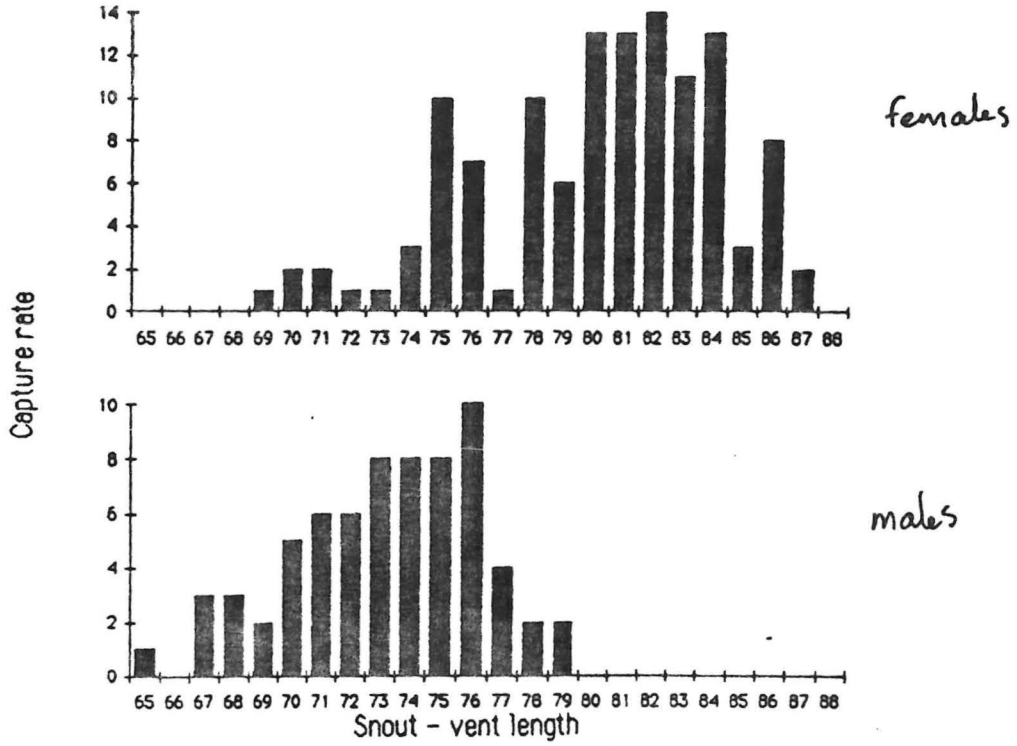

Figure 7. Histograms showing the size distribution (based on SVL) for female and male *C. lancelini* caught during spring 1994.

Fecal pellets have been collected as available since September, the usual tally being 2-5 pellets from *C.fallens* and *C.lancelini* each trip (but somewhat fewer for *E.bos* and *M.lineoocellata*). Preliminary inspection of pellets indicates the *Ctenotus* 'chew' invertebrates more than the other two species, and that earwigs (Dermaptera) form a common dietary component. (More detailed inspection of pellets will be undertaken when the size of the season's collection becomes known).

Capture rates for the four common species (Figure 8) indicate that the four skinks occur in each of the three main habitat types on the Island. Variation in the overall lizard capture rate indicates that lizard habitat quality varies substantially between grids, and the patterns of the relative capture rates for different grids suggests that a number of independent habitat parameters may interact to affect the nature of the lizard community in different areas. Relative capture rates for each of the four species differ by about a factor of ten between the highest and lowest grid capture rates, suggesting that, for each species, density varies substantially.

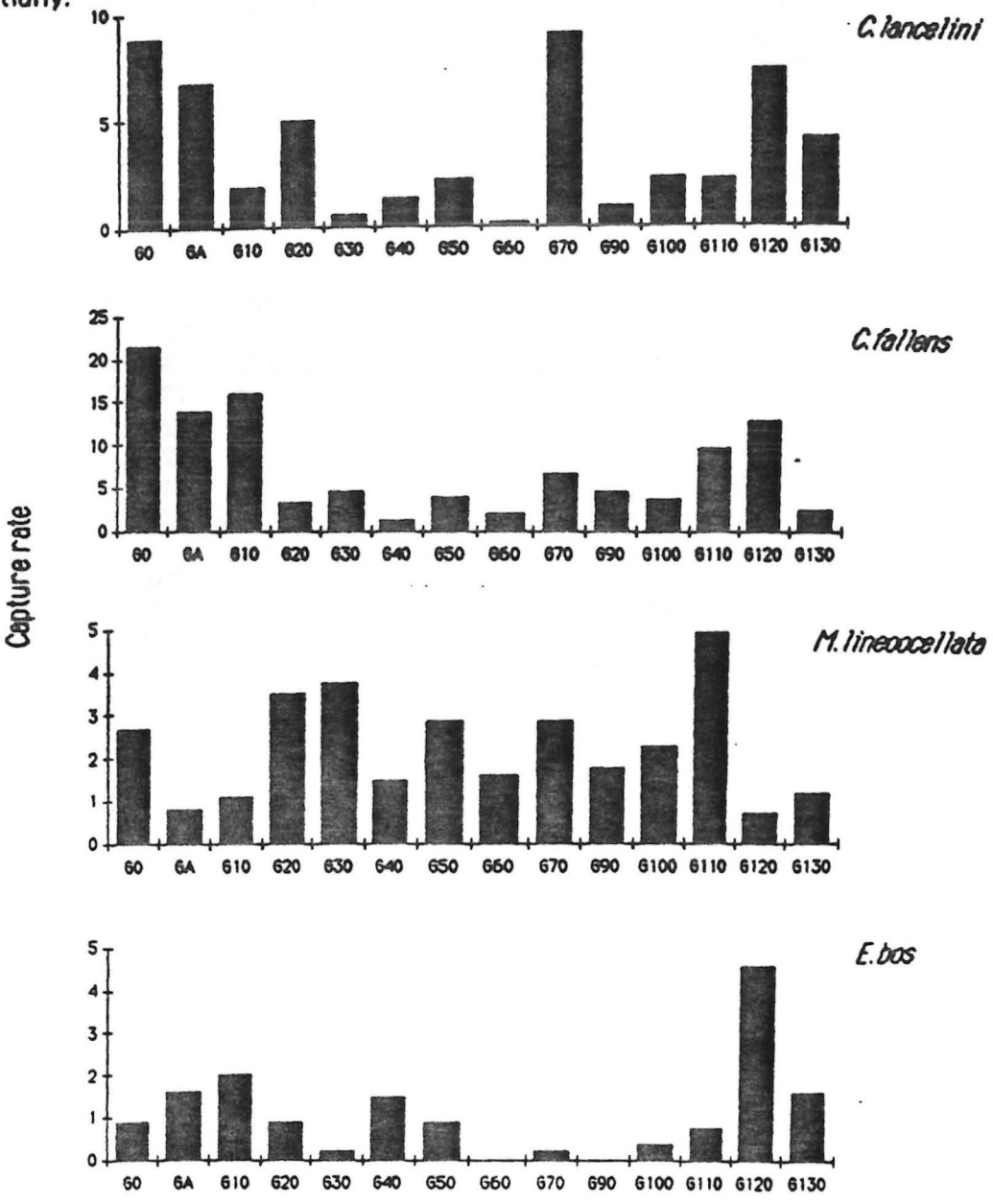

Figure 8. Capture rates (number of captures per hundred trapdays) for *C.lancelini*, *C.fallens*, *M.lineoocellata* and *E.bos* on different grids.

Several general trends appear likely to influence the overall lizard capture rates. The most prominent is the trend for grids with southern aspects (G30, G40, G50, G60) to have fewer lizard captures than those with a north-eastern aspect (G0, G10, G70, G120). G70, which has the highest *C. lancelini* capture rate, is the only grid on the limestone which has a northeastern aspect, and, of all the limestone grids G70 (along with G30) has the largest amount of the original perennial vegetation. A less prominent trend appears to relate to the overall abundance of perennial vegetation. Aspect and soil type are similar on G0, G10, and G120, which all have relatively high *Ctenotus* capture rates. Vegetation structure is most dense on G120 and most open on G10. In the more open vegetation of G10 only 9% of captures were of *C. lancelini* (and 76% were *C. fallens*), on G0 26% were of *C. lancelini* (and 63% were *C. fallens*), and in the more dense vegetation on G120, 31 % of captures were of *C. lancelini* (and 55% were of *C. fallens*).

By the end of November 1994, 210 adult (weight > 5 g) *C. lancelini* had been marked, but only 17 individuals had been caught more than once (Table 1). All recaptures were on the same grid as the first capture, and often animals were recaptured in the same or adjacent trap. By November 1,1994, 103 adult *C. lancelini* had been marked, and in early November (T24) 11% of 74 captures were recaptures. At the end of T24, 144 *C. lancelini* had been marked, and on T25, 17% of 41 captures were recaptures.

Table 1.

FEMALES

No	Date	Pit	WT	SVL
L010	20.1.94	006	8.5	75
	13.11.94	006	11.7	78
	26.11.94	A5	7.6	78
L012	23.12.93	006	8.5	80
	12.11.94	007	9.6	83
L016	9.10.94	004	6.8	76
	27.11.94	004	7.0	76
L030	18.1.94	075	10.6	82
	19.9.94	078	9.9	84
	15.11.94	077	8.4	84
L051	20.1.94	008	9.6	79
	20.9.94	007	8.4	81
L061	18.1.94	005	9.6	85
	25.2.94	A2	9.2	87
L063	4.2.94	008	7.9	77
	12.11.94	A3	10.1	78
L088	5.9.94	055	9.9	86
	26.11.94	058	11.2	86
L129	11.10.94	112	9.0	80
	28.11.94	116	10.4	81
L146	29.10.94	026	8.0	74
	27.11.94	026	8.2	76
L223	12.11.94	004	9.1	75
	27.11.94	002	8.0	75

MALES

No	Date	Pit	WT	SVL
L019	3.1.94	027	7.7	68
	29.11.94	027	8.9	72
L034	21.9.94	135	8.0	74
	13.11.94	135	8.8	75
L087	4.9.94	024	6.0	77
	8.10.94	024	8.2	76
L095	19.9.94	119	10.0	78
	15.11.94	118	9.7	78
L112	9.10.94	055	9.1	76
	13.11.94	051	9.4	76
L234	12.11.94	126	6.5	67
	28.11.94	124	6.9	67

Table 1. Records of recaptures of marked *C. lancelini*.

C.fallens was the most frequently caught species. By the start of T24 (early November), 116 adult *C.fallens* had been marked, and, of the 104 *C.fallens* captures on T24, 53% were second or subsequent captures. On T25, when 165 adult *C.fallens* had been marked, 61% of the 92 captures were second or subsequent captures. Comparison of recapture rates for *Ctenotus* indicates the 'trappability' of the species differed. An assumption that the trappability of each species is similar on all grids seems relatively safe, but the data indicates the assumption that each species is equally trappable is not valid.

Only vague estimates of the size of the *C.lancelini* population are possible on the basis of the data presented here. Assuming each grid samples the population of an area of 40m x 40m, then the 13 grids sample an area of 2.08 ha. Recapture rates for November 1994 suggest that the 210 marked *C.lancelini* account for about 10-20% of the animals likely to be present in the sampled area. These numbers yield a density estimates of 250-500 *C.lancelini* per hectare for the sampled area. This estimate would exclude recent hatchlings.

Results: Changes to the lizard populations of Lancelin Island

Table 2 shows Rolfe's (1993) table describing the data which suggested the decline of *C.lancelini* in the rocky areas, with several additional data references. The numbers assigned to the 1961 and 1975 records are the numbers of *C.lancelini* lodged in the Western Australian Museum.

Table 2.

Year	Month	Number recorded	Source
1961	Oct	6	Ford, 1963
1975	April	7	Hanlon & Petersen
1978	June	3	Harold
1981	Dec	10	Browne-Cooper & Maryan, 1992
1983	Mar	10	Browne-Cooper & Maryan, 1992
1987	?	3-4	Connell
1989	Oct	1	Harold
1991	Oct	0	Browne-Cooper & Maryan, 1992
1992	Jan	1	Rolfe 1993
1992	Nov	0	Rolfe 1993
1994	Oct	3	Jones et al

Table 2. Records of the numbers of *C.lancelini* encountered while turning rocks in limestone areas.

These data relate to rocky areas where the main collecting activity was rock-turning. There is a general trend indicating that *C.lancelini* have been more difficult to find since 1989 than in most earlier years. Greg Harold (unpublished notes) indicates that between 1978 and 1989 there was an apparent decline in the abundance of 'liftable rocks' which he attributed to accumulations of drifting sands. Hence, the lower numbers of *C.lancelini* found on trips made after 1988 may reflect the rarity of liftable rocks.

Harold's notes (unpublished notebooks) indicate that in 1978 he counted 17 *E.bos* from under rocks. Trapping results for this study are inconsistent with such numbers currently being present in the limestone areas (see Figure 8.).

Results: Seabirds on Lancelin Island

Two groups of seabirds use the island intensively: the burrowers, and surface nesters. Bridled terns (*Sterna anaetheta*) were far more abundant than any of the other surface nesting birds, and appeared on the island during October and left during April. During 1994 the number of breeding pairs of other surface-nesting species were estimated to be less than each 200 pairs, with only silver gulls and bridled terns exceeding these numbers. During February 1994, I (BJ) estimated there was over 2000 bridled terns using the island (perhaps as many as 5000). The bridled terns nested in all of the island habitat types.

The burrowers include the storm petrel (*Pelagodroma marina*), and the wedge-tailed shearwater (*Puffinus pacificus*). The fleshy footed shearwater (*Puffinus carneipes*) may also breed on the island. The burrowers used all vegetated areas where the soil was deeper, and burrows were very rare in the rocky areas. The density of burrow entrances in use (showed sign of recent excavation) over the central dune was estimated as 0.5-2 per square meter during June and July, 1994. These combine with old derelict burrows to form a substantial component of the terrestrial habitat available for lizards. *C.fallens* , *C.lancelini* and *E.bos* were seen using burrow entrances as basking spots, and were frequently seen to dash into burrows when disturbed or released.

The original brief for this work targeted silver gulls, and this is the only species for which repeated counts in specified areas were collected. Observations relating to the abundance of silver gulls on the three count areas are given in an appendix, along with other notes on silver gulls. The highest period of activity was associated with winter breeding. In spring a much smaller number of Silver Gulls nested. The patterns of use of the islands habitats differed between the nesting periods: in winter the majority nested on the rocky areas associated with G30 and G60-90, and only a few birds nested on the central dune or the northern limestone. In spring the nesting birds used only the central dune area. No nests were recorded within grids on the eastern foredune, although adult bird activity indicated that up to five pairs may have nested within this habitat type during August-September.

Estimates of the numbers of breeding pairs of silver gulls which use Lancelin Island for nesting each year (Table 3) were derived using the counts for the three count areas, and estimates for the two other main areas. A number of estimates and assumptions were required to derive these estimates, and I also used reference to field observations which were not quantifed or recorded (e.g. the relative level of attack behaviour my presence on the grid elicited). The estimates are based on the assumption that the counts of birds can be used as an indicator of the number of nest sites. The estimates are probably higher than the reality, since both birds in a pair were counted if present. Assuming the spring breeders are different pairs to the winter breeders leads to the suggestion that about 350 pairs breed on the Island.

Table 3.

Area:	SS		G30		G60-90	
Apr	10		3		15	
May	13		21		68	
Jun	26		41	*	153	*
Jul	25	*	33	*	138	*
Aug	21	*	42	*	153	*
Sep	17	*	27		82	
Oct	13	*	17		43	
Nov	11		5		10	

* denotes eggs present in the count area

Table 3. Monthly averages of the number of silver gulls in each of the count areas (raw data in Appendix.

Results: Weather

The mean monthly temperatures recorded at Lancelin are shown in Table 4. *C.lancelini* activity peaks in November, when the average maximum is 24°. *C.lancelini* capture rates were relatively low in months with a mean daily maximum ≥ 28°.

Table 4.

	Temperature		Rainfall					
Month	Min	Max	Mean	1990	1991	1992	1993	1994
Jan	17	29	10	101	0	5	0	0
Feb	18	30	15	5	24	67	8	0
Mar	16	28	14	15	10	46	13	1
Apr	14	25	35	34	30	38	7	2
May	12	22	88	83	68	43	90	132
Jun	11	20	135	92	212	126	96	77
Jul	10	19	131	169	128	105	93	101
Aug	10	19	94	82	54	187	85	92
Sep	10	21	54	39	61	56	58	37
Oct	12	23	31	34	30	24	22	20
Nov	14	24	24	7	69	39	21	2
Dec	16	27	8	2	34	7	2	8
Rainfall	annual total		638	665	722	743	496	472
	total: Sep-Nov		109	80	161	118	101	58
	total: Dec-Apr		74	155	68	189	36	6

Table 4. Lancelin weather records (provided by the Weather Bureau) showing mean monthly maximum and minimum temperatures and average rainfall. The actual monthly rainfall totals are also shown for the period 1990-94.

The rainfall patterns (Table 4) show that there is considerable variation in the annual total rainfall and the seasonal patterns. Both 1993 and 1994 were dry years. Rainfall was particularly low between December 1993 and April 1994.

Results: Winter weeds

The ryegrass was the dominant winter weed, and its abundance far exceeded any other winter annual (either introduced or native).

Grass seedlings were first observed in late May to early June. By mid-August much of the rye-grass was flowering. In early September lower leaves were starting to yellow, most of the ryegrass had seed heads and, in some areas with longer stems, was starting to fall over, which allowed sun to reach the layer of horizontal grass stems overlaying the substrate. By mid-October there was very little green left in the plants, and by late November the rye grass was brown and dry.

The ryegrass grew in all habitats and areas, except where the soils were very shallow ($<$ ca. 8 cm over limestone). Growth varied between habitat-types, the maximum height amongst the vegetation of the eastern foredune was 20-25 cm, whilst in most other areas its height was $\geq$ 60 cm. In some areas the ryegrass produced seed heads whose tips were up to one metre from the roots. In such areas the grass was still only ca 50 cm high.

In the limestone areas the growth of ryegrass was most extreme, and extensive. On the central dune and the eastern foredune rye grass growth tended to be less extensive and occurred as smaller patches of dense growth. In some parts of the lower slopes of the central dune ryegrass growth yielded 80 cm stems, but towards the upper slopes heights were lower (ca. 60 cm).

Results: Changes to the vegetation on Lancelin Island

Observations of the vegetation over the 11 months of fieldwork undertaken showed substantial deaths of perennial plants in both the limestone areas and the large central dune. In some areas the death of the *Rhagodia baccata* thickets was as high as 50% of the cover which was alive in December 1993. Such plants shed increasing amounts of foliage from March until late May, and were further stripped by a substantial storm which brought the first winter rain. Such deaths occurred in all habitat types, but on the shallower soils over limestone, where the winter grasses were most extensive, deaths were more frequent. On G60 and G70 deaths were most common to plants growing in the highest areas.

In 1975-76 Nick Dunlop worked on seabirds on Lancelin Island. In 1985 Greg Keighery visited the Island and qualitatively described its vegetation. Both workers have accompanied Barb Jones on a trip to the Island and discussed their views on the extent of changes to the vegetation. Dunlop also provided copies of photographs taken of several areas on the Island which could be compared with the current view of the same area.

The white sand foredune (see Figure 1), which currently has the second and third highest *C. lancelini* grid capture rates (G0, G120), was absent from Dunlop's 1976 photograph of the eastern beach. This area probably represents the largest area of high density occurrence of

C. lancelini on the Island. Presumably variable sea currents affect the stability of this patch of vegetation on a relatively short time scale. Whilst the rye grass is a prominent component of the vegetation on G0 and G20 its maximum height last winter was 20-25 cm.

The changes to the vegetation of the limestone areas have been most dramatic. Areas which in 1976 were characterised by ca 80% overall cover of (primarily) *Frankenia pauciflora*, *Carpobrotus virescens* and *Lavetera plebia* were, in 1993-4, characterised by cover of 80-90 % rye grass with only a few isolated perennial plants. The areas associated with G30 and G60 retain the highest abundances of *F.pauciflora* of any of the rocky areas. In 1976 the dominant weed in the rocky areas was the ice-plant, *Mesembryanthemum crystalinum*. This species is currently much less abundant, and has been replaced by winter grasses, except in areas with very shallow soil over limestone.

Changes to the vegetation on the large central dune appear to have been more subtle. The dominant grass in Dunlop's photo's appeared to be wild oats (*Avena barbata*), but ryegrass is currently the most common grass in this habitat type. It appears that there has been a decline in the extent of cover of woody shrubs, particularly of *Olearia axillaris*.

Overall, the general trend in vegetation change has been characterised by a shift from perennials towards winter weeds, and particularly towards the grasses. This can also be expressed as a shift in the seasonal patterns of productivity, with the grasses growing rapidly during the wet months (this year, late May to mid September), then laying dead and dry over the soil for the remainder of the season.

Discussion

The above results allow the re-evaluation of some of the initial hypotheses. Trapping results show that *C. lancelini* is not restricted to rocky areas, and that the species occurred on all grids, suggesting that it uses all available habitats. The capture records for *C. lancelini* are inconsistent with the hypothesis that the number of *C. lancelini* on the Island is very low. Re-evaluation of other workers capture records for *C. lancelini* in rocky areas provides only tentative support for the hypothesised decline of the species in such areas. The majority of silver gull activity occurred in rocky areas, which also had the highest grid capture rate for *C. lancelini* (on G70). Since the most intensive silver gull activity was concentrated in winter, when *Ctenotus* are apparently inactive, it seems unlikely that there is any substantial impact on *C. lancelini* due to a direct interaction with silver gulls.

Mary Gilham studied the impacts of nesting seabirds on island vegetation on southwestern islands (Gilham 1961), and points out that a major impact of birds is associated with changing patterns of guano deposition, and the patterns of release of its nutrient load into the soil. Seasonal patterns of rainfall result in the nutrients from winter guano being released into the soil regularly, while summer guano may accumulate for months between rainfall events. When rain runs over such accumulations the nutrients can be swiftly released into the soil, and Gilham notes that at higher concentrations such guano solutions may become toxic to plants, and that plants differ in their ability to tolerate higher concentrations.

The southern areas of shallow soils over limestone had the highest rates of death of

perennials, the most extensive ryegrass cover and height, and the highest densities of winter silver gull activity. On the eastern foredune ryegrass growth was lowest, and silver gull activity was also low. This pattern is consistent with the implication that, during winter, gull feaces may provide additional nutritional resources for the ryegrass. However, some parts of the lower slopes of the central dune had a low rate of gull nesting, a moderately high growth of ryegrass (e.g. G20: 60% grass cover with stems 50-70 cm long), and a relatively low rate of deaths of perennials. The only simple relationship apparent within these results indicates that the process of change to the island vegetation differs between shallow and deep soils, and that process of change has been most dramatic on shallow soils.

The Bridled terns contributed guano to the surface over the summer months. Rainfall presumably releases the nutrients contained in the dry guano into the soil. In summer 1993-4 the whole summer's accumulation of guano was available when the first winter rains arrived in late May-early June. The pattern of rainfall over other summers (Table 4) suggests that, in more average years, summer rainfall may flush some of the accumulated nutrients into the soil in a season when they are not available to the winter weeds.

The changes to the island's vegetation over the last twenty years have been substantial, and relatively rapid. Observations of deaths of perennials after a very dry summer, and the pattern of weed growth in winter prompts a model for the shift from perennials towards ryegrass. The growth of the grasses was so luxuriant during winter that it seemed small dicotyledon seedlings would be unlikely to survive if they germinated on early winter rains and amongst grass seeds. During dry summers, such as the 1993-4 season, mature perennials may die due to either water stress, or the toxic effects of high nutrient loads (from accumulated guano), but recruitment of such perennials is limited by the dense growth of winter weeds.

The extent of the changes to island vegetation over the last twenty years has been extreme, but observations of the rates of death of perennials in 1994 suggest that the pace of change might be substantially accelerated by very dry conditions during summer. Higher capture rates for *C. lancelini* tended to be associated with higher abundances of perennials. Thus, although *C. lancelini* appears to be relatively abundant on Lancelin Island, the lizards habitat can not be considered secure. Continuation of this study will permit numeric analysis of habitat characteristics and the relative abundance of *C. lancelini*. Results of such analysis will provide insights into the relative importance of different habitat parameters which have the potential to limit *C. lancelini* abundance.

Future study on Lancelin Island

During 1995 population and habitat studies will continue on the Island. Trapping will be concentrated in two periods: over summer and autumn (4-6 days of trapping each month); and during October-November (for a total of ca 20 days of trapping). Mean maximum temperatures during March, April and May are similar to those during the spring peak in *C. lancelini* activity, and extra trapping will be conducted during this period if there is substantial rainfall.

Habitat treatments may be applied during winter 1995, and comparison of capture rates for spring 1994 and spring 1995 should permit an initial assessment of their potential

effectiveness. A discussion paper on proposed treatments is currently being prepared for the recovery team.

Full analysis of the population and habitat data will be undertaken during 1995.

The apparently low capture rates for young *C. lancelini* may be real and associated with the very dry season over summer 1993-4. Should summer 1994-5 be equally dry, then similar capture rates are likely. Further trapping during April-May in a season which has had good summer rains would provide valuable data on variation in annual recruitment rates.

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Acknowledgements

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Appendix 1: Field notes on Silver Gulls

The notes provided include rough field notes (collected to help the process of derivation of reliable quantitative indicators of relative rates of usage of different areas by Silver Gulls) and, for later trips, more detailed counts chosen to provide quantitative indication of the relative usage rates by Silver Gulls.

Several conventions have been used to describe the patterns of usage of Lancelin Island habitats by Silver Gulls. As usage patterns changed with season new variables reflecting relative usage rates of areas have become available and some counts which were useful when gull numbers were low have become unusable.

The following list gives definitions or descriptions for the conventions and methods relating to Silver Gull observations.

AD: refers to estimates of the number gulls doing 'air defence': swooping and circling, usually as a response to being disturbed by me.

EB: the long eastern beach: the numbers refer to either a count or an estimate of the number of gulls sitting on the beach or in the shallows.

Southern slopes (SS): An area of the southern slopes viewed from the mid-point which is at the base of the slope. The count is of all gulls seen perching amongst the shrubby vegetation type (ie, excludes the SE slope of the large rocky area). Earlier counts sometimes included reference to birds doing 'air defence'.

SA: subadult: defined as any bird which retains some of the immmature plumage.

V ex G130: Viewed from G130. T131 is near the southern peak of the large central dune, and the viewing position is about 8m W of T131. From this position the gulls on much of the large limestone patch are visible, and can be counted without disturbance. G30 is on the small southern peninsula which is viewed from the same position. Counts designated V ex G130 refer to areas of vegetation associated with a particular vegetation type. Even though the Grid numbers are used for reference the land area used for these counts is much larger than the area enclosed by a grid.

New nests: gull nests on G30 and G60-90 were tagged when first sighted with eggs, and the number of nests tagged on each trip is listed.

Early day-trips: 8.12.93 8 of 12 gulls on southern beach showed some subadult (sa) plumage (1100 hrs); 1 nesting adult on area nr G110 (eggs not found); 1 adult sighted on G60 (1100). 3.12.93 2 nests with eggs in area of G60-90; 20-40 constantly overhead while in area of G60-90: seem to be coming mostly from southern slopes, where they are evenly spaced (10-20m) between birds or pairs.

Trip 1. Activity on southern slopes and area G60-90 similar to 3.12.93. Counts on eastern beach not possible due to abundance and activity of Crested Terns. 23.12.93 2-4 gulls in constant surveillance of nesting Fairy Terns (10-20 birds). They apparently worked together, one attacking and another sneaking in to steal egg. 2 successful attempts witnessed.

Trip 2. Eastern beach and southern slopes same as last trip. 18-20.1.94 1 subadult on beach in little cove: saw an adult delivering food sporadically, most frequently during late afternoon. The adult spent most of one morning attending/defending/eating a large dead cuttlefish.

Trip 3. 29.1.94 nesting adult with 2 eggs nr T119.

Trip 4. About 10-20 regularly seen feeding amongst northern patches of beached seagrass, along with 4-6 Banded Rails. 4.2.94 nest nr T119 same as last trip.

Trip 5. Seems to be generally fewer gulls about vegetated parts of island. Still using northern seagrass patch. 15.2.94 nest nr T119 abandoned; 100-150 gulls on eastern beach (1300) (only a few Crested Tern runners left).

Trip 6. The gulls previously seen regularly on the southern slopes seem to have gone. 25.2.94 1 adult sighted nr G0, 2 nr G110, 1 nr G60 none on other grids (800-1100); 6 of the 25 gulls on eastern beach have some sa plumage (1300)

Trip 7. Nesting activity seems to be at a minimum: no eggs, chicks or nesting behaviour. Air defence elicited by me presumed to be associated with birds pair bonding or establishing nest areas. No more than 3 individuals seen on southern slopes at any one time. 9.3.94 4 gulls doing 'air defence' (AD) on G130, 1 doing AD on G20, 7 adults (3 pr + 1) on G30, and no gulls on others (900-1200); 2 groups on eastern beach, 40 + 50 = 90, about 10% have sa plumage (0930); from G130, 1 gull on ground nr G60-90 (0950); 18 adults (all red) on G30 (1615). 10.3.94: 4 adults on G30 (1310); 2 pr AD on G50 (1600); none on G30 (1810).

Trip 8. 29.3.94. 3 of 27 gulls on EB with subadult plumage (0750). 30.3.94. 40 gulls on EB (1630). 31.3.94. 2 of 35 gulls on EB with subadult plumage (1400).

Trip 9. 9.4.94. 4 gulls on E beach (0800). 1 of 7 gulls on EB with subadult plumage (0840). None on G60-90 (0855). No gulls on any grid at opening. 10 gulls on EB (1100). 1 gull doing aid defence (AD) on G0 (1100). 55 gulls on EB (1340). V ex G130 (1445): no gulls on G60-90 or G30. 10.4.94. 7 gulls on EB (1040). V ex G130 (1130): no gulls on G60-90 or G30. 11.4.94. 21 gulls on EB (0640). 2-4 gulls in air over G100 and G110 (0730). 1 gull (runner!) on G20 (0735). V ex G130 (0845): no gulls on G60-90 or G30.12.4.94. 1 gull on EB (1200). 1 of 12 gulls on EB with subadult plumage (1250).

Trip 10. 19.4.94. No gulls on EB (1330). 2 gulls on G30 (1355). V ex G130 (1430): no gulls on G60-90 or G30. 20.4.94. 5 gulls on EB (0740). 35 gulls on G30 (0900). V ex G130 (1030): no gulls on G60-90 or G30. 2 gulls AD on G30 (1100). 35 gulls on EB (1300). 21.4.94. 2 of 20 gulls on EB with SA plumage (0915). 30-50 gulls doing AD over G30, G40, &G50 (1440). V ex G130 (1540) 35 gulls on G60-90, 15 gulls on G30.

Trip 11. 27.4.94. 40 gulls on G30 (1350). 8 gulls on S slopes (1355). 8 gulls AD G40 (1355). 32 gulls on S slopes (1400). V ex G130 (1420) 62 gulls on G60-90. 50 gulls on EB (1440). ca 30 gulls on N peninsula N of G110. 28.4.94. 5 gulls on G30 (0840). 2 gulls on G40 (0850). 2 gulls on G50 (0855). 8 gulls on G60 (0910). 14 gulls on G70 (0920). 7 gulls on G90 (0930). 3 gulls on S slopes (0935). V ex G130 (1000) 27 gulls on G60-90. ca 50 gulls on EB (1010). ca 70 gulls on EB (1100). 29.4.94. 17 gulls on G30 (0820). 2 gulls on G40 (0830). 5 gulls on G0 (0840). 5 gulls on G70 (0845). 5 gulls on G90 (0850). 9 gulls on S slopes (0835). 35 gulls on EB (0915). V ex G130 (1110) 14 gulls on G60-90. 3 gulls S slopes (1210). 11 gulls on G60 (1140). 7 gulls on G70 (1145). 8 gulls on G90 (1155). 2 gulls on G50 (1210). 2 gulls on G40 (1225).

Trip 12. 12.5.94. 9 gulls on G30 (0940). 1 gull on G60 (1000). 5 gulls on G70 (0950). V ex G130 (1030) 17 gulls on G60-90. 10 gulls on EB (0915). 1 gull on S slopes (0940). 13.5.94. 17 gulls on G30 (0840). 2 gulls on G50 (0900). 4 gull on S slopes (0900). 13 gulls on G60 (0910). 16 gulls on G70 (0910). 3 gulls on G90 (0915). 10 gull on S slopes (0920). 33 gulls on EB (1030). V ex G130 (1045) 4 gulls on G60-90, 11 gulls on G30. V ex G130 (1515) 64 gulls on G60-90, 14 gulls on G30. 5 gulls on G130 (1515).

Trip 13. 27.5.94. 9 gulls on G110 (0905). 5 gulls on EB (0930). ca 40 gulls on G30 (0945). 3 gulls on G40 (0955). 17 gulls on S slopes (0955). 1 gulls on G50 1000). 23 gulls on G60 (1005). 28 gulls on G70 (1015). 19 gulls on G90 (1030). V ex G130 (1055) 80 gulls on G60-90, 21 gulls on G30. 25 gulls on EB (1115). 28.5.94. 6 gulls on G110 (0810) and ca 40 to the N of G110. V ex G130 (0950) 173 gulls on G60-90, 39 gulls on G30. 5 gulls on G130 (0950). 23 gulls on EB (1030). 35 gulls on S slopes (1210). 1 gull on G40 (1215). 1 gull on G50 (1215).

Trip 14. 5.6.94. V ex G130 (1030) 150 gulls on G60-90, 45 gulls on G30. 32 gulls on S slopes (1050). 27 gulls on S slopes (1510). 45 gulls on EB (1520). first eggs seen nr G70. 6.6.92. 29 gulls on S slopes (1455). V ex G130 (1600) 188 gulls on G60-90, 52 gulls on G30. One nest with eggs (first seen this season) on G70.

13.6.94. 17 gulls on SS (1430). V ex G130 (1500) 25 gulls on G30, 120 on G60-90. Nests marked: 4 nests with eggs on G30; 4 nests with eggs on G70: 9 nests with eggs on G60.

26.6.94. Nests marked: 17 nests with eggs on G30; 1 nest with eggs on G100; 1 nest with eggs on G40; 1 nest with eggs on G50; 19 nests with eggs on G60; 5 nests with eggs on G70; 5 nests with eggs on G90, one hatching; 22 nest with eggs on G70; 9 nests with eggs on G30.

Trip 15. 4.7.94. 8 gulls on G110 (1000). no gulls on G100 (1000). V ex G130 (1015) 32 gulls on G30, 172 on G60-90. 6 of 7 nests sighted on G130 had no eggs. G20: no gulls (1040) and no nests seen. 2 gulls on G50 (1100). No gulls on G40 (1110).

Trip 16. 15.7.94. 28 gulls on SS (1520). 16.7.94. 25 gulls on SS (1030). V ex G130 (1120) 37 gulls on G30, 157 on G60-90. 17.7.94. 23 gulls on SS (1455). V ex G130 (1650) 21 gulls on G30, 98 on G60-90. 18.7.94. 27 gulls on SS (1115). V ex G130 (1220) 40 gulls on G30, 124 on G60-90.
New nests marked: 5 nests with eggs on G90; 12 nests with eggs on G60; 11 nests with eggs on G30; 3 nests with eggs on G110.

Trip 17. 7.8.94. V ex G130 (1220) 51 gulls on G30, 191 on G60-90. 8.8.94. 25 gulls on SS (1350).V ex G130 (1600) 49 gulls on G30.

Trip 18. 16.8.94. no chicks or eggs seen on G30. 20 gulls on SS (1130). V ex G130 (1140) 40 gulls on G30, 147 on G60-90. 17.8.94 V ex G130 (1210) 27 gulls on G30, 121 on G60-90. 13 gulls on SS (1510). 18.8.94. 25 gulls on SS (0955). V ex G130 (1100) 39 gulls on G30, 154 on G60-90.

Trip 19. 3.9.94. V ex G130 (1100) 1 gull on G30, none on G60-90: but two rafts of ca 30 birds each on the water, and ca 30 on the osprey's peninsula. 10 gulls on SS (1225). 4.9.94. V ex G130 (1600) 32 gulls on G30, 68 on G60-90. 5.9.94. V ex G130 (1000) 36 gulls on G30, 121 on G60-90. 19 gull on SS (1145). Very few gull eggs about: only two nests with eggs were seen this trip.

Trip 20. 21.9.94. 14 gulls SS (1420). V ex G130 (1200) 27 gulls on G30, 66 on G60-90.

Trip 21. 9.10.94. V ex G130 (0800) 30 gulls on G30, 99 on G60-90. 10.10.94. 10 gulls SS (1100). 22 of 50 birds on EB had subadult plumage: estimate about 100 gulls on EB.

Trip 22. 19.10.94. 11 gulls on SS (1045). V ex G130 (1230) 15 gulls on G30, 17 on G60-90.

Trip 23. 29.10.94. 17 gulls on SS (0800). V ex G130 (0830) 17 gulls on G30, 35 on G60-90. 30.10.94. V ex G130 (1230) 4 gulls on G30, 29 on G60-90. 14 gulls on SS (1400).

Trip 24. 12.11.94. 9 gulls on SS (1540). 13.11.94. V ex G130 (0905) 5 gulls on G30, 12 on G60-90. 14.11.94. 11 gulls on SS V ex G130 (1040) 1 gull on G30, 7 on G60-90.(1615). 15.11.94. V ex G130 (1015) no gulls on G30, 15 on G60-90. 11 gulls on SS (1300).

Trip 25. 28.11.94. V ex G130 (0900) 12 gulls on G30, 7 on G60-90. 13 gulls on SS (1230).

Appendix 2: Grid Descriptions

Brief descriptions of the 13 trapping grids are given below. 'Aspect' refers to the predominant direction of the slope of the land on which the grid was located, and the steepness of such slope is indicated by an estimate of the vertical distance between the highest and lowest traps on the grid. The locations of the grids is shown in Figure 1 in the main text. Vegetation descriptions make reference only to common plants (here 'common' is defined as covering at least 5% of the grid area) which were apparent during November 1994. Estimates of the extent of cover of any component refer to an estimate of the total area of each grid covered by a particular component: in some areas more than one species covers the same area (e.g. *Tetragonia decumbens* climbing over *Spinifex longifolia*, *Zygophyllum fruticulosum* on *Olearia axillaris*, winter grasses emerging from *Rhagodia baccata* thickets).

G0 (includes GA): In a narrow swale on the eastern foredune; with a NNE aspect, protected from SW winds by the large central dune, which rises steeply and immediately behind the grid. **Cover**: Winter grasses: 15%; bare sand: 5%; *Myroporum insulare*: 10%; *Nitraria billardieri*: 10%; *Olearia axillaris*: 5%; *Rhagodia baccata*: 10%; *Scaevola crassifolia*: 15%; *Spinifex longifolius*: 15%; *Tetragonia decumbens*: 10%; *Zygophyllum fruticulosum*: 5%.

G10: On a gentle slope (< 0.5 m) with NE aspect on the eastern foredune; protected from SW winds by the large central dune, which rises about 15 m behind the grid. **Cover**: Winter grasses: 25%; bare sand: 10%; *Atriplex isatidea*: 5%: *M. insulare*: 15%; *N.billardieri*: 5%; *O.axillaris*: 10 %; *R.baccata*: 5%; *S.crassifolia*: 15%; *S.longifolius*: 15%; *T. decumbens*: 15%; *Z.fruticulosum*: 10%.

G20: On a moderate slope (<1m) with E aspect on lower slopes of central dune. Moderate protection from SW winds by large central dune. **Cover**: Winter grasses: 60%; bare sand: 5%; *O.axillaris*: 10%; *R.baccata*: 30%; *T. decumbens*: 10%; *Z.fruticulosum*: 5%.

G30: On the small limestone peninsula: the central pit is a the apex of a slight rise, and the surface falls away from T35 evenly in all directions (slopes < 0.5 m). Exposed to the SW winds. **Cover**: Winter grasses: 45%; *Atriplex cinerie*: 15%; *Frankenia pauciflora*: 15%; *Mesembryanthemum crystallinum*: 25%; *R.baccata*: 5%.

G40: On the lower slope (SSW aspect, slope ca 1 m) of the large central dune. Exposed to the SW winds. **Cover**: Winter grasses: 20%; *A.cinerie*: 30%; *F.pauciflora*: 15%; *N.billardieri*: 5%; *R.baccata*: 20%; *Z.fruticulosum*: 35%.

G50: On the lower slope (SSW aspect, slope ca 0.3 m) of the large central dune. Exposed to the SW winds. **Cover**: Winter grasses: 15%; *A.cinerie*: 35%; *R.baccata*: 20%; *S.crassifolia*: 5%; *Z.fruticulosum*: 15%.

G60: On limestone with a gentle SSW slope (ca 0.3m). Exposed to the SW winds. **Cover**: Winter grasses: 65%; *A.cinerie*: 10%; *F.pauciflora*: 15%; *M.crystallinum*: 5%; *R.baccata*: 5%.

G70: On limestone with a NW-NE aspect and slopes of 1m (to the NW) and 2m (to the NE). Protected from SW winds by the rise on which G60 is located. **Cover**: Winter grasses: 65%; *A.cineria*: 25%; *M.crystallinum*: 5%; *R.baccata*: 5%.

G90: On limesone flat with only gentle SW slope in the SW corner of the grid. Slight protection from SW winds is provided by the rise on which G60 is located. **Cover**: Winter grasses: 90%; *M.crystallinum*: 5%; *R.baccata*: 5%.

G100: On western slope of central dune (W aspect, slope ca. 1 m). Slight protection from SW winds is provided by the western margins of the large central dune. **Cover**: Winter grasses: 30%; *N.billardieri*: 40%; *O.axillaris*: %; *Z.fruticulosum*: 20%.

G110: On shallow soil over limestone (SSE aspect, slope ca. 1m). Slight protection from SW winds is provided by the large central dune. **Cover**: Winter grasses: 75%; *A.cineria*: 10%; *F.pauciflora*: 5%; *R.baccata*: 10%.

G120: in a narrow swale on white sand of the eastern foredune; with a NNE aspect, protected from SW winds by the large central dune, which rises steeply and immediately behind the grid. **Cover**: Winter grasses: 15%; bare sand: 10%; *Olearia axillaris*: 5%; *Rhagodia baccata*: 5%; *Scaevola crassifolia*: 50%; *Spinifex longifolius*: 20%; *Tetragonia decumbens*: 5%.

G130: On the southern apex of the central dune and extends down its ENE slope (ca. 1.5m). Moderate protection (for most of the grid) from SW winds by large central dune. **Cover**: Winter grasses: 40%; bare sand: 5%; *R.baccata*: 15%; *Z.fruticulosum*: 45%.

APPENDIX 4: RECENT NEWSPAPER AND MAGAZINE ARTICLES ON THE LANCELIN ISLAND SKINK

ENDANGERED!



THE LANCELIN ISLAND SKINK

Lancelin [illegible] dunes and [illegible] a mere 7 [illegible] place that [illegible] (*Ctenotus* [illegible] making it [illegible] disturbance [illegible]

First [illegible] Ford, the species was initially considered to be a subspecies of the red-legged skink (*Ctenotus labillardieri*). Later work by Glenn Storr of the Western Australian Museum recognised that its distinctive colouring, larger size and different habits were sufficient to raise it to the status of a distinct species.

The upper body surface is pale brown with darker speckling, and the legs are yellow with blackish-brown streaks or spots. During the breeding season, the undersurface is [illegible]

[illegible] herpetologists [illegible] and Brad Maryan [illegible] searched the island for this species, but were dismayed to find only one individual. Earlier visitors reported the skink to be abundant, suggesting that there had been a dramatic decline in the population.

Urgent action was required. CALM requested Commonwealth funds to support a study to establish the size of the population, its biology, and the causes for its decline. Changes to the island's vegetation, due to weed [illegible] individuals and [illegible] on their [illegible] distribution with [illegible] habitats. The study will [illegible] develop suitable management strategies to ensure the Lancelin skink continues to be a unique [illegible] of the reptile fauna of Lancelin [illegible] and Western Australia.

David Pearson and Barbara Jones
Photo - Brad Maryan

THE LIZARD THAT CALLS LANCELIN ISLAND HOME

The Lancelin Island Skink (*Ctenotus lancelini*) was discovered in 1961, and its only known habitat is on tiny Lancelin Island. Few Australian reptiles have such a restricted distribution, and this makes the species particularly vulnerable to extinction.

Lancelin Island is a Nature Reserve which is a haven for a range of native animals and plants. In addition to the Lancelin Island Skink, six other lizards occur on the Island, and it is an important breeding area for many sea-birds. The Island is less degraded than many other near-coastal islands, and has been lucky to escape invasion by pests such as rats, mice, foxes and feral cats, which could devastate its fauna.

During 1991 and 1992, amateur herpetologists Robert Browne-Cooper and Brad Maryan, and scientists from the Department of Conservation and Land Management (CALM) spent time on the Island looking for the Lancelin Island Skink, and were disturbed to find only one individual. Earlier workers had found the Skink to be much more abundant, suggesting there has been a dramatic decline in the size of the population. Consequently, CALM secured Commonwealth funds to support a study of the species aimed at establishing its population size, its biology and the causes for its decline. Future research will also be funded by the R & I Bank and CALM from proceeds of the Landscope credit card.

In November 1993, wildlife consultant Barbara Jones commenced a field study of the lizards on Lancelin Island. This has involved their capture using pit-traps to collect data on individual lizards, and to determine which parts of the Island are most important for the Lancelin Island Skink. The preliminary results indicate that it still survives in a small section of the Island. The study will take about 18 months to complete, and the results should assist management of the Island's habitats to ensure the continued existence of one of Australia's rarest lizards. Ms. Jones asks that visitors to the Island keep to existing tracks and avoid disturbing any scientific equipment which will be in use from time to time. Further information may be obtained from David Pearson at CALM on (09) 405 5100.

Coastal Courier

The
Lancelin Island Skink
(Ctenotus lancelini)

Brian Bush

The Lancelin Island Skink is one of six types of lizards found on the island. It is the only one of the six not found anywhere else.

It is a small to medium sized, slender lizard growing to a total length of about 24 centimetres. It has well-developed limbs with five fingers and toes. Its back colour is pale to reddish-brown streaked with numerous fine black markings. Its upper sides are black, bordered above and below by a continuous narrow white stripe and broken in the middle by a series of white spots and dashes. Its legs are reddish, boldly marked with black.

Little is known about its biology and behaviour. Many close relatives feed on invertebrates and some vegetable matter, forage during the day and lay 2-5 eggs in a clutch.

The Lancelin Island Skink was first noted as unusual by naturalist Mr Julian Ford in 1963. He went on to scientifically describe it as a subspecies in 1968 naming it *Ctenotus labillardieri lancelini.* It has full species status today. There is some confusion concerning the year Mr Ford's description was first published. Many authors refer to 1969 although I have seen a reprint of the original description dated 1968.

Mr Ford in the early 1960's found this skink ".....under slabs of limestone where it appears to be not uncommon". In recent years its numbers appear to have declined. For some time now it has been gazetted endangered. CALM recently initiated the Lancelin Island Skink Recovery Program and is currently examining, by way of intensive field work, its true status on the island.
