

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

2. A qualitative assessment of the relative abundance of the Norfolk and Lord Howe Island reptiles *Christinus guentheri* and *Oligosoma lichenigera* and comparison with previous surveys.

prepared for

the Department of the Environment and Heritage

by

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Australian Government



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A survey of the native reptiles of islands in the Norfolk Island complex

Report 2: A qualitative assessment of the relative abundance of the Norfolk Island lizards *Christinus guentheri* and *Oligosoma lichenigera* and comparison with previous surveys

by

H. Cogger¹, G. Shea² and G. Muir³

Preamble: Lizards were searched for at all localities visited by the team. The native skink (*Oligosoma lichenigera*) is occasionally diurnal but primarily crepuscular/nocturnal, while the native gecko (*Christinus guentheri*) is primarily nocturnal, becoming active at dusk.

Diurnal searches consisted of opportunistic observations of occasionally active skinks and active searches of all accessible shelter sites for both skinks and geckos. Search sites included boulder slopes, beach rubble, fallen (dead) trees and branches, rock crevices, anthropogenic structures and litter (huts, planks, sheets of iron and other building materials), and holes and crannies within living trees.

Drift fences, 20–40m lengths of orange, heavy plastic sheeting supported by bamboo stakes, were used in combination with 20cm-deep plastic buckets sunk into the ground with their openings at ground level, to trap active lizards. They were expected to be effective only with skinks as it was assumed that geckos, with their large adhesive toe-pads, would easily climb out of the buckets. However, geckos were often found in the traps. Pit traps were used only to supplement our hand captures, and did not provide any useful quantitative data.

Nocturnal searches involved scanning bare ground, shrubs, trees and boulder slopes with head torches to detect both active and stationary lizards. Searches were confined to Phillip Island and the main island, as the risk of stranding, due to heavy sea conditions, did not permit overnight stays on other islands during our visit.

On Phillip Island, nocturnal searches were largely confined to the upper slopes within the vicinity of the Parks Hut and the quadrants used for the population density studies, as traversing the steeper slopes of Phillip Island at night carried a high risk of injury. The location of all lizards found/observed during the course

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of the field survey are shown in Figures 1–3. Key locations on Phillip Island mentioned in the text are shown in Figure 2 in the *Background Document*.

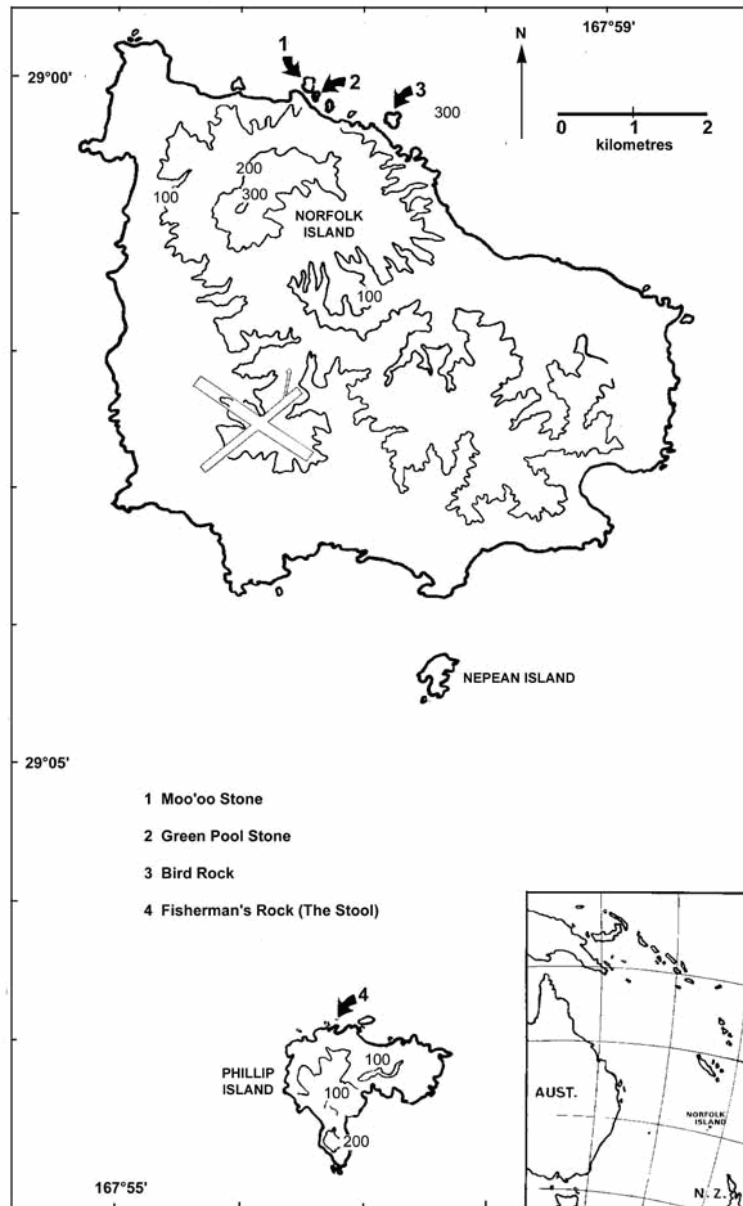


Figure 1: Map of the Norfolk Island complex, showing the major localities mentioned in the text (from Cogger *et al.*, 1979, 1983. Lizards were recorded from Moo'oo Stone and Bird Rock, Nepean Island and Phillip Island. A census of the gecko *Christinus guentheri* was undertaken in March 2005 on Phillip Island.

Phillip Island – qualitative surveys: On Phillip Island, not only were both species widely distributed but were recorded from the supralittoral splash zone to within a few metres of the highest point on the island. A total of 503 lizard observations were made in the course of five days and four nights spent on Phillip Island, consisting of 31 individual *Oligosoma lichenigera*, 453 individual *Christinus guentheri* and 19 *C. guentheri* recaptures.



Figure 2: Aerial photograph of Phillip Island showing location of 453 individual captures of the gekkonid lizard *Christinus guentheri*. A single point may represent the observation/capture of one or more individuals at that location.

In 1978 Phillip Island was extremely barren compared with its current (2005) vegetation cover (Fig. 4).

In 1978 rabbits were still present, and regeneration was extremely low. Only a few scattered Norfolk Island pines (*Araucaria heterophylla*) were present and soil erosion had exposed their roots for a metre or more. White Oaks (*Lagunaria patersonia*) were present in most of the gullies, but most were gnarled, mature trees with much of the lower bark removed by rabbits; few saplings or younger trees were seen. Scattering of African Olives (*Olea africana*) were also present, while ground cover was sparse except in the littoral zone or on vertical cliff faces that were difficult for rabbits to graze. Stands of Moo'oo (*Cyperus lucidus*) were not grazed by rabbits, and so offered dense vegetative cover for lizards in the lower gullies and behind accessible beaches. New Zealand flax (*Phormium tenax*) was also present as mostly small stands in different parts of the island and also provided shelter sites for both skinks and geckos.

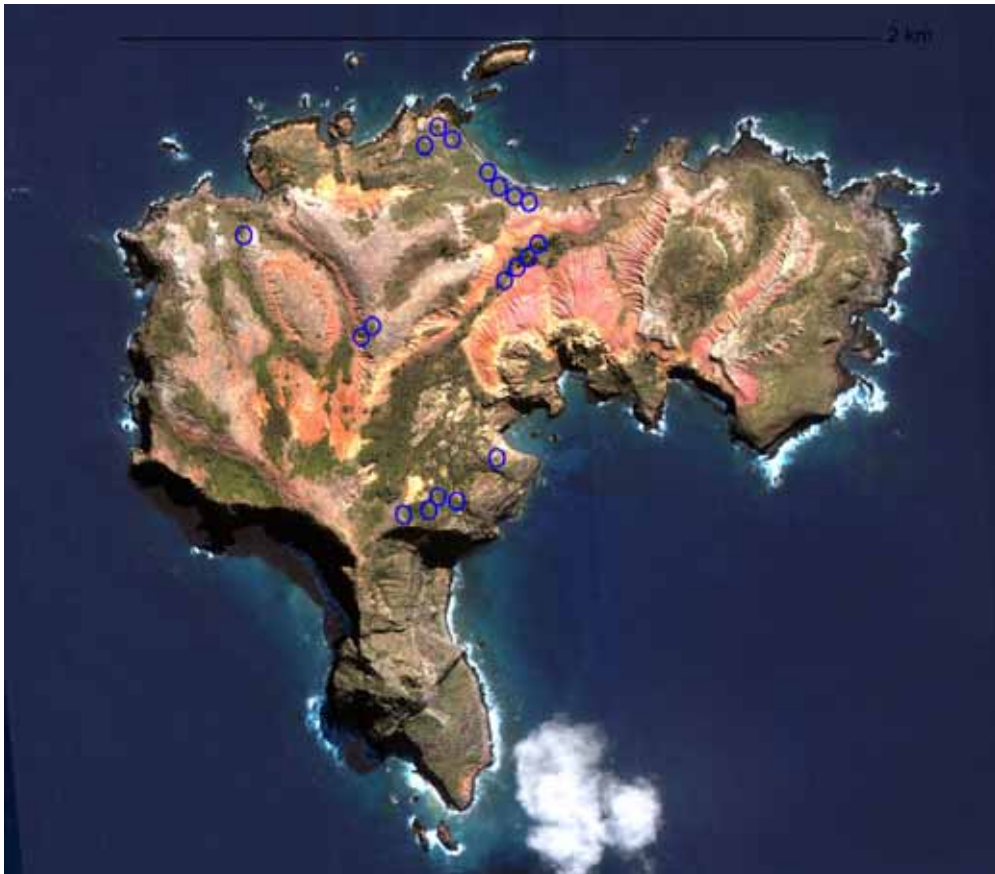


Figure 3: Aerial photograph of Phillip Island showing location of 31 individual captures of the scincid lizard *Oligosoma lichenigera*. A single point may represent the observation/capture of one or more individuals at that location.

In the early 1980s an active and effective programme of rabbit eradication was undertaken by the relevant Norfolk Island authorities. The last known rabbit was destroyed in 1986 (P. Davidson, *pers. comm.*).



Figure 4: Aerial photographs of Phillip Island taken in 1977 and 2002, showing the extent of the increase in vegetative cover from mostly natural regeneration following the elimination of rabbits from the island in the 1980s.

By 2005 vegetation cover on Phillip Island had increased significantly compared with that present in 1978, as shown in Figure 4. Much of this cover has been due to the expansion of invasive species such as the African Olive and paspalum grass (?*Paspalum* sp.). However, native species, especially the White Oak, the preferred arboreal habitat of the gecko *Christinus guentheri*, have also greatly expanded their range and age structure since 1978. Figures 5 and 6 each include a pair of photographs (one taken in 1978, one in 2005) showing the great increase in vegetative cover at particular sites.

One might reasonably expect that the increased habitat represented by the increase in vegetative cover since 1978 might result in a significant increase in lizard numbers. While this appears to be true in expanded native habitats such as *Lagunaria* or upland grassfields, the large and expanding areas of densely packed immature African Olive, and of paspalum in the lower valleys, appear to be excluding the lizards. Both lizard species appear to be largely absent from all but the edges of dense immature groves of African Olives and the dense stands of paspalum. But as these continue to expand in area (despite substantial effort put into African Olive control measures by the Norfolk Island National Park and Botanic Gardens) it is reasonable to assume that lizards are being largely excluded from areas dominated by these invasive plants.



Figure 5: Vegetative changes on Phillip Island between 1978 and 2005: a lone surviving Norfolk Island pine (*Araucaria heterophylla*) photographed in First West End Valley in November 1978 (left) and photographed again in 2005 (right).

The skink *Oligosoma lichenigera* is also relatively abundant and widespread across Phillip Island. Individuals were abundant at the strand sites at which they were also common in 1978. However, they were also numerous at sites across the island (Fig. 3), sites which were bare and devoid of skinks in 1978 but which now have extensive and healthy vegetative cover. As for the gecko, this would suggest that the range of the skink has expanded since 1978 and, by implication, its population size has also increased. This improved conservation status is especially [gratifying] given that the species is currently known *only* from Phillip Island within the Norfolk Island complex.

Phillip Island – quantitative survey (census): In 1978, as part of a herpetofaunal survey of the islands in the Norfolk Island complex (Cogger et al., 1979, 1983), a census of the gecko *Christinus guentheri* was conducted on the small islet (identified in the cited report as Fishermans Hut Rock, and its location indicated in Fig.1). The planar area of the base of this rock, based on its footprint on available maps as approximating an ellipse measuring approximately 60m x 30m and with a circumference of ca. 300m, was estimated to be ca. 5660m² and ca. 30m in elevation. Based on a hemisphere with an identical circumference, the surface area of this rock is estimated to be ca. 8940 m². The mean population estimate for geckos on this rock was estimated, in 1978, to be ca. 680 individuals, or 0.076 individuals/m²; the minimum of five estimates obtained was 0.053 geckos/ha.



Figure 6: Vegetative changes on Phillip Island between 1978 and 2005: the bare summit area in 1978 (upper) compared with the relatively richly vegetated summit in 2005 (lower).



Access was granted by Mr Brooke Watson, Conservator, Norfolk Island National Park and Botanic Gardens, to the Park's hut on the slopes above the track from the northern landing site beside Fishermans Hut Rock (the ANPWS hut location is indicated on Fig. 1). Initially two study plots were chosen within 200m of the hut for nocturnal mark-recapture census studies. Each of these plots was a quadrat measuring 90m x 90m (0.81 ha), including the opposing slopes above a small gully, and each separated from the other by a distance of approximately 50m. The location of these quadrats, and their dominant vegetation, are shown in Figure 7.



Figure 7: Location of two census plots – each 90m x 90m, established near the Park's Hut near the centre of Phillip Island. The western plot (right) was abandoned after the first night because of the difficulty in moving through the dense grasses in the gully without causing lizards to flee before capture.

The vegetative cover on these two plots was very different. That on the eastern plot consisted primarily of a forest of relatively young white oaks (*Lagunaria patersonia*) ranging from saplings to mature trees with a maximum height of ca. 4–5 m (Fig. 8). None of the trees were large-trunked and gnarled, nor were they present in earlier (1977) aerial photographs, suggesting that they have developed since the eradication of rabbits in 1986. There are some open, grassy areas within the white oak stand.

The western plot consisted mostly of waist-high paspalum with emergent clumps of New Zealand flax and a couple of trees (*Araucaria heterophylla* and *Lagunaria patersonia*). Its southern edge abutted a large, dense, continuous and impenetrable stand of African olive averaging about 4m in height (Fig. 7).

All geckos were captured by hand within the two census plots described above and each individual gecko was measured, weighed and painted as indicated above.

On the first night's survey the team recorded 80 *C. guentheri* within the western plot, virtually all of which were captured; weighing, measuring and marking these

lizards took several hours and so no survey was undertaken on that night in the western plot as gecko activity decreased markedly after midnight.

However, the western plot was the first to be sampled starting from dusk the following night, during which only a small number of geckos were observed and most avoided capture because of the density of ground cover and inability to approach active geckos through this cover without creating such a disturbance that the geckos would retreat to cover before they could be captured and marked. Further, no geckos were found active along the outer branches of the African olive forest, in marked contrast to the frequency of geckos on the outer branches of white oak stands..

Given the search effort involved in the census, and the much higher numbers observed and capture rates in the eastern plot, it was determined that on the third and subsequent nights that the team would confine the mark/recapture census to the eastern quadrat. Our observations over five nights indicated, consistent with the 1978 survey, that stands of white oak constituted the preferred habitat of *Christinus guentheri*. It is also noteworthy that within the eastern plot two nocturnally-active individuals of the skink *Oligosoma lichenigera* were found during the gecko surveys, emerging from under rocks while the team was seated on the ground measuring and weighing geckos.

Some 341 individual geckos captures were recorded from the eastern census plot. Given the relatively high density revealed by the first nights survey (80 individuals in 0.81 ha) we anticipated a reasonably high recapture rate on subsequent nights, but this did not prove to be the case. A summary of nightly captures and recaptures over 4 nights is given in Table 1.

Colour	Date	No. Captured	No. marked & released	No. recaptured from Day 1	No. recaptured from Day 2	No. recaptured from Day 3
Day 1 - yellow	4-Mar-05	80	80	*	*	*
Day 2 - green	5-Mar-05	89	89	3	*	*
Day 3 - red	6-Mar-05	103	103	3	10	*
Day 4 - none	7-Mar-05	103	103	5	5	4
	Total No. of individuals marked = 341					
	Total No. of captures = 375					

Table 1: Numbers of individual *Christinus guentheri* captured, marked and recaptured over four nights in the eastern census plot (8100m²).

The data in Table 1 were used to calculate raw (unmodified) Lincoln-Peterson Indices (see *Background Document* for methodology) of the numbers of geckos present in the study quadrat. These results are summarised in Table 2, in a format that is directly comparable with the results of the 1978 census as shown in Table 8 in Cogger *et al.* (1979). This latter report is reproduced as Appendix 2 in the *Background Document* accompanying this report.

Data Combinations	Population Estimate
Day 1 : Day 2	2433
Day 1 : Day 3	2747
Day 1 : Day 4	1648
Day 2 : Day 3	916
Day 2 : Day 4	1833
Day 3 : Day 4	2652
Days 1+2 : Day 3	1339
Days 1+2 : Day 4	1741
Days 1+2+3 : Day 4	2001
Day 1 : Days 2+3+4	2145
Day 1 : Days 2+3	2560
Days 1+2 : Days 3+4	1514
	Mean = 1960.75

Table 2: Population size estimates for the eastern census plot based on application of raw Lincoln-Peterson Index score for the data combinations'

These results indicate a mean density of 1960 individuals of the gecko *Christinus guentheri* in the census plot of 8100 m², or 0.242/m². This compares with 0.089/m² estimated for this same species on Fishermans Hut Rock in the three-night census carried out in 1978 (Cogger et al., 1983).

Whether this 2.7 increase between the 1978 and 2005 censuses reflects an overall increase in the mean density of geckos on Phillip Island over time *within* suitable habitats due to the improved habitat quality resulting from rabbit elimination and other habitat improvements, or whether it simply reflects natural differences between wooded habitats and rocky littoral habitats with low ground cover, is a moot point. We believe the latter explanation is the most parsimonious. There is no evidence to suggest that the carrying capacity of particular habitats has increased during this period.

Rather, we would argue that the total area of suitable habitat has increased significantly since 1978 (Fig. 4), and that this would have resulted in a significant (though unquantified) increase in the numbers and range of both lizard on Phillip Island. The 2.7 increase in estimated densities between Fishermans Hut Rock and our 2005 eastern quadrat is much more likely to reflect the higher structural complexity and volumetric increase of available habitat in a woodland ecosystem compared with coastal cliff systems.

However, in an attempt to obtain a conservative estimate of total gecko numbers on Phillip Island the 2002 aerial photograph of Phillip Island was used to estimate the relative extent of three structural habitat types – wooded areas, areas with

only herbaceous ground cover, and areas mostly lacking vegetation (bare rock faces and bare eroded slopes).

Figures 8 and 9 show the extent of wooded areas and those with only low ground cover. The latter vary widely in the density of herbs present, but their lower densities of geckos reflect the virtual absence of height in the habitat (vs. the multi-layered habitat in wooded areas) and the dependence of the geckos on underlying boulders and rock crevices for winter shelter and egg-deposition sites.



Figure 8: Approximate area (138.8 ha, in solid black) of Phillip Island with vegetative cover in 2002; the balance of 51.2 ha consists of bare eroded slopes or unvegetated rocky cliffs and screes.

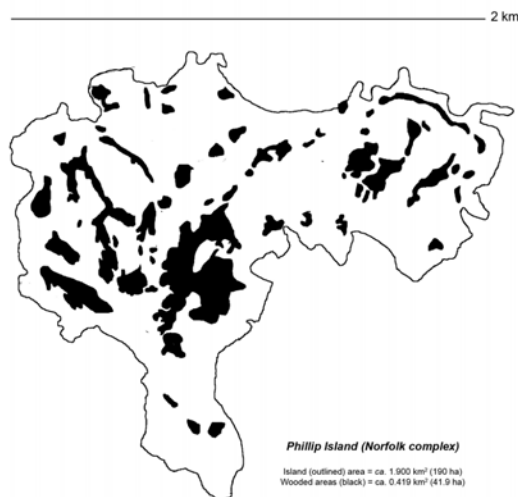


Figure 9: Approximate area (in solid black) of Phillip Island with wooded cover (41.9 ha) in 2002; the remaining vegetated area in Fig. 8 (96.9 ha) consists of a low herbaceous ground cover of varying density.

As indicated in Figures 8 and 9, Phillip Island has a total land surface of approximately 190 ha, of which 138.8 ha is covered by vegetation. Of the latter, 41.9 ha. are covered by wooded habitats (as at 2002) leaving the balance of 96.9 ha. covered by low herbs of varying densities. Bare rocky cliffs and screes, or bare eroded slopes comprise 51.2 ha. . Geckos are found on the latter at night when they venture from vegetated cover to feed, or when there are isolated boulders or fallen timber that provide small diurnal shelter sites to allow small numbers of geckos to permanently occupy these slopes.

If we utilise the *minimum* densities calculated for our 2005 wooded study site (1130 geckos/ha) and our 1978 rocky herbaceous site (530 geckos/ha), together with the vegetation cover in 2002, one obtains a very conservative estimate of the number of *Christinus guentheri* on Phillip Island as follows:

Wooded areas (Fig. 9) 1130 geckos/ha x 41.9 ha woodland =
47,347

Herbaceous areas (Figs 8 & 9) 530 geckos/ha x 96.9 ha. herb cover only =
52,357

Total number of geckos (Phillip Island) 98,704

If we take a less conservative approach, and use the *mean* population density estimates (woodland 2005: 2420 geckos/ha; ground cover only 1978: 760 geckos/ha) the estimated population of geckos on Phillip Island would be 175,582. Note that these estimates compare with the previous conservative estimate made by Cogger *et al.* (1979) of at least 100,000 geckos.

Other islands: Brief surveys were conducted on only three other islands in the Norfolk Island complex – Bird Rock (Red Stone), Moo’oo Stone and Nepean Island. On the first two of these islands two members of the team (GM and GS) found only one adult on each island, although two eggs were also found on Red Rock and utilised for the genetic studies. About an hour was spent on each island.

Only one of the team (HGC) visited Nepean Island, where just over an hour was spent to obtain tissue samples for the genetic study. About 10 *Christinus guentheri* were located, most in rock rubble beneath the wind-stunted cluster of white oaks on the northeastern tip of the island. Searches in the grassy slopes in the centre of the island produced only shed skins, old eggs and one mummified carcass of *Christinus guentheri*. As indicated elsewhere in this report, the scincid lizard *Oligosoma lichenigera* is not recorded from Nepean Island.

Despite floristic changes in the vegetation since our 1978 survey of Nepean Island, no obvious structural changes in the vegetation of the island since 1978 were noted other than a generally sparser grass cover. However this was more likely to reflect different seasonal conditions than fundamental long-term changes.

Ancillary biological data: In the course of our work on Phillip Island we made many observations on the behaviour and habitat preferenda of both native lizard species. Some key results are discussed below.

The relationship between snout-vent length and body mass is shown in three graphs (Figs 10, 11 and 12) covering both species. Insufficient numbers of *Oligosoma lichenigera* were located to warrant the separate treatment of each sex.

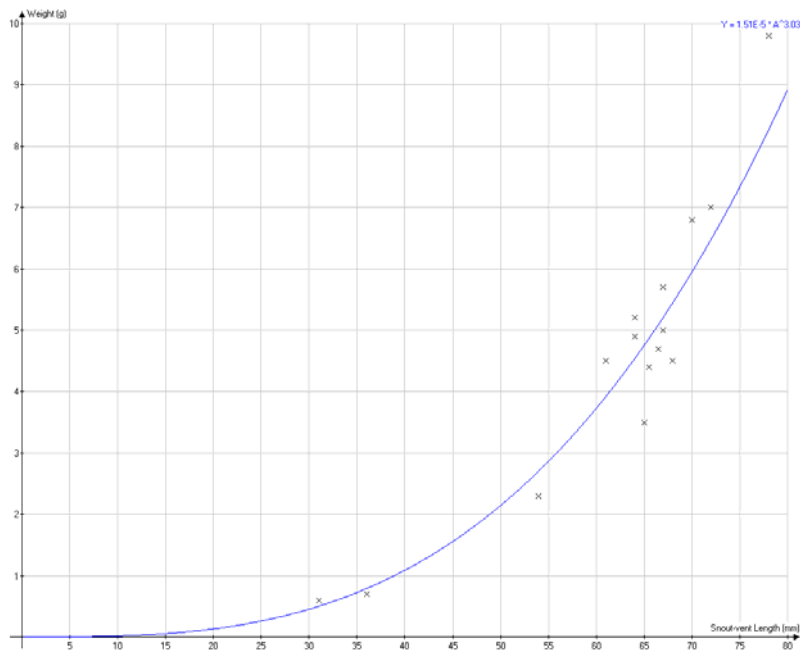


Figure 10: Power curve showing best-fit (correlation (R) = 0.981) relationship between snout-vent length and body mass in *Oligosoma lichenigera* (sexes combined) from Phillip Island, March 2005.

The size distribution of captured lizards is shown for *Christinus guentheri* (Fig. 13), the latter also showing the proportion of tail loss/reproduction among individuals in each size class. Insufficient numbers of *Oligosoma lichenigera* were observed to warrant such an analysis.

The male:female sex ratio in a sample of 345 adult *Christinus guentheri* was 219:126 or 1:0.575, and of 16 females with large eggs visible through the ventral body wall, 10 were carrying a single full-term egg in the left ovary only, two were carrying single eggs in the right ovary, and four were carrying two eggs, one in each ovary.

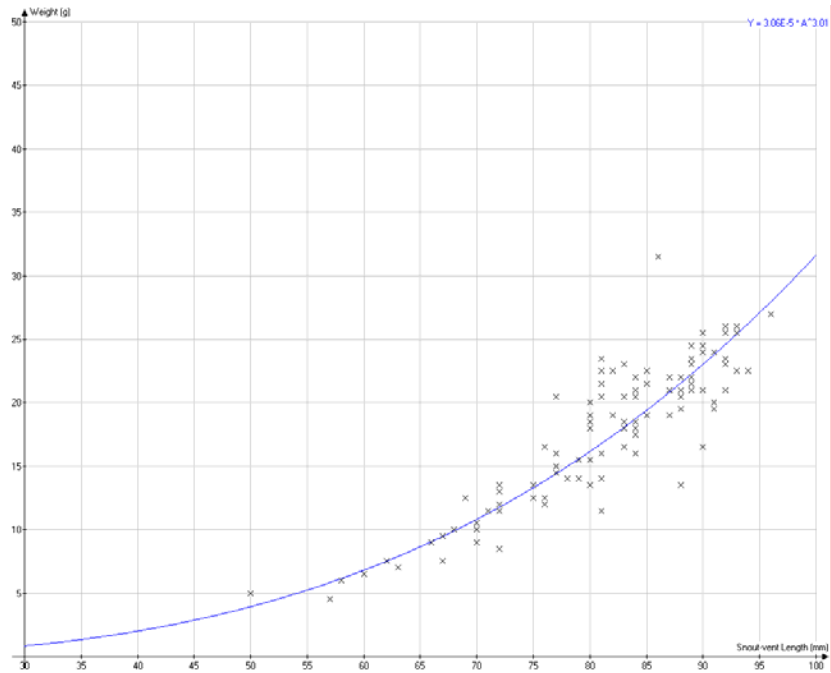


Figure 11: Power curve showing best-fit (correlation (R) = 0.936) relationship between snout-vent length and body mass in *Christinus guentheri* males from Phillip Island, March 2005.

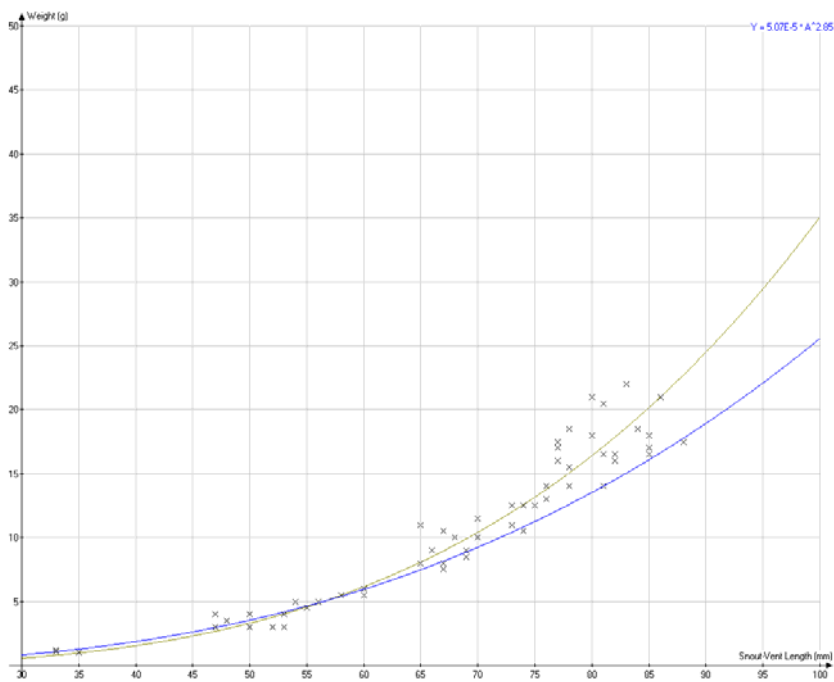


Figure 12: Power curve showing best-fit relationship between snout-vent length and body mass in *Christinus guentheri* females (upper, correlation (R) = 0.951) and unsexed juveniles (lower, correlation (R) = 0.954) from Phillip Island, March 2005.

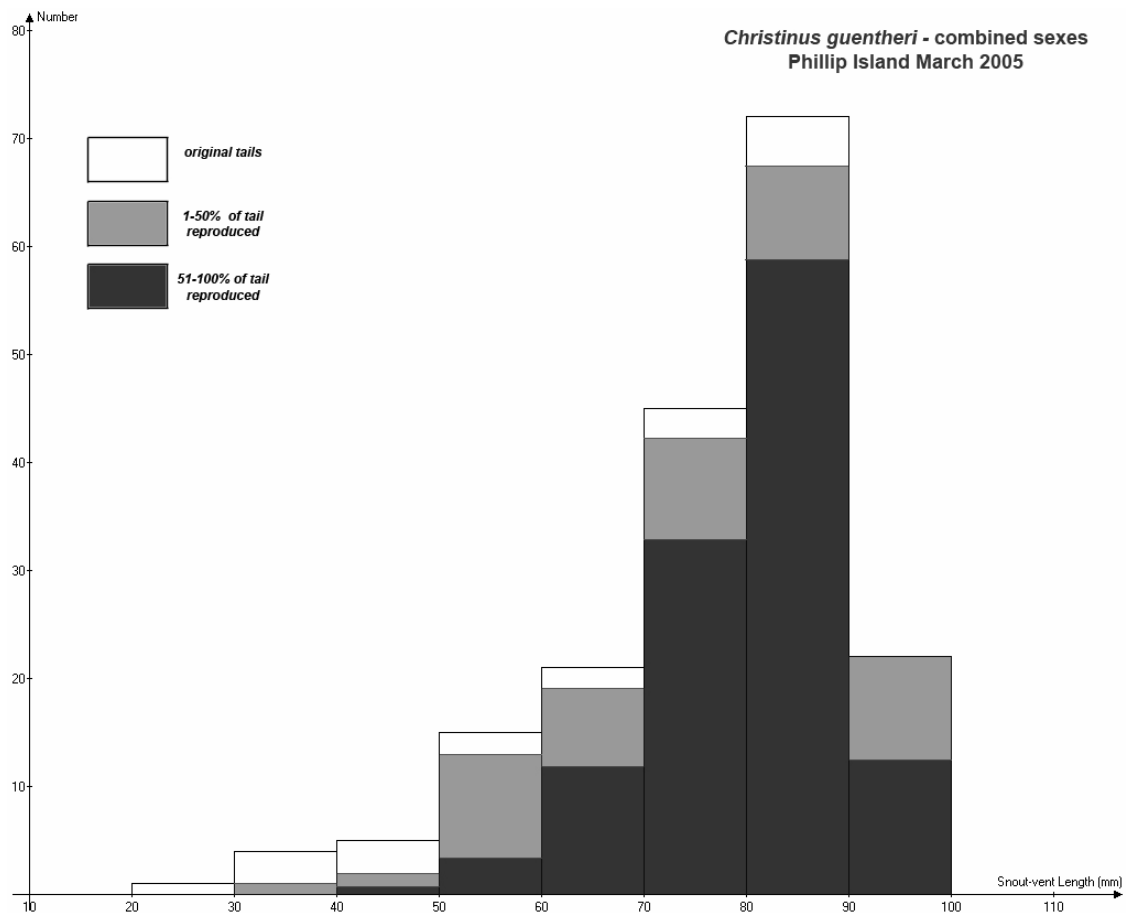


Figure 13: Size classes of *Christinus guentheri* (both sexes combined) from Phillip Island, March 2005, also showing frequency and extent of reproduced tails in each class.

As indicated in the *Background Document*, and in earlier studies (Cogger *et al.*, 1979, 1983) *Christinus guentheri* feeds extensively on nectar during the white oak flowering season, and this has been regarded as a potentially significant seasonal food source. Flowering had long ended at the time of our 2005 survey, but the large pear-shaped fruiting bodies were abundant at this time. These fruits are smooth and hard, and would appear to offer no sustenance to a small insectivorous/nectivorous gecko.

However, we observed a number of geckos licking the basal region of white oak fruiting bodies and discovered, on closer examination, that they were feeding on small quantities of a viscous, brown exudate oozing from the fruit bracts (Fig. 15). We subsequently found that this exudate was utilised by a variety of insects, including ants (Fig. 15) and moths.



Figure 14: *Christinus guentheri* feeding on exudate from the bracts of White Oak (*Lagunaria patersoni*) fruit, Phillip Island, March 2005

While it is not possible to assess the significance of this food source in the diet of the Norfolk Island gecko, it is possible that the exudate itself, and insects attracted to it, may well constitute key dietary elements for this gecko during the white oak fruiting season, thus extending the previously recorded role of nectar as a dietary element during the earlier flowering season.

In relation to the diet of the skink *Oligosoma lichenigera*, the following items were recorded in scats or regurgitated items produced by five individual lizards while being held captive briefly in the course of being weighed, measured and photographed:

- 11 flies (Diptera), two as regurgitated maggots 16.5–17mm long
- 5 beetles (Coleoptera)
- 2 sclerotised insect larvae (? Coleoptera)
- 21 ants (Hymenoptera)
- 2 grasshoppers (Orthoptera)
- 1 isopod (Isopoda).

The numbers of insects are estimates of minimum numbers based on quantity of heads/limbs/wings/elytra, etc.



Figure 15: Ants feeding on exudate from the bracts of White Oak (*Lagunaria patersoni*) fruit, Phillip Island, March 2005

Conclusions: Both species of native lizards are currently secure on Phillip Island and both have populations that are large and likely to be larger (because of the increase in their preferred habitat) than those present in 1978. The available data also suggest that both native lizard species have significantly expanded their geographic ranges on Phillip Island as a result of the revegetation of previously bare slopes.

Conversely, the increased coverage and density of invasive plant species such as paspalum (*Paspalum* sp.) and African Olive (*Olea africana*) appear to have had the effect of depressing populations of lizards that previously occupied the areas into which these plants have expanded. The total effect of these antithetic trends is unknown, but ongoing control of invasive plants is clearly essential to the maintenance of healthy lizard populations.

Time spent on the smaller islands was insufficient to assess changes in abundance that might have occurred in the gecko populations of these islands since 1978. However, the presence of adults and viable eggs on two of the three islands leaves little doubt that populations of the native gecko continue to exist

there, and that minor structural and floristic changes in the habitats present do not appear to have significantly altered their suitability as gecko habitat.

No geckos were located on the main island, reinforcing earlier surveys which concluded that the native species is extinct (though once present) on that island. However, the recent discovery of free-ranging colonies of the highly invasive house gecko (*Hemidactylus frenatus*) on the main island presents a major new threat to the native gecko on the offshore islands and to the latter's successful reintroduction to Norfolk's main island. This issue is more fully discussed in *Report 3*.

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