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**A survey of the terrestrial reptiles of Norfolk Island
March 2005:**

1. Executive Summary and Background Document

prepared for

the Department of the Environment and Heritage

by

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A survey of the terrestrial reptiles of Norfolk Island March 2005

Report 2: Executive Summary & Background Document

by

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Executive Summary

Following is a summary of the principal conclusions and recommendations of the three separate reports submitted in fulfillment of the project *A survey of the terrestrial reptiles of Norfolk Island March 2005*.

1. The gekkonid lizard *Christinus guentheri* and the scincid lizard *Oligosoma lichenigera* are native to the islands of the Norfolk Island complex, with both species listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).
2. *Christinus guentheri* is currently known from Phillip Island, Nepean Island, Moo'oo Stone, Bird Rock and Green Pool Stone, and almost certainly occurs on other rocky islets lying just offshore from Norfolk's main island. It once occurred on the main island but became extinct prior to the first European settlement of the island.
3. *Oligosoma lichenigera* is known only from Phillip Island within the Norfolk complex.
4. Both species have their only (in the case of the skink) or largest and most significant populations (by several orders of magnitude, in the case of the gecko) on Phillip Island, making the latter the critical island for the conservation of both species.
5. Both lizard species are currently regarded as being restricted to the islands of the Norfolk and Lord Howe Island complexes; however the taxonomic relationships between the Lord Howe and Norfolk populations of both species are uncertain, and it is hoped that tissue samples taken in the course of the present survey will help to resolve taxonomic problems. Such resolution is important because, if it should prove that one or both of these species is distinct from its counterpart on Lord Howe Island, then

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- the reduced range and population size, and geographically-restricted endemism, would place any resultant species at greater risk of extinction by removing the multiple-population buffer that protects these species from threatening processes that operate at the local level.
6. Both species are estimated to have populations in the Norfolk Island complex that are large and secure. Survey data suggests that the species are at least as abundant — probably much more abundant as a result of natural increase in revegetation and expanded habitat on Phillip Island — than they were during the last survey in 1978.
 7. A four-night census on Phillip Island of the gecko *Christinus guentheri* in a 0.81 ha plot of young White Oak (*Lagunaria patersonia*), the primary habitat of this gecko, resulted in 375 captures of 341 marked gecko providing an estimated density of 0.24 geckos/m².
 8. Estimates of the number of *Christinus guentheri* present on Phillip Island were extrapolated from density estimates in wooded and low vegetated areas. A conservative estimate based on minimum gecko density numbers in these areas was 99,000, while an estimate based on mean gecko density was 176,000.
 9. Sequencing of specimens of *Christinus guentheri* for two gene segments clearly indicates that all are conspecific and does not suggest that the species is regionally genetically structured in the Norfolk Island group. Specimens were available from four populations, two larger at Phillip and Nepean Islands and two from smaller islands at Moo-oo and Bird Rocks. Unique haplotypes were found in all of these populations suggesting that each has some significance for the preservation of the genetic variation in the species.
 10. Should a decision be made to attempt the reintroduction of *Christinus guentheri* to the main island, it is recommended that:
 - a. a single site be chosen on the northern side of Norfolk Island for a cat- and rodent-proof enclosure to be constructed around an area of suitable habitat, to include significant stands of semi-mature to mature white oak trees (*Lagunaria patersoni*). Further habitat enhancement should be made as recommended above.
 - b. while clearly there is no maximum size for such an enclosure, an initial enclosure should be at least 0.5 ha in area with a preferred area of about one hectare.
 - c. that the enclosure be made cat- and rodent-free by trapping or baiting potential predators until such time as the enclosure can be considered predator-free.

- d. that at least 50 **adult** *Christinus guentheri* be collected and removed from Phillip Island and released into the new enclosure at a time in late spring–early summer when white oak flowering is at its peak. The released geckos should have close to a 1:1 sex ratio.
- e. all released geckos should be marked temporarily by paint spots and permanently by either the use of implanted PIT tags or Visible Implant Elastomer (VIE) for future monitoring purposes.
- f. A monitoring programme should be developed that censuses the gecko population within the enclosure at least four times in the first year following introduction. The results of that census would be used to determine subsequent monitoring methods and frequency. This programme should also monitor for the presence of the invasive gecko *Hemidactylus frenatus* and its impact, if any, on the native species.
- g. Should the house gecko (*Hemidactylus frenatus*) become established on either Nepean or Phillip Islands *prior to the reintroduction of the native gecko* to the main island, any re-introduction should be abandoned and resources invested in studies of the impact of the introduced gecko on populations of the native gecko on these offshore islands.

Background Document

Preamble: In February 2005 the Australian Government, through the Department of Environment and Heritage (DEH), commissioned (Com ID: 50777) Australian Museum Business Services (AMBS) to undertake a field survey of the native reptiles of islands in the Norfolk Island complex. This survey was to be conducted by a small team of herpetologists to be led by Dr Hal Cogger, John Evans Memorial Fellow at the Australian Museum. The survey was conducted in March 2005 by Dr Cogger, Dr Glenn Shea and Mr Glenn Muir under the Australian Museum Animal Care and Ethics Committee's Approval 02–03.

The need for such a survey was recognised by DEH following the preparation of a draft Recovery Plan (Cogger, 2004) which indicated that the available data on which to base such a plan was almost entirely restricted to that collected for a survey of Norfolk Island reptiles conducted in 1978 (Cogger *et al.*, 1979, 1983).

Recognising that many significant changes had occurred in the ecology of Norfolk Island, especially that of its two larger satellite islands (Phillip and Nepean), since the 1978 survey, it was considered essential to determine whether significant changes in the status of the islands' threatened reptiles had occurred in the intervening 27 years. Accordingly, AMBS was requested to carry out the following tasks:

- 1 A Field Study consisting of:
 - a. a qualitative assessment of the relative abundance of the Norfolk and Lord Howe Island reptiles *Christinus guentheri* and *Oligosoma* (previously *Pseudemoia*) *lichenigera*, on as many as possible of the islands of the Norfolk Island complex, based on knowledge of related species elsewhere, and on the results of a previous survey carried out in 1978. Estimates were to be based on visual and hand searches for lizards in all accessible habitats, supplemented on some larger islands (Phillip, Nepean) by live trapping;
 - b. quantitative studies of particular sites in which rough approximations of the total number of lizards present at those sites over sampling periods of 1–4 days would be made using mark/recapture techniques;
 - c. spotlight surveys at localities on Norfolk's main island where suitable habitat occurs, to determine whether *Christinus guentheri* has been able to recolonise from nearby rocky islets since the 1978 survey;
 - d. assessment of the suitability and location of potential re-introduction sites on Norfolk's main island; and

2. A Genetic variation study of *Christinus guentheri*, utilising tissue collected in the field, to estimate genetic variation indicating the level of gene flow between the various island populations. This stage of the project to be dependant on the necessary samples being collected, as lengthy periods of inclement weather during the field programme could deny the team access to some islands.
3. Completion of revised species profiles for *Christinus guentheri* and *Oligosoma lichenigera*, for the DEH Species Profiles and Threats Database (SPRAT), utilising the information from the stages above and all other available data and knowledge of the species.

The contract between AMBS and DEH specifies that the results of the above project be presented as five stand-alone reports as follows:

- A report on the outcomes of the surveys and comparison to previous population surveys. This report must include the results of the assessment of relative abundance, qualitative studies and spotlight surveys.
- A report on the outcomes of the genetic variation study. This report must include conclusions on whether the various island populations of *Christinus guentheri* [in the Norfolk Island complex] represent a single, genetically homogenous population or whether each island (or group of adjacent islands) possesses a distinct gene pool.
- A report containing recommendations to DEH on: recovery or management actions for *Christinus guentheri* and *Oligosoma lichenigera* (including changes to the actions proposed in the draft recovery plan Cogger, 2004)); and the suitability of re-introduction sites, based on the project results. This report may be made available to the public via the DEH web site.
- two completed species profiles, one for *Christinus guentheri* and one for *Oligosoma lichenigera*, for the DEH Species Profiles and Threats Database, in the format specified in the SPRAT Data Sheet template provided by DEH.

This is an additional report including an Executive Summary for all reports, together with a background document providing supplementary information about Norfolk Island and its lizards to help interpret the results presented in the other reports.

These reports are submitted in fulfillment of the above contract. It should be noted that several of the stand-alone reports contain common or overlapping explanatory elements, so that some of these elements may be duplicated in one or more reports.

Field Programme: Field work was conducted by the team during 2–13 March 2005. During this period sea conditions were generally unfavourable for island landings, and on the advice of the contracted boatman (David Bigg) only two windows occurred which enabled a stay of five days on Phillip Island (4–8 March) and one day surveying the northern stools, of which landings could be made on only two islands (Moo'oo Stone and Red Rock) due to prevailing sea conditions.

However, as it was considered important to attempt to obtain tissues of the Nepean Island population of *Christinus guentheri* for the genetic studies, Dr Cogger remained on Norfolk Island for a further week to await suitable conditions for a Nepean landing, and was successful (both in landing and collecting tissues) on 15 March.

During those periods when conditions precluded offshore island visits, the team travelled to those parts of Norfolk's main island where conditions (rocky cliffs and sufficient forest cover) indicated some potential for the future successful reintroduction of the native gecko (*Christinus guentheri*). The gecko appears to have been absent from the main island since at least the time of European colonization in 1788, but most probably since the introduction of the Pacific Rat (*Rattus exulans*) by Polynesian visitors to Norfolk Island about 1200 years ago (Cogger *et al.*, 1983; Matisoo-Smith, Horsburgh, Robins and Anderson, 2001; Smith, Clark and White, 2001). Accessible areas, with the greatest potential for successful reintroduction of the species, were also surveyed at night for the presence of geckos, in order to check whether the species might have successfully recolonised the main island unaided by human agency.

Materials and Methods: In our 1978 survey, significant numbers of voucher specimens of the gecko *Christinus guentheri* were preserved and returned to the Australian Museum for subsequent research and future availability to gekkonid taxonomic specialists. However, given its recent discovery and uncertain status at that time, the then Australian National Parks and Wildlife Service permitted the removal and preservation of only four individuals of the scincid lizard *Oligosoma lichenigera* from Phillip Island. These specimens (together with the first specimen collected by Mr Owen Evans, a single specimen in the Queensland Museum, and one currently on display in the Norfolk Island Museum) still constitute the only voucher specimens of this scincid lizard from the Norfolk Island complex available for scientific study by researchers.

With the exception of the tails removed for genetic studies (below), no voucher specimens were removed or preserved during the 2005 survey. The information

upon which this report is based therefore consists solely of information obtained from living individuals that were released after examination, thus limiting the available data on individual lizards to sex and the presence of eggs in females (*C. guentheri*, but not *O. lichenigera*) and basic body dimensions (snout-vent length, tail length and weight). Any unusual features about an individual lizard were noted, but available time and facilities precluded detailed observation on scalation in all recorded lizards. All specimens examined during this survey (as against those that were simply observed from a distance) were collected either by hand or removed from pit traps associated with drift fences laid out for that purpose. Individuals collected by hand were taken while active at night using head torches or from their diurnal shelter sites (under rocks, in rock crevices or under fallen timber or anthropogenic debris). Pit traps, used in association with low, plastic drift fences (fig. 1), were used only on Phillip Island at the two locations indicated in fig. 2.

Within the plots selected for mark/recapture censuses (fig. 2), all captured individuals were marked with a small spot of water-based acrylic paint on the rump. This method has been widely used on small lizards in the past without any measurable side effects or mortality. Such paint spots weather and fade quickly in the wild, with any residual paint being shed when the lizard next sloughs. A different coloured paint is used on each night's captures so that the day and sampling period of each subsequent capture of the same individual is known.



Figure 1: Erecting drift fence and pit traps at Moo'oo Beach, Phillip Island, in prime habitat for *Oligosoma lichenigera*.

Population estimates within the eastern plot were made by applying an unmodified Lincoln-Peterson Index to the capture/recapture data using various

combinations of the nightly returns. This method and its limitations are well known, and various modifications have been developed to overcome these limitations where they operate within a particular study. The most significant of these limitations are:

- Behavioural sampling bias. Do all individuals have the same chance of being captured? For example, does one sex or age class live in a different and inaccessible part of the habitat being sampled, or is only one segment of the population active at any given sampling time?
- Immigration and emigration. Are significant numbers of individuals leaving or entering the survey area during the sampling period?
- Mortality. Are significant numbers of individuals with the population dying during the sampling period?
- Births (recruitment). Are significant numbers of individuals being born into the population during the sampling period?

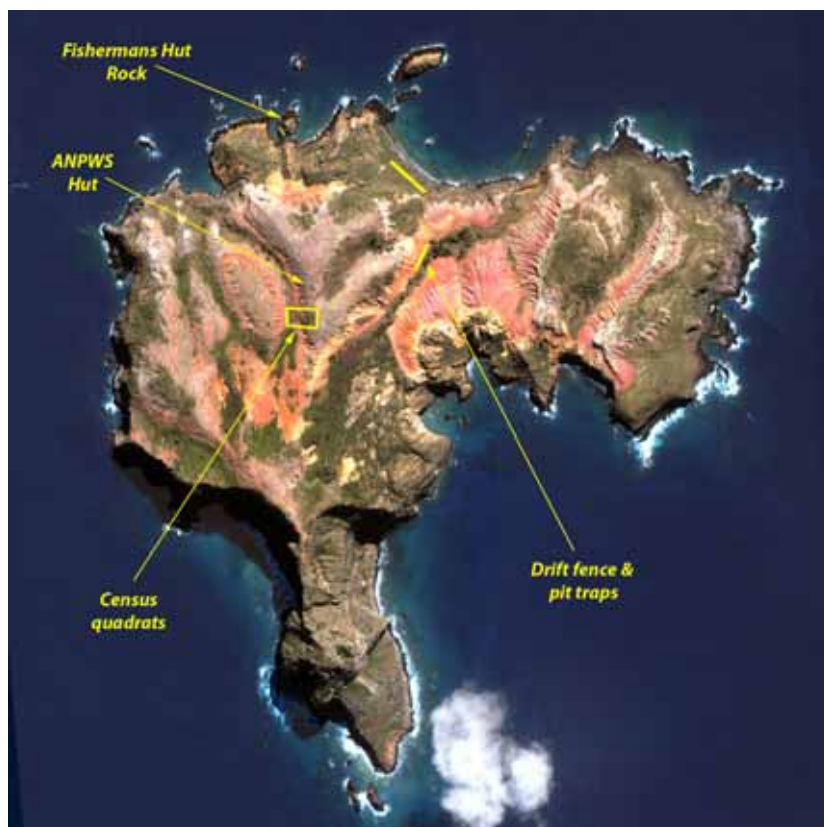


Figure 2: Aerial photograph of Phillip Island showing key features mentioned in the text.

With perhaps one exception (under-representation of juveniles) there is no evidence that any of these potential biases are likely to be significant during the four successive nights of the census, and so estimates of population size are made using the simple equation:

$$\text{Population size} = \frac{\text{number initially captured, marked \& released} \times \text{number subsequently captured}}{\text{number of marked individuals (recaptures) within number subsequently captured}}$$

Further, if the above limiting conditions are shown not to apply, then various combinations of the recapture data can be used to make independent estimates of population size in the area sampled, i.e. the results of days 1 and 2 can be combined and compared with the combined data for days 3 and 4, or day 1 with days 2+3+4, etc.

The number of geckos observed on the open slopes between vegetated areas is relatively few, except on rocky screes where the shelter provided by numerous large rocks accommodates a resident population of geckos. This observation suggests that short-term migration (i.e. over 3–4 days) is not significant, an observation that is supported by the occasional discovery during the day, on exposed slopes well away from shelter, of dead and partly consumed geckos (fig.3). Such mortality may result from predation by large centipedes that range widely across exposed slopes at night, or possibly by geckos wandering so far from shelter that they die from heat stress before being able to regain shelter the following morning. At night, the frequency of geckos observed declines with distance from cover, suggesting that most geckos make only relatively short forays onto bare ground from the cover of edge vegetation or rock screes.

The few available data suggest that *Christinus guentheri* females have multiple clutches, as gravid females were common in both November (1978) and March (2005). Eggs collected in the wild on Phillip and Nepean Islands in the last week in November hatched 79–87 days later, while an egg laid in the laboratory on 9 December hatched 91 days later. Consequently the likelihood of significant recruitment over a four day census period is extremely low.

Nevertheless many population studies of long-lived species (*C. guentheri* almost certainly has a potential lifespan of 10+ years) have indicated either very low levels of recruitment **or** behavioural differences between adults and hatchlings that result in juveniles being under-represented in standard surveys.

However there is no evidence to suggest that any of the potential biases cited above would significantly affect estimates of population density of this gecko based on a four-day sampling period.



Figure 3: Carcass of *Christinus guentheri* found in the early morning on bare slopes of Phillip Island. Probable prey of large centipede. Tail not found, probably removed and/or consumed by predator.

Because it is known that this gecko feeds on White Oak nectar during the latter's flowering season, and that geckos also actively seek out sweet processed food such as honey, jams and sugar when these are available (Cogger *et al.*, 1983), we set up several feeding stations along the northern perimeter of the eastern census plot to determine whether geckos might be attracted to such sites. Each station consisted of a sugar and water sludge painted onto the lower trunk and/or branches of an individual white oak. While a number of individuals were found feeding on these sugar baits, geckos were not attracted to the baits in large numbers.

A small number (*ca.* 30) of tissue samples were taken of both lizard species by removing *ca.* 1 cm of the tail tip, using a fresh scalpel to make a clean cut. This procedure was approved by the relevant authorities on Norfolk Island following public consultation, and was also approved by the Australian Museum's Animal Care and Ethics Committee under Approval No. 02–03. It is important to stress that this method was adopted primarily because the tails of both species regenerate fully after full or partial loss from natural causes, including intraspecific fighting and mating, and large, predatory centipedes. Some 89% of all geckos observed in the course of this survey had suffered partial or full tail loss as indicated by tail loss or partially- or fully-regrown tails (see discussion below and fig. 13 in Cogger *et al.*, 2006b). Details of the methods used in the genetic study are set out in a separate report (Cogger *et al.*, 2006c).

All measurements were made using vernier calipers and lizard weights obtained using Pesola spring balances. The locality of each observation was determined using a Garmin GPS model GPSmap 76.

Finally, it is important to acknowledge that some taxonomic issues await resolution. Wells & Wellington (1984) erected the genus *Vaderscincus* to accommodate the scincid lizard found only on the Lord Howe Island and Norfolk Island complexes and at that time known under the combination *Leiopisma lichenigerum*. Their “diagnosis” of *Vaderscincus* did not strictly comply with the requirements of Article 13 (a) of the Third Edition of the International Code of Zoological Nomenclature (then applying) and so its status in nomenclature remains uncertain; it has not been used as a valid genus in the literature other than by its authors.

Currently, both species of lizards recorded from the Norfolk Island complex are considered to be conspecific with their counterparts on Lord Howe Island. Cogger *et al.* (1979) noted, via a table, some differences between populations of *O. lichenigera* (under the combination *Leiopisma lichenigera*) on Phillip Island and Lord Howe Island, while Wells & Wellington (1985) introduced the name *Vaderscincus coynei* for the Norfolk Island skink. Their description was not “accompanied by a description or definition that states in words characters that are purported to differentiate the taxon” but refers to such a description or definition in other works (Cogger, 1971; Cogger *et al.*, 1983). However no such definition purporting to differentiate this taxon was provided in either of these works, as required by Article 13 of the International Code of Zoological Nomenclature, and so the name *Vaderscincus coynei* remains an unavailable *nomen nudum*.

Nevertheless, the differences between the Lord Howe and Phillip Island populations of *O. lichenigera* noted in Cogger *et al.* (1979) were confirmed and reinforced by the additional data obtained in our 2005 survey. These morphological differences, combined with planned genetic studies of the two populations that will now be possible from the tissue samples taken in 2005, will hopefully resolve questions as to the level of genetic differentiation in these two native lizard complexes.

Finally, it should be noted that this same species has since 1983 been cited in the scientific literature under the combinations *Pseudemoia lichenigera* and *Cyclodina lichenigera*.

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