Field study of *Ctenotus lancelini* on Lancelin Island

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Summary

This document reports on the progress and available results of a field study of *Ctenotus lancelini* on Lancelin Island, which is being conducted under the auspices of CALM and ANCA. A total of 344 *C. lancelini* captures have been recorded in the course of trapping conducted in each month between December 1993 and April 1995. The data collected during the first season of activity trapped (intermittently) from beginning to end (spring 1994-autumn 1995) is herein summarised, presented and subjected to preliminary analysis and interpretation.

C. lancelini was caught between Mid-August and late April. Adult capture rates peaked in October-November and had declined substantially by the time recent hatchlings started to appear in January. Juvenile body condition fell by an average of 15% (both body weight and basal tail diameter (TD)) between January and March, but increased in April after the first substantial rains in 1995, which occurred during the last week of March.

Adult *C. lancelini* were sexually dimorphic in body size, with females being larger than males. The relative recapture rates of marked males and females suggested that about 65% of the adult population was female.

Mean female weight and TD rose from September to October, but TD peaked during October, and weight in November. Mean male TD and weights both peaked during October. Female capture rates peaked dramatically in November which was interpreted to reflect an increase in surface activity associated with the females' reproductive activities. Egg deposition appears to have been concentrated between mid- and late-November. Mean female SVL peaked in October and November: the lower mean SVLs of other months reflected the rarity of encountering the largest females (SVLs ≥ 86mm) in months other than October and November.

C. lancelini was caught on all grids and there was substantial variation in capture rates between grids (which did not appear to reflect obvious aspects of habitat variation such as vegetation patterns or substrate type). Preliminary investigation of patterns of variation in relative capture rates showed that the lowest capture rates were recorded on grids which had southern aspects, and the highest capture rates on grids with northern-eastern aspects.

Inspection of patterns of captures on five grids with higher capture rates showed patterns suggesting a tendency for males to avoid traps or areas with the highest rates of capture for females. Captures of large, gravid females were not evenly dispersed, but were concentrated in a few pits which were distinguished from most other pits by possessing slopes rising to the south in the immediate vicinity of individual pits. The resultant north-facing slopes were assumed to be favored incubation sites, and the relatively high capture rates of gravid females were assumed to have resulted from increased surface activity of gravid females associated with their sampling of soil temperature regimes prior to selection of incubation sites.

The prominence of trends in relative capture rates associated with topographic variation implies that other aspects of habitat variation are of less importance to *C. lancelini* ecology than the incubation/thermoregulatory parameters. The potential for a habitat variable like topography to limit local abundance seems limited, unless there exists social factors or behaviour which limit some individuals' ability to access to such a resource. These considerations imply that *C. lancelini* has so far been little disturbed by the process of change to the vegetation of Lancelin Island. The best density estimates available are crude, but indicate the Island's current *C. lancelini* population is likely to consist of between 1,750 and 3,500 adults.

Future field study will be conducted during the seasonal peak of activity in late September to early December on Lancelin Island and at selected sites around Lancelin to collect further data. Such data will facilitate more reliable estimates of population densities, and provide more numerically robust data which should clarify some of the interesting trends suggested by results obtained during the 1994-5 season. A final report summarising the results of the field studies of *C. lancelini* is expected to be completed during February 1996.

Introduction

This document is the fifth report prepared on the progress and results of a field study of *Ctenotus lancelini* on Lancelin Island, which commenced during November 1993 under the auspices of CALM and ANCA. The *C. lancelini* project is approaching its conclusion, with only two major blocks of work remaining: intensive trapping during the seasonal peak of *C. lancelini* activity (September-December 1995) of the two known Lancelin populations, with the aim of generating reliable estimates of density (and hence deriving an estimate of population size); and subsequently, the final analysis and write-up, which is expected to be completed during February 1996.

Earlier reports (eg April 1994, December 1994) address the issues raised in the Interim Management Guidelines (Burbidge 1993) as possible factors associated with the postulated decline of *C. lancelini*. These factors are unlikely to be of major significance to the status of the current *C. lancelini* population on Lancelin Island, since there has been no indication in the results collected in this study which might suggest the species is, or was recently, declining in any substantial manner. The field methods used in this study were presented in earlier reports (April 1994, December 1994 reports).

This report concerns itself primarily with the documentation of data and preliminary analysis and interpretation of capture records for *C. lancelini* collected throughout the 1994-5 season. This document offers the first opportunity to examine the data set which has resulted from trapping throughout a full season of *C. lancelini* activity.

C. lancelini data and results

Summary of *C. lancelini* trap data

Table 1 shows the number of *C. lancelini* caught during each of the 35 trapping periods conducted since the study commenced in December 1993. The seasonal pattern of captures shows that captures of adults were rare between February and August, and captures of juveniles were rare between May and December. Table 2 lists capture details for each month of the 1994-95 season. Records for *C. lancelini* caught more than once are listed in Table 3.

By August 1994, 41 adult and 19 juvenile *C. lancelini* had been marked. No juveniles or males marked in the 93-94 season were recaptured in the 1994-5 season. Five females marked in the 93-94 season were recaptured in the 94-95 season. Over the 94-95 season 13% of the season's total of 145 captures of females were second or subsequent captures, and 15% of the 81 captures of males were second captures. These results suggest that the the relative capture rates for the genders are probably a 'good' estimate of the sex ratio in the 'population' using the trapped areas. On this basis, 65% of the (1994-5) adult population was female.

Figure 1 shows the position of trapping grids.

Juvenile *C. lancelini*

In both the 93-94 and 94-95 seasons juveniles were first caught in mid-January (Table 1), when the range of body measurements (based on 94-95 season) was: SVL: 29-35 mm, tail length: 46-64, tail diameter: 1.9-2.6 mm and weight 0.4-0.7 g. Captures of juveniles for the 94-95 season (Table 2) showed that the monthly capture rate declined from a January peak. The mean juvenile SVL remained constant between January and April. Mean tail diameter fell during February and March, but rose by April (though it was still lower than the January maximum). Mean weight was constant during January and February, low in March, but by April mean weight was higher than the mean weight in January and February. The size of juveniles caught in April was substantially more heterogeneous than earlier samples (April ranges of: SVL: 32-42mm; weight: 0.5-1.3 g; tail diameter: 2.3-3.3mm). Records for L22.5 (Table 3) show that, when recaptured one month after the initial capture, L22.5 had lost about 17% of body weight, and the tail diameter had fallen from 2.1 mm to 1.7 mm (about 20%). Rain during the last week of March was the first substantial fall of 1995, and preceded the April rises in juvenile body measurements.

Although there are no useful records with which to evaluate juvenile mortality, it seems likely that the falling body condition between hatching and the first autumn rains may have been associated with increasing mortality for juveniles. (Some of the animals handled in early March looked very skinny and sick.) Both the 93-94 and the 94-95 seasons have been extremely dry. The average Lancelin rainfall during January-March totals 39 mm, but in good years can be as high as 120 mm (as in early 1990 and 1992). Recruitment rates seem likely to fluctuate substantially as a result of variation in climate between seasons.

Adult *C. lancelini*

Inspection of mean monthly body measurements of females and males caught in the 93-94 season (Table 2) shows that male *C. lancelini* were smaller than females. The largest male captured had an SVL of 79mm, and weighed 9.9 g. Variation in mean female SVL reflects the relative rarity of larger females during months other than October and November. The following list gives the month and the percentage of all females caught during the month which had SVLs of 81-85mm, followed by the percentage with SVLs ≥ 86mm: September: 44%, 0%; October: 52%, 10%; November: 42%, 8%; December: 16%, 8%; January: 29%, 0%.

Mean male tail diameter and weight both peaked during October, which is presumed to coincide with the early part of the mating season. Mean female tail diameter peaked in November, but had fallen by November, when mean female weight peaked. Only heavily gravid females could be recognised in the field with any degree of confidence.

The array of points on the plot of female weight against SVL (Figure 2a) suggests that most gravid females tended to have weights ≥ 10 g and SVL ≥ 78mm. Only two females recognised (in the hand) as gravid had an SVL of < 80mm (75 and 79 mm). The plot of weight against tail diameter shows a disjunction at about 10.2 g. It seems probable that smaller gravid females may need to shift resources from the tail to the task of egg-growing, but larger females may have less need to do so.

Histograms based on SVLs of all first captures of females and males during the 94-95 season (Figure 3) highlight the extent of sexual dimorphism in body size of Lancelin Island *C. lancelini*. With a bit of imagination two size classes could be implied for males: 65-72mm and 73-79mm. Just a tad less imagination is required to discern three size classes in the female data: 69-73mm, 74-77mm and 78-87mm. The measurements used to construct the histograms were collected throughout the season, so growth of smaller individuals may be confusing size class data which would otherwise provide a sharper definition of age structure.

Four females were caught in both the 93-94 and the 94-95 seasons (L012, L30, L51 & L63) and their SVLs increased by 1-3 mm over 8-11 months (Table 3). Given the error value inherent in measuring the SVL, such increases are almost insignificant. L12 and L30 were both large (SVLs 80 to 83 mm, and 82 to 84mm).

Diet of *C. lancelini*

In September six *C. lancelini* were placed in calico bags after processing and left in the pit for 24-36 hours in an effort to collect faecal pellets. None of these animals produced pellets. No juveniles were held, and no juvenile pellets were found in pits. Pellets were only found in pits between October and early December. This presumably indicates that this period was characterised by higher feeding levels than either earlier or later in the season.

Seven pellets were collected from pits which had had only *C. lancelini* in them since last cleaning/clearing. Inspection of pellet material showed that *C. lancelini* masticated food items well, which limited quantitative and reliable identification of food items. Four of these pellets contained remnants of earwigs (Dermaptera). Three pellets contained remnants of between 1 and 11 bugs (Hemiptera: Heteroptera). Of these, all but one were of a small species common in the pits only between September and November. I had no records of the larger species on the Island, but the identification of the diagnostic mouth parts left no doubt as to its classification. The pellet which contained the large bug also contained a length of grass leaf of ca 1cm. Two pellets contained adult beetle (Coleoptera) fragments: one of a small terrestrial Chrysomelidae, and one of a Tenebrionidae, both of which were commonly found in pits during late spring and early summer. All the invertebrates which were recognised as being those caught in pits tended to appear in pits overnight, rather than during daylight hours.

One female *C. lancelini* was found in a pit with one large spider leg. On other occasions some of the larger spiders which were found in pits with lizards had lost several legs, presumably due to harassment by lizards.

C. lancelini movements

The two juveniles caught twice were caught in the same pit on both occassions. Of adults which were caught twice (14 females and 12 males) 50% of females and 50% of males were caught in the same pit on both occasions. First and second captures were separated by 10m for 21% of females and 17% of males, by 15m for 14% of females and 8% of males, by 20m for 7% of females and 25% of males. One female caught twice was recaptured about 90m from the first capture. Two females caught three and four times were caught in different pits on each occasion. Captures of L30 were enclosed by a minimum area of $50m^2$ and those of L61 were enclosed by a minimum area of $10m^2$.

Behavioral observations

At 1010 am on November 14, 1994, two *C. lancelini* were seen to be in a copulatory position in a pit when the cover was lifted. After slow removal of the cover I saw the two animals lined up longitudinally, with the male's tail (both sexed later) under the female's and vents very close (my view was limited to dorsal). I watched them in that position for about 2 minutes and noted that the male's respiratory rate was about double that of the female. The male broke the apparent union and I could see the extended intromittent bits still exposed. He remained stationary for about 5 seconds, took one slow step, them moved very quickly and the hemipenes disappeared.

At 950 am on November 29, 1994, I noticed an adult *C. lancelini* amongst litter under an *Olearia*, which had a narrow strip of clear sand enclosing the litter below the shrub. Two adults were moving about the area (of about 1.5 sq m), and for much of the time I could sight only one. While I watched the two emerged from an old storm petrel burrow, the follower clasping the leader's tail tip in its jaws. They moved about 30 cm, then one animal gently bit the other's body up and down its length for about 20 seconds. They separated and moved about 10 cm before I saw them lying side-by-side. They stayed that way for about 2 minutes, until my efforts for a better view disturbed them, and they scurried apart and disappeared. I watched the spot for about 15 minutes and sighted one animal at a time about five times moving about the margins of the litter, or around the basal parts of the stems, which were laying flat on the ground. I concluded the watching when I saw one individual at the margin of the litter suddenly dash across about 1 m of bare ground then slowly disappear into a dense mass of *Tetragonia*. The litter was not deep and there was four apparent burrow openings under the bush (3 old storm petrel, one *Egernia bos*).

During the course of the study I've had only about a dozen sightings of *C. lancelini* on the surface which were of animals other than those just released. Juvenile *C. lancelini* account for about half of these sightings. Sightings of *Ctenotus fallens*, *Morethia obscura* and *Egernia bos* were all substantially more abundant. Released *C. lancelini* quickly sought cover and disappeared.

Patterns of geographic variation in capture data

The capture rates of *C. lancelini* varied between grids (Figure 4). Within each major habitat type there was substantial variation in capture rates for different grids. Grids with the lowest capture rates had southern aspects. Grids with the highest capture rates had a variable northern component in the predominant aspect. Grids with eastern or western aspects had moderate capture rates. The highest capture rates for each major habitat type were associated with proximity to steeper slopes.

Inspection of the capture rates of females, males and juveniles on different grids (Table 4) shows that variation in the capture rates of females dominates the patterns of between grid variation. Further, the relative rates of capture of males and females suggest sex ratios differ between grids. Inspection of captures per pit for the 3 main grids with high capture rates and the one grid with male captures much more frequent than female captures (Table 5) shows some interesting trends. Five pits (7, 124, 127, 75 and 78) each caught more than 6 females, and between them these pits caught 41% of all females (40 of 97) caught on G0, GA, G120 and G70. These five pits caught only 14% of all males (4 of 28) caught on the four grids. The general trend apparent in the pattern of captures on these four grids is for pits which caught large numbers (≥ 7) of either females or juveniles (pit A1) to have caught low numbers of the other two groups.

Table 6 lists the SVLs of all females caught in pits which had caught more than two females during the 94-95 season. Records for G0, GA and G120 suggest that pits which caught large numbers of females tended to catch larger females than other pits which caught fewer and smaller females. This result is interpreted as indicating that the pits with high capture rates of large females are in the immediate vicinity of high quality incubation sites, and that larger females have the best rate of access to such sites.

The pits with the highest female capture rates (or mean female SVLs) for each grid (eg 7, 43, 10) all possess some degree of rise towards the south to south-south-west within 50 cm of the pit-cover. The two main areas with the highest female capture rates (G0, G120 and G70) differ substantially in both vegetation and substrate, but these two areas differ from all other sampled areas in having relatively long and steep, north-facing slopes through or above the grids. These observations implicate the characteristics associated with solar radiation reaching the substrate as being a habitat factor affecting incubation site quality.

The overall pattern of covariation between capture rates and topography indicates that issues associated with thermoregulation are a major determinant of relative habitat quality. More extensive and formal numerical analyses of the season's data should provide a more detailed picture of the patterns suggested in this preliminary inspection of trends in the data set.

Status of *C. lancelini*

The status of the mainland population can not be assessed on the basis of the single capture which indicated the presence of *C. lancelini* in coastal dunes at Lancelin. The accurate estimates of population densities required for reliable estimates of the size of the Island's *C. lancelini* population are not currently available, but capture results suggest densities in the range of 250-500 *C. lancelini* per hectare (December report), and hence the size of the Island population would be estimated as 1,750-3,500 individuals.

The species was caught on all grids, suggesting it uses all major vegetation-types on substrates of both sand and rock. In the 94-95 season juveniles were caught on 8 of the 13 main grids, suggesting that successful mating, egg-production, incubation and hatching occurred in a range of different areas.

Preliminary investigation of patterns of variation in Lancelin Island trapping results suggest that the major component of variation in relative abundance of females is associated with incubation site parameters, which are influenced primarily by topographic factors, rather than vegetation characteristics. Hence, this important aspect of *C. lancelini*'s ecology should be relatively immune to the recent changes to the Island's vegetation and seabird usage seems probable that soil temperature regimes are of substantial importance. In terms of the population biology the most important habitat requirement appears to be related to the abundance or quality of suitable incubation sites. A reduction of such could be expected to limit successful recruitment.

The relatively complex pattern of variation apparent in sex ratios in different areas is consistent with *C. lancelini* population structures being influenced by social forces. There is no other evidence at hand to further substantiate the proposition that complex social behaviour may regulate local abundance.

Male *C. lancelini* appear to be excluded from areas with a high density or quality of incubation sites, which are characterised by having slopes which face north to north east. Males accounted for a larger than average proportion of the adult population on grids with slopes predominantly facing east (G20, G130) or west (G100), suggesting that while such areas lacked high occurrences of suitable incubation sites for gravid females they provided more comfortable temperature regimes for adults than grids facing south.

The nature of the vegetation growing on slopes could be expected to limit the amount of solar radiation incident at the surface. Also, the nature of material overlying the sand surfaces may play a role by insulating the soil at night, or by influencing soil relative humidity. It is notable that the areas with the highest capture rates for females have a substantial abundance of winter grasses, which by late November have seeded, fallen over, and partially dried out.

Attempts to quantify the aspect of habitat variation associated with topographic variation present substantial problems. The patterns of captures of large females on grids with low female abundance suggests that the scale of variation associated with slope could be as small as the piles of sand which are created at the entrance of the larger seabird burrows (roughly 50 x 50 cm). The capture data indicates that two components of topography are important: small scale, and larger scale, at about grid dimensions. Both aspect and slope could be measured, but the resultant variables would not be normally distributed, and hence could not be included in habitat analysis which included vegetation and invertebrate abundance parameters.

Although there is an overall pattern of covariation between slope, aspect and *C. lancelini* capture rates, the presence of apparent social exclusion may indicate that some less prominent resource is limiting relative abundance independantly of any temperature factors. Food abundance is a possible contender. Although the data is not presented herein, the relative levels of invertebrate activity were recorded once each trapping trip for each pit. The pursuit of the identification of the main habitat factors with the potential to limit *C. lancelini* abundance remains fundamental to assessing the longer-term viability of the Lancelin Island population, which is the only known population in a conservation reserve.

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References

Earlier reports in this series have been referred to by the month in which they were written (e.g. April, 1994, December, 1994), and the reference refers to the version supplied to CALM and authored by Barbara Jones.

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Table 1. The numbers of adult and juvenile *C. lancelini* caught on each trip (trapping period) since the study commenced. Captures rates can not be compared for the 1993-4 and the 1994-5 season, since the full array of grids was not stabilised until Trip 9 in April 1994.

			ADULTS		JUVENILES	
Trip no	Dates	Month	No of first captures	No of Recaps	No of first captures	No of Recaps
1	22-23	Dec 93	9			
2	17-20	Jan 94	18		1	
3	29-31	Jan	3		4	
4	4-6	Feb	8			
5	14-16	Feb	1		5	
6	25-27	Feb	0		3	
7	9-11	Mar	0		1	
8	29-31	Mar	1		1	
9	9-12	~~Mar~~ Apr	1		1	
10	19-21	Apr			1	
11	27-29	Apr			2	
12	12-13	May				
13	27-28	May				
14	5-6	Jun				
15	3-4	Jul				
16	16-18	Jul				
17	7-8	Aug				
18	16-18	Aug	1			
19	3-5	Sep	5			
20	18-22	Sep	18	2		
21	8-12	Oct	20	1		
22	18-19	Oct	4			
23	29-31	Oct	25			
24	12-15	Nov	32	9		
25	26-30	Nov	64	7		
26	10-13	Dec	12	6		
27	22-24	Dec	3	2		
28	8-10	Jan 95	6	2	5	
29	23-25	Jan	3		20	1
30	2-3	Feb	1	1	7	
31	16-18	Feb	2		3	
32	3-5	Mar			10	1
33	29-30	Mar				
34	11-13	Apr	1		3	
35	19-21	Apr			6	
		Totals	238	30	73	2

Table 2. Summaries of the main details for all *C. lancelini* captures in each month of the 1994-95 season. Tail diameter (TD) refers to the measurement of the basal tail diameter, which was measured laterally and at a distance of 3-5 scale rows posterior to the vent.

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	TOTALS
No of captures										
Adults	1	24	49	115	23	10	4			226
Females	1	16	19	85	12	8	4		1	146
Males		8	30	30	11	2				81
Juveniles						21	11	11	10	53
ALL	1	24	49	115	23	31	15	11	10	279
Capture rates (captures/100 TD)										
Adults	0.2	3.3	4.3	12.2	4.1	2.2	0.9			
Females	0.2	2.2	1.7	9.0	2.1	1.8	0.9			
Males		1.1	2.6	3.2	2.0	0.4				
Juveniles						4.7	2.4	2.0	2.2	
Females										
Mean weight	7.7	8.48	9.38	10.20	8.60	8.75	8.45		9.00	
std dev		1.554	1.658	1.802	0.861	1.285	1.555			
Mean SVL		78.44	80.74	80.13	79.00	78.50	78.75		76.00	
std dev		5.366	4.318	3.728	3.357	2.449	1.708			
Mean TD		7.44	7.90	7.43	6.98	7.04	6.87		7.10	
std dev		0.654	0.546	0.578	0.584	0.447	0.833			
Males										
Mean weight		7.53	8.53	8.06	8.13	9				
std dev		0.938	1.340	1.231	1.521					
Mean SVL	77	73.63	73.73	70.38	73.09	70.5				
std dev		2.774	3.877	12.422	3.700					
Mean TD	7	7.31	7.52	7.21	7.00	6.65				
std dev		0.402	0.467	0.470	0.605					
Juveniles										
Mean weight						0.62	0.62	0.53	0.84	
std dev						0.099	0.178	0.179	0.241	
Mean SVL						33.48	34.27	33.82	33.77	
std dev						1.503	2.195	1.779	7.489	
Mean TD						2.48	2.18	2.12	2.29	
std dev						0.238	0.312	0.333	0.607	

Table 3. Details of individual *C. lancelini* caught on two two or more occasions. TD is defined in the caption with Table 2. Tail length: total tail length (from vent to tip) is indicated by the last figure in the series, the distance between the vent and apparent old tail-break scars precedes total length (e.g. L12's old tail breaks were missed on the first capture, but at the second capture were recorded as being at 55, 65 and 92 mm from the vent).

NO	PIT	DATE	WT	SVL	TD	TAIL LENGTH
Females						
L010.A	6	20.1.94	8.5	75		157
L010.A	6	13.11.94	11.7	78	8.1	85/130
L018	A5	26.11.94	7.6	78	7.1	32/115
L018	A5	22.12.94	7.8	78	6.1	32/114
L012	6	23.12.93	8.5	80		130
L012	7	12.11.94	9.6	83	7.6	55/65/92/101
L016	4	9.10.94	7.8	76	7.4	15/97
L016	4	27.11.94	7.0	76	6.9	16/97
L030	75	18.1.94	10.6	82		61/120
L030	78	19.9.94	9.9	84	8.5	60/121
L030	77	15.11.94	8.4	84	8.4	59/105
L051	8	20.1.94	9.6	79		147
L051	7	20.9.94	8.4	81	6.9	96/150
L063	8	4.2.94	7.9	77	7.5	84/138
L063	A3	12.11.94	10.1	78	8.1	85/140
L063	A2	11.12.94	7.8	79	7	85/140
L063	5	13.12.94	8	78	6.7	84/139
L088	55	5.9.94	9.9	86	7.7	72/129
L088	58	26.11.94	11.2	86	8.2	74/148
L096	119	19.9.94	8.0	75	7.4	35/105
L096	1	8.1.95	7.5	77	6.6	33/108/109
L119.A	25	11.10.94	9.4	85	8.4	35/37
L119.A	25	12.12.94	9.8	86	8	34/59/70
L129	112	11.10.94	9.0	80	7.4	50/114/116
L129	116	28.11.94	10.4	81	6.8	53/115/125
L146	26	29.10.94	8.0	74	7.7	51/68
L146	26	27.11.94	8.2	76	6.6	51/62/63
L178	72	20.9.94	11.1	83	8.0	101/154
L178	72	14.11.94	14.0	83	8.4	102/157
L223	4	12.11.94	9.1	75	7.4	60/140
L223	2	27.11.94	8.0	75	6.9	60/111
L249	123	12.12.94	8.8	79	6.8	153
L249	123	2.2.95	7.2	78		152
L259	119	14.11.94	8.8	74	7.6	42/131
L259	116	9.1.95	9.3	74	7.3	40/113/115
L019	27	3.1.94	7.7	68		90/129
L019	27	29.11.94	8.9	72	7.1	91/141
L034	135	21.9.94	8.0	74	7.1	84/128
L034	135	13.11.94	8.8	75	7.5	82/110/122

NO	PIT	DATE	WT	SVL	TD	TAIL LENGTH
Males						
L061	5	18.1.94	9.6	85		42/109
L061	A2	25.2.94	9.2	87	7.4	46/110
L087	24	4.9.94	6.0	77	7.1	15/109
L087	24	8.10.94	8.2	76	7.4	15/107
L093	121	19.9.94	7.1	69	7.3	70/121
L093	123	13.12.94	6.8	70	6.3	73/125
L095	119	19.9.94	10.0	78	8.0	75/142
L095	118	15.11.94	9.7	78	7.7	76/141
L097	23	19.9.94	6.0	70	6.3	29/97
L097	23	14.11.94	7.3	71	7.3	29/105
L112	55	9.10.94	9.1	76	8.0	43/134
L112	51	13.11.94	9.4	76	7.9	43/135
L126	26	8.10.94	5.8	70	6.9	9/30/34
L126	27	23.12.94	6.5	69	6.6	10/33/55
L158	77	29.10.94	10.7	78	7.7	100/150
L158	77	13.12.94	9.6	76	7.3	100/151
L234.A	126	12.11.94	6.5	67	6.9	18/84/92
L234.A	124	28.11.94	6.9	67	6.5	16/95
L287	72	31.10.94	10.2	75	8.0	80/105
L287	72	13.12.94	11	74	7.5	80/126/140
Juvenile						
L022.5	29	3.2.95	0.6	35	2.1	61
L022.5	29	3.3.95	0.5	34	1.7	60

Table 4. Captures of female, male and juvenile *C. lancelini* listed for different grids. Grid locations are shown in Figure 1. GA refers to five extra pits placed within G0. Effort refers to the number of trapdays per grid during the 1994-5 season. Capture rates are expressed as captures per 100 trap days.

Grid	G0	GA	G0+GA	G10	G20	G30	G40	G50	G60	G70	G90	G100	G110	G120	G130
Effort	370	285	655	414	414	406	425	425	425	425	408	392	430	419	425
Females															
Raw	25	17	42	5	10	1	2	4	0	25	1	5	11	30	10
Cap. rate	6.75	5.96	6.41	1.21	2.42	0.25	0.47	0.94	0.00	5.89	0.25	1.27	2.56	7.17	2.35
Males															
Raw	4	2	6	2	18	0	3	5	1	12	2	9	3	10	10
Cap. rate	1.08	0.70	0.92	0.48	4.35	0.00	0.71	1.18	0.24	2.82	0.49	2.29	0.70	2.39	2.35
Juveniles															
Raw	4	12	16	6	1	0	2	4	3	6	2	2	2	8	2
Cap. rate	1.08	4.20	2.44	1.45	0.24	0.00	0.47	0.94	0.71	1.41	0.49	0.51	0.46	1.91	0.47
Adults															
Raw	29	19	48	7	28	1	5	9	1	37	3	14	14	40	20
Cap. rate	7.83	6.66	7.32	1.69	6.77	0.25	1.18	2.12	0.24	8.71	0.74	3.57	3.25	9.56	4.71
All															
Raw	33	31	64	13	29	1	7	13	4	41	5	16	16	48	22
Cap. rate	8.91	10.86	9.77	3.14	7.01	0.25	1.65	3.06	0.94	9.65	1.23	4.08	3.72	11.47	5.18

Table 5. The numbers of male, female and juvenile *C. lancelini* caught during the 1994-5 season in individual pits on G0, GA, G120, G70, and G20 (pits with no *C. lancelini* captures not included).

Trap no.	No of Fems	No of Males	No of Juvs
1	3	4	1
3	3		
4	4		1
5	3		1
6	1		1
• 7	10		
8	1		
A1	1		9
A2	5	1	
A3	5		
A4	1	1	1
A5	5		2
121	5	1	2
123	2	1	
• 124	7	2	1
125	3	1	1
126	1	3	2
• 127	8		
128	2	2	2
129	2		
71			
72	4	5	1
74	1		
• 75	8	1	1
76	1		1
77	3	4	2
• 78	7	1	
79	1	1	1
21		2	
23	1	3	
24	1	4	
25	2	1	
26	3	2	
27	1	2	
28	2	2	
29		2	2

Table 6. SVLs of all females caught in pits which had 2 or more captures of female *C. lancelini* during the 1994-5 season.

Trap no	Mean SVL	Raw SVLs
1	77.3	76,77,79
2	75.5	76,77
4	77.3	75,76,76,82
5	79.3	78,80,80
7	81.7	80,80,81,81,81,81,82,82,83,86
A2	76.2	74,75,76,78,79
A3	81.4	78,81,82,83,83
A5	75.6	72,73,77,78,78
11	80.5	80,81
25	85.5	85,86
26	73.7	74,76
28	81.0	78,84
43	80.5	80,81
72	81.0	79,79,83,83
75	82.8	80,81,81,82,83,84,85,86
77	84.3	84,84,85
78	82.9	78,82,83,83,83,83,87
109	78.5	71,86
116	78.1	74,76,78,78,80,80,81
121	78.6	74,76,78,81,84
123	78.5	78,79
124	81.6	78,80,80,82,82,82,87
125	79.3	77,79,82
127	80.8	75,80,80,81,82,82,82,84
128	75.5	72,79
129	76.0	75,77
133	81.5	77,79,86
134	84.0	84,84
135	79.5	75,84
136	81.0	79,83

Figure 1. Map of Lancelin Island showing the approximate location of grids and the three main habitat types (L: shallow soil over limestone, CD: central dune, EF: eastern foredune). The trap array indicates the numbering system used for pits: pit one on each grid was that pit in the most southwesterly corner of each grid.

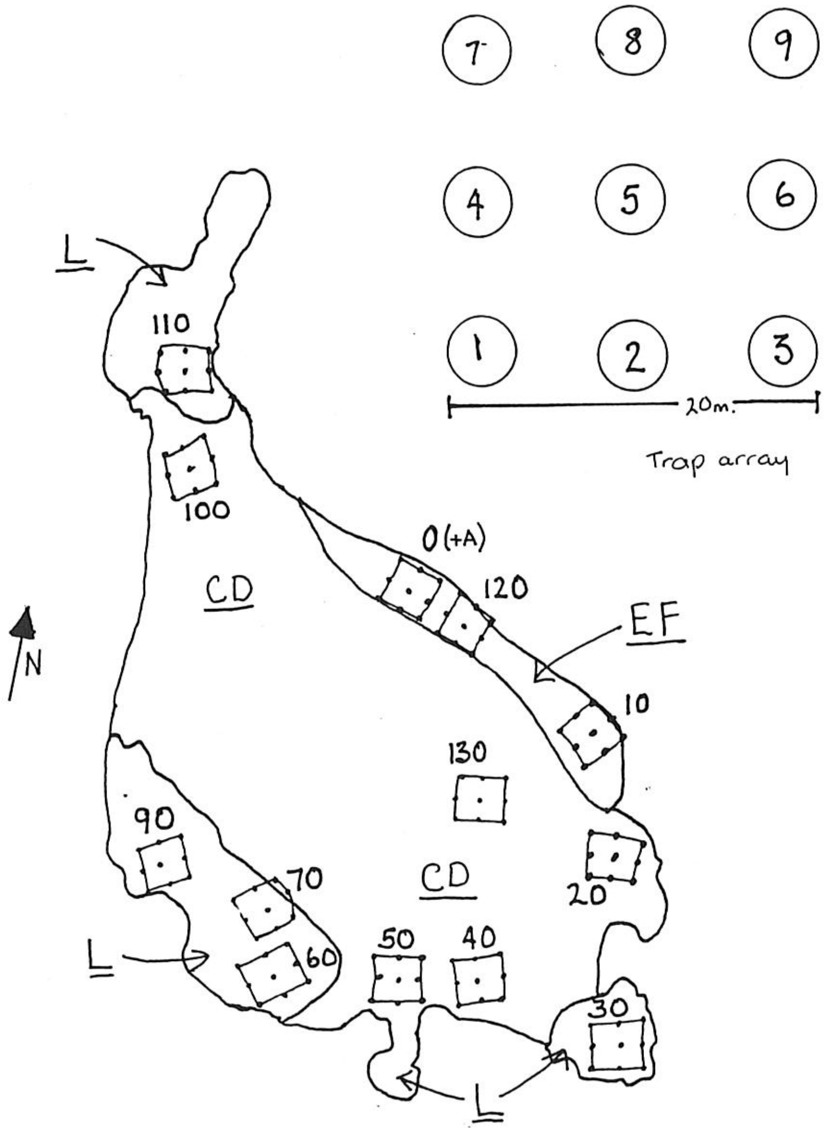


Figure 2. Size-weight relationships for female *C. lancelini* caught during September (solid diamonds) October (open squares) and November (solid squares) of the 1994-5 season. (a) female weight and SVL, and (b) females weight and tail diameter.

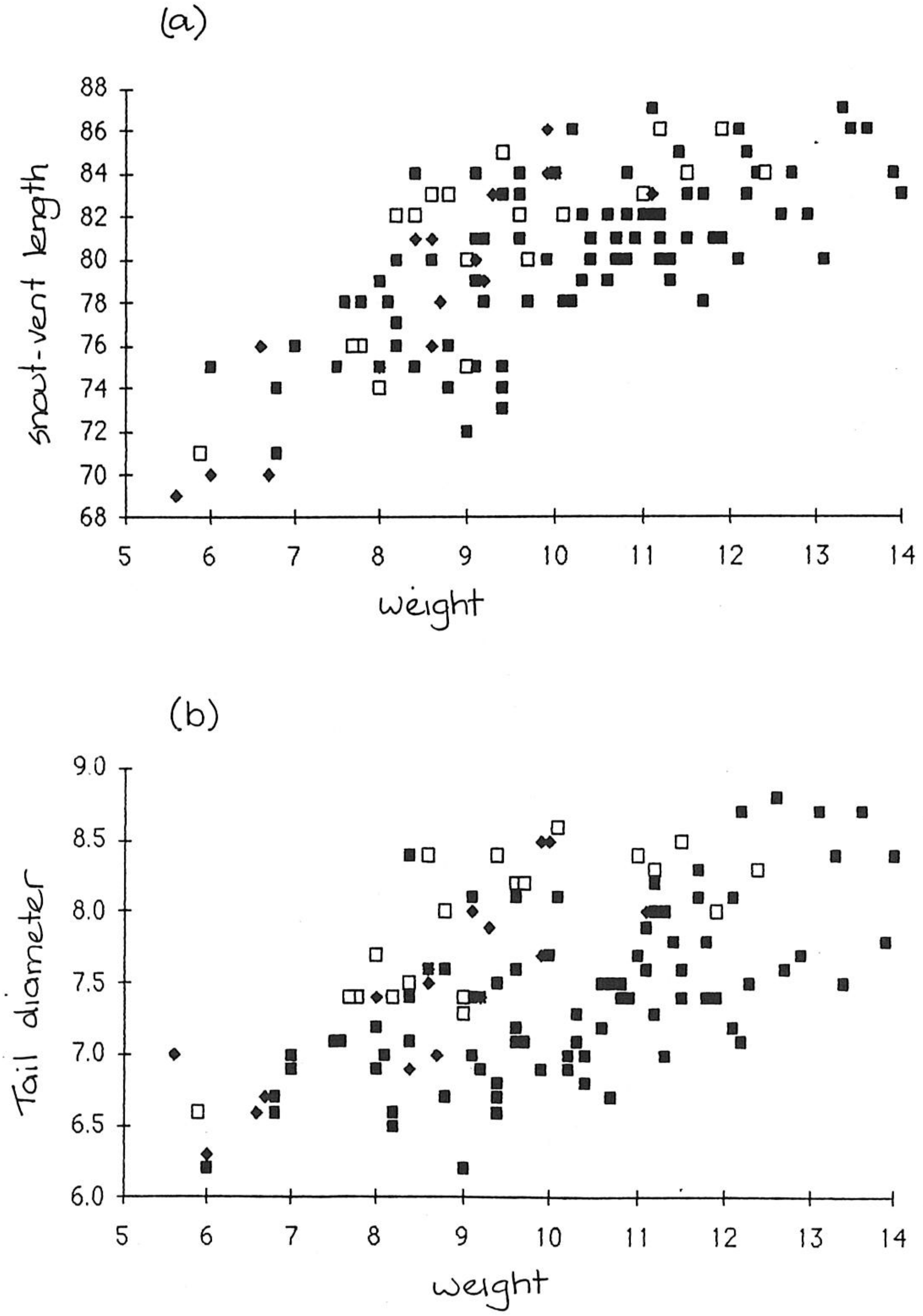


Figure 3. Frequency histograms showing the size distribution based on SVL at first capture of (a) female and (b) male *C. lancelini* caught during the 1994-5 season.

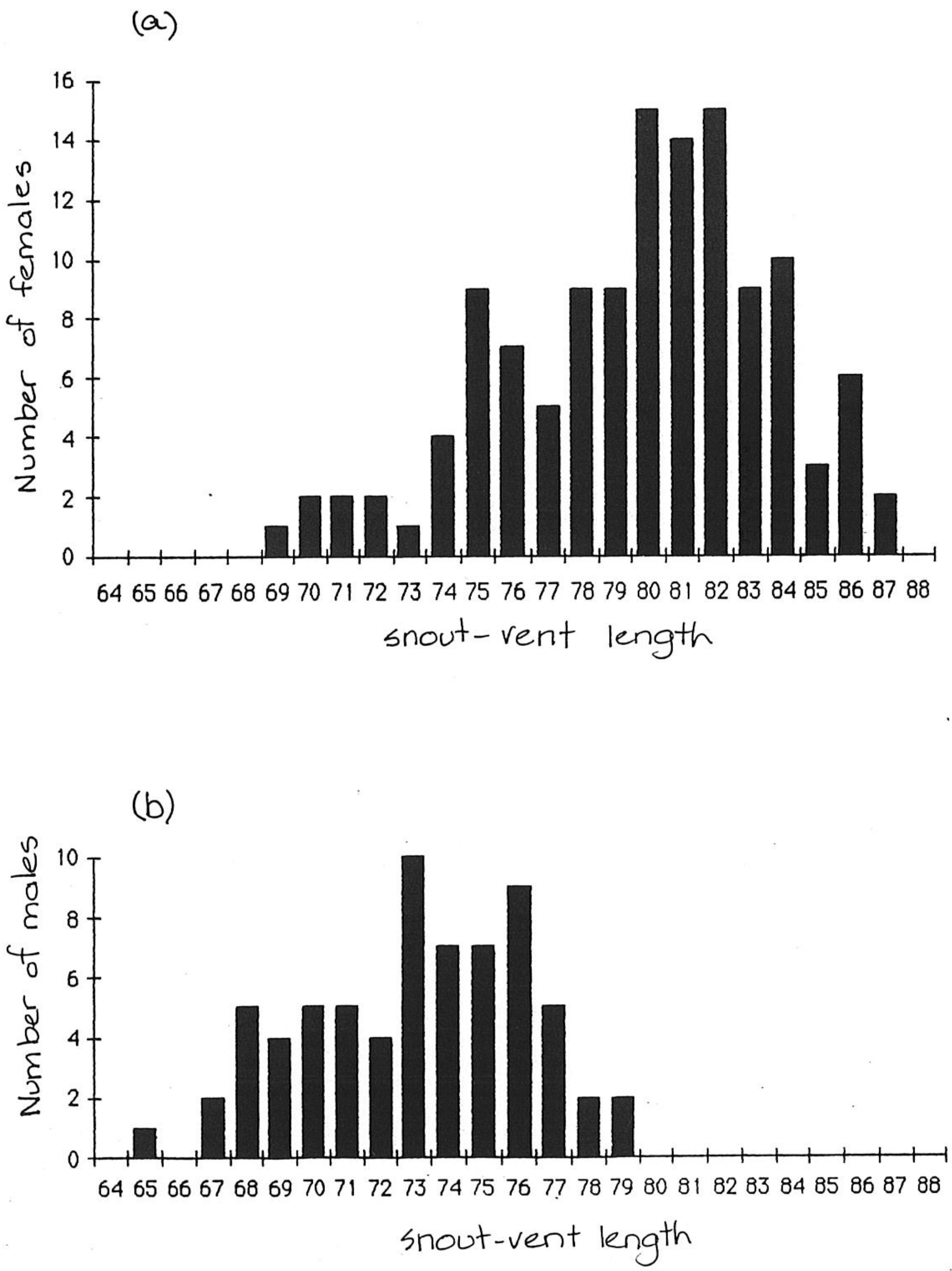
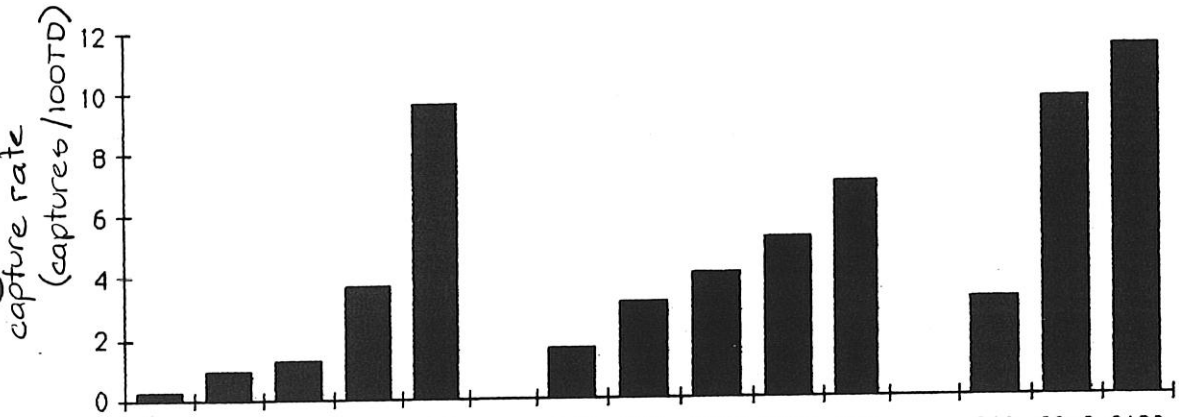


Figure 4. Histogram of capture rates of *C. lancelini* on each grid (based on all captures per 100 TD). The tabulation below summarises some aspects of non-biotic habitat variation between grids.



Grid #	G30	G60	G90	G110	G70	G40	G50	G100	G130	G20	G10	G0+GA	G120
Predominant Aspect	S	S	S	SE to SW	NNW to NE	S	SSE	W	E	ENE to SE	ENE	NNE	ENE
Slope	SL	SL	SL	ST	ST	M	M	ST	ST	ST	SL	S*	S*
Substrate	shallow grey sand over limestone					deep fawn sand					deep white sand		
Topo	elevated areas above cliffs					slopes of large central dune					swale behind beach		

Slope codes: SL: slight; ST: steep; M: moderate

* some pits (1, 4, 7, 121, 124, 127) are within 1m of the base of a very steep NE slope

Figure 5. Histogram of capture rates of female (solid bars), male (open bars) and juvenile (stippled bars) on different grids. Capture rates were based on all captures during the 1994-5 season.