An Investigation of Bait Uptake by Feral Cats on Peron Peninsula, Western Australia

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Abstract

Bait uptake by feral cats has indicated variability in bait consumption both on a temporal and spatial scale. Examination of whether bait uptake is influenced by short-term weather parameters and/or the time of year and if so, when bait uptake is at its peak, will determine the optimum timing of control programs to maximise efficiency. With the aim of improving on-track baiting efficacy of feral cats on Peron Peninsula, a bait uptake study was conducted.

The results of this study indicated that bait uptake by feral cats displayed a high degree of short-term variability but clearly became more frequent and consistent as the study period progressed. Patterns in bait response as well as on-track activity appeared to be related to a number of environmental factors. Significantly, bait response was related to the abundance of rabbits. Bait response and track activity were not controlled by the same environmental factors and as such there was no clear relationship between the two. There was a significant preference for the standard cat bait and this could be potentially enhanced by the use of visual lures. Baiting efficacy can also be significantly affected by non-target species consuming baits, reducing bait availability to feral cats.

This study has provided a number of avenues to improving existing on-track baiting efficacy.

Introduction

Examination of bait uptake by feral cats has indicated variability in bait consumption both on a temporal and spatial scale. Unlike canids that will continue to eat after they are sated (pers. ob.), cats, despite being opportunistic predators, will only consume a food item if they are hungry (Bradshaw 1992). Thus for cats to consume baits they must encounter them when hungry. If a cat encounters a bait it may not consume it regardless of the acceptability of the bait. This will cause a degree of variability in daily bait uptake over a given period.

Bait uptake trials are generally conducted over short periods (eg. nightly, over a three-night period), over relatively short distances (eg. 20 km/night) where relatively few animals are present (4 – 5 cats). These trials with low sample size can only be expected to provide a high daily variability in bait uptake due to the short-term condition of the animals and their relative state of hunger. The amount of time cats spend seeking food varies between individuals, sexes and seasons however, it accounts for less than 50% of total activity (Turner and Meister 1988). Improving sample size in bait uptake trials by increasing the distance of observations or the number of days of observation may not necessarily reduce variability. Variability will be due to the response of individuals and a combination of individual response and the influence of short-term weather conditions respectively.

The influence of prevailing (short-term) weather conditions and lunar phase on animal behaviour and activity has long been of interest to biologists. Behaviour and activity are in part a response to environmental stimuli, as animals have a limited ability to modify their immediate environment to maintain physiological function. Feeding patterns and thus bait uptake by feral cats are therefore likely to be influenced by these short-term environmental variables.

The relationship between hunger and bait acceptability can also be extended to prey availability and bait consumption. It follows that if there is an abundant prey population, the likelihood of cats encountering baits when hungry is somewhat diminished. Therefore when prey availability is high, bait uptake is invariably low – “the baiting window theory”. If the assumption that the relationship between prey availability and bait uptake is real, variability across months/seasons is likely to occur giving a seasonal/temporal trend. As predator-vulnerable young prey becomes more abundant, which is a function of long-term weather conditions (season/rainfall), bait uptake is likely to decline. This baiting window occurs in autumn in areas influenced by an arid, Mediterranean climatic regimes when live young, predator-vulnerable prey are often not present. In the arid zone where rainfall is unreliable, the time and intensity of rainfall events such as cyclones and thunderstorms will determine the abundance of live prey (King *et al.* 1983). A difference in bait uptake across geographic areas, when conducted at the same time of year may reflect differences in prey availability.

Examination of whether bait uptake is influenced by short-term weather parameters and/or the time of year and if so, when bait uptake is at its peak, will determine the optimum timing of control programs to maximise efficiency.

With the aim of improving baiting efficacy of feral cats on Peron Peninsula, a research program was conducted with three main objectives: -

- to assess whether bait uptake by cats is influenced by measurable and predictable environmental factors and if so can bait uptake be enhanced by baiting at specific times;
- to compare the efficacy of the current standard bait against other bait types;
- to examine a number of lures that may invoke a gustatory response and thus potentially improve bait uptake on the peninsula.

The results of this research program are presented in this document.

Methodology

Study Site

Peron Peninsula was formerly a pastoral station. The peninsula was purchased by the State Government in 1990 to establish Francois Peron National Park on the northern end of the peninsula. The peninsula, an area of 1,050 km^2, lies within the Shark Bay World Heritage Area (see Fig. 1) and is joined to the mainland by a narrow neck (the 3.4 km Taillefer Isthmus). This area is now the site of Project Eden, part of the broader Western Shield program. Project Eden is aimed at controlling introduced predators and returning native wildlife to an area from which many mammal species have become extinct (Thomson and Shepherd, 1995; Algar and Smith, 1998). To prevent reinvasion by foxes and cats from the mainland onto the peninsula a barrier fence was built across the isthmus in 1995. This has effectively created an island of the peninsula in terms of introduced predator management.

Peron Peninsula has been arbitrarily divided into four zones (see Figure 1). These zones are operated on a rotational basis for predator control, by Project Eden staff. The bait uptake trials were conducted along transects in Zones 2, 3 and 4 (see transect locations on Figs. 2-4). The whole of Zone 1, and parts of others, was omitted from the study site due to the high level of public use.

It was necessary to conduct the bait uptake trials along transects in zones distant from where the operational trapping programs were being conducted during any given period. The availability of track access and zone selection was therefore governed by the location of District operational activities. As toxic baits were used in this study, further track and area restrictions were imposed because of the 1080 poison bait buffers. Legislation controlling the use of 1080 toxin in Western Australia prohibits the laying of poison baits near to areas frequented by humans. Therefore, in the interest of public safety, buffers exist around areas such as Denham town-site, Monkey Mia Resort, camping areas and public roads.

Climate

Beard (1976) describes the climate of the Peron Peninsula as 'semi-desert Mediterranean'. Payne *et al.* (1980) provide climatic data for a number of nearby centres. Prevailing summer winds are southerly to south-westerly, relatively dry,

Figure 1: Peron Peninsula

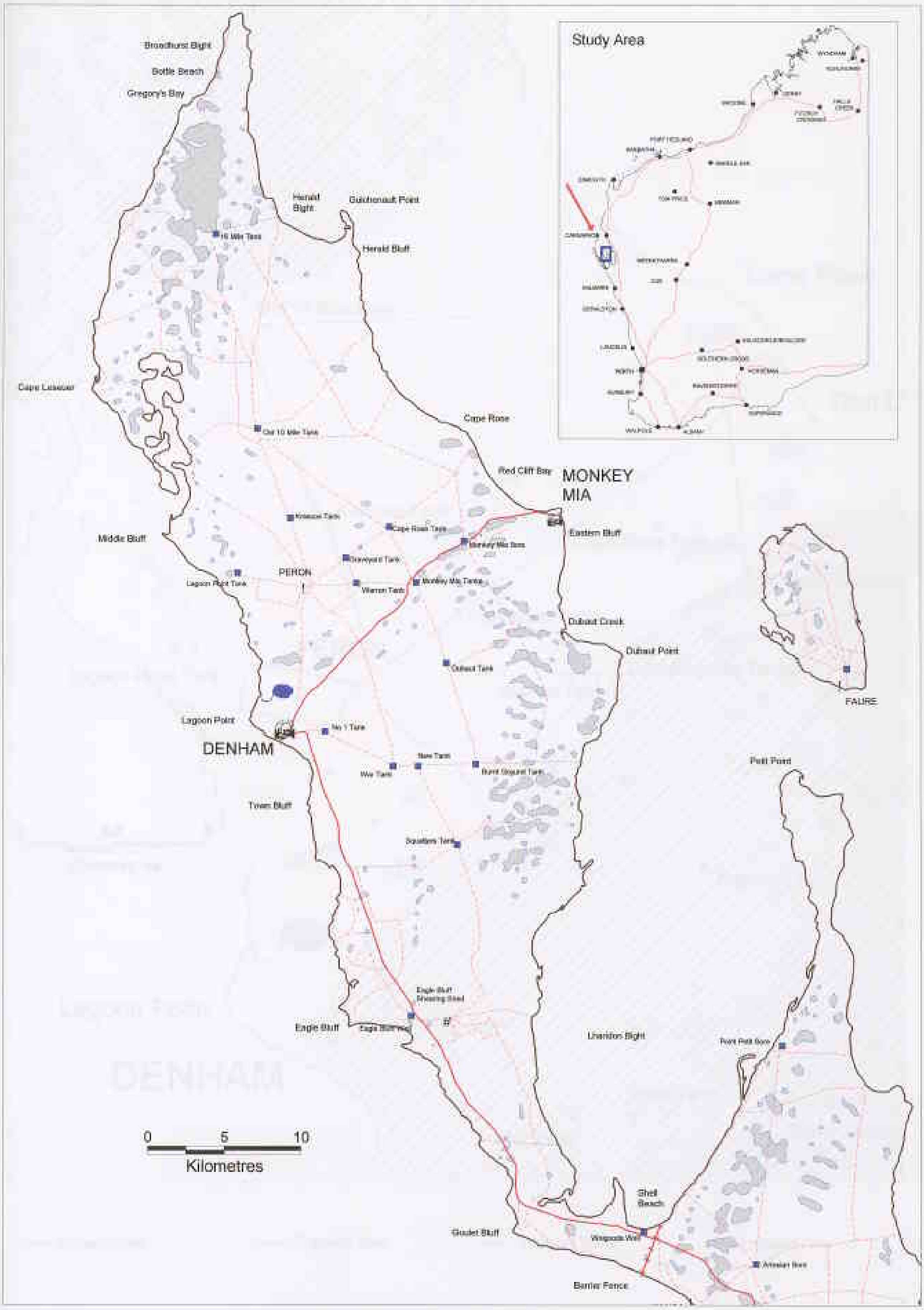


Figure 2: Zone Two

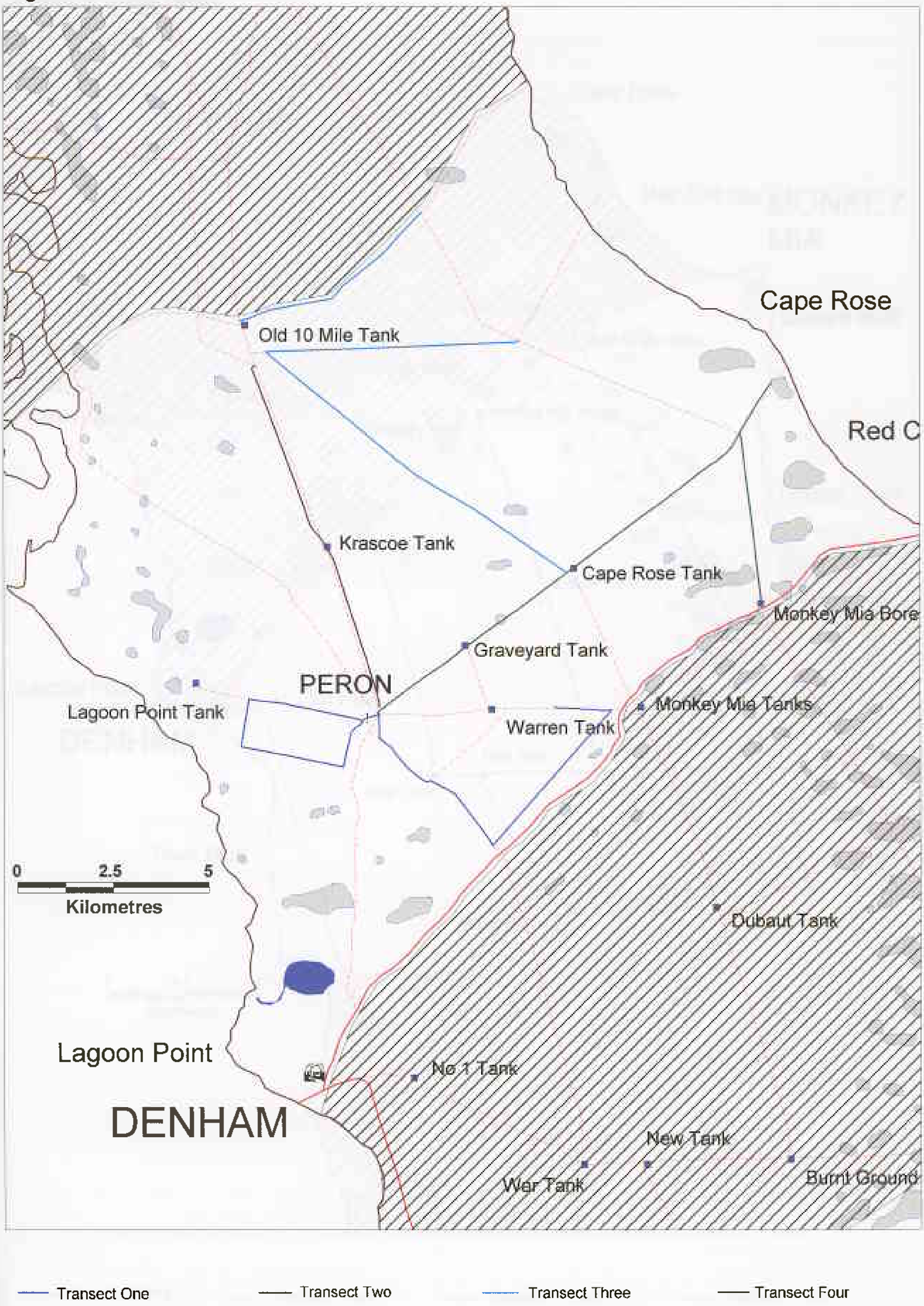
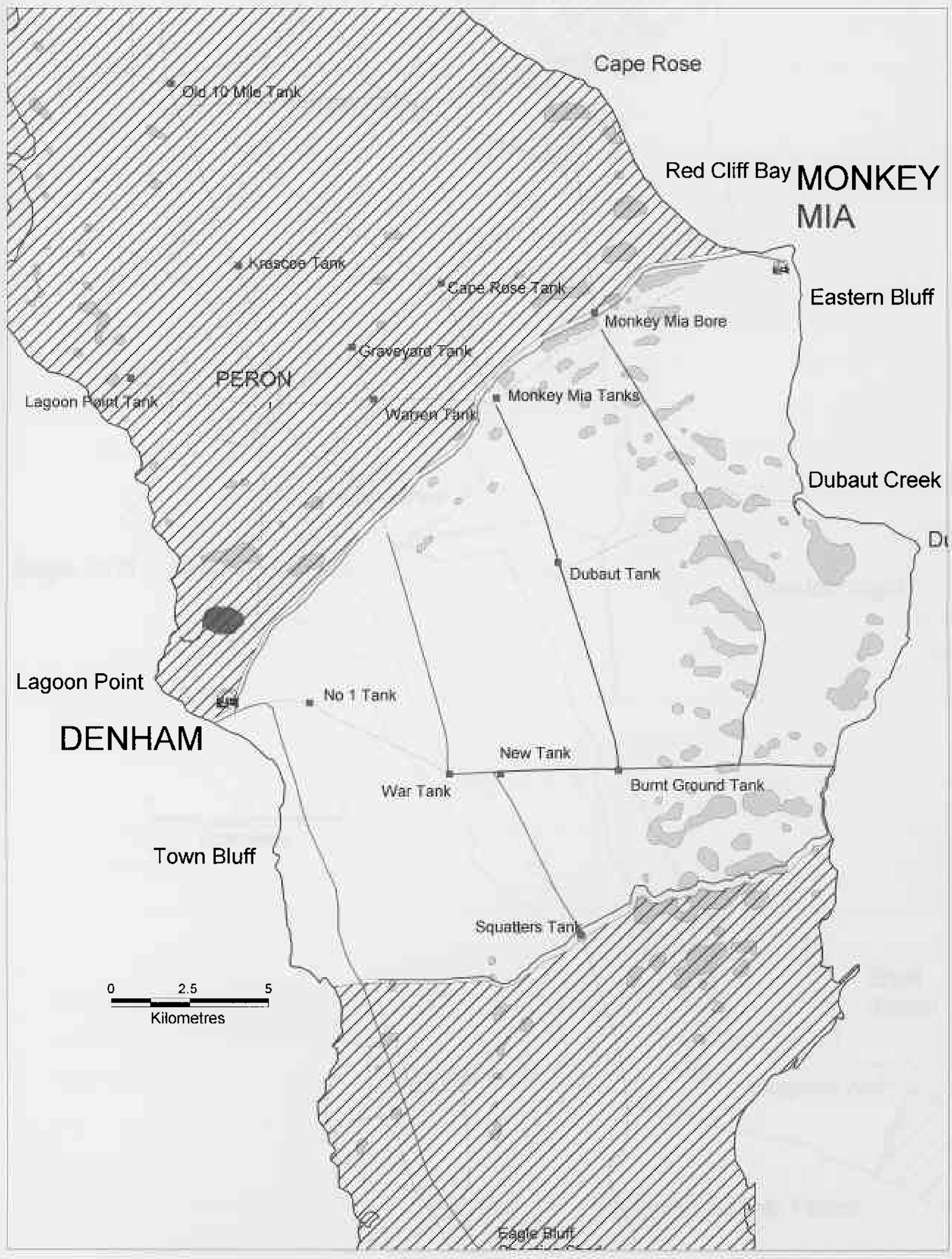


Figure 3: Zone Three



—— Transect One —— Transect Two —— Transect Three —— Transect Four

Figure 4: Zone Four

warm and moderately strong. Prevailing winter winds are lighter, more humid and cool. There is a prevailing south-easterly morning tendency and a south-westerly afternoon tendency. Mean maximum daily temperatures, for nearby reporting centres, are as high as 38^0 C for summer months and as low as 21^0 C for winter months. January and February are the hottest months while June and July are the coolest winter months. Annual average rainfall for centres adjacent to the Peron Peninsula are in the vicinity of 215-220 mm. The area receives reliable winter rainfall with June being the wettest month at approximately 50 mm on average. Rainfall is extremely unreliable and often absent, outside the winter months. However mean annual rainfall may be exceeded during a single cyclonic event.

Geology

The Peron Peninsula is situated on the Gascoyne sub-basin of the Carnarvon basin. Hocking *et al.* (1987) describe the geology of the Carnarvon Basin while Playford (1990) provides more detail on the peninsula itself.

The peninsula is formed principally of Peron Sandstone. This formation is a red aeolian sandstone, accumulated in the Pleistocene, as a series of interlocking dunes. The west coast of the peninsula, from near Denham - south, is of Tamala Limestone. This rock formed as a succession of aeolian limestones, when oceanic sands accumulated as dunes, under the influence of very strong prevailing winds. The Peron formation is now mostly overlain by superficial deposits of red sand and the ancient dune system is still obvious. The Tamala formation is mostly overlain by calcareous yellow-red sand but has a number of surficial expressions to the west of the Denham-Hamelin Road. Small playa lakes (birridas) are common across the peninsula, in interdunal depressions. These consist of gypsiferous evaporite deposits.

Vegetation

Beard (1976) and Payne *et al.* (1980) describe the vegetation of the peninsula. The two agree roughly on the nature and location of the associations present.

Five broad vegetation units occur across the study area - *Acacia ramulosa* scrub, *Acacia* thicket, *Acacia ligulata/Triodia plurinervata* shrub steppe, *Acacia/Lamarchea* thicket and the succulent steppe of the birridas. A minor association occurs in small, near-coastal strips. This is variously a *Spinifex longifolius* grassland or myrtaceous heath on coarse, pale sand or coquina deposits.

The Acacia scrub occurs on undulating orange sand dunes. This association is dominated by *Acacia ramulosa* which grows to ~3m in sheltered positions. Associated species are *A. sclerosperma, A. tetragonophylla*, *Grevillea* spp, *Santalum spicatum* and mallees over low shrubs of *Dodonea inaequifolia*, *Scaevola spinescens* and several *Eremophila* spp.

The *Acacia* thickets occur on orange and pale yellow sands, on the exposed western side of the peninsula. This association is strongly dominated by dense, low *A. ligulata*, with occasional low *A. sclerosperma*, *A. tetragonophylla* and *Atriplex bunburyana*.

Shrub steppe occurs on the paler, calcareous sands over Tamala Limestone. It is dominated by *Triodia plurinervata* grassland with occasional emergent low *A. ligulata* and scattered *A. sclerosperma* and *A. tetragonophylla*. A large disturbed area, to the south of the Eagle Bluff shearing shed, is dominated by *Cenchrus ciliaris* grassland, generally to the exclusion of native species.

The *Acacia/Lamarchea* thicket occurs on undulating red dunes, in the exposed north-west portion of the study site. It exists as a low dense scrub to 1.5 m, dominated by *A. ligulata* and *Lamarchea hakeifolia*. Common associates are *Melaleuca cardiophylla*, *A. tetragonophylla, S. spinescens and Eremophila* spp.

Birridas are variously vegetated with succulent steppe, many with large areas of bare, saline and alkaline clay. Margins and lake flats support low, halophytic shrubs such as *Frankenia* spp, *Halosarcia* spp, *Atriplex* spp and *Muellerolimon salicorniaceum*. Many birridas encompass areas of mounded gypsiferous deposits. These areas are vegetated by scattered low shrublands of *Scaevola crassifolia*.

Vegetation and Zones

Most of Zone 2 supports *Acacia* scrub on undulating dunes. A relatively small area near the intersection of Woylie Track, Aerial Track and the 10 Mile Buffer supports shrub steppe on a northern outlyer of the Tamala Limestone. The western-most portion of the zone supports *Acacia/Lamarchea* thicket. A small number of birridas occur in Zone 2. They are seldom more than 600 m in extent.

Most of Zone 3 supports *Acacia* scrub on undulating dunes. The eastern portion, in particular, is dissected by numerous birridas, many of which are several kilometres in extent. The northwest portion of the zone (west of New Bore) is vegetated by Acacia thicket.

Transects in Zone 4 are almost exclusively through shrub steppe, including the modified grasslands in the vicinity of the Eagle Bluff Shearing Shed. The southernmost sections traverse a series of birridas, generally flanked by *Acacia* scrub (the latter unmapped). The western-most transect is over a sizeable area of *Spinifex longifolius* grassland, variously on coquina deposit or coarse pale sand.

Bait Uptake Trials

The bait uptake trials were conducted along track access (transects). During the first five-day period, two transects, each of 20 km, were conducted per night. One transect was used to investigate bait uptake of the standard bait type, the second, separate transect (cafeteria trial) was used to assess the acceptability/consumption of different bait media and potential lures that may enhance bait uptake (see below, Bait types and Bait lures). Operating two transects proved to be extremely difficult because the time required to complete the circuits allowed for a high level of non-target activity by diurnal species. This led to difficulty in interpreting the track activity at bait stations and often higher bait consumption by non-target species. Conducting two transects per night also reduced the number of tracks available without repeatedly using the same transects during that period. As such, after the first five-day period, the standard and cafeteria trials were combined in the one transect (see below).

Bait laying procedures

Four series of bait uptake trials were conducted per month across lunar phases and weather conditions. The proposed trial periods were mid November – mid December, mid January – mid February and mid March – mid April. These time frames were reviewed in early February (Project Eden Management Committee meeting) and it was decided to extend the second period into March, after a short break. The field time extension occurred because of the onset of continuous bait uptake from late January and the need to maximise sampling periods prior to the onset of rainfall.

Bait uptake trials were conducted over four to five-day periods each week, depending on available track access. Transects available for use was determined by the operational rotation of trapping by Project Eden staff. At least one 10-day operational trapping program was conducted on any particular transect, prior to being used again for this study. Tracks were chain-dragged as the baits were laid to clear sign of previous activity. Bait laying commenced two hours before dark. Baits (bait stations) were laid, in the centre of the track, at 100 m intervals, measured by the vehicle odometer, along approximately 20 km of track per night.

The transects comprised: -

- a single, standard cat bait laid at 100 m intervals;
- a cafeteria where three bait types (see 2.2.2. Bait types) were offered at 500 m intervals;
- a lure (see 2.2.3. Lure types) with cafeteria at the1000 m intervals.

Thus in a 20 km bait uptake transect there was a 20 x 1 km replicate containing: -

a) standard baits at 100, 200, 300, 400, 600, 700, 800 and 900 m
b) a set of the three different bait media at 500 and 1000 m
c) a lure at the 1000 m cafeteria

A 20 km bait uptake transect presented: -
a) 160 standard bait stations;
b) 20 cafeteria stations;
c) 20 cafeteria stations with lure

Baits were positioned only on sandy substrate where it was possible to observe track activity (eg. baits were not located on birridas). All baits were treated with an ant deterrent compound (Coopex®) at a concentration of 12.5 g l^{-1} Coopex as per the manufacturer's instructions.

Bait types

The acceptability of the standard cat bait was assessed against two other bait types at cafeteria stations that were placed along the bait uptake transects. The three bait types were: -

- Standard sausage cat bait approximately 25 g wet-weight, dried to 20 g and then blanched. The bait was composed of 70% kangaroo meat mince, 20% chicken fat and 10% digest and flavour enhancers. Each bait was injected with 4.5 mg 1080.
- Chicken sausage bait produced in the same manner and to the same specifications as the standard cat bait but composed entirely of chicken mince. Each bait was injected with 4.5 mg 1080.
- Dead day old cockerel. This bait medium was not included on the existing experimental bait permit and therefore baits were non-toxic.

The latter two baits were selected for the bait preference trial after discussions with associates. The chicken sausage was nominated because of its relative ease of manufacture but different composition from the standard bait. The dead day old cockerel provided a "natural bait" alternative to the other two and has been used successfully in controlling feral cats elsewhere (Brothers 1982; Twyford *et al.* 2000).

Bait lures

Initially, five different lures were employed to compare relative frequency of bait uptake in their presence. The lures comprised three visual (tinsel, rodent and reptile) and two audio lures (rabbit and bird sound). The lures are described below: -

- Tinsel lure was constructed from a sheath of tinsel attached to a chaining arrow, such that the tinsel fluttered in the breeze
- Rodent lure comprised a fluffy toy rat/mouse that was attached to a spring on a chaining arrow to allow it to move in the wind
- Reptile lure consisted of a plastic fishing lure presented in the same manner as the rodent
- The rabbit and bird audios consisted of a 36 x 25 mm printed circuit boards with microprocessor data driven voice roms that imitated sounds of "rabbit" or "bird" calls.

One lure type was used per day over the four-five day period. At the end of the first month the rodent lure was abandoned as avoidance behaviour by cats was noted on several occasions as lures were approached.

Assessment of bait response

The bait uptake transects were examined the morning following bait placement, commencing one hour after dawn. Track assessment was conducted from a 4-WD vehicle, driven at a speed of less than 10 km/h. The observer was seated in an elevated position on a chair bolted to the kangaroo bar. Each bait station was inspected and the response of individual cats at the bait stations was recorded as no tracks present, a bait pass, visit or uptake. These bait responses are described by: -

- No track — There was no cat track within 3 m of the bait.
- Pass — A cat track was located within 3 m of the bait but the cat did not deviate from its path to inspect the bait.
- Visit — Cat tracks were within 0.5 m of the bait and indicated that the animal had deviated from its path to inspect the bait, but the bait had not been eaten.
- Uptake — Bait removed. Cat prints approaching the bait, pes and/or tail imprints present, indicating the cat had assumed a sitting position. No non-target prints within reasonable reach of the bait position.

It was necessary to add a further response category of "probable uptake". This response displayed the characteristics of a bait "visit" but where the bait had been removed. Wind erosion or the presence of non-target species' activity prevented assigning a species to removal of the bait with absolute certainty. This category was classified a bait visit in the actual bait uptake summaries. Potential uptake was the sum of actual uptake and probable uptake.

The spacing of baits on the transects often enabled individual cats to encounter more than one bait. The response of individual cats was recorded for each bait station however; the highest ranking bait response for the individual animals was used in bait uptake summaries and statistical analyses. As such, if an individual cat was recorded as passing a bait and then visiting another bait later on the transect, the individual cat's bait response was categorised as a visit, and so on.

Cat Activity

The location of individual cats along transects was recorded and their on-track distances logged. Feral cat use of vehicular tracks, as a measure of activity, was based upon the actual distances travelled on the track, rather than the total span of interaction with the track. The total on-track activity of all individuals present was recorded, including those that did not encounter baits.

Measuring exact on-track distances travelled by individuals is generally impractical. For the purposes of this exercise, the only objective measures of distance available to observers, were the 100 m intervals (initially measured with the vehicle odometer) at which baits were placed. Therefore recording of distance travelled was effectively coded for distances of <100 m, ≥100 m or multiples thereof. Distances of <100 m were nominally coded as 10 m, or multiples thereof.

The total on-track distance travelled was the sum of all <100 m and ≥100 m intervals assigned to the particular individual.

Non-target Bait Uptake

Consumption of baits by non-target animals was recorded. Consumption was assigned to a particular non-target animal when no other was within reasonable reach of the bait position.

Assessment of Rabbit Abundance

Rabbits, when present, can form a substantial proportion of feral cat diet (e.g. Jones and Coman, 1981 and Martin *et al.*, 1996). This is the case at Peron Peninsula (Project Eden unpub. data). The presence of such a food source was seen as potentially impacting upon bait acceptance by feral cats. Therefore rabbit abundance was subjectively determined, over a 10 m interval, at each 100 m bait station. The number of rabbits at each station was recorded as a category based on the number of tracks present. It was not possible to differentiate tracks from two or more rabbits and as such four categories were used: - (0= rabbits absent; 1=1 rabbit; 2=2 rabbits and 3=> 2 rabbits).

Weather Data and Lunar Phase

Weather data was obtained from the Australian Bureau of Meteorology weather station in Denham. The data collected comprised: - temperature, wet bulb temperature, dew point, relative humidity, barometric pressure, wind direction, wind speed, rainfall and cloud cover. The method of data collection for the measured variables and also the formulae for the derived variables is presented below.

Temperature (^{0}C)	Thermometer, Mercury, Dry Bulb (Type Dobbie)
Wet Bulb (^{0}C)	Thermometer, Mercury, Wet Bulb) (Type Dobbie)
Barometric Pressure (hPa)	Barometer (Type Kew pattern mercury, replaced 30/11/99 with Vaisala PTB220B)
Wind speed & direction (km/h & deg)	Anemometer (Type Synchrotac-dial, replaced 02/03/00 with Davis Weather Wizard).
Rainfall (mm)	Raingauge (Type 203)
Cloud Cover (scale 1-8)	Estimated visually by observer

Dew-point temperature (T_d) = (234.18*ln(e/6.11)/{17.08-ln(e/6.11)}

Relative humidity (RH) = e/e_w*100

where: T = temperature and (T_w) = wet-bulb temperature

e (vapour pressure) = e_w - 0.00066*p*(T-T_w)

e_w (saturation vapour pressure) = 6.11*exp{17.088T_w/(234.18 + T_w)}

p is air pressure (hPa)

Readings for each of the above variables were collected at three hourly intervals over a 24 h period. The Bureau of Meteorology does not record the 2100 h readings because of the cost involved. As such, night-time weather data were for available for 1800, 0000, 0300 and 0600 h.

The lunar cycle was described by luminosity, which was calculated by the time difference between moon rise to moon set and the time of sunrise/sunset, multiplied by the lunar stage as a percentage. The Perth Observatory supplied this data.

Statistical Analyses

Bait uptake

The step-wise methodology for statistical analysis of the bait uptake data is illustrated in a flow chart (see Figure 5). The proportion of contacting cats taking baits ('bait uptake') was related to a set of potential predictor variables (see Table 1) using logistic regression analysis. Logistic regression is analogous to the common linear regression model, but is appropriate where the dependent variable, in this case whether or not a cat takes a bait, is a binary ('yes/no') response. In ordinary regression the response variable is assumed to have a normal distribution. Data were appropriately transformed in order to achieve homoscedasticity and approximate normality of residuals. Appropriate transformations were determined by diagnostic tests of residuals: stem-and-leaf plots, normal-normal plots and plots of studentized residuals against fitted values.

Logistic regression analysis provides a method of determining those variables that are related to bait uptake, and the direction and extent of that relationship. The logistic regression model was applied using the SAS software package (procedure LOGISTIC, SAS Institute Inc., 1989).

To estimate the relationships between categorical variables such as lure type and the bait uptake, each categorical variable was coded as a design (or 'dummy') variable (see for example Hosmer and Lemeshow, 1989). Each categorical attribute consisting of (n) categories was replaced with (n-1) binary design variables. For example, in the case of lure 3, the four design variables would be coded as lure 2 = 0, lure 3 = 1, lure 4 = 0, lure 5 = 0 (see Table 1). The names of these design variables were created by concatenating the parent variable name and the category number. This method of coding means that the estimated regression coefficient for each design variable represents the deviation of that category from the first category. For example, a significant, positive regression coefficient associated with the design variable lure 3, would indicate a higher incidence of bait uptake at bait stations

Figure 5: Logistic regression model building.

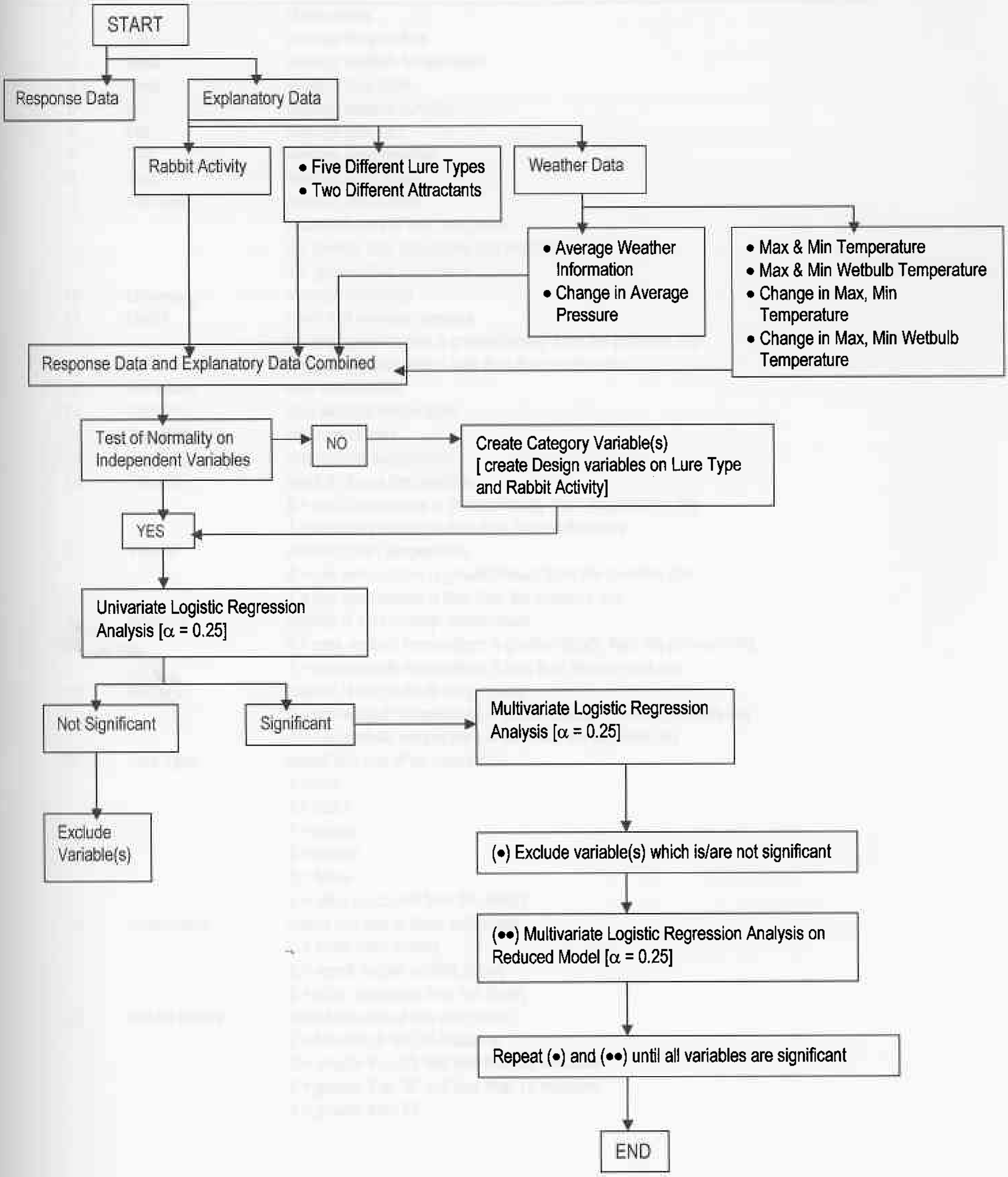


Table 1: Description of variables used in logistic regression.

no	Variable	Description
1	n	observations
2	Temp	average temperature
3	Wetb	average wetbulb temperature
4	Dwpt	average dew point
5	RH	average relative humidity
6	Msl	average pressure
7	DIR	average wind direction
8	Kmh	average wind speed
9	CldCode	average cloud cover coded into one of two categories : 0 = greater than 0 inclusive and less than 1 1 = greater than 1 inclusive
10	Luminosity	average luminosity
11	MslRF	rise/fall of average pressure 0 = average pressure is greater/steady from the previous day 1 = average pressure is less than the previous day
12	TempMax	max temperature
13	WetbMax	max wetbulb temperature
14	TempMin	min temperature
15	WetbMin	min wetbulb temperature
16	TMaxRF	rise/fall of max temperature 0 = max temperature is greater/steady from the previous day 1 = max temperature is less than the previous day
17	TMinRF	rise/fall of min temperature 0 = min temperature is greater/steady from the previous day 1 = min temperature is less than the previous day
18	WMaxRF	rise/fall of max wetbulb temperature 0 = max wetbulb temperature is greater/steady from the previous day 1 = max wetbulb temperature is less than the previous day
19	WMinRF	rise/fall of min wetbulb temperature 0 = min wetbulb temperature is greater/steady from the previous day 1 = min wetbulb temperature is less than the previous day
20	Lure Type	coded into one of six categories : 1 = bird 2 = rabbit 3 = reptile 4 = rodent 5 = tinsel 6 = other (excluded from the study)
21	audio/visual	coded into one of three categories : 0 = audio (bird, rabbit) 1 = visual (reptile, rodent, tinsel) 2 = other (excluded from the study)
22	Rabbit activity	coded into one of four categories : 0 = between 0 and 25 inclusive 1 = greater than 25 and less than 50 inclusive 2 = greater than 50 and less than 75 inclusive 3 = greater than 75

where lure type 3 was used, when compared with stations using lure type 1. Similarly, binary categorical variables such as a rise or fall in daily temperature, were coded 1 (fall) or 0 (rise). For these variables, a significant, positive regression coefficient indicates a higher incidence of bait uptake associated with a fall in temperature.

The final multiple regression model was estimated using the stepwise model-building strategy of Hosmer and Lemeshow (1989). This strategy uses backward elimination of variables deemed non-significant at alpha = 0.25. A value of 0.25 ensures that in building an initial model, no potentially important variable is excluded. As the transect data was the result of a limited number of surveys, we sought to identify all possible environmental variables that may be useful as predictors of bait uptake. Thus lure type was excluded because it was an imposed manipulation, independent of prevailing environmental conditions. In all other statistical tests, the conventional level of alpha = 0.05 was used to identify statistical effects.

Cat activity

The total distance of cat tracks recorded per transect, and the average distance covered per cat, was regressed on the same set of potential predictor variables (see Table 1) using ordinary regression analysis. In contrast to bait uptake, these measures gauged cat activity, as opposed to their propensity to take baits. Residual diagnostic tests (stem and leaf plots and plots of residuals versus fitted values) were inspected for normality, and distance data subsequently square root transformed to achieve normality of residuals. The regression model was applied using the SAS software package (procedures REG and GLM, SAS Institute Inc., 1989).

Bait preference

In order to determine if cats expressed a preference amongst the three alternative baits, and if this preference was affected by the alternative lures, the consumption of baits was analysed using the method proposed by Roa (1992). This method uses multivariate analysis of variance (MANOVA) of bait consumption, with lure type treated as an applied treatment. The MANOVA method is preferred to simpler methods, such as chi-squared analysis of bait consumption, because the amounts of different baits taken are likely to be related. This correlation biases techniques such as chi-squared analysis that treat bait consumption as independent. As the number of baits of a particular type, in the cafeteria, was not always equal the proportion of baits consumed to those laid was used in the analysis. Bait consumption data were transformed as necessary.

Results

The study was terminated after 6 March 2000 due to the approach of a tropical cyclone. Heavy rainfall associated with the cyclone severely restricted access to the study site, as most roads became impassable. This significant rainfall event also had the potential to alter cat response to baiting, particularly through impacts upon prey species activity and abundance.

Bait Uptake

Combined bait uptake for standard and cafeteria trials

A total of 42 bait uptake trials was conducted during the study period. Bait station response by individual cats is summarised in Table 2 (see Appendix A). Figures 6 (probable uptakes categorised as visits) and 7 (includes potential uptakes, where probable uptakes categorized as uptakes) illustrate the frequencies and proportions of the various bait responses over the study period. The various categories of bait response as a percentage of individual cats contacting the bait stations, over the study period, are presented in Figures 8 to 12.

The proportion of individuals, recorded on transects, that contacted bait stations, was relatively consistent throughout the study period at 62% $\pm$ 3% ($\mu \pm$ s.e.) (see Figure 8). Figure 8 illustrates a degree of daily fluctuation, but little in terms of any discernible trends. The proportion of contacting individuals, on any given day, was generally more than 50% but rarely 100% and zero only once.

The responses by cats to the bait stations exhibit marked short-term variation. The Figures illustrate several examples of a particular response by 100% of individuals that contacted a bait station on one day and 0% of contacting individuals on the previous or subsequent day. Longer-term trends include the relative decrease in the pass response (see Figure 9), over the course of the study period. Conversely, the proportion of the visit response (see Figure 10), and in turn the uptake response (see Figures 11 and 12) increased over the course of the study period. Figures 11 and 12 also illustrate that in addition to occurring with greater frequency, the uptake response occurred with greater consistency during the later sampling periods. Bait uptake occurred on 25% of sampling days prior to 25 January 2000 and 76% of sampling days post this date. Baits were accepted by 6.2% of contacting individuals

Figure 6: Bait interactions for the entire sampling period (probable uptake categorised as visit).

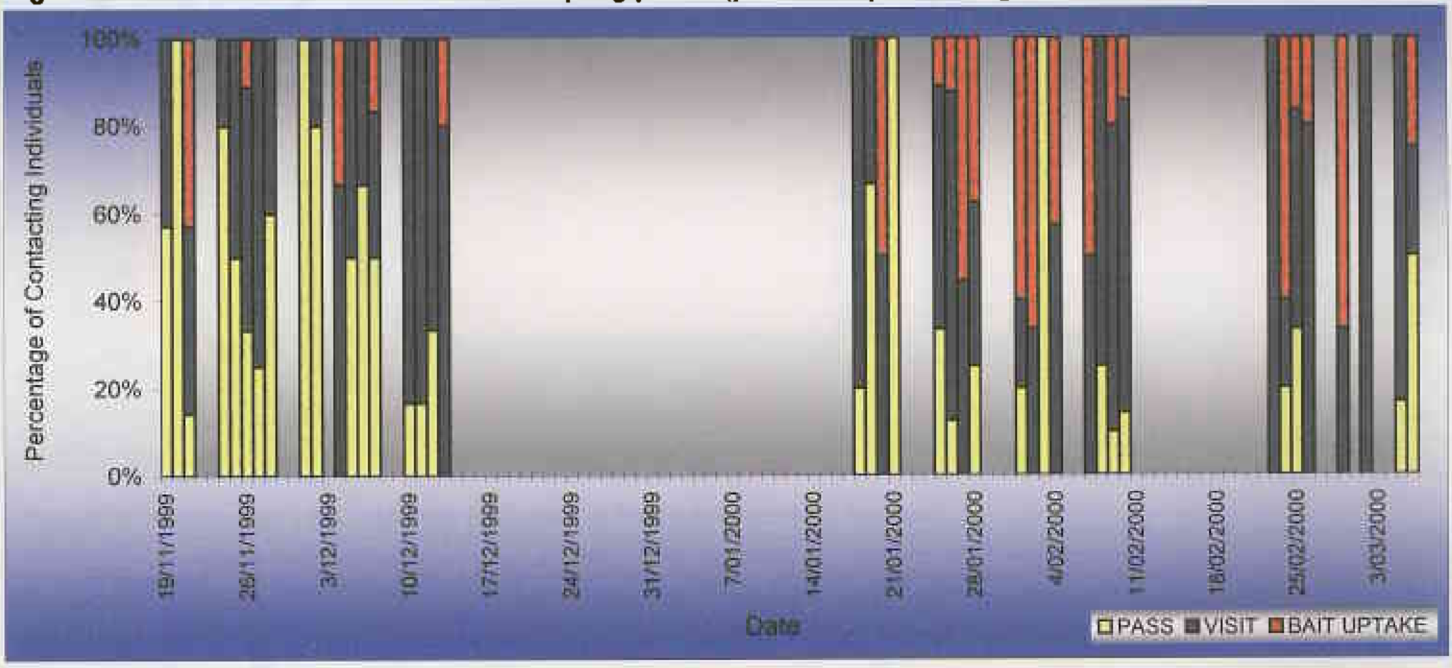
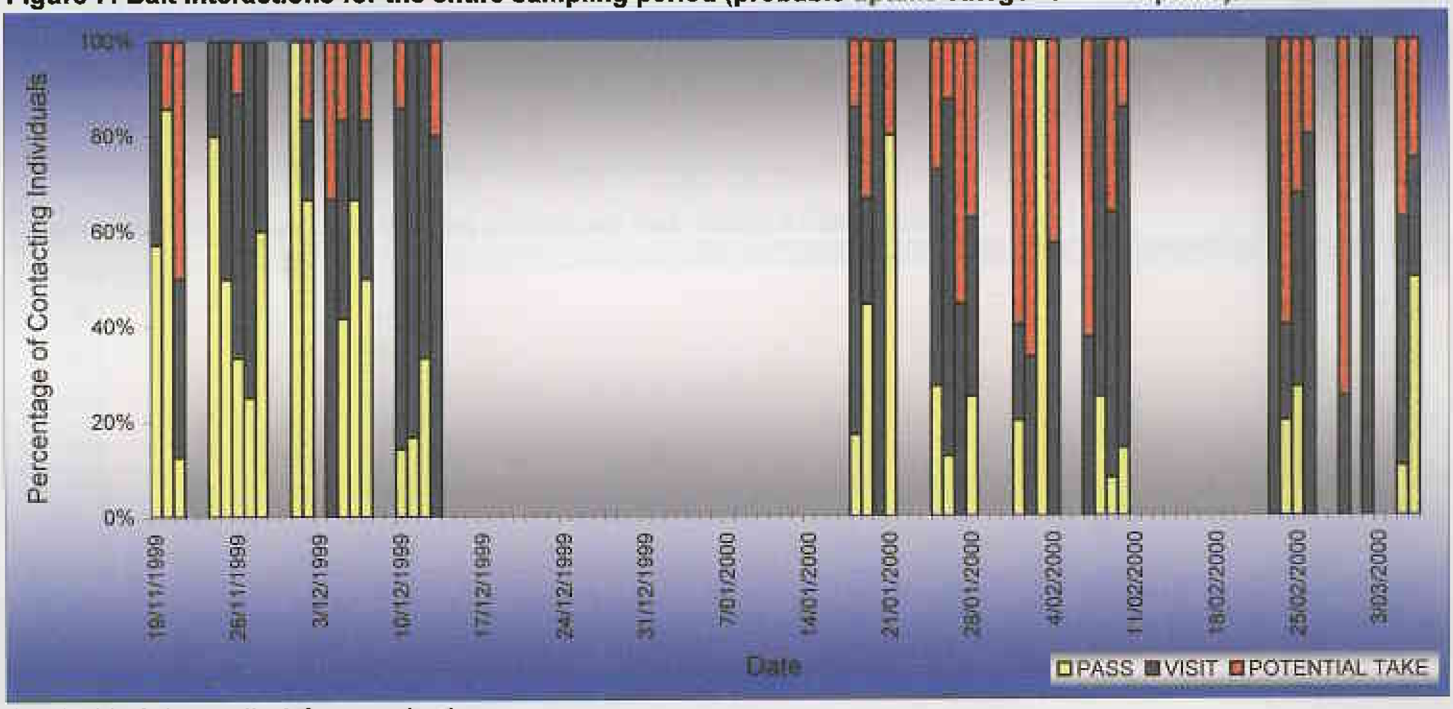


Figure 7: Bait interactions for the entire sampling period (probable uptake categorised as uptake).



See Table 2 Appendix A for sample sizes.

Figure 8: Percentage of individuals present that contacted a bait station.

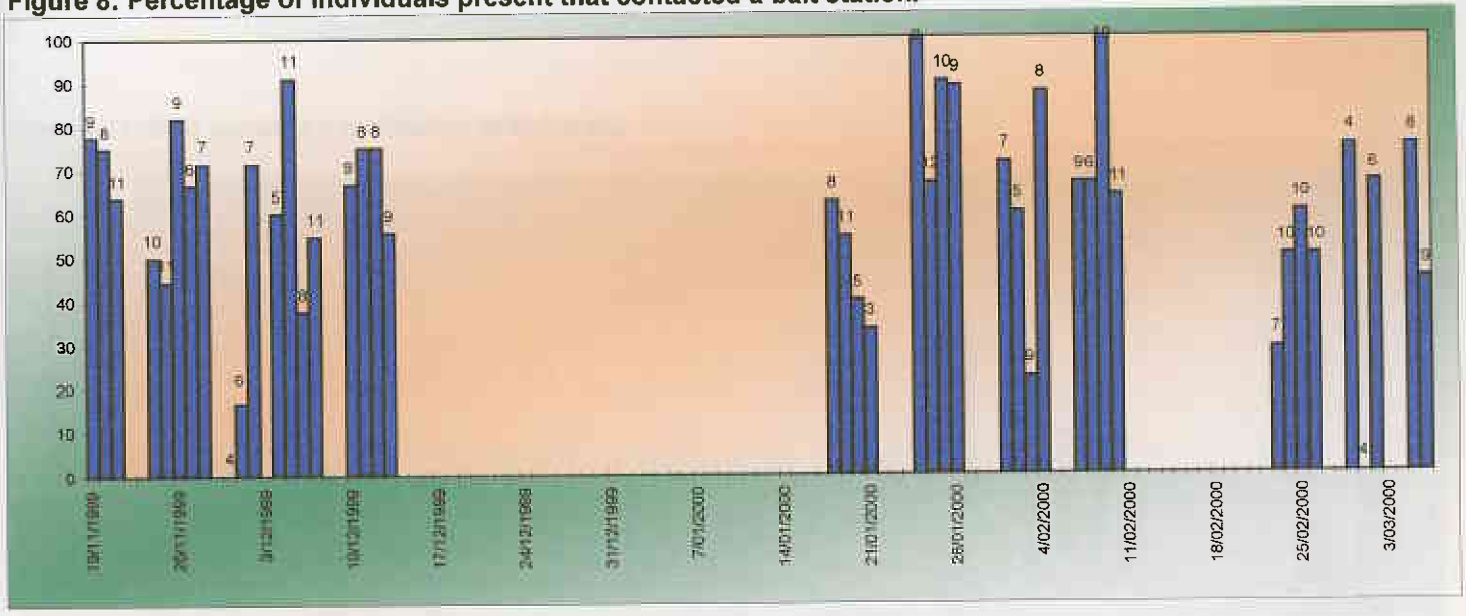


Figure 9: Percentage of contacting individuals that passed a bait station.

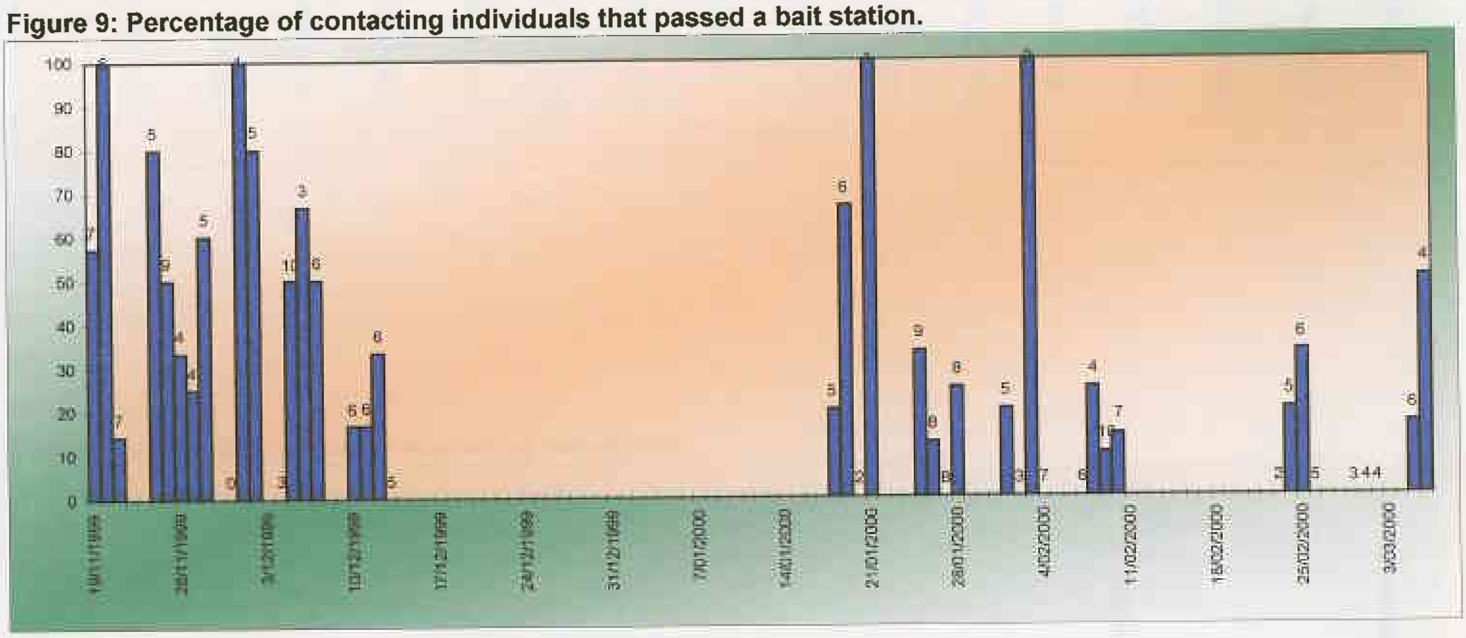
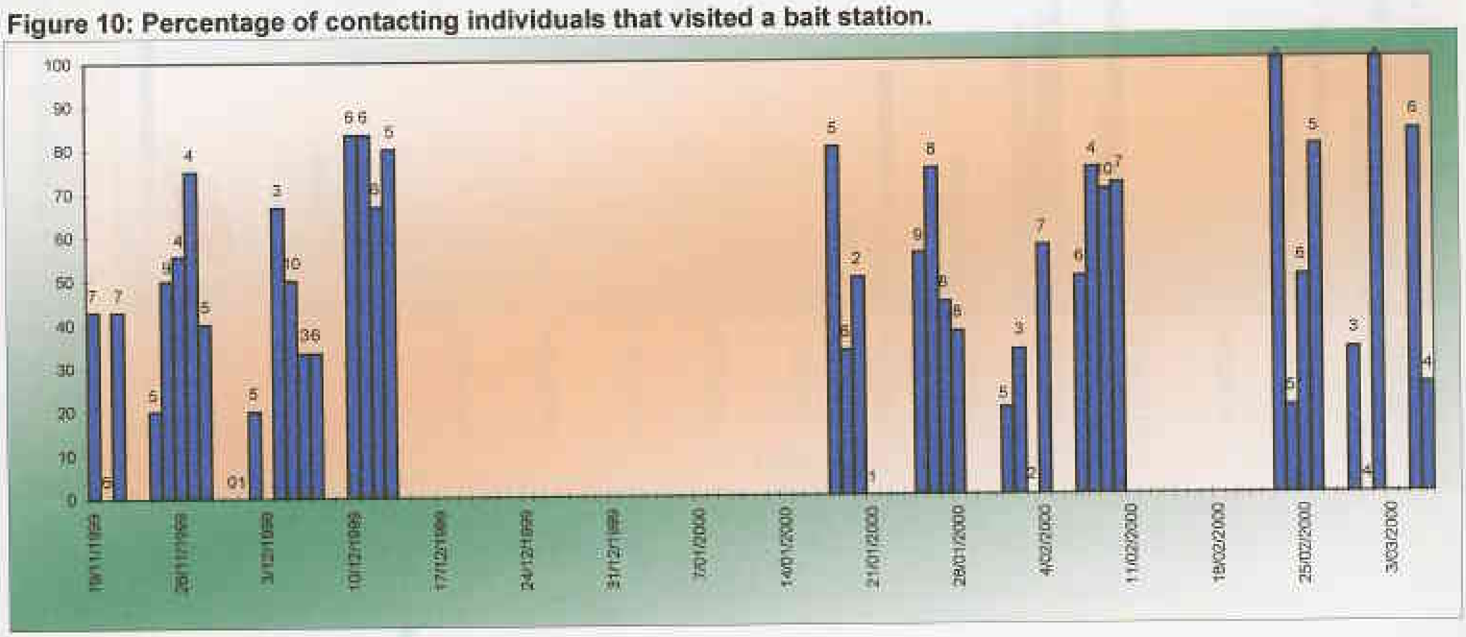


Figure 10: Percentage of contacting individuals that visited a bait station.



Note: Series data labels indicate sample size (n).

Figure 11: Bait uptake by contacting individuals.

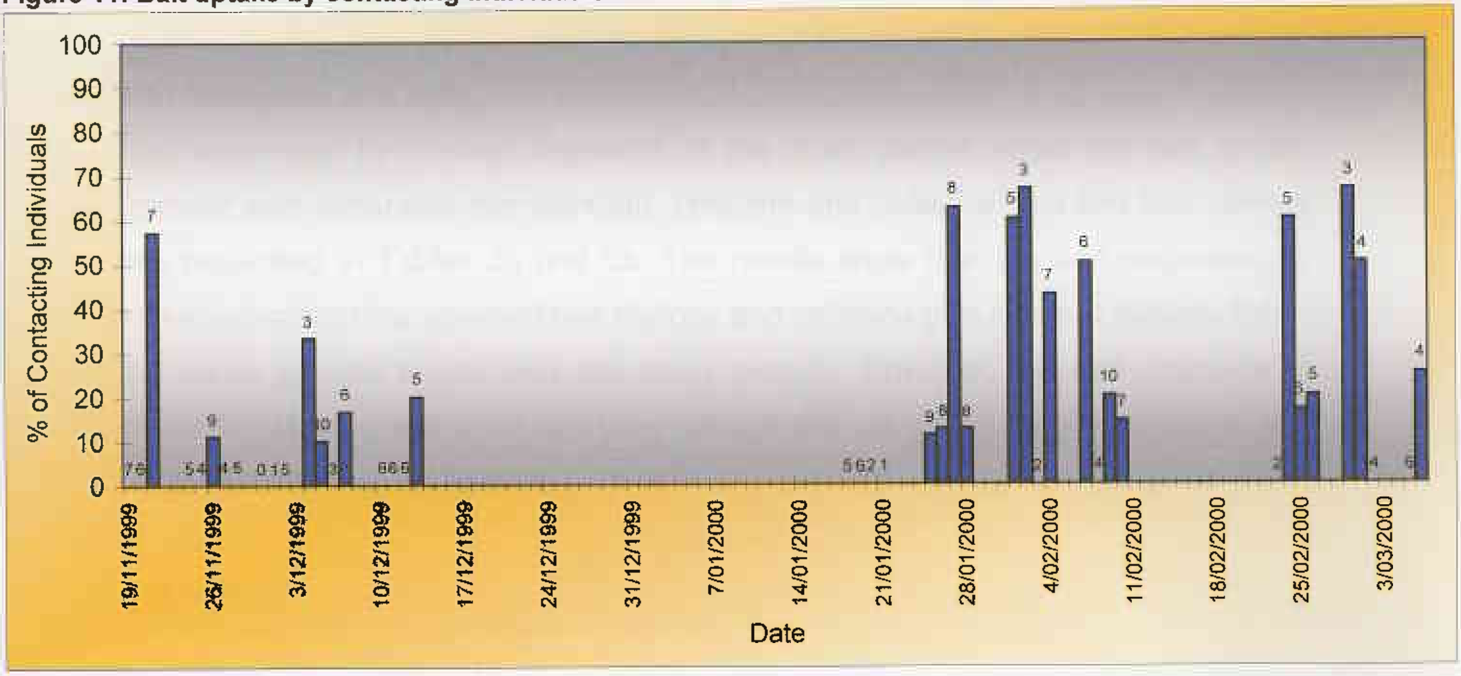
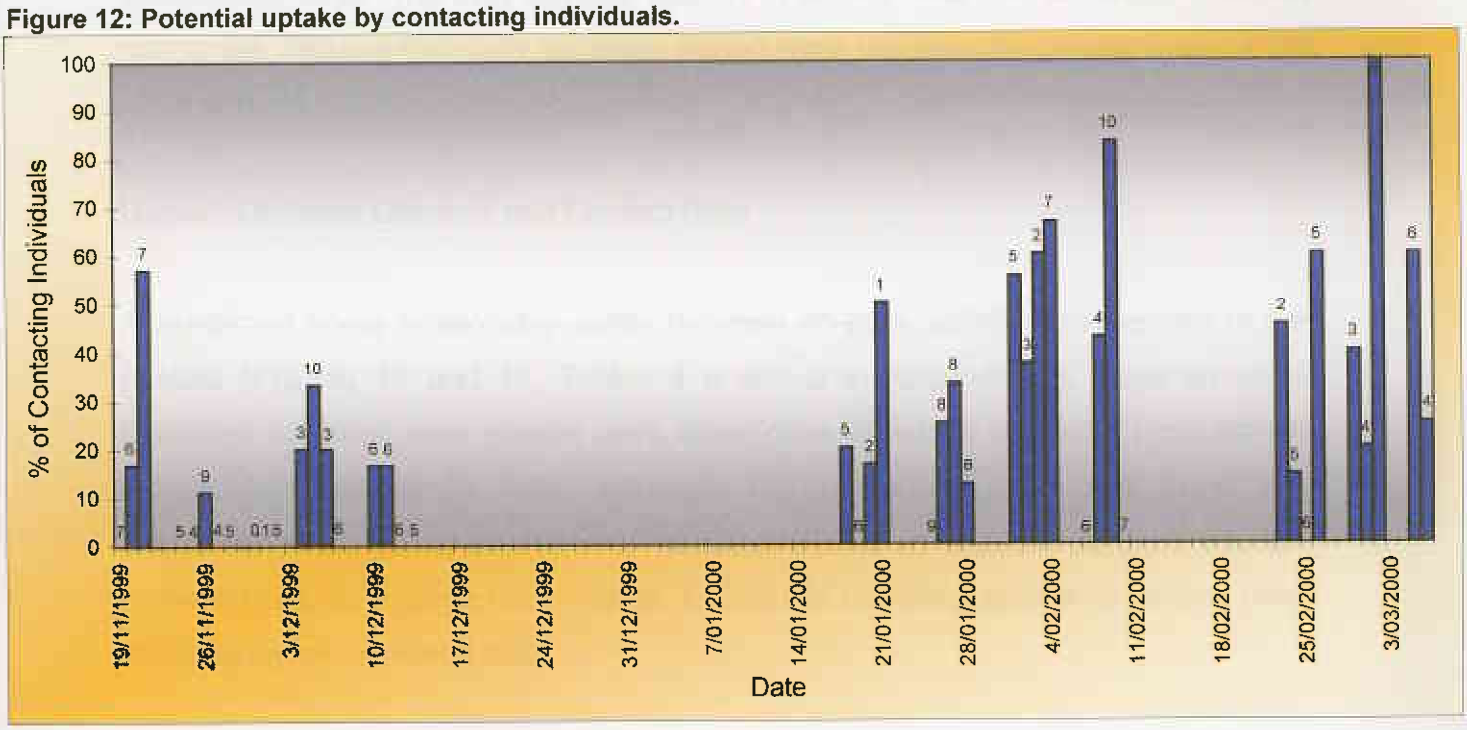


Figure 12: Potential uptake by contacting individuals.



Note: Series data labels indicate sample size (n).

prior to this date and 28.1% of contacting individuals post this date. Therefore results from the 25 January 2000 have been isolated in subsequent analyses in an attempt to clarify potential influences on short-term variability in bait uptake.

Bait media and lure trials

Bait responses for various segments of the study period, when the bait uptake transect was separated into standard, cafeteria and cafeteria plus lure bait stations are presented in Tables 3a and 3b. The results show that the bait responses by individual cats to the standard bait stations and cafeteria plus lure bait stations follow the same general trends over the study periods. However, the bait response to cafeteria stations where no lure was present did not display any increase in bait uptake over the sampling period.

Cat Activity

The cumulative and average on-track distances travelled by cats during the study period are presented in Figures 13 and 14. On-track distances, travelled by individual cats, exhibited daily variation. The Figures illustrate several examples of on-track activity that is inordinately greater or smaller than on the previous or subsequent days. The only obvious pattern in activity was that distances travelled during the January-February sampling period were consistently greater than for the other periods.

Uptake, On-track Distance and Contact Rate

A significant linear relationship exists between on-track activity and the rate of bait contact (Figures 15 and 16, Tables 4 a and b in Appendix B). Days on which distances travelled were greater were those days on which a greater proportion of individuals encountered baits. Although not presented here, this trend was consistent when individual response was considered, as opposed to the proportion of individuals on a given day. That is, individuals travelling greater distances more consistently encountered baits.

No significant linear relationship exists between the rate of bait contact and the rate of bait uptake (Figure 17, Table 4 c in Appendix B). Days of relatively high bait contact were not necessarily days of high bait uptake. Bait uptake was most

Table 3a: Summary of responses by contacting individuals to bait station type; potential uptake categorised as visit.

SAMPLING PERIOD	PASS			VISIT			UPTAKE		
	S	C	C/L	S	C	C/L	S	C	C/L
Pre 25.01.2000	51%	67%	33%	43%	25%	59%	5%	8%	7%
Post 25.01.2000	15%	42%	14%	58%	49%	57%	26%	9%	29%
Entire sampling period	33%	53%	23%	51%	38%	58%	16%	9%	19%

Table 3b: Summary of responses by contacting individuals to bait station type; potential uptake categorised as uptake.

SAMPLING PERIOD	PASS			VISIT			UPTAKE		
	S	C	C/L	S	C	C/L	S	C	C/L
Pre 25.01.2000	51%	67%	33%	40%	22%	52%	9%	11%	15%
Post 25.01.2000	15%	42%	14%	48%	44%	46%	36%	14%	40%
Entire sampling period	33%	53%	23%	44%	34%	48%	22%	13%	29%

S= standard bait station
C= cafeteria station
C/L= cafeteria station with lure

Figure 13: Cumulative daily on-track distances travelled.

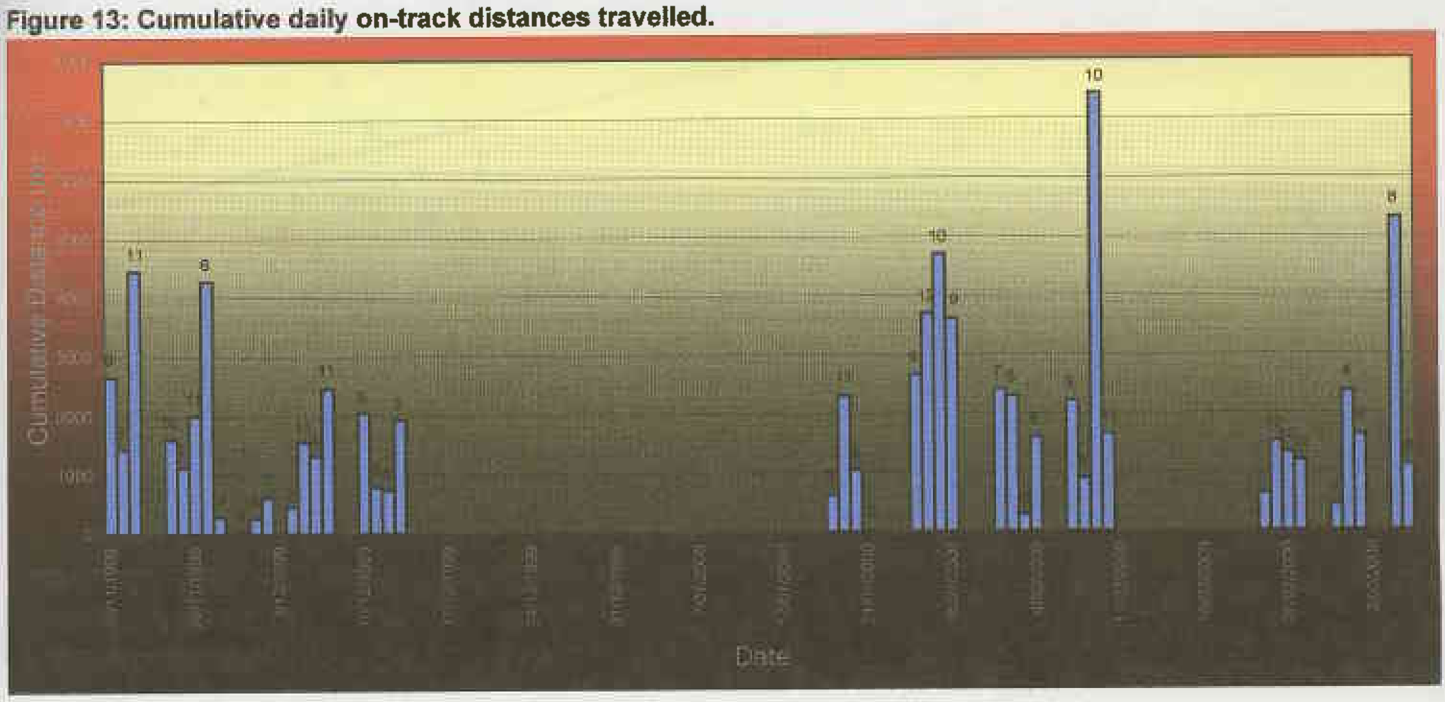
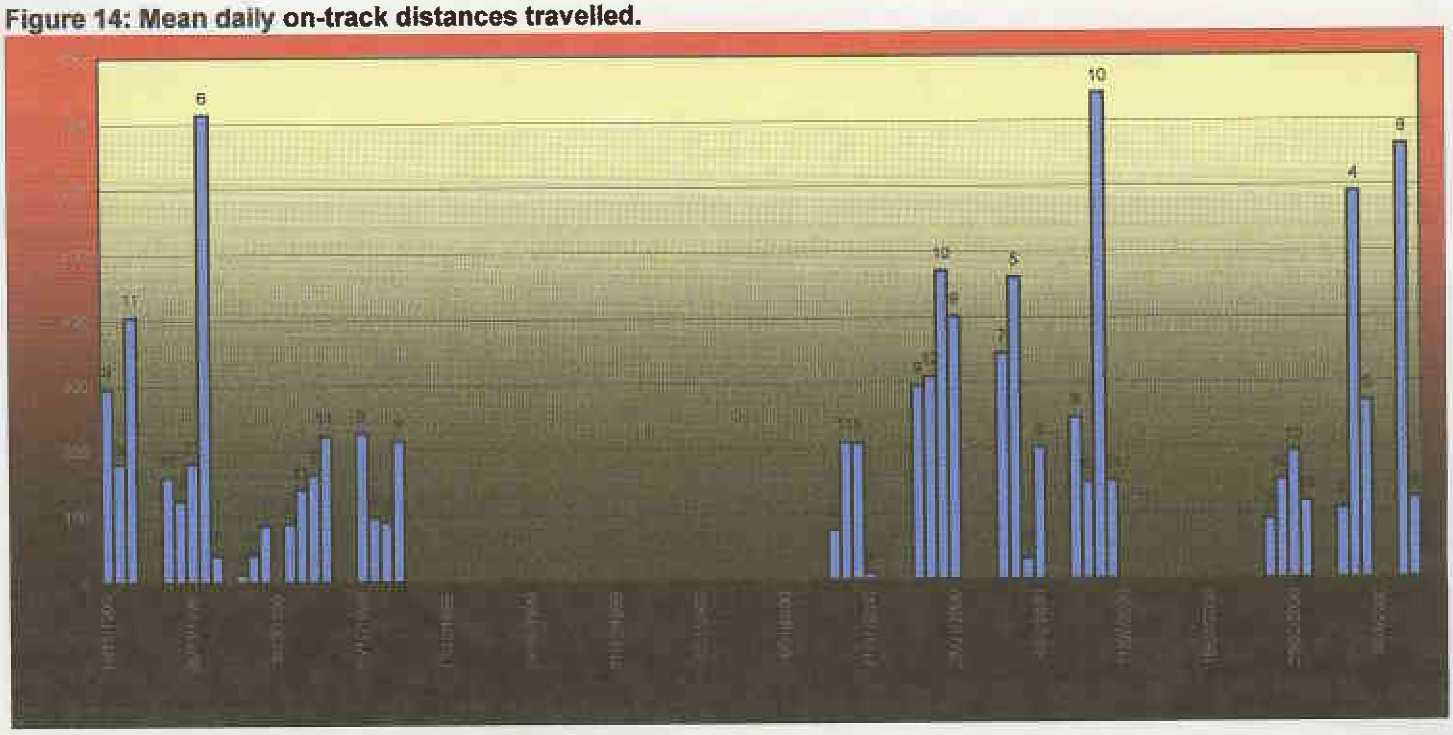


Figure 14: Mean daily on-track distances travelled.



Note: Series data labels indicate sample size (n).

Figure 15: Cumulative on-track distances travelled v rate of contact (entire sampling period).

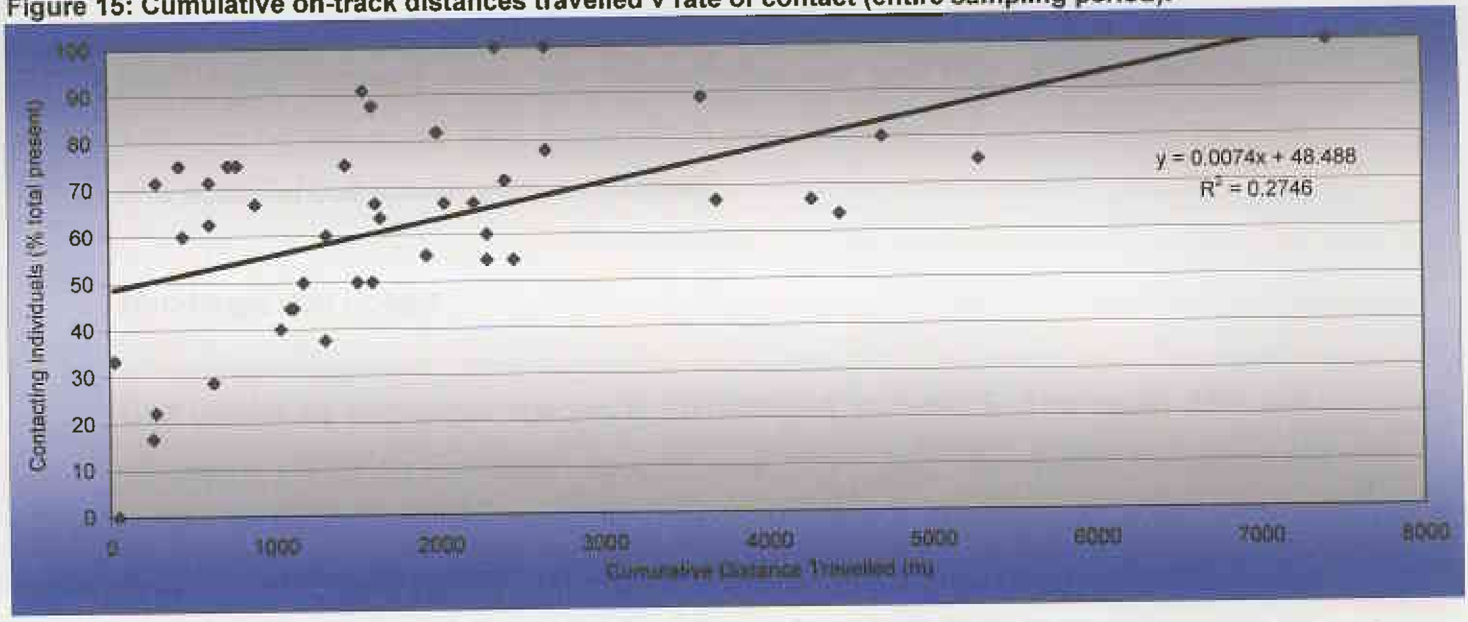


Figure 16: Mean daily on-track distances travelled v rate of contact (entire sampling period).

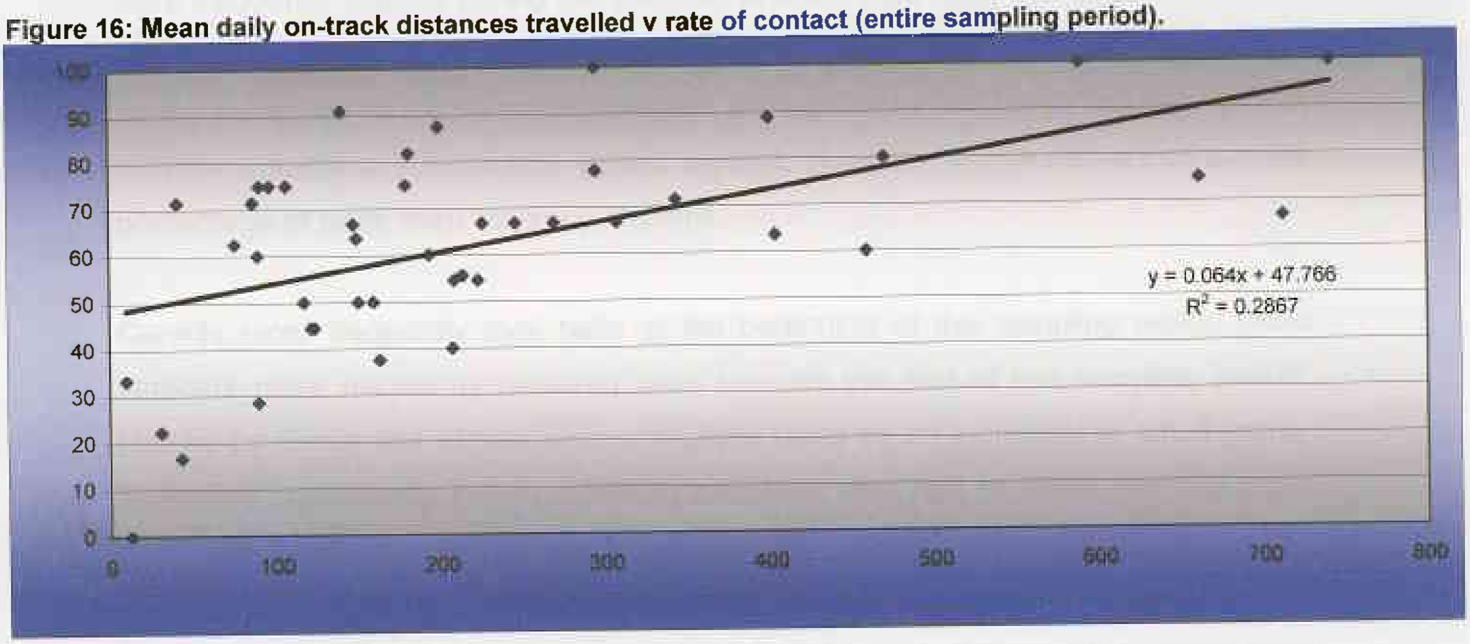
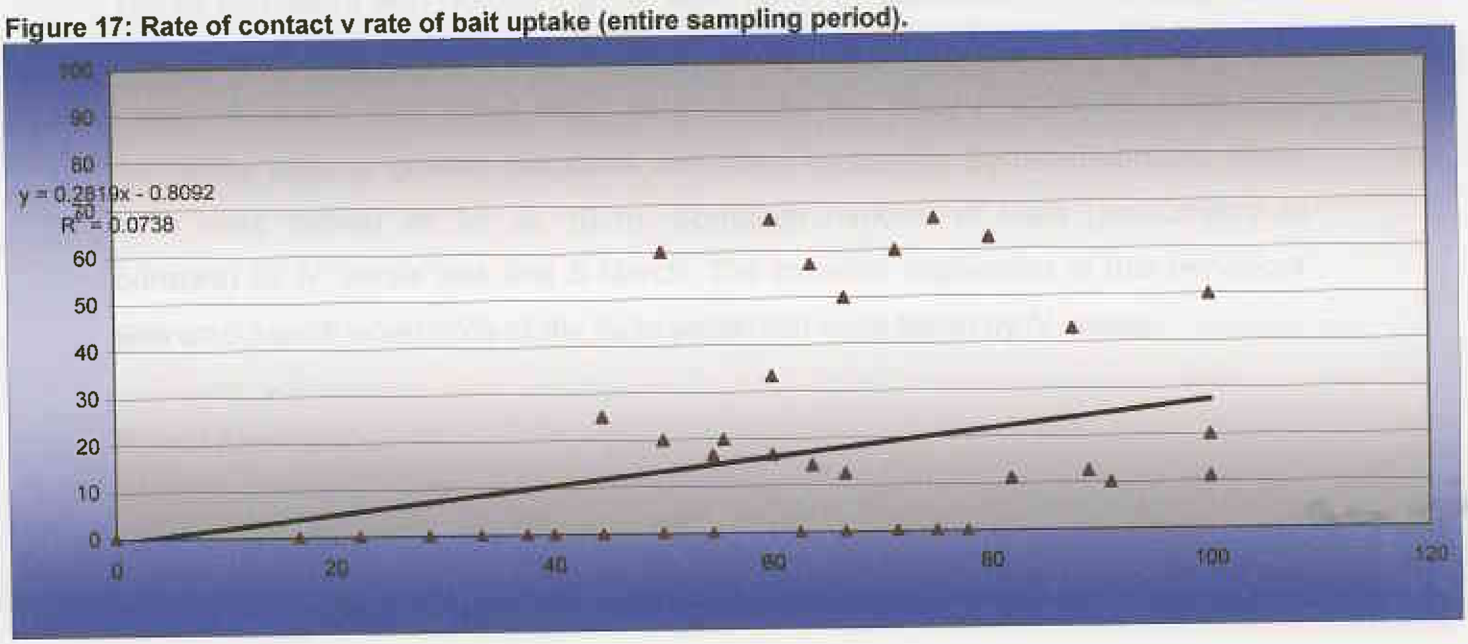


Figure 17: Rate of contact v rate of bait uptake (entire sampling period).



consistent between 60 and 90% contact, but this condition did not preclude poor bait uptake days. Bait uptake was generally poor at the extremes of contact rate and no bait uptake occurred when the contact rate was less than 40% of individuals. Although not presented here, these trends were consistent when individual response and potential bait uptake were considered.

Non-target Bait Uptake

Bait uptake by non-target species is summarised in Table 5. The mean daily bait uptake ($\mu \pm$ s.e.) by non-target species was 22% $\pm$ 3%. The relative frequency of uptake by the various species is illustrated in Figure 18. Corvids and Varanids were most frequently responsible for non-target bait uptake. The Torresian and Little Crow were frequently sighted during the exercise and are both likely to be responsible for uptake by this family. *Varanus gouldii* was the most frequently observed Varanid during sampling. All tracks associated with bait uptake by this family were consistent with the numerous sub-adult *V. gouldii* sighted. However, it is possible that a small percentage of baits were taken by *V. tristis*.

Corvids more frequently took baits at the beginning of the sampling period while varanids more frequently removed baits towards the end of the sampling period. Uptake by Emus was almost always multiple takes by an individual or small group. Therefore, a relatively large proportion of uptake assigned to Emus, on any given day, did not indicate a widespread occurrence.

Tracks consistent with *Notomys alexis* were noted in association with sausage baits throughout the study period. Early in the study, rodent activity was dense around baits, with some baits rolled short distances. As the study progressed, baits were moved by rodents greater distances and more frequently. By late February, some baits were moved as far as 10 m. Complete removal of baits (presumably to burrows) by *N. alexis* was first 5 March. The extreme expression of this behaviour was on 6 March when 85% of the baits presented were taken by *N. alexis*.

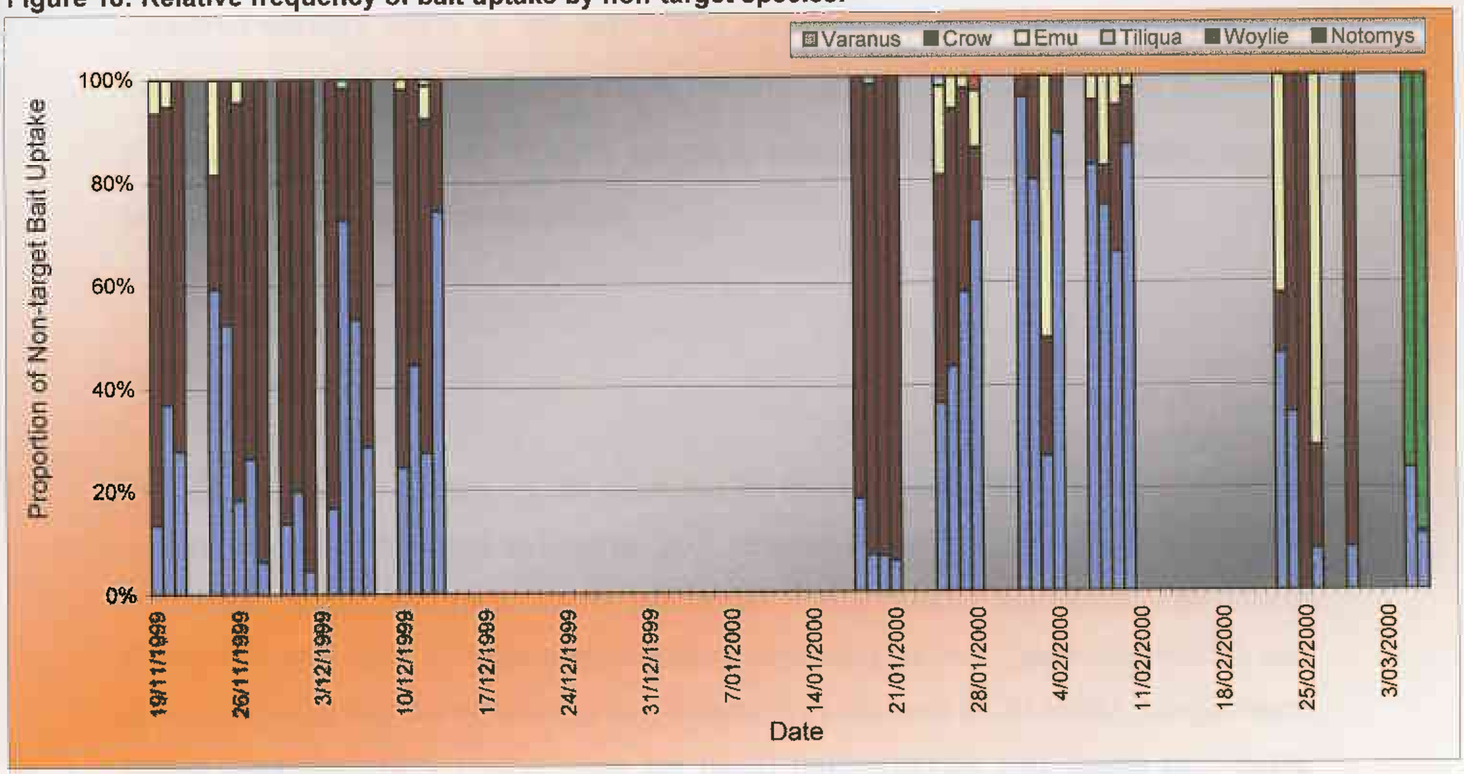
Rabbit Abundance

Rabbit abundance counts, on bait uptake transects, are presented in Table 6 (see Appendix C). A summary of rabbit presence/absence over the study period is

Table 5: Summary of bait uptake by non-target species.

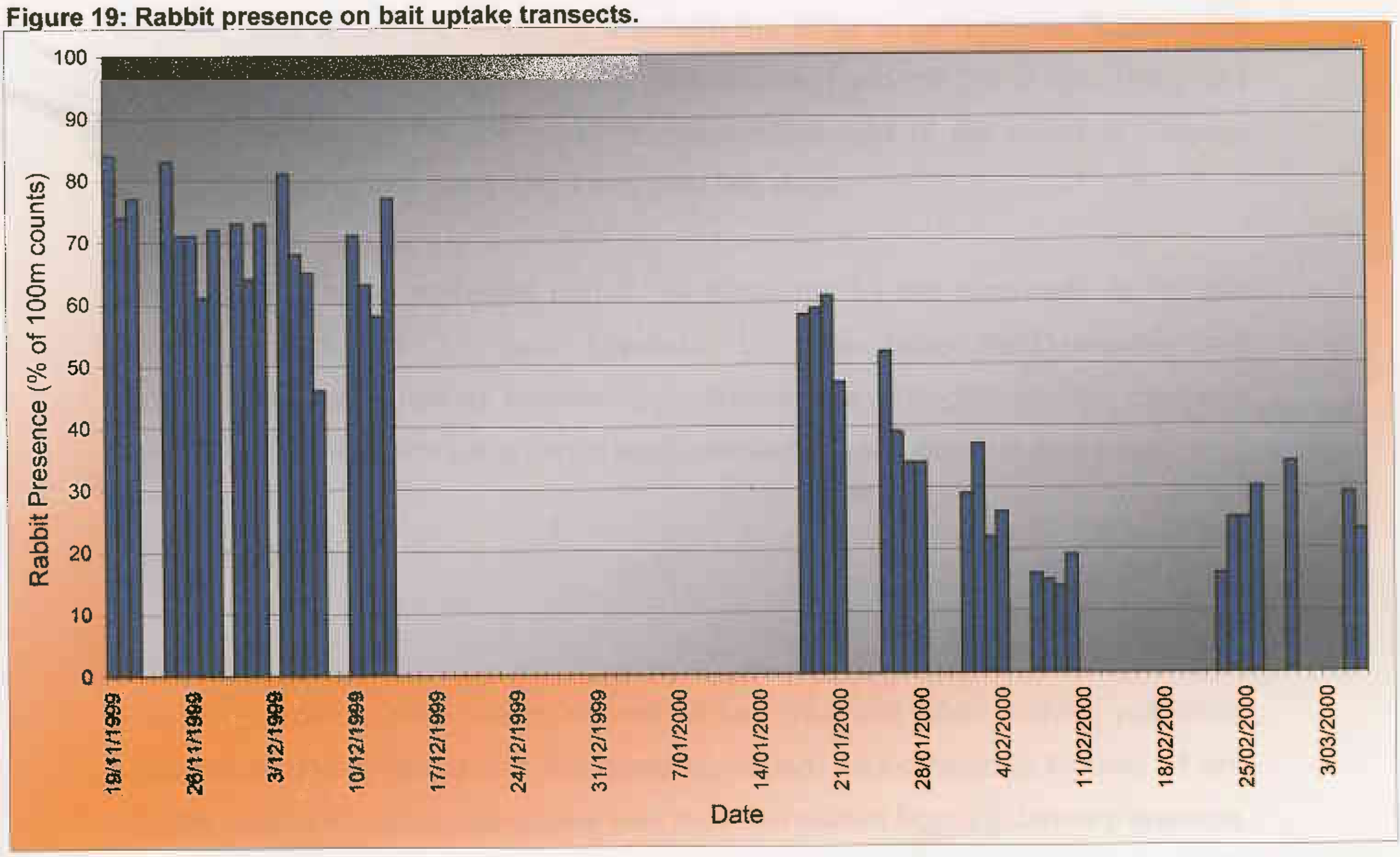
Date	Zone	N° Baits	Varanid	Corvid	Emu	Tiliqua	Woylie	Notomys	Total Take	% Take
19/11/1999	2	196	2	12	1	0	0	0	15	7.7
20/11/1999	2	176	7	11	1	0	0	0	19	10.8
21/11/1999	2	185	5	13	0	0	0	0	18	9.7
24/11/1999	2	200	16	6	5	0	0	0	27	13.5
25/11/1999	3	200	11	10	0	0	0	0	21	10.5
26/11/2000	3	165	4	17	1	0	0	0	22	13.3
27/11/2000	3	190	5	14	0	0	0	0	19	10.0
28/11/2000	3	200	2	30	0	0	0	0	32	16.0
30/11/2000	4	200	3	19	0	0	0	0	22	11.0
1/12/1999	4	190	4	16	0	0	0	0	20	10.5
2/12/1999	4	161	2	42	0	0	0	0	44	27.3
4/12/1999	4	100	7	35	0	0	0	0	42	42.0
5/12/1999	3	188	40	14	0	1	0	0	55	29.3
6/12/1999	3	160	16	14	0	0	0	0	30	18.8
7/12/1999	3	160	8	20	0	0	0	0	28	17.5
10/12/1999	2	195	12	36	1	0	0	0	49	25.1
11/12/1999	2	170	12	15	0	0	0	0	27	15.9
12/12/1999	2	180	21	50	5	1	0	0	77	42.8
13/12/1999	2	200	26	9	0	0	0	0	35	17.5
18/01/2000	4	192	6	27	0	0	0	0	33	17.2
19/01/2000	4	200	5	64	0	1	0	0	70	35.0
20/01/2000	4	157	4	54	0	0	0	0	58	36.9
21/01/2000	4	100	2	31	0	0	0	0	33	33.0
25/01/2000	2	197	19	23	9	1	0	0	52	26.4
26/01/2000	2	168	7	8	1	0	0	0	16	9.5
27/01/2000	2	180	25	17	1	0	0	0	43	23.9
28/01/2000	2	195	26	5	4	0	1	0	36	18.5
1/02/2000	3	190	23	1	0	0	0	0	24	12.6
2/02/2000	3	123	8	2	0	0	0	0	10	8.1
3/02/2000	3	156	16	14	31	0	0	0	61	39.1
4/02/2000	3	160	8	1	0	0	0	0	9	5.6
7/02/2000	2	200	87	13	5	0	0	0	105	52.5
8/02/2000	2	168	30	3	7	0	0	0	40	23.8
9/02/2000	2	175	23	10	2	0	0	0	35	20.0
10/02/2000	2	189	39	5	1	0	0	0	45	23.8
23/02/2000	3	159	12	3	11	0	0	0	26	16.4
24/02/2000	3	155	9	17	0	0	0	0	26	16.8
25/02/2000	3	100	0	3	0	0	0	0	3	3.0
26/02/2000	3	156	2	5	18	0	0	0	25	16.0
29/02/2000	4	100	1	11	0	0	0	0	12	12.0
5/03/2000	4	180	13	0	0	0	0	42	55	30.6
6/03/2000	4	154	16	1	0	0	0	131	148	96.1

Figure 18: Relative frequency of bait uptake by non-target species.



See Table 5 for sample sizes.

Figure 19: Rabbit presence on bait uptake transects.



presented in Figure 19. The data ($\mu \pm$ s.e.) indicate that rabbit activity declined markedly between the November/December (70% ± 2% presence) and January/February (33% ± 3% presence) sampling periods. Activity continued to decline during the latter period to <20% presence in mid February. Activity increased slightly during the February/March sampling period to 28% ±2% presence for the last five days of the sampling period.

Weather and Lunar Phase

Prevailing weather conditions, as recorded by the Australian Bureau of Meteorology – Denham, are presented in Figures 20 - 32 (see Appendix D). Night-time weather conditions were generally warm (minimum temperatures generally >20 ^{0}C in November and >25 ^{0}C from early January onwards), humid (generally >80%) and windy (average night-time wind speed commonly in excess of 30 km/h). Longer-term trends over the study period were for rising temperatures and falling barometric pressure. Other parameters exhibited greater short-term fluctuations, but little in terms of consistent trends. Wind direction exhibited a strong SSW tendency with very few days where the tendency was from the other seven octants. Rainfall was restricted to 7 February, when 0.4 mm was recorded and the 3-4 March when 19.1 mm was recorded. The study was terminated because of the onset of Tropical Cyclone Steve that delivered 150.6 mm over five days.

Lunar cycles for the sampling period, as illustrated by the luminosity curve, are presented in Figure 33 (see Appendix D). The November/December and January/February sampling periods approximated the first gibbous-first crescent. The February/March sampling period approximated the last gibbous-new moon.

Statistical Analyses

Bait uptake

A range of weather parameters, as well as lure type and rabbit activity, potentially impacted on bait uptake during the sampling period. As indicated in Figures 11 and 12, bait uptake and potential uptake was most consistent from 25 January onwards. For this reason, results from this period were isolated in an attempt to clarify potential influences on short-term variability in bait uptake. Results for analyses performed for both actual and potential bait uptake over the entire study period and post 25 January are presented in Tables 7 - 10 (see Appendix E). The significant variables to regression model building are presented in flow diagrams (see Figures 34 - 37).

Bait Media and Lure Preference

Multivariate analysis of variance indicated that there was a significant preference, in the cafeteria bait trial, for the standard cat bait (Wilk's ? = 0.80, $p = 0.04$). Uptake of the standard bait was 64% greater than the chicken bait and 170% higher than the cockerel. Significance of relative uptake at stations with all the various lures was tested in the regression analysis of standard bait uptake (see Tables 7a, 8a, 9a and 10a, see Appendix E). Note that Table 1 describes the coded variables. Uptake of standard baits was significantly more frequent in the presence of the visual lures used, as opposed to the audio lures.

Cat Activity and Bait Contact

Although not presented in Tables and Figures, results of the multivariate analyses for cat activity and contact rate indicated a temperature dependence. These measures of behaviour were respondent to the measured temperature and to changes in temperature.

Figure 34: Regression model building steps for bait uptake (entire sampling period).

Figure 35: Regression model building steps for potential bait uptake (entire sampling period).

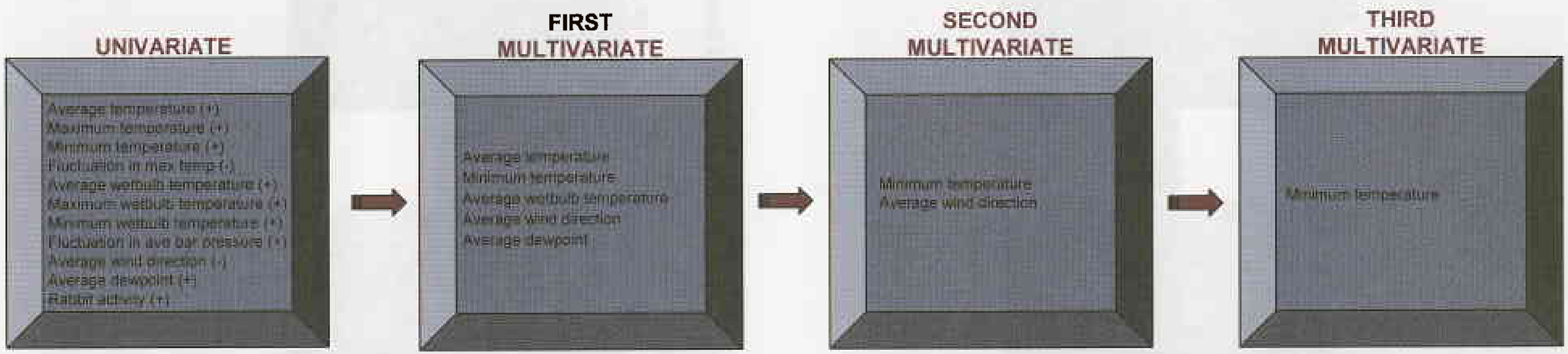


Figure 36: Regression model building steps for bait uptake (post 25 January).

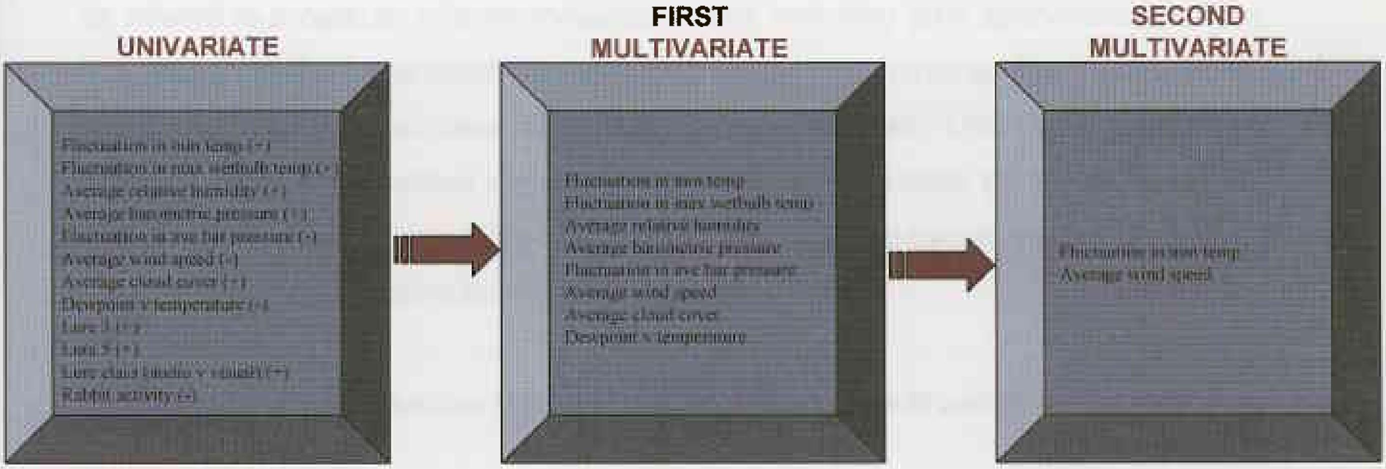
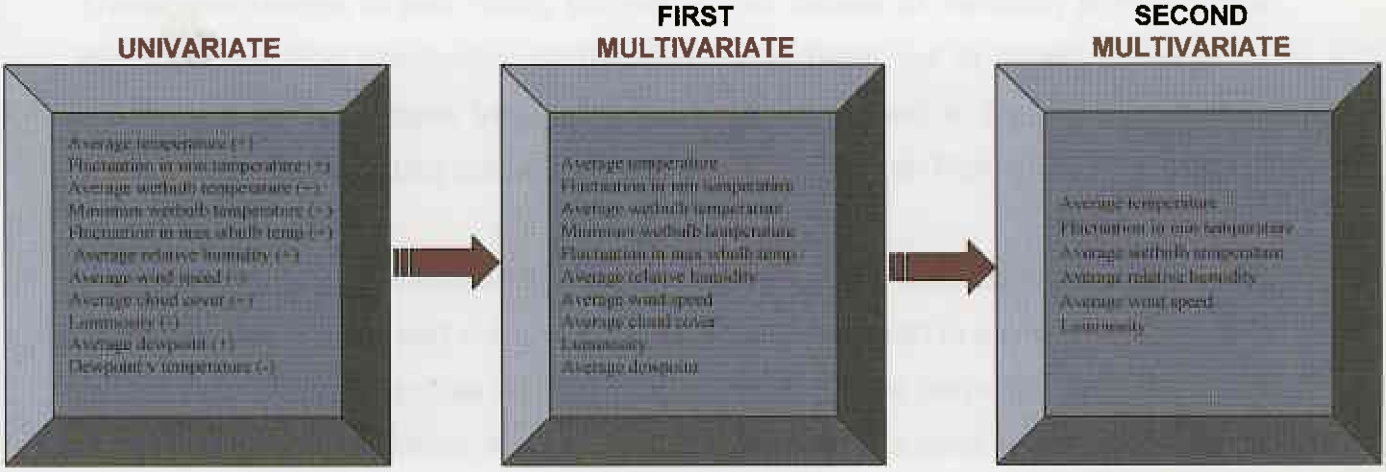


Figure 37: Regression model building steps for potential bait uptake (post 25 January).



Discussion

Bait uptake by feral cats on Peron Peninsula displayed a high degree of short-term variability but clearly became more frequent and consistent as the study period progressed. Uptake occurred on 25% of days prior to 25 January and on 76% of days post this date. Patterns in bait response as well as on-track activity appeared to be related to a number of environmental factors including prey abundance (rabbits). Bait response and track activity are not controlled by the same environmental factors and as such there is no clear relationship between the two. There was a significant preference for the standard cat bait and this could potentially be enhanced by the use of visual lures. Baiting efficacy can be affected by non-target species consuming baits and thereby reducing bait availability to feral cats.

A number of key conclusions regarding bait uptake can be drawn from this work: -

- Bait uptake is largely independent of bait contact (encounter);
- The variability associated with bait uptake in the short-term (daily variation) can, in part, be explained by several key environmental variables;
- There was a seasonal (long-term) relationship between bait uptake and certain key environmental variables.

These conclusions, in part, clarify the nature and causes of variability in bait uptake by feral cats. The conclusions of this study are discussed in detail, examined in relationship to bait uptake trials conducted elsewhere and in regard to potentially improving on-track baiting methodology and thus efficacy on Peron Peninsula.

Feral cat activity and bait response varies both daily and between individuals. Therefore bait uptake and cat activity were considered both in terms of the average response of cats present as well as in terms of individual response or activity. The average response provides an understanding of daily/seasonal baiting efficacy and the individual response provides information on the condition individuals that take or leave a bait.

The percentage of individual cats encountering a bait remained relatively constant over the study period at 62 ± 3 (μ ± s.e.) of animals, on any given night. There was no linear relationship between bait uptake and either distance travelled or bait contact along tracks however, the distance a cat travelled influenced bait contact. The average daily on-track distance, travelled by individual cats, was approximately 340 m. This distance would be covered in a relatively short period of time and would represent a small proportion of a cat's daily activity cycle. Therefore the baits would not necessarily be encountered when individual cats were hungry. When the primary prey, in this case rabbits (see below) became less abundant, the chances of encountering a bait when hungry increased.

Animals that travelled relatively long distances (greater than 1 200m), in the context of this study were, in general, not receptive to baits and their behaviour appeared focussed on activity unrelated to hunger and seeking food.

The daily variability associated with bait uptake on Peron Peninsula was also influenced by short-term weather conditions. Cats throughout history have been relied on as meteorological almanacs as they display behaviour responses to short-term weather patterns (De Wire 1992). During the latter period of study (post 25 January) when bait uptake was a regular occurrence, yet still displayed daily variability, the two most important environmental factors that affected both actual and potential bait uptake were wind speed and fluctuations in minimum temperature. Actual and potential bait uptake tended to decrease with an increase in average wind speed, while increasing with a rise in overnight minimum temperature, from the previous day. The relationship between wind speed and bait uptake may be explained by bait recognition. Cat activity and rate of contact exhibited no significant relationship to wind speed. Cats were active and encountering bait stations on windy nights, however bait uptake diminished. If bait odour is important to inducing bait uptake, windy conditions will disperse this odour, reducing bait recognition and uptake. The importance of changes in minimum temperature cannot be explained but it is possible that this environmental variable is involved with a range of other factors that could not be measured or deduced to influence bait uptake.

Luminosity was only of importance to potential uptake post 25 January however, very few bait uptake trials were conducted when luminosity was greater than 2. Data collected during first period straddled the full moon and indicated peaks in bait uptake either side of the full moon. As such, it is suggested that the influence of lunar phase on bait uptake requires further investigation.

A number of environmental factors were significant in to bait uptake over the entire sampling period but insignificant post 25 January, when bait uptake was a regular occurrence. This may reflect their relative stability over the short-term and their clear seasonal trend. The importance of the temperature variables may be an artifact of seasonal progression. However, it may be that baits were more acceptable at higher temperatures. It was noted that oils within the bait penetrated the sausage skin during warmer more humid weather. The oil itself may have increased acceptability. However, a number of the essential flavour enhancers that are added to the bait are lipid soluble. The exuding oil will have brought these substances to the surface, while they are normally encased within the skin.

Of the other environmental factors, two had a significant relationship with bait uptake; these were fluctuations in minimum temperature and rabbit abundance. There was an increase in bait uptake with a rise in overnight minimum temperature from the previous day as was found for actual and potential bait uptake post 25 January. There was also an increase in bait uptake with the decrease in rabbit abundance.

Analysis of stomach contents from cats captured on the peninsula has indicated that rabbits are the main dietary item however, the importance of rabbits as prey varies seasonally (Project Eden unpub. data). This is consistent with studies elsewhere (e.g. Catling, 1988; Jones and Coman, 1981; Molsher *et al.*, 1999 and Risbey *et al.*, 1999), however these studies present relatively small sample sizes and were conducted over relatively few seasons. Optimising predatory cats prefer rabbits to rodents, when both are equally available. This is because it is more efficient to hunt and obtain a single young rabbit than pursue a number of rodents to achieve the same food intake (Kitchener 1991). The seasonal decline in this primary prey species for cats on Peron is consistent with the increase in bait uptake from mid-January onwards. Rabbit abundance, especially the incidence of predator vulnerable, young rabbits in the prey population is a function of season. Rabbit breeding in this environment occurs immediately following the onset of significant rainfall and will also occur following summer rains (King *et al.* 1983). The gestation period of a rabbit is approximately 30 days and thus prey availability can increase rapidly following rain. Young rabbits and emergent rabbit kittens are present in the population until late spring/early summer. The abundance of rabbits tends to decline through summer and autumn and this may be significantly affected by summer epizootics of mosquito vectored myxomatosis.

The standard cat bait, composed of 70% kangaroo meat mince, 20% chicken fat and 10% digest and flavour enhancers was the most preferred bait medium in the cafeteria trials, with the dead day old cockerel being least preferred. The preference for the standard cat bait, in this study follows that demonstrated in exhaustive laboratory and field trials where the standard bait has been compared against a variety of bait media (Algar and Sinagra in prep.). These cafeteria trials, where the acceptability of various individual constituents was assessed, have been instrumental in the development of the standard cat bait.

Only two individual cats consumed a dead day old cockerel, both also consumed the standard cat bait. Interestingly, both these occurrences took place on the coast. Control programs conducted elsewhere using this medium have been on islands where breeding colonies of birds have been present (Brothers 1982; Twyford *et al.* 2000).

The percentage of contacting cats that consumed a bait at standard bait stations was significantly greater than for those that contacted cafeteria stations (See Tables 3 a and b). Presentation of baits in cafeteria stations is unlikely, in itself to have deterred cats from bait uptake, as this has not been noted previously in cafeteria trials. It is suggested that the presence of the dead chicken may have discouraged bait consumption as this is the only obvious difference (at least to human senses) between the two bait station types. This affect appeared negated in the presence of visual lures.

The use of lures significantly improved bait uptake in the cafeteria trials (See Tables 7-10). The contact rate did not differ between audio and visual lures, however the use of visual lures resulted in a higher bait uptake. Observations of domestic cat behaviour suggest that certain stimuli will attract at a distance but act as a deterrent at close proximity. The types of audios used may have brought about this reaction, thus not providing a suitable situation for bait recognition and consumption.

Deployment of visual lures at bait stations has been shown to improve bait uptake in other studies (Friend and Algar 1995; Algar and Sinagra 1995). The constant and inanimate nature of visual lures may leave cats more comfortable for close examination and better recognition of baits and the confidence to sit and eat. The exception in this study was the rodent lure, this relatively large object may have been considered threatening. The range of visual lures, tested to date, is not exhaustive. There is potential for considerable improvement in their design and function.

Activity by non-target species complicates the accurate assessment of bait uptake by feral cats. As previously discussed, this can sometimes preclude the assigning of uptake to a particular species. Bait uptake by non-target species, during this study, was almost exclusively by those of diurnal habit. Thus the rate of recorded non-target uptake was principally limited by the length of time baits were available, during daylight hours. That is, the time between bait placement and sunset and the time between sunrise and transect assessment. As bait placement was completed close to sunset, the morning hours were the period of greatest non-target uptake. This is supported by the fact that the uptake recorded was significantly greater towards the end of each transect and that any delays experienced during assessment, magnified this effect. Therefore the level of recorded non-target uptake does not necessarily reflect any real trends in non-target response.

Rainfall on the 3 and 4 March delayed transect assessment until 1300h. This sample has been excluded from the study of uptake by feral cats but serves as a useful indication of non-target uptake. Just 19 hours after bait placement, non-targets (principally Varanids in this case) had consumed more than 80% of baits.

It is possible the impact of non-target uptake, during the study, was amplified by a certain level of learnt behaviour. That is, bait placement on the various transects allowed association between transect alignment and/or vehicular activity and the presence of a highly palatable food source. Vehicular activity, in itself, often creates a focus of activity for carrion-eaters as (particularly when drags are used) it regularly results in the death of invertebrates, slower-moving Agamids and Skinks, as well as fossorial reptiles.

Uptake by varanids may have been unusually high due to a particularly successful breeding event by *Varanus gouldii*. The numerous individuals observed daily were generally of a common cohort, less than one year old. Sightings and tracks of mature adults were relatively uncommon.

There is no indication in the data that learnt behaviour developed during the study period as sampling practices were geared toward minimising the impact of non-target activity on the assessment of feral cat bait response. Fluctuation in non-target uptake is more a function of the time taken to complete daily transect assessment.

Prior to the approach of TC Steve, the intention was to conduct a series of concurrent studies to clarify the impact of bait placement and vehicular activity, on non-target uptake. This study was cancelled due to heavy rainfall associated with the passage of the cyclone.

Interest in the bait medium, by rodents (most particularly *Notomys alexis*), has been noted previously at Peron, as well as at other study sites. The complete removal and presumed consumption of baits has not been noted previously. Although purely circumstantial, indications are that this behaviour may have been in response to the approach of TC Steve.

Ant attack on baits rapidly degrades the bait medium, reducing palatability. Persistence of ants on the bait deters uptake by feral cats. The residual insecticide Coopex ® was used successfully, during this study, to eliminate ant attack. Trials with this product have demonstrated that its use can greatly enhance bait uptake by feral cats. Bait uptake exercises elsewhere routinely employ this product.

The level of non-target uptake may have been exacerbated by the sampling methods and/or prevailing seasonal conditions. However non-target species potentially impact greatly on baiting efficacy.

A number of bait uptake studies have been conducted elsewhere during the course of bait design and development. These studies are described and the results presented in Table 11. In general, it is inappropriate to compare bait uptake between the various trials, principally because they were conducted with different prototypes of the standard bait as bait development progressed. However, these trials and operational programs have indicated relatively higher bait consumption than that often found on Peron. There have also been two lack lustre baiting responses; the initial baiting campaign on the Montebellos (Burbidge unpub. data) and one of three programs in the Gibson Desert (Burrows *et al.* in prep.). The reason for these two performances is not known, but similar results are occasionally found with fox baiting.

Table 11: Summary of bait uptake at various WA locations.

Date	Location	Methodology	Sample size (n)	Baiting efficacy (%)
November 1994	Nullarbor	Biomarked non-toxic baits, shot sample (1)	35	71
May 1995	Nullarbor	Biomarked non-toxic baits, shot sample (2)	15	53
August 1997	Wanjarri	Biomarked non-toxic baits, trapped sample	11	82
September 1998	Kimberley	Biomarked non-toxic baits, trapped sample (3)	19	79
February 1999	Wanjarri	Bait uptake on track transects	17	71
April 1999	Wanjarri	Bait uptake on track transects	6	66
June 1999	Montebellos	Toxic operational baiting (4)	-	> 80

(1) Friend and Algar (1995).
(2) Algar and Sinagra (1995).
(3) Sinagra and Algar (1998).
(4) Algar and Burbidge (2000).

The reasons for higher bait consumption in these areas may be twofold. Firstly the majority of these trials have either been conducted with biomarker baits, labeled with rhodamine B (Fisher *et al.* 1999), or toxic baits rather than through the observation of track activity. Baits are therefore available to cats for more than one night and as such the likelihood of encountering a bait when hungry is greater. On several occasions, cats have been recorded consuming baits more than 10 days after bait distribution.

The difference between bait uptake trials conducted along tracks and biomarker trials was clearly demonstrated in an exercise conducted on Peron at the beginning of February 1999. Project Eden Staff conducted standard bait uptake trials at the same time as biomarker baits were laid. The results of this exercise indicated a bait uptake of 18.8% (n = 16) occurred along bait uptake transects while 38.1% (n = 21) of cats had consumed a bait in the biomarker trial. A collaborative bait uptake study has been conducted with the Department of Natural Resources and Energy (Victoria). The standard cat bait, labeled with the biomarker was deployed along tracks on French Island. The island, an area of 240 km^2, was traversed by a 180 km network of tracks and firebreaks, providing a baiting intensity across the island of approximately 7.5 baits/km^2. Results of this exercise indicated that 50% of captured cats (n = 24) had consumed baits, despite the presence of emergent rabbit kittens (Fisher *et al.* 2000).

The second reason for higher bait consumption in the other study areas is that these sites also have a much lower prey abundance. Therefore if the relationship between prey abundance and bait consumption is valid it follows that bait uptake in these areas is likely to be higher than on Peron. It is not that Peron is unique but rather that prey abundance on Peron is significantly greater, in particular, the abundance of rabbits is very important. Rabbit abundance in these other sites is significantly lower than on Peron (even the Nullarbor sites) which has a dramatic influence on prey availability, especially when rabbit kittens are present in the prey population.

Broad-based studies, such as this, tend to lead to further investigations and fine-tuning of findings, this program has been no exception. This study has, in part, resolved the variability associated with bait uptake by feral cats both in the short- and long-term and as such further studies can be conducted in the light of these findings to achieve a high degree of baiting efficacy. In the interim, this study has provided many avenues to improving existing baiting efficacy on-track. Methods of improving baiting efficacy are described below: -

- The current on-track baiting regime, of bait placement at 100 m intervals, provides an adequate baiting intensity. This intensity provided an average contact rate of 62% of individuals across the sampling period, with individual cats travelling a mean distance of 340 m. Increasing on-track baiting density will increase contact rate but not necessarily bait uptake. Increasing the frequency of baiting is more likely to achieve a higher baiting efficacy as fresh baits will be present at different times and thus increasing the chances that cats are hungry when the baits are encountered. Increasing baiting frequency will also reduce the one-dimensional nature of on-track baiting. Road alignments are only likely to be accessed by a small proportion of the cat population at any given time. Those cats accessing roads do so for a relatively small proportion of their daily activity. This condition dictates that a very small proportion of the population can be accessed, at any one time, by a track-based control measure. Increasing baiting frequency will also reduce the affect of short-term weather variables on bait uptake

- Timing of baiting is fundamental. Consistent uptake is more important than any one individual result. Routine and regular bait uptake exercises should be conducted when the onset of uptake is expected. Consistent bait uptake can be expected as rabbit abundance declines. This period, the “baiting window”, will occur from December through to May, depending on the significance of summer rainfall events and timing of rabbit breeding. Resources should be focussed on capitalising on this period of most efficacious baiting. Current indications are that baiting is not likely to be effective outside this period.

- Rabbit abundance is a critical influence on bait uptake. Maximising baiting efforts during seasonal declines in rabbit activity, the “baiting window”. Manipulation of rabbit populations, most likely through assisting the development and transmission of myxomatosis epizootics and introduction of a virulent strain of RCD, is likely to broaden the “baiting window”.

- Non-target activity may impact significantly upon efficacy. Sufficient baiting density and frequency will allow for the removal of baits by non-targets. Increasing baiting density may not result in a greater number of baits available to cats. Replacing baits taken by more frequent baiting may be the only answer. Placing baits slightly off road alignments, during hand-baiting and laying bait as late as possible in the afternoon, may reduce non-target uptake. There is little scope for altering the timing of baiting programs to reduce non-target uptake. The principle guide to the timing of baiting is when baits are most readily accepted by cats. Unfortunately this is always likely to closely follow the emergence and dispersal of young Varanids. Ant attack quickly degrades bait media, making them less palatable. The presence of ants on a bait will prevent uptake by feral cats. The use of Coopex ® is effective in preventing ant attack.

- Only fresh baits should be used. The baiting exercises described here employed baits that were no older than two months. Studies have not yet be completed on bait longevity in storage and acceptability.

Further research will be required to assess the influence of lunar phase on bait uptake and also the design and merit of incorporating a visual lure in bait presentation to enhance bait recognition.

Acknowledgments

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Appendix A

Table 2: Summary of bait station response by individual cats.

DATE	DISTANCE	TOTAL CATS	CATS/100km	CONTACTS	PASS	VISIT	TAKE	%Contacts	%Passes (contact)	%Visit (contact)	%Take (contact)	% Potential Take (contact)
19/11/1999	38.5	9	23.4	7	4	3		77.8	57.1	42.9	0.0	0.0
20/11/1999	33.6	8	23.8	6	6			75.0	100.0	0.0	0.0	16.7
21/11/1999	37.5	11	29.3	7		3	4	63.6	0.0	42.9	57.1	57.1
24/11/1999	40	10	25.0	5	4	1		50.0	80.0	20.0	0.0	0.0
25/11/1999	20	9	45.0	4	2	2		44.4	50.0	50.0	0.0	0.0
26/11/1999	16.5	11	66.7	9	3	5	1	81.8	33.3	55.6	11.1	11.1
27/11/1999	19	6	31.6	4	1	3		66.7	25.0	75.0	0.0	0.0
28/11/1999	20	7	35.0	5	3	2		71.4	60.0	40.0	0.0	0.0
30/11/1999	20	4	20.0	0				0.0	n/a	n/a	n/a	n/a
1/12/1999	19	6	31.6	1	1			16.7	100.0	0.0	0.0	0.0
2/12/1999	16.1	7	43.5	5	4	1		71.4	80.0	20.0	0.0	0.0
4/12/1999	10	5	50.0	3		2	1	60.0	0.0	66.7	33.3	20.0
5/12/1999	18.8	11	58.5	10	5	4	1	90.9	50.0	40.0	10.0	33.3
6/12/1999	16	8	50.0	3	2	1		37.5	66.7	33.3	0.0	20.0
7/12/1999	16	11	68.8	6	3	2	1	54.5	50.0	33.3	16.7	0.0
10/12/1999	19.5	9	46.2	6	1	5		66.7	16.7	83.3	0.0	16.7
11/12/1999	17	8	47.1	6	1	5		75.0	16.7	83.3	0.0	16.7
12/12/1999	18	8	44.4	6	2	4		75.0	33.3	66.7	0.0	0.0
13/12/1999	20	9	45.0	5		4	1	55.6	0.0	80.0	20.0	0.0
18/01/2000	19.2	8	41.7	5	1	4		62.5	20.0	80.0	0.0	20.0
19/01/2000	20	11	55.0	6	4	2		54.5	66.7	33.3	0.0	0.0
20/01/2000	15.7	5	31.8	2		2		40.0	0.0	100.0	0.0	16.7
21/01/2000	10	3	30.0	1	1			33.3	100.0	0.0	0.0	50.0
25/01/2000	19.7	9	45.7	9	3	5	1	100.0	33.3	55.6	11.1	0.0
26/01/2000	16.8	12	71.4	8	1	6	1	66.7	12.5	75.0	12.5	25.0
27/01/2000	18	10	55.6	8		3	5	80.0	0.0	37.5	62.5	33.3
28/01/2000	19.5	9	46.2	8	2	5	1	88.9	25.0	62.5	12.5	12.5
1/02/2000	19	7	36.8	5	1	1	3	71.4	20.0	20.0	60.0	55.6
2/02/2000	12.3	5	40.7	3		1	2	60.0	0.0	33.3	66.7	37.5
3/02/2000	15.6	9	57.7	2	2			22.2	100.0	0.0	0.0	60.0
4/02/2000	16	8	50.0	7		4	3	87.5	0.0	57.1	42.9	66.7
7/02/2000	20	9	45.0	6		3	3	66.7	0.0	50.0	50.0	0.0
8/02/2000	16.8	6	35.7	4	1	3		66.7	25.0	75.0	0.0	42.9
9/02/2000	17.5	10	57.1	10	1	7	2	100.0	10.0	70.0	20.0	83.3
10/02/2000	18.9	11	58.2	7	1	5	1	63.6	14.3	71.4	14.3	0.0
23/02/2000	15.9	7	44.0	2		2		28.6	0.0	100.0	0.0	45.5
24/02/2000	15.5	10	64.5	5	1	1	3	50.0	20.0	20.0	60.0	14.3
25/02/2000	14.6	10	68.5	6	2	3	1	60.0	33.3	50.0	16.7	0.0
26/02/2000	15.6	10	64.1	5		4	1	50.0	0.0	80.0	20.0	60.0
29/02/2000	10	4	40.0	3		1	2	75.0	0.0	33.3	66.7	40.0
1/03/2000	10	4	40.0	4		2	2	100.0	0.0	50.0	50.0	20.0
2/03/2000	10	6	60.0	4		4		66.7	0.0	100.0	0.0	100.0
5/03/2000	18	8	44.4	6	1	5		75.0	16.7	83.3	0.0	60.0
6/03/2000	15.4	9	58.4	4	2	1	1	44.4	50.0	25.0	25.0	25.0

Table 4a: ANOVA summary, contact v cumulative distance travelled.

Regression Statistics	
Multiple R	0.524035463
R Square	0.274613167
Adjusted R Square	0.257342051
Standard Error	18.79976555
Observations	44

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5619.605699	5619.605699	15.90014109	0.000261355
Residual	42	14844.10975	353.4311846		
Total	43	20463.71545			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	48.48777241	4.504696599	10.76382645	1.191E-13	39.39692375	57.57862107	39.39692375	57.57862107
Tot distance	0.007411261	0.001858624	3.987498099	0.000261355	0.003660404	0.011162117	0.003660404	0.011162117

Table 4b: ANOVA summary, contact v mean distance travelled.

Regression Statistics	
Multiple R	0.535455262
R Square	0.286712337
Adjusted R Square	0.269729298
Standard Error	18.64231986
Observations	44

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5867.199685	5867.199685	16.88227456	0.000180167
Residual	42	14596.51576	347.5360896		
Total	43	20463.71545			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	47.7658261	4.546436099	10.50621301	2.51643E-13	38.59074369	56.94090851	38.59074369	56.94090851
Ave distance	0.063973767	0.015569922	4.108804517	0.000180167	0.032552382	0.095395152	0.032552382	0.095395152

Table 4c: ANOVA summary, rate of bait uptake v rate of contact.

Regression Statistics	
Multiple R	0.271635557
R Square	0.073785876
Adjusted R Square	0.051733159
Standard Error	22.04647478
Observations	44

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1626.257978	1626.257978	3.345885913	0.074478894
Residual	42	20413.9761	486.04705		
Total	43	22040.23408			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.809200788	10.18217911	-0.07947226	0.937034455	-21.35767664	19.73927507	-21.35767664	19.73927507
%Contacts	0.281904803	0.15411571	1.829176294	0.074478894	-0.02911339	0.592922996	-0.02911339	0.592922996

Appendix C

Table 6: Summary of rabbit activity counts.

DATE	ZONE	% ABSENCE	% ONE	% TWO	% THREE	% PRESENCE
19/11/1999	2	16	64	20	2	84
20/11/1999	2	26	68	5	0	74
21/11/1999	2	23	69	8	1	77
24/11/1999	2	17	70	14	1	83
25/11/1999	3	29	54	16	2	71
26/11/1999	3	29	54	17	0	71
27/11/1999	3	39	54	6	0	61
28/11/1999	3	28	60	12	1	72
30/11/1999	4	27	54	19	1	73
1/12/1999	4	36	54	9	1	64
2/12/1999	4	27	50	22	1	73
4/12/1999	4	19	37	17	27	81
5/12/1999	3	32	51	11	7	68
6/12/1999	3	35	44	14	6	65
7/12/1999	3	54	34	8	4	46
10/12/1999	2	29	42	9	21	71
11/12/1999	2	37	40	12	11	63
12/12/1999	2	42	40	14	4	58
13/12/1999	2	23	49	11	18	77
18/01/2000	4	42	42	8	7	58
19/01/2000	4	41	39	15	5	59
20/01/2000	4	39	39	13	8	61
21/01/2000	4	53	30	10	7	47
25/01/2000	2	48	33	5	14	52
26/01/2000	2	61	32	3	4	39
27/01/2000	2	66	25	5	3	34
28/01/2000	2	66	28	4	3	34
1/02/2000	3	71	26	2	1	29
2/02/2000	3	63	25	5	7	37
3/02/2000	3	78	16	3	1	22
4/02/2000	3	74	23	2	2	26
7/02/2000	2	84	14	2	2	16
8/02/2000	2	85	13	1	1	15
9/02/2000	2	86	13	1	0	14
10/02/2000	0	81	17	2	1	19
23/02/2000	3	84	14	1	1	16
24/02/2000	3	75	21	3	2	25
25/02/2000	3	75	19	4	2	25
26/02/2000	3	70	24	6	0	30
29/02/2000	4	66	31	2	1	34
5/03/2000	4	71	25	4	0	29
6/03/2000	4	77	21	1	0	23

Appendix D: Weather Parameters and Lunar Phase.

Figure 20: Average night-time temperature.

Figure 21: Maximum night-time temperature.

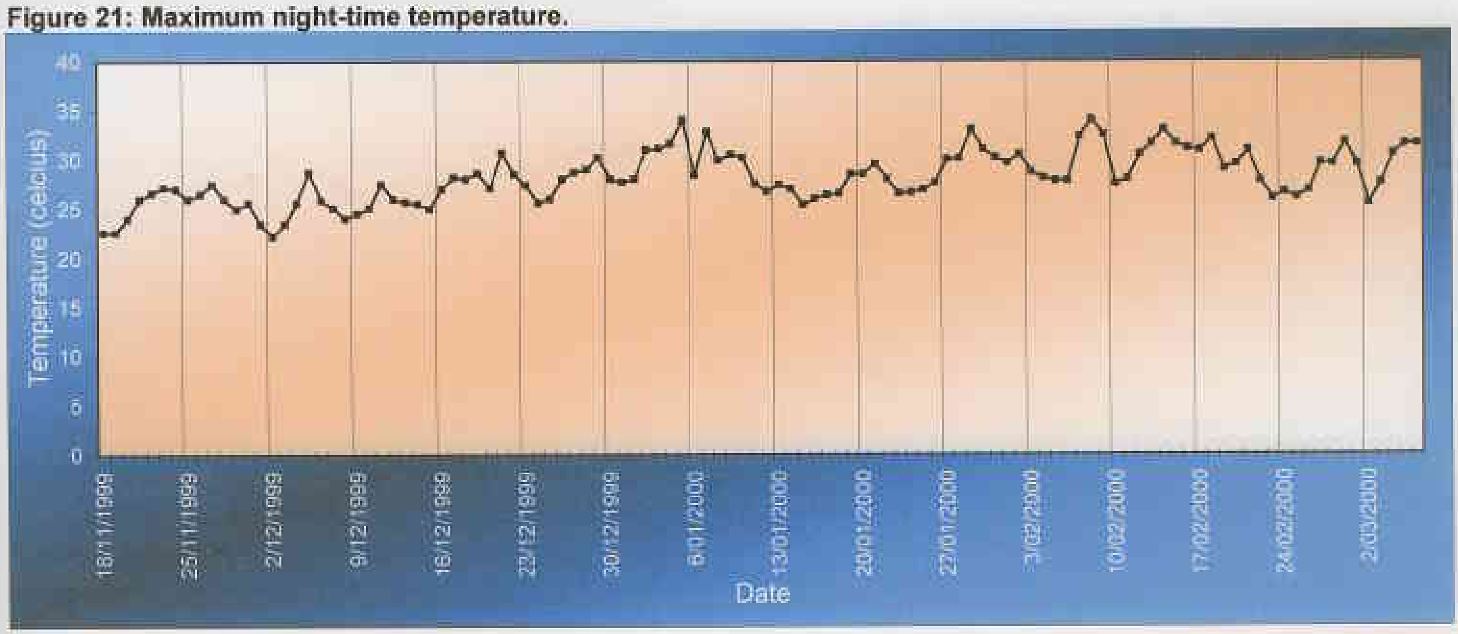


Figure 22: Minimum night-time temperature.

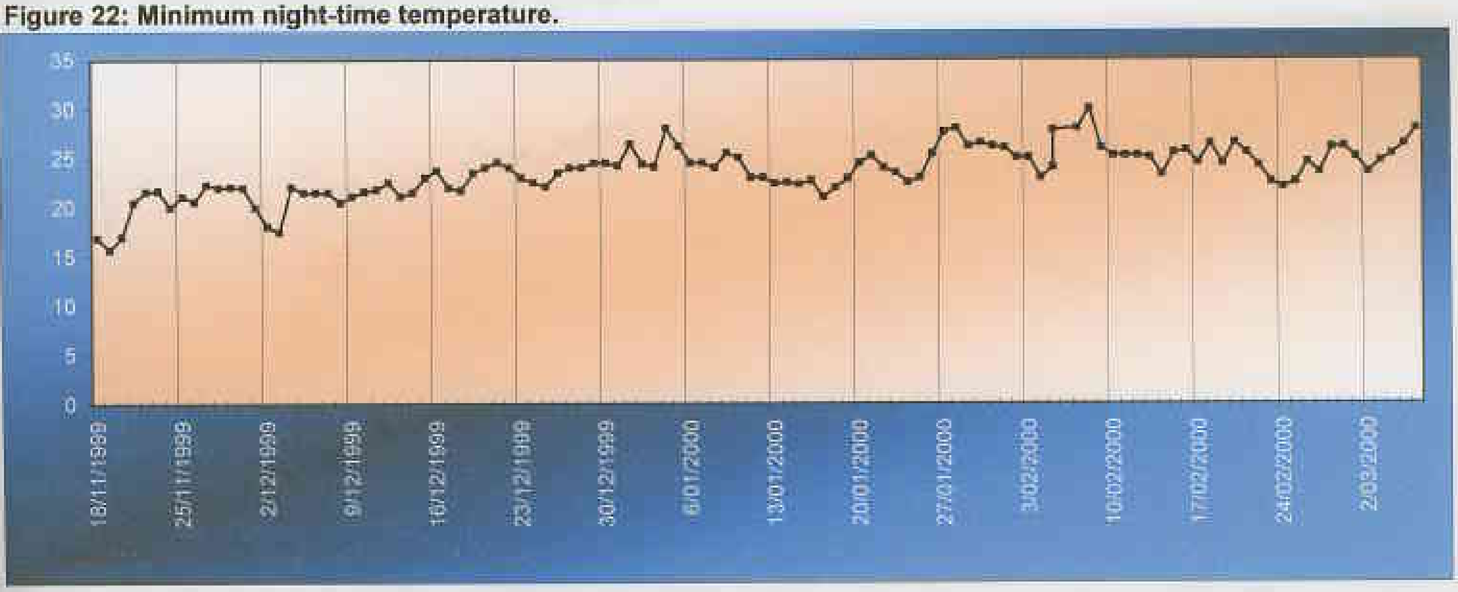


Figure 23: Average night-time wetbulb temperature.

Figure 24: Maximum night-time wetbulb temperature.

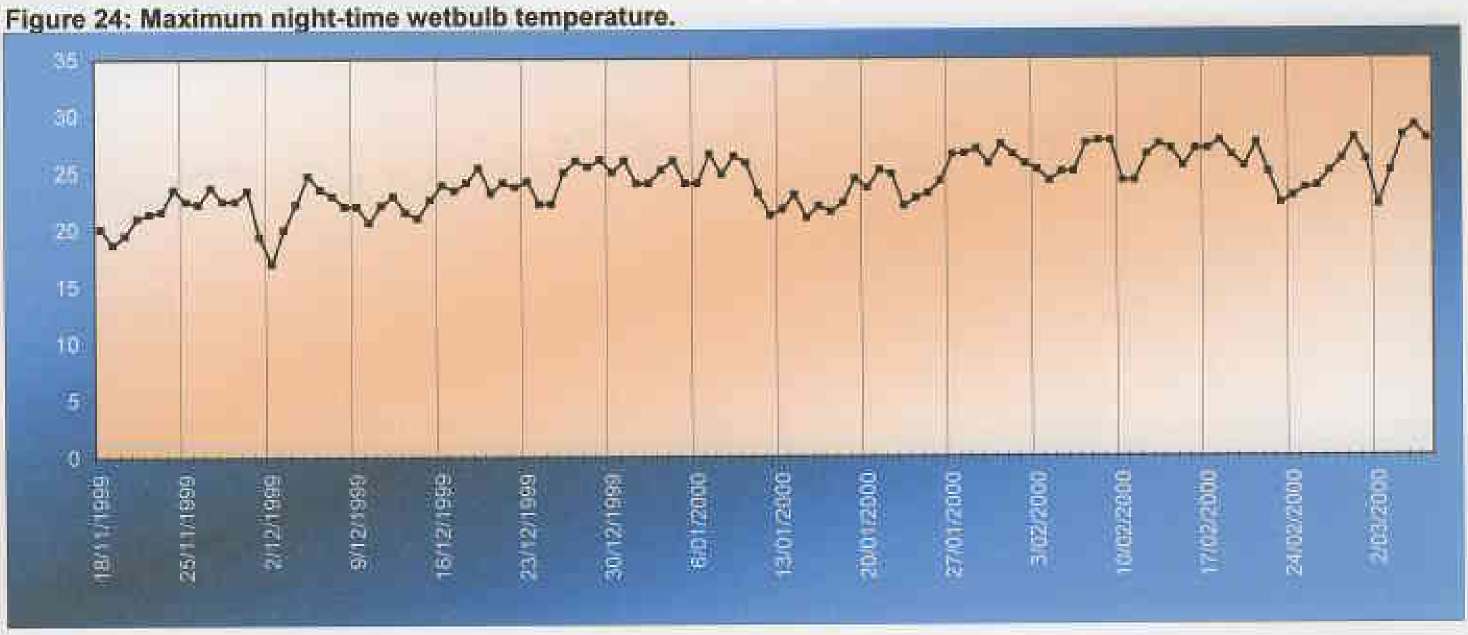


Figure 25: Minimum night-time wetbulb temperature.

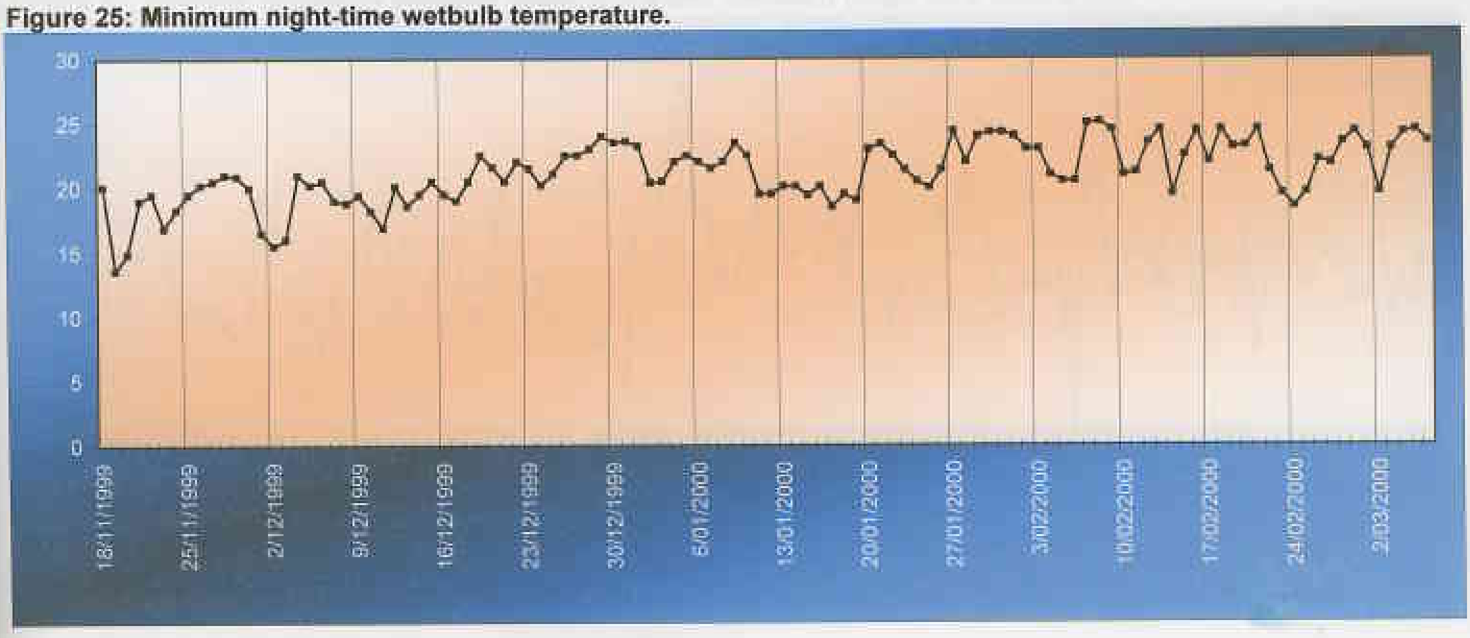


Figure 26: Average night-time relative humidity.

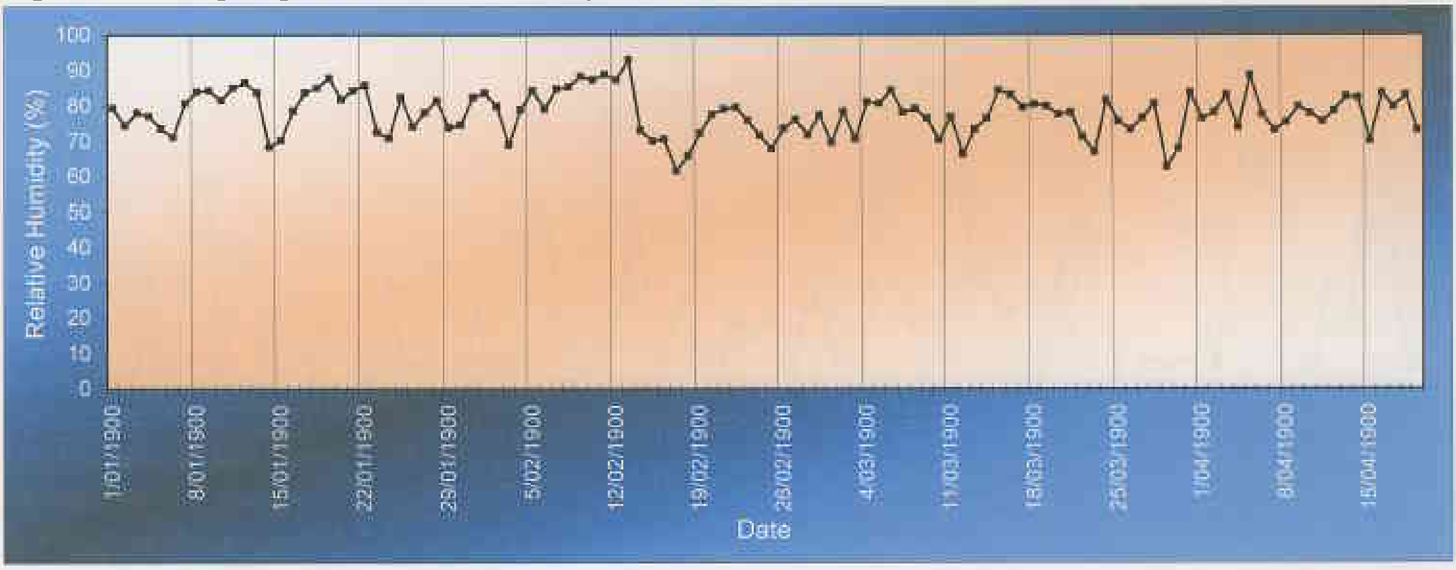


Figure 27: Average night-time dewpoint.

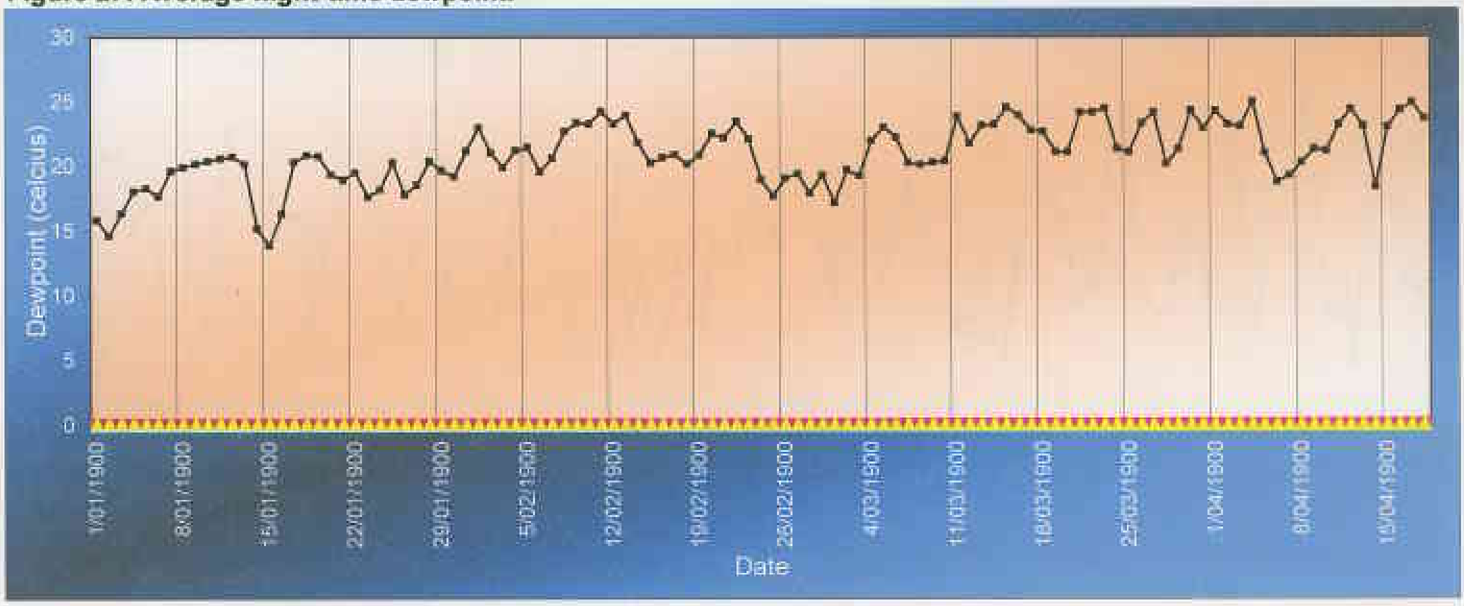


Figure 28: Average difference between temperature and dewpoint (night-time recordings).

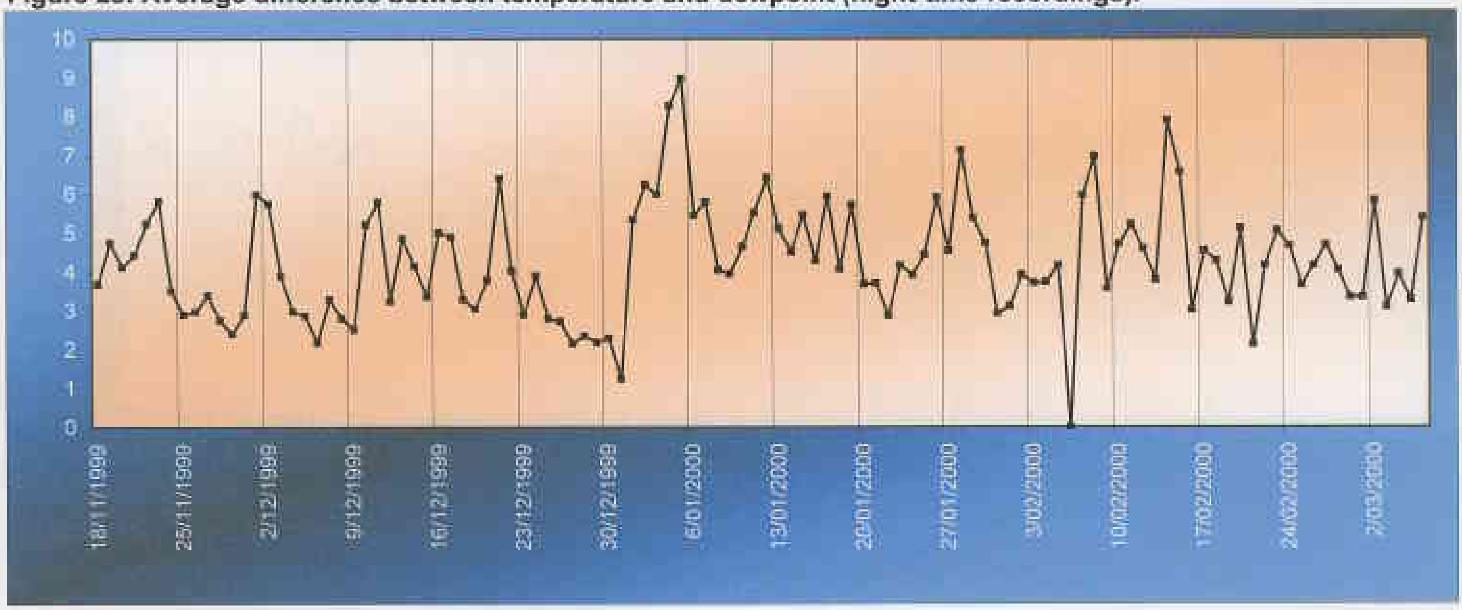


Figure 29: Average night-time cloud cover.

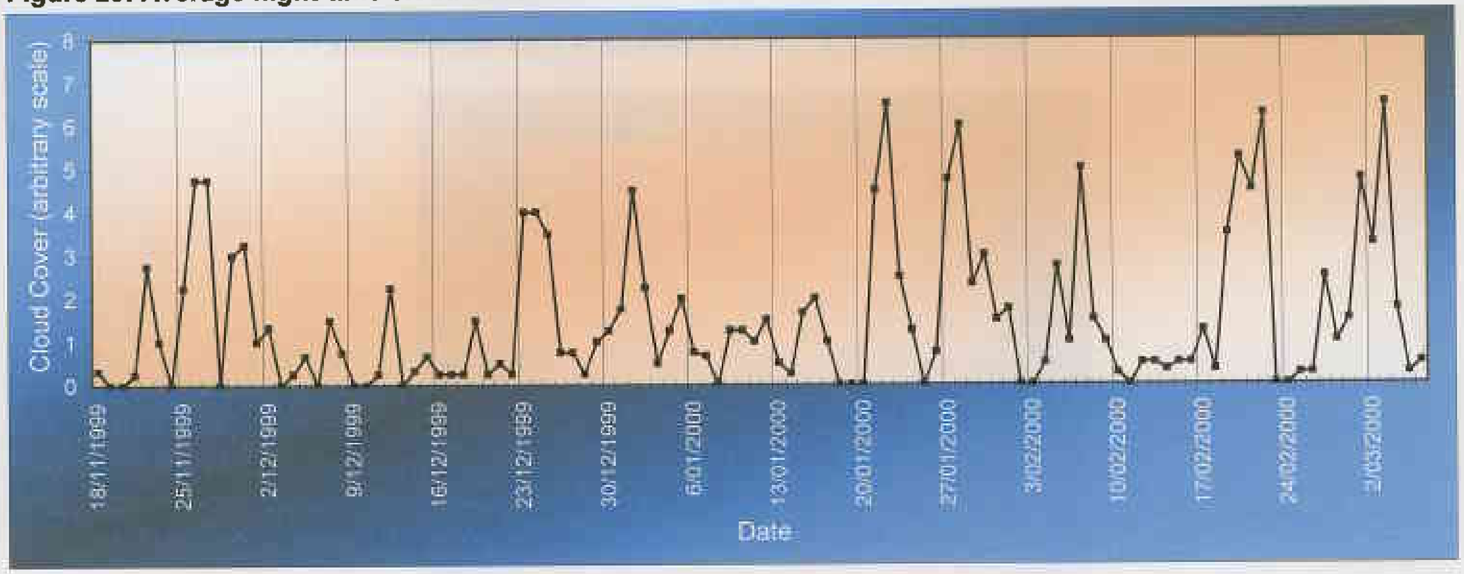


Figure 30: Average night-time wind speed.

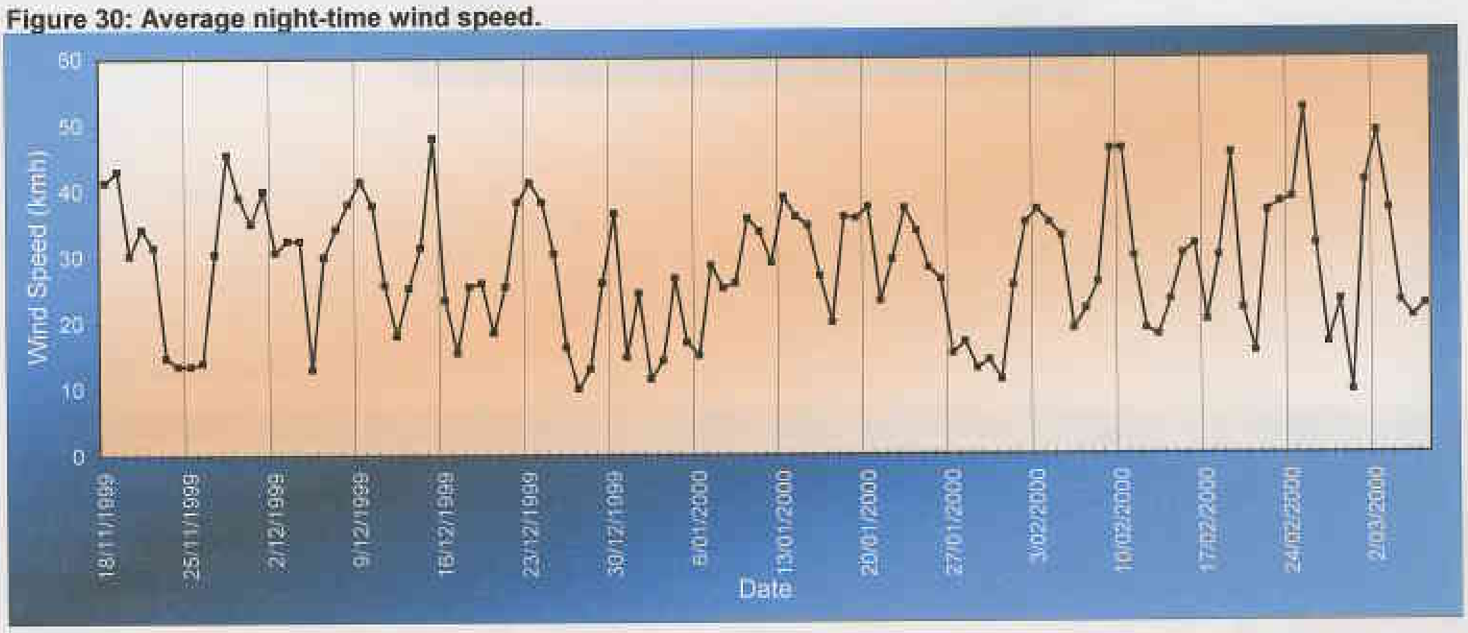


Figure 31: Average night-time barometric pressure.

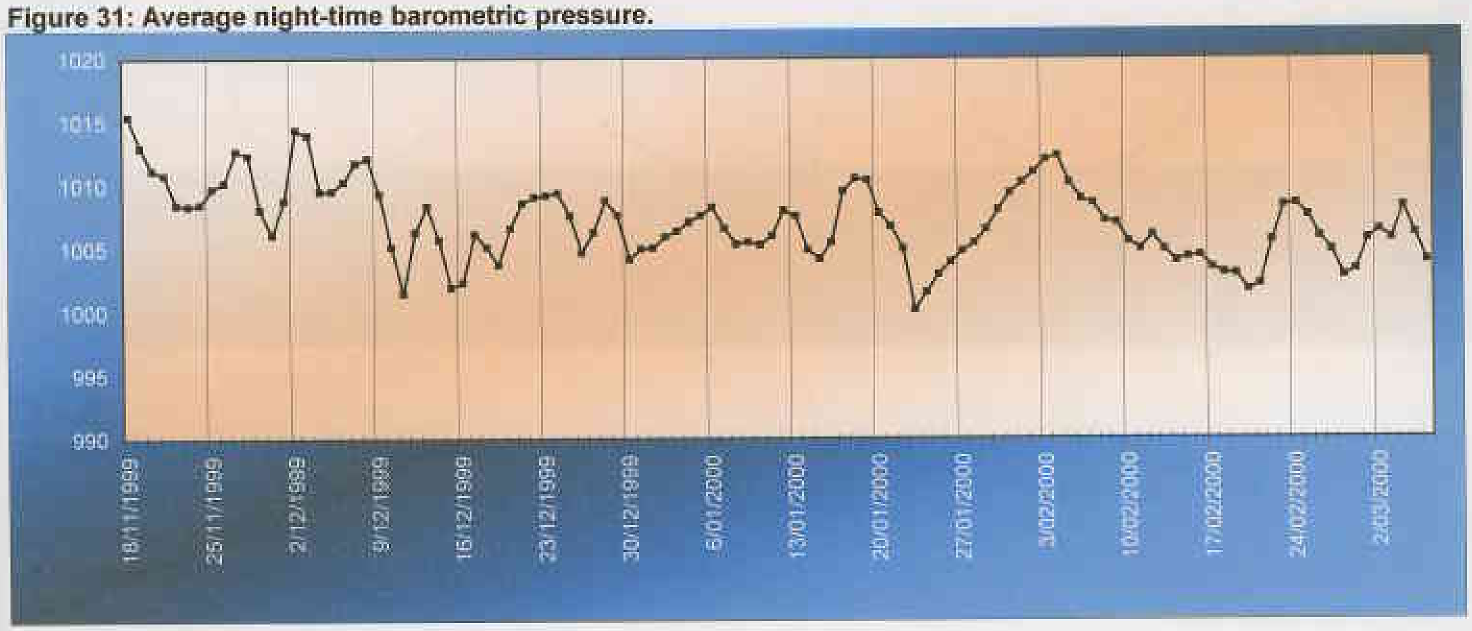


Figure 32: Frequency of average night-time wind direction (19/11/1999-6/3/2000).

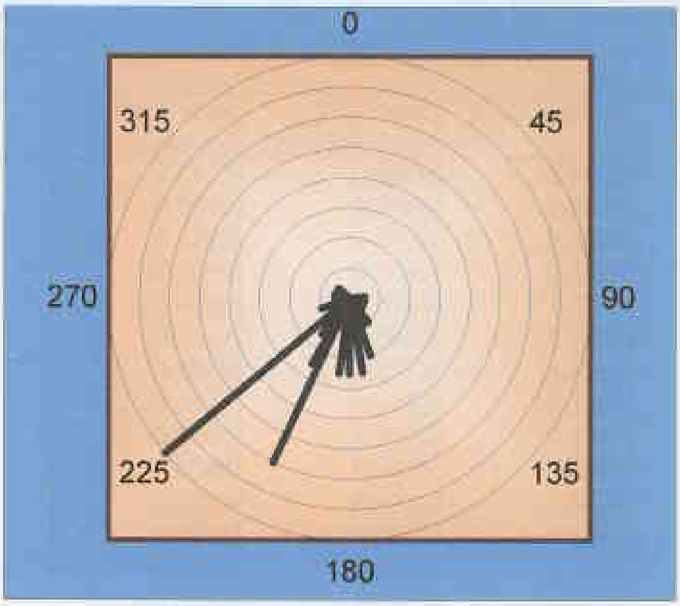
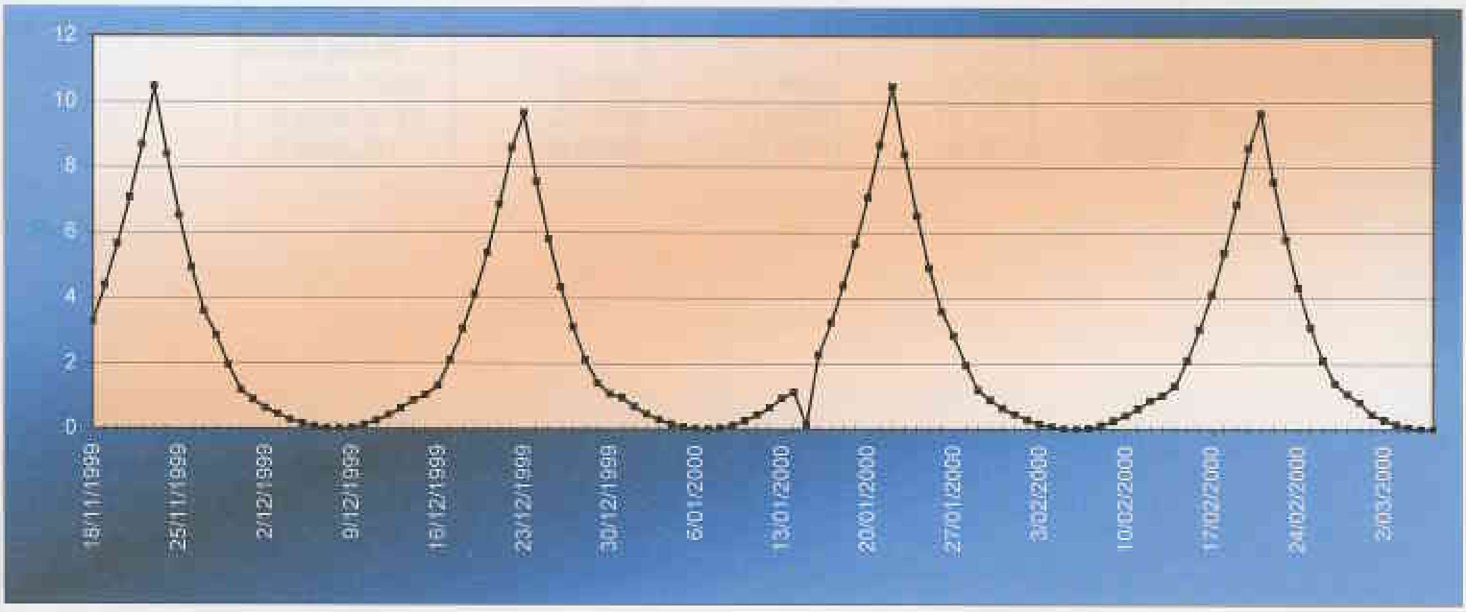


Figure 33: Luminosity.



Appendix E: Logistic regression analysis for bait uptake and potential bait uptake.

Table 7a: Estimated coefficients and standard errors for univariate logistic regressions of bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Temp	0.1970	0.0679	8.4228	0.0037
TempMax	0.0736	0.0448	2.6940	0.1007
TempMin	0.1783	0.0608	8.5904	0.0034
TMaxRF	-0.2094	0.3540	0.3500	0.5541
TMinRF	0.4660	0.3545	1.7275	0.1887
Wetb	0.2507	0.0803	9.7546	0.0018
WetbMax	0.1688	0.0772	4.7787	0.0288
WetbMin	0.2417	0.0752	10.3306	0.0013
WMaxRF	0.3961	0.3579	1.2247	0.2684
WMinRF	-0.0040	0.3532	0.0001	0.9910
RH	0.0218	0.0312	0.4895	0.4841
Msl	-0.0225	0.0554	0.1647	0.6848
MslRF	-0.1361	0.3556	0.1465	0.7019
DIR	-0.0053	0.0050	1.1489	0.2838
Kmh	-0.0078	0.0167	0.2157	0.6423
CldCode	0.4566	0.3552	1.6521	0.1987
Luminosity	-0.0672	0.0745	0.8142	0.3669
Dwpt	0.2427	0.0776	9.7839	0.0018
Lure type				
Rabbit	0.5596	0.5674	0.9726	0.3240
Reptile	0.8091	0.5504	2.1605	0.1416
Rodent	1.2246	0.6859	3.1879	0.0742
Tinsel	0.5419	0.5817	0.8679	0.3515
Audio/Visual	0.4811	0.3612	1.7742	0.1829
Rabbit activity				
Rabbit-25-50	0.3883	0.4433	0.7674	0.3810
Rabbit-50-75	-2.1748	0.6817	10.1772	0.0014
Rabbit-75+	-0.0953	0.5777	0.0272	0.8690

Table 7b: Estimated coefficients and standard errors for 1st multivariate logistic regression of bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	5.3408	7.1412	0.5593	0.4545
Temp	2.4359	1.8045	1.8223	0.1770
TempMax	0.0807	0.1435	0.3163	0.5739
TempMin	0.0229	0.4392	0.0027	0.9584
TMinRF	1.1195	0.5416	4.2722	0.0387
Wetb	-7.3351	4.8434	2.2935	0.1299
WetbMax	-0.4092	0.3086	1.7575	0.1849
WetbMin	0.1349	0.4126	0.1069	0.7437
CldCode	-0.3394	0.5279	0.4134	0.5202
Dwpt	4.7386	3.0353	2.4372	0.1185
Audio/Visual	1.0527	0.5108	4.2473	0.0393
Rabbit activity				
Rabbit-25-50	1.2285	0.6205	3.9195	0.0477
Rabbit-50-75	-1.6147	0.9528	2.8718	0.0901
Rabbit-75+	0.9578	0.9999	0.9175	0.3381

Table 7c: Estimated coefficients and standard errors for 2nd multivariate logistic regression of bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	4.2874	6.3999	0.4488	0.5029
Temp	2.4605	1.5501	2.5195	0.1124
TMinRF	0.9695	0.4633	4.3789	0.0364
Wetb	-7.2067	4.5402	2.5195	0.1124
WetbMax	-0.2360	0.2237	1.1130	0.2914
Dwpt	4.6908	2.7777	2.8518	0.0913
Audio/Visual	1.0250	0.4653	4.8523	0.0276
Rabbit activity				
Rabbit-25-50	1.1958	0.5670	4.4477	0.0349
Rabbit-50-75	-1.5756	0.8543	3.4012	0.0652
Rabbit-75+	1.0821	0.8265	1.7144	0.1904

Table 7d: Estimated coefficients and standard errors for 3rd multivariate logistic regression of bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	3.3872	6.3629	0.2834	0.5945
Temp	2.1673	1.5420	1.9755	0.1599
TMinRF	0.9394	0.4561	4.2426	0.0394
Wetb	-6.9871	4.6246	2.2827	0.1308
Dwpt	4.5808	2.8405	2.6007	0.1068
Audio/Visual	0.9177	0.4480	4.1958	0.0405
Rabbit activity				
Rabbit-25-50	0.9879	0.5296	3.4794	0.0621
Rabbit-50-75	-1.8427	0.8149	5.1132	0.0237
Rabbit-75+	0.8372	0.7881	1.1283	0.2881

Table 8a: Estimated coefficients and standard errors for univariate logistic regressions of bait uptake (post 25.1.2000).

Variable	Parameter Estimate	Estimated Standard error	Walled Statistic	P - value
Temp	0.0153	0.1072	0.0205	0.8863
TempMax	-0.0316	0.0574	0.3035	0.5817
TempMin	0.0027	0.1024	0.0007	0.9791
TMaxRF	0.2578	0.4307	0.3584	0.5494
TMinRF	0.8481	0.4376	3.7566	0.0526
Wetb	0.0913	0.1255	0.5290	0.4670
WetbMax	-0.0789	0.1192	0.4385	0.5078
WetbMin	0.0703	0.1105	0.4050	0.5245
WMaxRF	0.9510	0.4496	4.4739	0.0344
WMinRF	0.0104	0.4335	0.0006	0.9808
RH	0.0611	0.0441	1.9232	0.1655
Msl	0.1289	0.0801	2.5887	0.1076
MslRF	-0.5081	0.4362	1.3567	0.2441
DIR	0.0013	0.0070	0.0346	0.8524
Kmh	-0.0228	0.0196	1.3445	0.2462
CldCode	0.6035	0.4337	1.9366	0.1640
Luminosity	-0.0592	0.1209	0.6243	0.6243
Dwpt	0.1212	0.1174	1.0665	0.3017
DwptTemp	-0.2449	0.1944	1.5859	0.2079
Lure type				
Rabbit	0.7684	0.6680	1.3230	0.2501
Reptile	1.2186	0.6725	3.2830	0.0700
Rodent	0.0000			
Tinsel	1.0561	0.7126	2.1964	0.1383
Audio/Visual	0.6844	0.4351	2.4748	0.1157
Rabbit activity				
Rabbit-25-50	0.4925	0.4512	1.1912	0.2751
Rabbit-50-75	-0.9220	1.1156	0.6831	0.4085
Rabbit-75+	0.0000			

Table 8b: Estimated coefficients and standard errors for 1st multivariate logistic regression of bait uptake (post 25.1.2000).

n = 19

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-2.2222	118.5	0.0004	0.985
TMinRF	1.1595	0.7473	2.4073	0.1208
WMaxRF	0.2409	0.4997	0.2324	0.6298
RH	0.4356	0.4335	1.0095	0.315
Msl	-0.0366	0.1134	0.1041	0.747
MslRF	0.2621	0.5531	0.2246	0.6355
Kmh	-0.0682	0.0311	4.8161	0.0282
CldCode	-0.0963	0.5757	0.028	0.8672
DwptTemp	1.4649	1.9083	0.5893	0.4427

Table 8c: Estimated coefficients and standard errors for 2nd multivariate logistic regression of bait uptake (post 25.1.2000).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	0.7759	0.6188	1.5725	0.2099
TMinRF	1.2860	0.5215	6.0807	0.0137
Kmh	-0.0571	0.0237	5.7977	0.0160

Appendix E cont.

Table 9a: Estimated coefficients and standard errors for univariate logistic regressions of potential bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Temp	0.2339	0.0603	15.0412	0.0001
TempMax	0.1330	0.0399	11.1175	0.0009
TempMin	0.1884	0.0527	12.7888	0.0003
TMaxRF	-0.3863	0.3017	1.6391	0.2005
TMinRF	0.0987	0.3029	0.1062	0.7445
Wetb	0.2802	0.0701	15.9824	0.0001
WetbMax	0.2626	0.0697	14.1744	0.0002
WetbMin	0.2492	0.0645	14.9392	0.0001
WMaxRF	0.2195	0.3007	0.5326	0.4655
WMinRF	0.2848	0.3015	0.8922	0.3449
RH	0.0092	0.0261	0.1230	0.7258
Msl	-0.0467	0.0472	0.9806	0.3220
MslRF	0.3837	0.3009	1.6269	0.2021
DIR	-0.0069	0.0042	2.6296	0.1049
Kmh	0.0005	0.0141	0.0011	0.9731
CldCode	0.2311	0.3041	0.5776	0.4473
Luminosity	-0.0691	0.0625	1.2195	0.2695
Dwpt	0.2590	0.0670	14.9428	0.0001
Lure type				
Rabbit	0.2877	0.4241	0.4600	0.4976
Reptile	-0.0918	0.4415	0.0432	0.8353
Rodent	0.3747	0.5910	0.4020	0.5261
Tinsel	-0.1766	0.4595	0.1477	0.7007
Audio/Visual	-0.1913	0.3000	0.4066	0.5237
Rabbit activity				
Rabbit-25-50	0.1976	0.4023	0.2412	0.6233
Rabbit-50-75	-1.1173	0.4224	6.9965	0.0082
Rabbit-75+	-0.7187	0.5546	1.6792	0.1950

Table 9b: Estimated coefficients and standard errors for 1st multivariate logistic regression of potential bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	4.1011	5.9497	0.4751	0.4906
Temp	2.0395	1.5544	1.7217	0.1895
TempMax	-0.0231	0.1291	0.0319	0.8582
TempMin	-0.5925	0.3303	3.2175	0.0729
TMaxRF	-0.4439	0.5730	0.6002	0.4385
Wetb	-4.9975	3.9018	1.6405	0.2003
WetbMax	-0.0558	0.2486	0.0505	0.8223
WetbMin	-0.1727	0.3250	0.2824	0.5952
MslRF	0.3541	0.4551	0.6054	0.4365
DIR	-0.0189	0.0086	4.8756	0.0272
Dwpt	3.7738	2.4628	2.3479	0.1254
Rabbit-25-50	0.3431	0.6284	0.2981	0.5851
Rabbit-50-75	-0.7667	0.7135	1.1546	0.2826
Rabbit-75+	0.3245	0.9236	0.1234	0.7253

Table 9c: Estimated coefficients and standard errors for 2nd multivariate logistic regression of potential bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-3.4911	4.6711	0.5586	0.4548
Temp	0.5079	1.2554	0.1637	0.6858
TempMin	-0.4000	0.2656	2.2682	0.1321
Wetb	-0.7923	3.4047	0.0542	0.8160
DIR	-0.0159	0.0066	5.7479	0.0165
Dwpt	0.9553	2.0851	0.2099	0.6468

Table 9d: Estimated coefficients and standard errors for 3rd multivariate logistic regression of potential bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-4.4556	1.7349	6.5959	0.0102
TempMin	0.1776	0.0541	10.7584	0.0010
DIR	-0.0033	0.0045	0.5489	0.4588

Table 9e: Estimated coefficients and standard errors for 4th multivariate logistic regression of potential bait uptake (entire sampling period).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-5.3608	1.2653	17.9519	0.0001
TempMin	0.1884	0.0527	12.7888	0.0003

Table 10a: Estimated coefficients and standard errors for univariate logistic regressions of potential bait uptake (post 25.1.2000).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Temp	0.1143	0.0988	1.3377	0.2474
TempMax	0.0471	0.0515	0.8379	0.3600
TempMin	0.0458	0.0935	0.2394	0.6246
TMaxRF	0.0057	0.3933	0.0002	0.9884
TMinRF	0.5781	0.3985	2.1047	0.1469
Wetb	0.2456	0.1182	4.3188	0.0377
WetbMax	0.1146	0.1075	1.1379	0.2861
WetbMin	0.1860	0.1036	3.2238	0.0726
WMaxRF	0.6190	0.3969	2.4329	0.1188
WMinRF	0.1797	0.3963	0.2055	0.6503
RH	0.0868	0.0407	4.5543	0.0328
Msl	0.0654	0.0738	0.7848	0.3757
MslRF	0.0625	0.3918	0.0255	0.8732
DIR	0.0059	0.0064	0.8540	0.3554
Kmh	-0.0251	0.0178	1.9939	0.1579
Cldcode	0.6690	0.3987	2.8159	0.0933
Luminosity	-0.1567	0.1124	1.9459	0.1630
Dwpt	0.2708	0.1114	5.9035	0.0151
DwptTemp	-0.3064	0.1758	3.0382	0.0813
Lure type				
Rabbit	0.3483	0.5301	0.4317	0.5112
Reptile	<0.0000	0.5636	0.0000	1.0000
Rodent	0.0000			
Tinsel	0.2429	0.5944	0.1671	0.6827
Audio/Visual	-0.0864	0.3946	0.0479	0.8267
Rabbit activity				
Rabbit-25-50	0.3448	0.4116	0.7017	0.4022
Rabbit-50-75	-0.1591	0.7703	0.0426	0.8364
Rabbit-75+	0.0000			

Table 10b: Estimated coefficients and standard errors for 1st multivariate logistic regression of potential bait uptake (post 25.1.2000).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-258.1000	120.2000	4.6124	0.0317
Temp	16.7044	7.9388	4.4275	0.0354
TMinRF	1.5421	0.6843	5.0791	0.0242
Wetb	-14.1321	9.6640	2.1384	0.1437
WetbMin	-0.5350	0.6030	0.7871	0.3750
WMaxRF	0.7901	0.5996	1.7364	0.1876
RH	2.9220	1.3562	4.6423	0.0312
Kmh	-0.0728	0.0290	6.3096	0.0120
CldCode	-1.0295	0.9192	1.2543	0.2627
Luminosity	0.5964	0.3193	3.4880	0.0618
Dwpt	-2.9652	5.7011	0.2705	0.6030

Table 10c: Estimated coefficients and standard errors for 2nd multivariate logistic regression of potential bait uptake (post 25.1.2000).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-173.1000	89.8462	3.7105	0.0541
Temp	12.5683	6.9222	3.2965	0.0694
TMinRF	1.1857	0.5726	4.2877	0.0384
Wetb	-13.5533	7.5478	3.2244	0.0725
WMaxRF	0.4958	0.5284	0.8806	0.3480
RH	2.0645	1.0848	3.6220	0.0570
Kmh	-0.0665	0.0284	5.4748	0.0193
Luminosity	0.3902	0.2384	2.6782	0.1017

Table10d: Estimated coefficients and standard errors for 3rd multivariate logistic regression of potential bait uptake (post 25.1.2000).

Variable	Parameter Estimate	Estimated Standard error	Wald Statistic	P - value
Intercept	-174.2000	92.4315	3.5529	0.0594
Temp	12.5600	7.1126	3.1183	0.0774
TMinRF	1.3020	0.5684	5.2465	0.0220
Wetb	-13.5023	7.7529	3.0331	0.0816
RH	2.0672	1.1152	3.4358	0.0638
Kmh	-0.0606	0.0277	4.7891	0.0286
Luminosity	0.3768	0.2407	2.4499	0.1175