Conservation Science W. Aust. 6 (1) : 109–149 (2007)

Influence of bait type, weather and prey abundance on bait uptake by feral cats (*Felis catus*) on Peron Peninsula, Western Australia

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ABSTRACT

Bait uptake by feral cats has shown variability both on a temporal and spatial scale. This study examined 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. We aimed to determine the optimum timing of baiting programs to maximize efficiency. The result was that bait uptake by feral cats displayed a high degree of short-term variability but clearly became more frequent and consistent into late summer/early autumn. A number of temperature factors were significantly related to bait uptake over the entire sampling period (long-term weather conditions) but insignificant when bait uptake was a regular occurrence. The exception was fluctuations in minimum temperature, which was of significance in both the long and short-term. Of the other environmental factors, rabbit abundance had a significant relationship with bait uptake. As rabbit abundance decreased from late spring through to early autumn, there was an increase in bait uptake. The two most important environmental factors that affected bait uptake in the short-term were wind speed and fluctuations in minimum temperature.

There was a significant preference for the kangaroo meat sausage bait over a chicken meat sausage bait and day-old cockerel and this could be potentially enhanced by the use of visual lures. Baiting efficacy was also significantly affected by non-target species, particularly Varanids and Corvids, consuming baits, reducing bait availability to feral cats.

INTRODUCTION

Baiting campaigns to control feral cats (*Felis catus*) have been conducted on Peron Peninsula, the site of 'Project Eden', since 1996. 'Project Eden', part of the broader 'Western Shield' program, aims to control introduced predators and return native wildlife to an area from which many mammal species have become extinct (Thomson and Shepherd 1995; Algar and Smith, 1998; Morris *et al.* 2004). The baiting programs have used both on-track deployment from a vehicle and delivery from an aircraft. Bait uptake trials conducted in conjunction with the baiting programs and baiting efficacy achieved during the baiting programs have indicated variability in bait consumption both on a temporal and spatial scale (Algar and Angus 2000a; Morris *et al.* 2004; Algar and Burrows 2004). Knowledge of predictable patterns in this variability (if any) and the possible causal factors, could lead to increased efficacy and cost efficiency of control measures undertaken. Management efforts could be focused on seasons or events where bait acceptance is likely to be greatest and less variable. It may also be possible to undertake complementary management actions that maximize bait acceptance by feral cats.

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 potentially influenced by short-term (day-to-day) and/or long-term (seasonal) weather conditions.

The amount of time cats spend seeking food varies between individuals, sexes and seasons, but it accounts for less than 50 % of total activity (Turner and Meister 1988). Cats, despite being opportunistic predators, will only consume a food item if they are hungry (Bradshaw 1992). Cats have the ability to regulate calorific intake to maintain body weight (MacDonald *et al.* 1984; Baker and Czarneki-Maulden 1991; Legrand-Defretin 1994; Bradshaw *et al.* 1996). Cats will generally not exceed dietary requirements when provided food *ad libitum.* Thus for cats to consume baits they must encounter them when they are hungry. If a cat encounters a bait when not hungry it may not be consumed regardless of the acceptability of the bait.

The relationship between bait consumption and hunger can be extended to prey abundance, which is also a function of long-term weather conditions (season/rainfall). The likelihood of cats encountering baits when hungry is potentially diminished in the presence of an abundant prey population. Therefore bait uptake is invariably low when prey availability is high. Rabbits (*Oryctolagus cuniculus*), when present, can form a substantial proportion of feral cat diet (e.g. Jones and Coman 1981; Martin *et al.* 1996; Risbey *et al.* 1999). This is also 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 as was found in an earlier study (Short *et al.* 1997) on the adjoining Heirisson Prong.

A research program was conducted with the aim of improving baiting efficacy on Peron Peninsula. The first objective was 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. The second objective was to compare the efficacy of the current standard bait against other bait types. Finally, a number of lures that may invoke a feeding response and thus potentially improve bait uptake were assessed.

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 km², 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). To prevent reinvasion by foxes (*Vulpes vulpes*) and cats from the mainland onto the peninsula a barrier fence was built across the isthmus in 1995. An electronic recording of a barking dog activated by movement sensors, and a cattle grid have been installed in the gap in the fence where the Denham road passes. These devices have provided an effective deterrent to fox and cat movement across this gap (Morris *et al.* 2004). The fence and prevention of movement across the grid has effectively created an island of the peninsula for introduced predator management.

Feral cat control on Peron Peninsula consists of a trapping program and ground and aerial baiting campaigns; these are described in detail in Morris *et al.* (2004). In summary, the Peninsula has been arbitrarily divided into four zones (see Fig. 1) and these zones are trapped on a rotational basis for feral cat control, by district staff. The trapping technique utilizes padded leg-hold traps, Victor 'Soft Catch'® traps No. 3 (Woodstream Corp., Lititz, Pa.; U.S.A.), an audio lure (Felid Attracting Phonic) that produces a sound of a cat call, and a blended mixture of faeces and urine (Pongo). Prior to this study, ground and aerial baiting campaigns were conducted annually in late summer/early autumn. During the course of this study, no baiting campaigns were conducted by district staff. Neither previous baiting exercises nor the ongoing trapping program were likely to compromise the bait uptake trials, however it was necessary to conduct the trials 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 1080 poison bait regulations. The bait uptake trials were conducted along tracks in Zones 2, 3 and 4 (see track 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 tourist traffic on the majority of track access.

Climate

The climate of Peron Peninsula is described as 'semi-desert Mediterranean' (Beard 1976; Payne *et al.* 1987) Prevailing summer winds are southerly to south-westerly, relatively dry, 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 are as high as 38° C for summer months and as low as 21° C for winter months. January and February are the hottest months while June and July are the coolest winter months. Rainfall averages 220 mm per year, most of it falling between April and September.

Vegetation

Beard (1976) and Payne *et al.* (1987) describe the vegetation of the peninsula. 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 steppe of the birridas. A minor association occurs in small, near-coastal strips. This is variously a *Spinifex longifolius* grassland or myrtaceous heath. The *Acacia* scrub occurs on undulating sand dunes and is dominated by *Acacia ramulosa* which grows to ~3 m. The *Acacia* thickets occur on the exposed western side of the peninsula and are dominated by dense, low *A. ligulata*. The shrub steppe is dominated by *Triodia plurinervata* grassland. 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 dunes in the exposed northwest portion of the study site. It exists as a low dense scrub to 1.5 m, dominated by *A. ligulata* and *Lamarchea hakeifolia*. The birridas are variously vegetated with steppe, many with large areas of bare, saline and alkaline clay.

Most of Zone 2 supports *Acacia* scrub. 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. The eastern portion, in particular, is dissected by numerous birridas, many of which are several kilometres in extent. The north-west 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 western-most transect is over *Spinifex longifolius* grassland.

Bait Types, Lures and Uptake Trials

Bait types

The acceptability of the standard sausage cat bait was assessed against two other bait types at cafeteria stations. Bait type (1) was the standard sausage cat bait approximately 20 g wet-weight, blanched and then dried to 15 g. This 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. Bait type (2) was a chicken sausage bait produced in the same manner and to the same specifications as the standard cat bait but chicken mince replacing the kangaroo mince. This bait was used because of its relative ease of manufacture but different composition from the standard bait. This bait was also injected with 4.5 mg 1080. Bait type (3) was a dead day-old cockerel which provided a readily available and relatively inexpensive 'natural bait' alternative to the other two and has been used successfully in controlling feral cats elsewhere (Brothers 1982; Twyford *et al.* 2000; Bester *et al.* 2002). The cockerel bait medium was not included on the Australian Pesticides and Veterinary Medicines Authority experimental bait permit and therefore these baits were non-toxic.

Ant attack on baits rapidly degrades the bait medium, reducing palatability. Persistence of ants on the bait deters uptake by feral cats. All three bait types were treated with an ant deterrent compound (Coopex®) at a concentration of 12.5 g l^{-1} Coopex as per the manufacturer's instructions. Previous trials with this product have demonstrated that its use can greatly enhance bait uptake by feral cats (Algar unpub. data).

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 sounds). The tinsel lure was constructed from a sheath of tinsel attached to a chaining arrow (40 cm rigid 12 gauge wire), such that the tinsel fluttered in the breeze. The 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. The reptile lure consisted of a modified soft plastic fishing lure resembling a lizard, 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' vocalizations.

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.

Bait laying procedures

Bait uptake trials were conducted at weekly intervals across lunar phases and weather conditions. The trial periods were mid November – mid December 1999, mid January – mid February and mid March – mid April 2000. The second period was extended into March because of the onset of continuous bait uptake from late January and the need to maximize sampling periods prior to the onset of rainfall.

Bait uptake trials were conducted along discrete sections (transects) of existing track network. A pilot study conducted during the first four days over transect lengths of up to 40 km in length indicated that a reduction in transect length was warranted because of the time required to complete observations. All subsequent observations were conducted over transect lengths of up to 20 km of track per night. Transects were chain-dragged as the baits were laid to clear sign of previous activity. Bait laying commenced two hours before sunset. Baits (bait stations) were laid at 100 m intervals in the centre of the track. Baits were positioned only on sandy substrate where it was possible to observe track activity (eg. baits were not located on birridas).

Each transect comprised a single, standard cat bait laid at 100 m intervals; a cafeteria where the three bait types were offered at 500 m intervals and a lure with cafeteria at the 1000 m intervals. Thus in a 20 km bait uptake transect there was a 20 x 1 km replicates containing standard baits at 100, 200, 300, 400, 600, 700, 800 and 900 m; a set of the three different bait media at 500 and 1000 m and a lure at the 1000 m cafeteria. The lure type used changed daily through the series of lures trialed. A 20 km bait uptake transect presented 160 standard bait stations; 20 cafeteria stations and 20 cafeteria stations with lures. A total of 42 bait uptake trials was conducted during the study period.

Assessment of bait uptake

Baits were examined the morning following bait placement, commencing one hour after dawn. Transect 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 front of the vehicle. 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 were no cat tracks within 3 m of the bait;
- Pass — Cat tracks were 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 an "uptake" because the bait had been removed, but 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 as a "visit" in the uptake summaries rather than "uptake", as it could potentially overestimate bait consumption by cats. In the analyses "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. Thus, if an individual cat was recorded as "passing" a bait and then later "visiting" another bait, the individual cat's bait response was categorized as a visit, and so on.

Cat Activity

The location of individual cats along transects was recorded and their on-track distances logged. Imprints of individual animals were differentiated on the basis of location on the road transect. An imprint was assigned to an individual animal if no other imprint was present on at least the previous 1 km of transect. Subsequent imprints were also assigned to that individual unless at least 1 km was traversed with no new imprints present, or the imprint could be clearly differentiated on the basis of size or the direction of travel or the direction of entry/exit to and from the transect. 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 was 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, ³100 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 ³100 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 evidence of other species was within reasonable reach of the bait position.

Assessment of Rabbit Abundance

The presence or absence of rabbit tracks, over a 10 m plot, was recorded at each 100 m bait station. An index of rabbit abundance along the transect was calculated as the percentage of plots where rabbits were present.

Weather Data and Lunar Phase

Weather data for measured and derived variables were obtained from the Australian Bureau of Meteorology weather station in Denham. The data collected comprised: – temperature (°C), wet bulb temperature (°C), dew point (°C), relative humidity (%), barometric pressure (hPa), wind speed and direction (km/h & deg), rainfall (mm) and cloud cover (scale 1–8). Night-time weather data were for available for 1800, 0000, 0300 and 0600 h. Analyses were conducted on data averaged over these time periods and the maximum and minimum values of certain parameters (see Table 1).

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 proportion of contacting cats taking baits ("uptake") was related to a set of 21 potential predictor variables (see Table 1) using logistic regression analysis. 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 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 α = 0.25. A value of 0.25 ensures that in building an initial model, no potentially important variable is excluded. As the transect data were 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 α = 0.05 was used to identify statistical effects.

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.

Cat activity

The total distance of cat tracks recorded per transect per day, 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).

RESULTS

Bait Uptake

Combined bait uptake for standard and cafeteria trials

Bait station response by all cats is summarized in Table 2. Figures 5 (probable uptakes categorized as visits) and 6 (includes potential uptakes, where probable uptakes categorized as uptakes) illustrate the frequencies and proportions of the various bait responses over the study period. The proportion of individuals recorded on transects that contacted bait stations (see Fig. 7) was relatively consistent throughout the study period at 62 % ± 3 % (μ ± s.e.). Figure 7 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 various categories of bait response as a percentage of individual cats contacting the bait stations, over the study period, are presented in Figs. 8 to 11. The responses by cats to the bait stations exhibit marked short-term variation. Figures 7 – 11 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 Fig. 8), over the study period. Conversely, the proportion of the visit response (see Fig. 9), and in turn the uptake response (see Figs. 10 and 11) increased over the study. Figures 10 and 11 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 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 sampling 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 Figs. 12 and 13. 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 (Figs. 14 and 15, Tables 4 a and 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 on the transect more consistently encountered baits.

No significant linear relationship exists between the rate of bait contact and the rate of bait uptake (Fig. 16, Table 4 c). Days of relatively high bait contact were not necessarily days of high bait uptake. Bait uptake was most 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

The mean daily bait uptake ($\mu \pm$ s.e.) by non-target species was 22 % ± 3 %. The relative frequency of uptake by the various species is illustrated in Figure 17. Corvids and Varanids were most frequently responsible for non-target bait uptake. The Torresian Crow (*Corvus orru*) and Little Crow (*C. bennetti*) were frequently sighted during the exercise and are both likely to be responsible for uptake by this family. The Sand Monitor (*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 the Black-tailed Monitor (*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 (*Dromaius novaehollandiae*) 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 Spinifex Hopping Mouse (*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 summer 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 observed on 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

A summary of rabbit presence/absence over the study period is presented in Figure 18. The data ($\mu \pm$ s.e.) indicate that the rabbit abundance index declined markedly between the November/December (70 % ± 2 % presence) and January/February (33 % ± 3 % presence) sampling periods. The abundance index continued to decline during the latter period to <20 % presence in mid February. The abundance index 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 are summarized below; "raw" weather data are available through the authors if required. 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 after 6 March 2000 because of the onset of Tropical Cyclone Steve that delivered 150.6 mm over five days. The heavy rainfall associated with the cyclone severely restricted access to the study site, as most roads became impassable.

Lunar cycles for 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 10 and 11, 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 5 – 8. The significant variables to regression model building are presented in flow diagrams (see Figs. 19 – 22). A number of temperature factors were significantly related to bait uptake over the entire sampling period (long-term weather conditions) but insignificant post 25 January, when bait uptake was a regular occurrence. The exception was fluctuations in minimum temperature, which was of significance in both the long and short-term. Of the other environmental factors, rabbit abundance had a significant relationship with bait uptake. As rabbit abundance decreased from late spring through to early autumn, there was an increase in bait uptake. Results indicate that the two most important environmental factors that affected both actual and potential bait uptake in the short-term 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.

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 $\lambda = 0.80$, $p = 0.04$). 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). 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.

DISCUSSION

Bait uptake by feral cats on Peron Peninsula displayed a high degree of short-term variability but became more frequent and consistent through late summer/early autumn. Uptake occurred on 25 % of days prior to 25 January and on 76 % of days after this date. Bait uptake was largely independent of bait contact (encounter). The percentage of individual cats encountering a bait remained relatively constant over the study period at 62 % of animals on any given night, which suggests that the current on-track baiting regime of bait placement at 100 m intervals provides an adequate baiting intensity. 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. Therefore, increasing on-track baiting density will increase contact rate but not necessarily bait uptake. 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 1,200 m), in the context of this study were, in general, not receptive to baits and their behaviour appeared focused on activity unrelated to hunger and seeking food. Zezulak and Schwab (1980) found that long-distance movements by bobcats (*Lynx rufus*) were associated with conspecific interactions, while shorter movements were associated with foraging behaviour.

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 increase 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 at Peron 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 will encounter baits 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.

Short-term weather conditions influenced the daily variability associated with bait uptake by feral cats on Peron Peninsula. During the latter period of study 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. 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, but 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 two. Data collected during the first period straddled the full moon and indicated peaks in bait uptake either side of the full moon. It is therefore suggested that the influence of lunar phase on bait uptake requires further investigation.

A number of temperature factors were significantly related to bait uptake over the entire sampling period (long-term weather conditions) but insignificant post 25 January, when bait uptake was a regular occurrence. The exception to this was fluctuations in minimum temperature, which was of significance in both the short and long-term. The importance of temperature factors significant only in the long-term 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, rabbit abundance had a significant relationship with bait uptake. There was an increase in bait uptake with the decrease in rabbit abundance observed from late spring through to early autumn.

Cats throughout history have been relied on as meteorological almanacs as they display behaviour responses to short-term weather patterns (De Wire 1992). A number of authors have studied the correlation between short-term physical parameters and behaviour of smaller felids (Langham 1992 cats; Zezulak and Schwab 1980 bobcats; Beltran and Delibes 1994 Iberian lynx, *Lynx pardinus*, Schmidt 1999 Eurasian lynx, *Lynx lynx*; Avenant and Nel 1998 caracals, *Felis caracal* and Daniels *et al.* 2001 wildcats, *Felis silvestris*). A cause and effect relationship is difficult to establish, however felid activity has been found to be correlated with a number of biotic and abiotic environmental factors. Authors variously attribute the response as a combination of maintaining homeostasis (avoidance of extreme conditions) and response to patterns in prey behaviour and apparent availability.

Avenant and Nel (1998) found ambient temperature the most significant correlate with caracal behaviour. Caracals avoided temperatures greater than 20° C, probably to assist with water conservation. Beltran and Delibes (1994) found a range of short-term weather parameters to influence lynx behaviour and the most important factor varied with seasons. Lynx avoided extreme temperatures and juveniles appeared to be more strongly influenced by weather than adults. Lynx activity was synchronized to that of their primary prey (rabbits). Lynx were active for longer during strong moonlight but did not necessarily move further. Schmidt (1999) found little response by lynx except that they avoided heavy rain and strong wind. Activity was more closely related to the success of procuring primary prey with activity being greater when foraging was less successful. Daniels *et al.* (2001) found little evidence of short-term weather influence on wildcat activity except that they avoided strong wind and were significantly less active during low moonlight. Zezulak and Schwab (1980) found bobcats to avoid extremes of temperature and that peak activity was synchronized with that of their primary prey. Langham (1992) indicated that cat foraging activity was an important component of overall behaviour. When and where cats foraged was related to the relative activity/abundance of various prey species. In canids, Molsher *et al.* (2000) found foxes to predate less mammals during moonlit nights and related this to 'behavioural resource depression'. Prey species modify behaviour in an attempt to balance successful foraging and the risk of predation (Leaver and Daly 2003; Brown and Kotler 2004). In Molsher's *et al.* study, foxes predated alternative food sources during full moon in response to an apparent decline in the availability of their primary prey.

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. Coman and Brunner 1972; Bayly 1976, 1978; Jones 1977; Fitzgerald and Karl 1979; Jones and Coman 1981; Catling, 1988; Jones and Coman, 1981; Martin *et al.* 1996; Molsher *et al.* 1999; Risbey *et al*, 1999; Read and Bowen 2001; Pontier *et al.* 2002; Malo *et al.* 2004). Optimizing predatory cats prefer rabbits to small 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; Carbone *et al.* 1999). However in the absence or extreme low abundance of such a significant primary prey source, cats exhibit a considerable dietary breadth as they are able to capitalize on a variety of prey sources (Martin *et al.* 1996; Catling 1998; Molsher *et al.* 1999; Risbey *et al.* 1999; Read and Bowen 2001; Paltridge 2002). This functional shift to predating secondary prey sources only occurs after a significant decline in primary prey (Norbury *et al.* 1998).

The seasonal decline in this primary prey species for cats on Peron was consistent with the increase in bait uptake from mid-January onwards. Baiting efficacy for feral cats is therefore strongly linked to the seasonal availability of primary prey species, particularly the rabbit as was found by Short *et al.* (1997). The natural, seasonal rabbit population cycle was sufficient to elicit a functional shift to include consumption of baits as an alternative prey. 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. Baiting efforts should be maximized during seasonal declines in rabbit abundance, the "baiting window". Control of rabbit populations, most likely through assisting the development and transmission of myxomatosis epizootics and introduction of a virulent strain of RHD, is likely to both increase the magnitude of bait response and broaden the 'baiting window'.

Timing of baiting for feral cats is fundamental. Consistent uptake is more important than any 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. On Peron Peninsula, this period, the "baiting window", will usually occur from December through to May, depending on the significance of summer rainfall events and timing of rabbit breeding. Resources should be focused on capitalizing on this period of most efficacious baiting. This study suggests that baiting is not likely to be effective outside this period. 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 (eg. King *et al.* 1983; Morton 1990). A difference in bait uptake across geographic areas, when conducted at the same time of year, may reflect differences in prey availability.

The standard cat bait 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 unpub. data). 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, and both also consumed the standard cat bait. Interestingly, both these occurrences took place on the coastal transect. 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; Bester *et al.* 2002). These sites may have presented the situation where chickens closely resembled prey items to which they had previously been exposed. A period of free feeding prior to toxic presentation by Twyford *et al.* (2000) may also have improved bait acceptance as familiarity with food items is known to increase their acceptance (Bradshaw 1986). Use of laboratory mice by Short *et al.* (1997) may have better approximated "familiar naturally occurring prey" for Peron Peninsula, but their availability as a bait medium for large-scale operational baiting programs and cost precluded their use here.

The percentage of contacting cats that consumed a bait at standard bait stations was significantly greater than for those that contacted cafeteria stations. Presentation of baits in cafeteria stations is unlikely to have deterred cats from bait uptake, as this has not been noted previously in cafeteria trials (Algar unpub. data). 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 effect appeared to be negated in the presence of visual lures.

The use of lures significantly improved bait uptake in the cafeteria trials. The contact rate did not differ between audio and visual lures, however a higher bait uptake was observed at sites with a visual lure. Observations of domestic cat behaviour suggest that certain stimuli will attract at a distance but act as a deterrent at close proximity (Algar unpub. data). The types of audios used may have brought about this reaction and thus not provided 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 and 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 and 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 inspection. 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 inspection 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 1300 h. 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.

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. It is possible that 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. 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 Tropical Cyclone Steve.

Non-target activity may impact significantly upon baiting 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 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 principal determinant to the timing of baiting programs is when baits are most likely to be accepted by cats.

In summary, bait uptake by feral cats on Peron Peninsula in the long-term is driven by the abundance of primary prey (rabbits). Subsequent baiting exercises (Algar and Angus 2000b; Algar and Burrows 2004) comparing campaigns on Peron with sites where rabbits were absent or in low numbers, have confirmed the significance of rabbit abundance in determining bait uptake. Reduction of rabbit abundance on the peninsula will improve bait acceptance and extend the period of effective baiting. In the short term, conducting baiting programs around the full moon may provide potential peaks in bait uptake, while baiting under conditions of strong wind should be avoided. Operationally, the efficacy of on-track baiting during the "baiting window" will be improved by employing visual lures and increasing baiting frequency rather than density.

ACKNOWLEDGEMENTS

This project was funded in part by the Commonwealth, Shark Bay World Heritage Property, provided by Environment Australia World Heritage Unit. We are grateful for the support given by the Project Eden team, in particular Terry Cowell who provided invaluable information with the GOCAT database. We thank Joe-Ann Sinagra and Graeme Liddelow for assisting with the early part of this study. We would like to thank Neil Burrows, Keith Morris and Nicky Marlow for critically reviewing earlier drafts of this manuscript. The manuscript was also improved following comments from three anonymous referees.

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Table 1
Potential predictor variables

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

Table 2

Summary of bait station responses.

DATE	Transect length (km)	Total No. cats	Cats/ 100 km	Bait contacts	Pass	Visit	Uptake
19/11/1999	38.5	9	23.4	7	4	3	
20/11/1999	33.6	8	23.8	6	6		
21/11/1999	37.5	11	29.3	7		3	4
24/11/1999	40	10	25.0	5	4	1	
25/11/1999	20	9	45.0	4	2	2	
26/11/1999	16.5	11	66.7	9	3	5	1
27/11/1999	19	6	31.6	4	1	3	
28/11/1999	20	7	35.0	5	3	2	
30/11/1999	20	4	20.0	0			
12/01/1999	19	6	31.6	1	1		
12/02/1999	16.1	7	43.5	5	4	1	
12/04/1999	10	5	50.0	3		2	1
12/05/1999	18.8	11	58.5	10	5	4	1
12/06/1999	16	8	50.0	3	2	1	
12/07/1999	16	11	68.8	6	3	2	1
12/10/1999	19.5	9	46.2	6	1	5	
12/11/1999	17	8	47.1	6	1	5	
12/12/1999	18	8	44.4	6	2	4	
13/12/1999	20	9	45.0	5		4	1
18/1/2000	19.2	8	41.7	5	1	4	
19/1/2000	20	11	55.0	6	4	2	
20/1/2000	15.7	5	31.8	2		2	
21/1/2000	10	3	30.0	1	1		
25/1/2000	19.7	9	45.7	9	3	5	1
26/1/2000	16.8	12	71.4	8	1	6	1
27/1/2000	18	10	55.6	8		3	5
28/1/2000	19.5	9	46.2	8	2	5	1
2/01/2000	19	7	36.8	5	1	1	3
2/02/2000	12.3	5	40.7	3		1	2
2/03/2000	15.6	9	57.7	2	2		
2/04/2000	16	8	50.0	7		4	3
2/07/2000	20	9	45.0	6		3	3
2/08/2000	16.8	6	35.7	4	1	3	
2/09/2000	17.5	10	57.1	10	1	7	2
2/10/2000	18.9	11	58.2	7	1	5	1
23/2/2000	15.9	7	44.0	2		2	
24/2/2000	15.5	10	64.5	5	1	1	3
25/2/2000	14.6	10	68.5	6	2	3	1
26/2/2000	15.6	10	64.1	5		4	1
29/2/2000	10	4	40.0	3		1	2
3/01/2000	10	4	40.0	4		2	2
3/02/2000	10	6	60.0	4		4	
3/05/2000	18	8	44.4	6	1	5	
3/06/2000	15.4	9	58.4	4	2	1	1

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

Table 4a

ANOVA summary, contact v cumulative distance travelled.

Regression Statistics	
Multiple R	0.52403546
R Square	0.27461317
Adjusted R Square	0.25734205
Standard Error	18.7997655
Observations	44

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5619.605699	5619.606	15.90014	0.000261355
Residual	42	14844.10975	353.4312		
Total	43	20463.71545			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	48.4877724	4.504696599	10.76383	1.19E-13	39.39692375	57.57862	39.39692375	57.57862107
Tot distance	0.00741126	0.001858624	3.987498	0.000261	0.003660404	0.011162	0.003660404	0.011162117

Table 4b

ANOVA summary, contact v mean distance travelled.

Regression Statistics	
Multiple R	0.53545526
R Square	0.28671234
Adjusted R Square	0.2697293
Standard Error	18.6423199
Observations	44

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5867.199685	5867.2	16.88227	0.000180167
Residual	42	14596.51576	347.5361		
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	10.50621	2.52E-13	38.59074369	56.94091	38.59074369	56.94090851
Ave distance	0.06397377	0.015569922	4.108805	0.00018	0.032552382	0.095395	0.032552382	0.095395152

Table 4c

ANOVA summary, rate of bait uptake v rate of contact.

Regression Statistics	
Multiple R	0.27163556
R Square	0.07378588
Adjusted R Square	0.05173316
Standard Error	22.0464748
Observations	44

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1626.257978	1626.258	3.3458859	0.074478894
Residual	42	20413.9761	486.0471		
Total	43	22040.23408			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.80920079	10.18217911	-0.07947	0.9370345	-21.35767664	19.739275	-21.3576766	19.7392751
%Contacts	0.2819048	0.15411571	1.829176	0.0744789	-0.02911339	0.592923	-0.02911339	0.592923

Table 5a

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 5b

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	0.1970	0.0679	8.4228	0.0037
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 5c

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 5d

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 6a

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

Variable	Parameter Estimate	Estimated Standard error	Wald 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 6b

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 6c

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

Table 7a

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 7b

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 7c

Estimated coefficients and standard errors for 2nd multivariate logistic regression of potential bait uptake (entire sampling perid).

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 7d

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 7e

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 8a

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 8b

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 8c

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

Table 8d

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

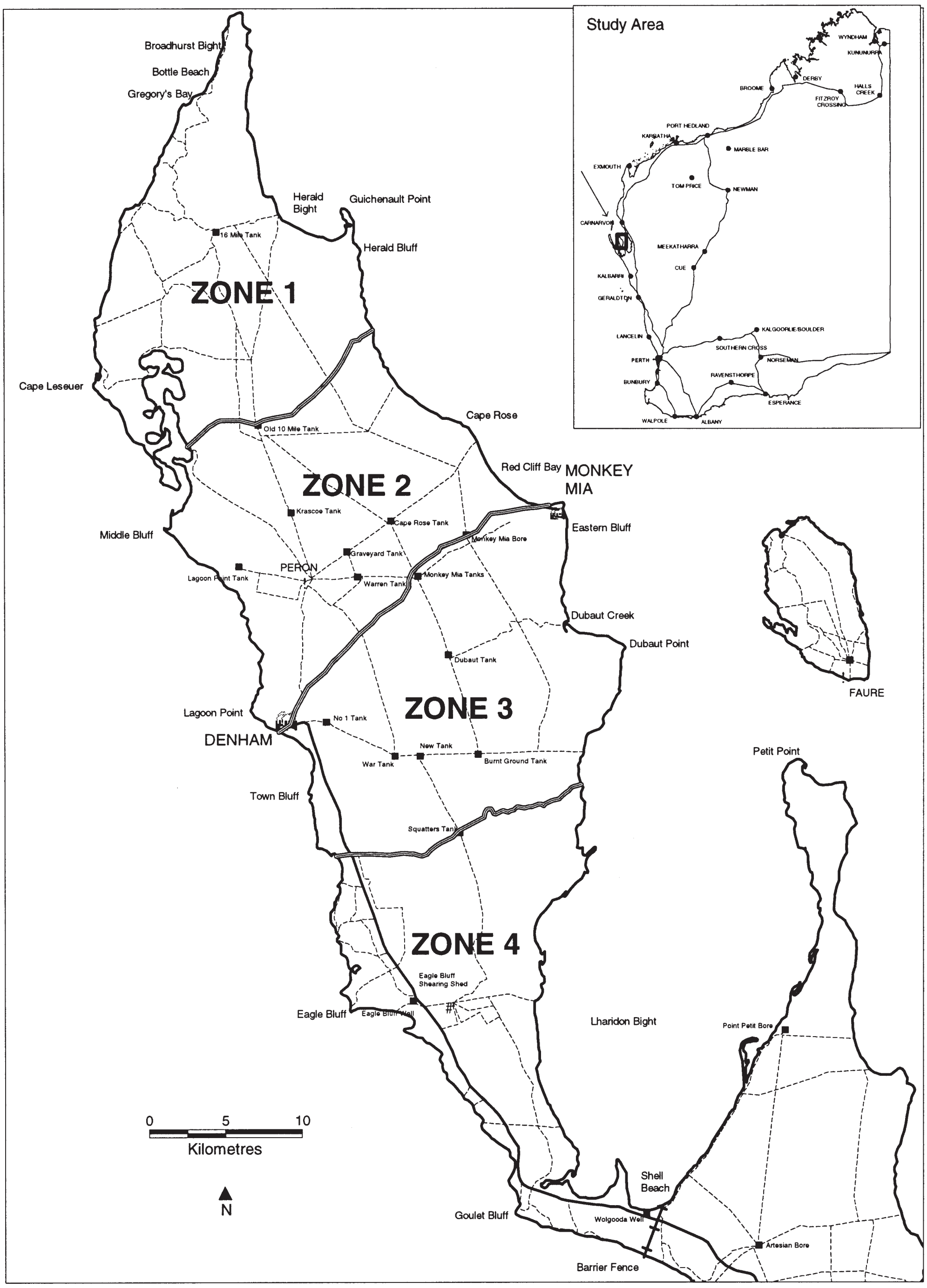

Figure 1. Peron Peninsula.

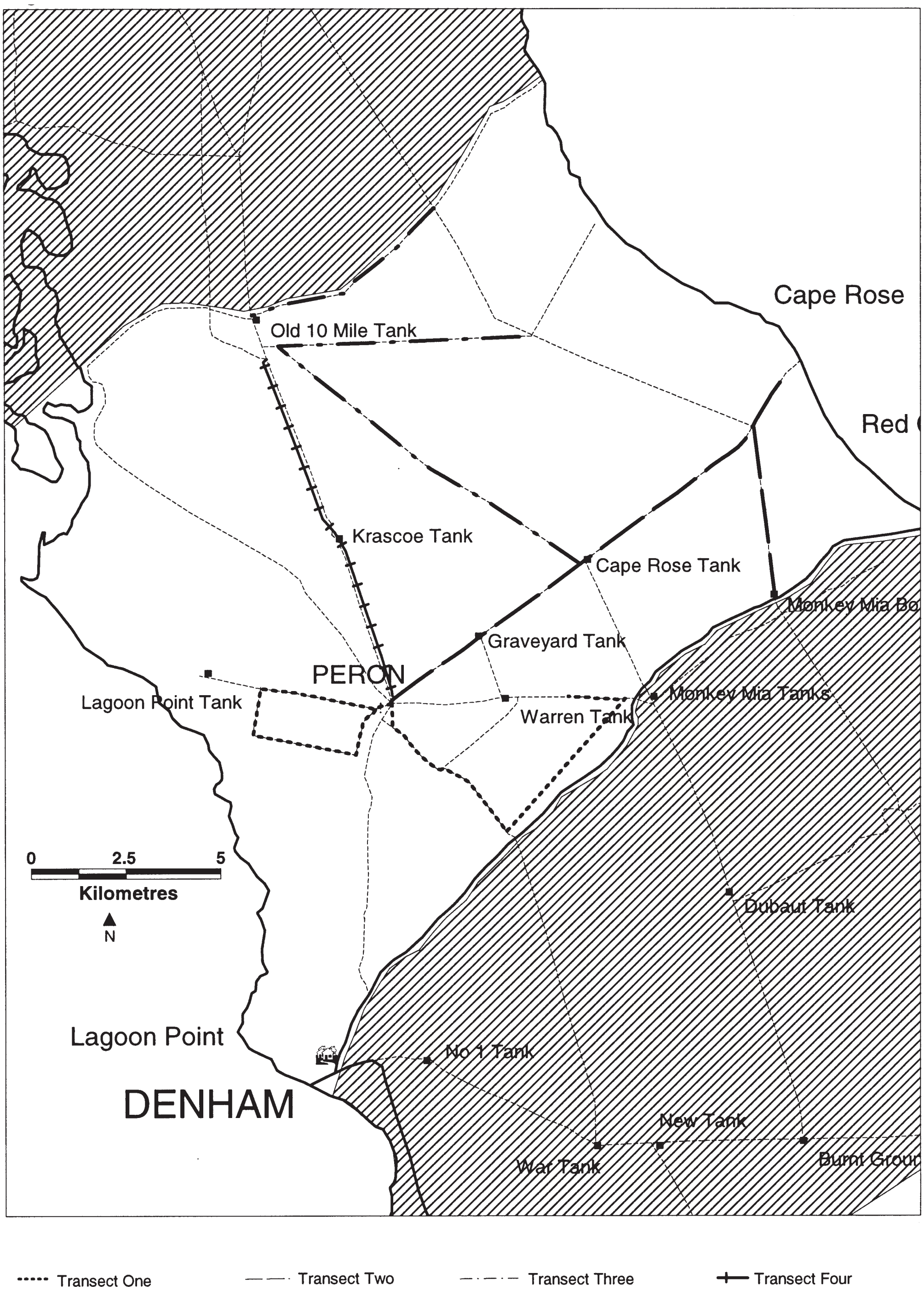

Figure 2. Zone Two.

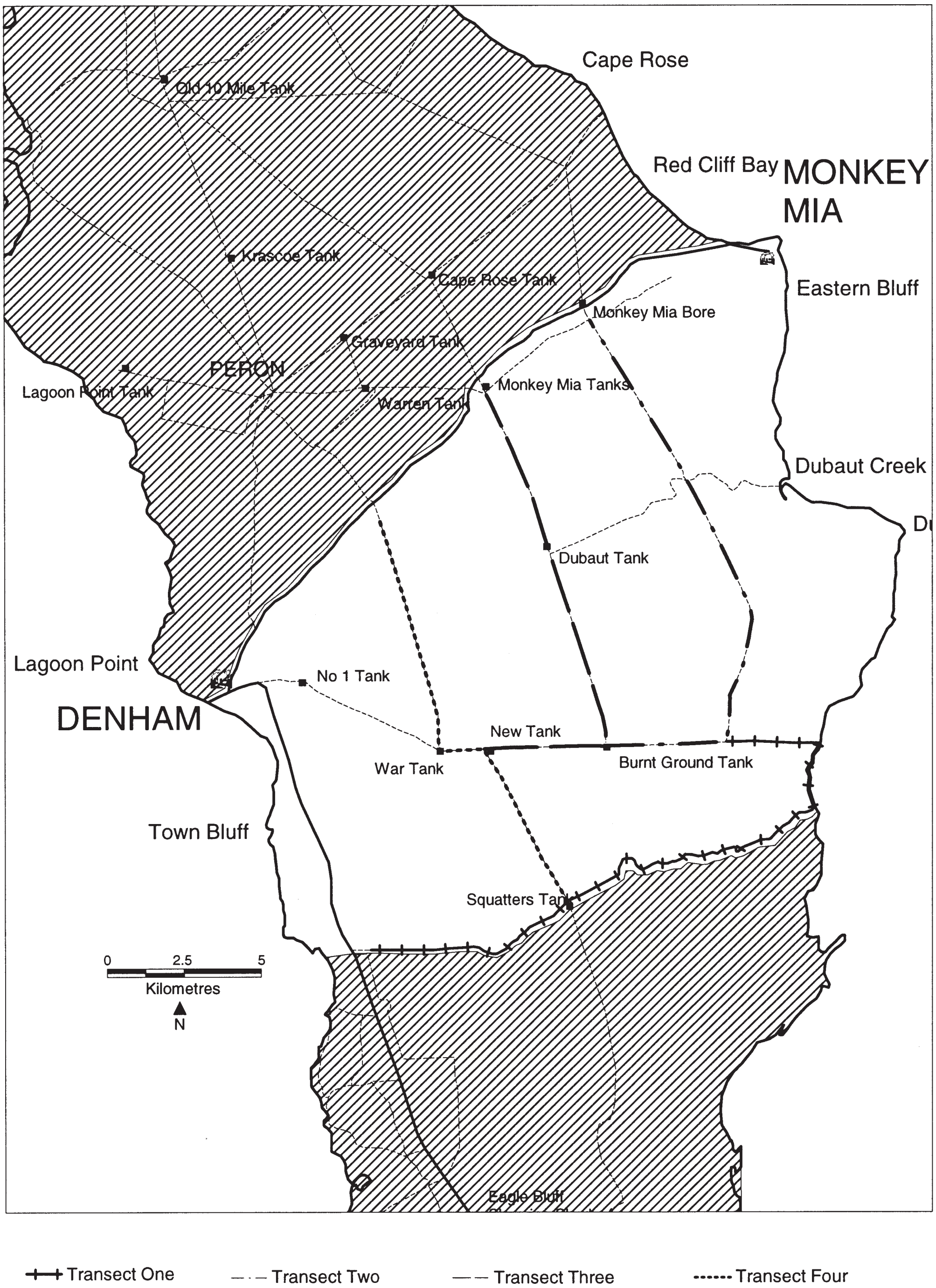

Figure 3. Zone Three.

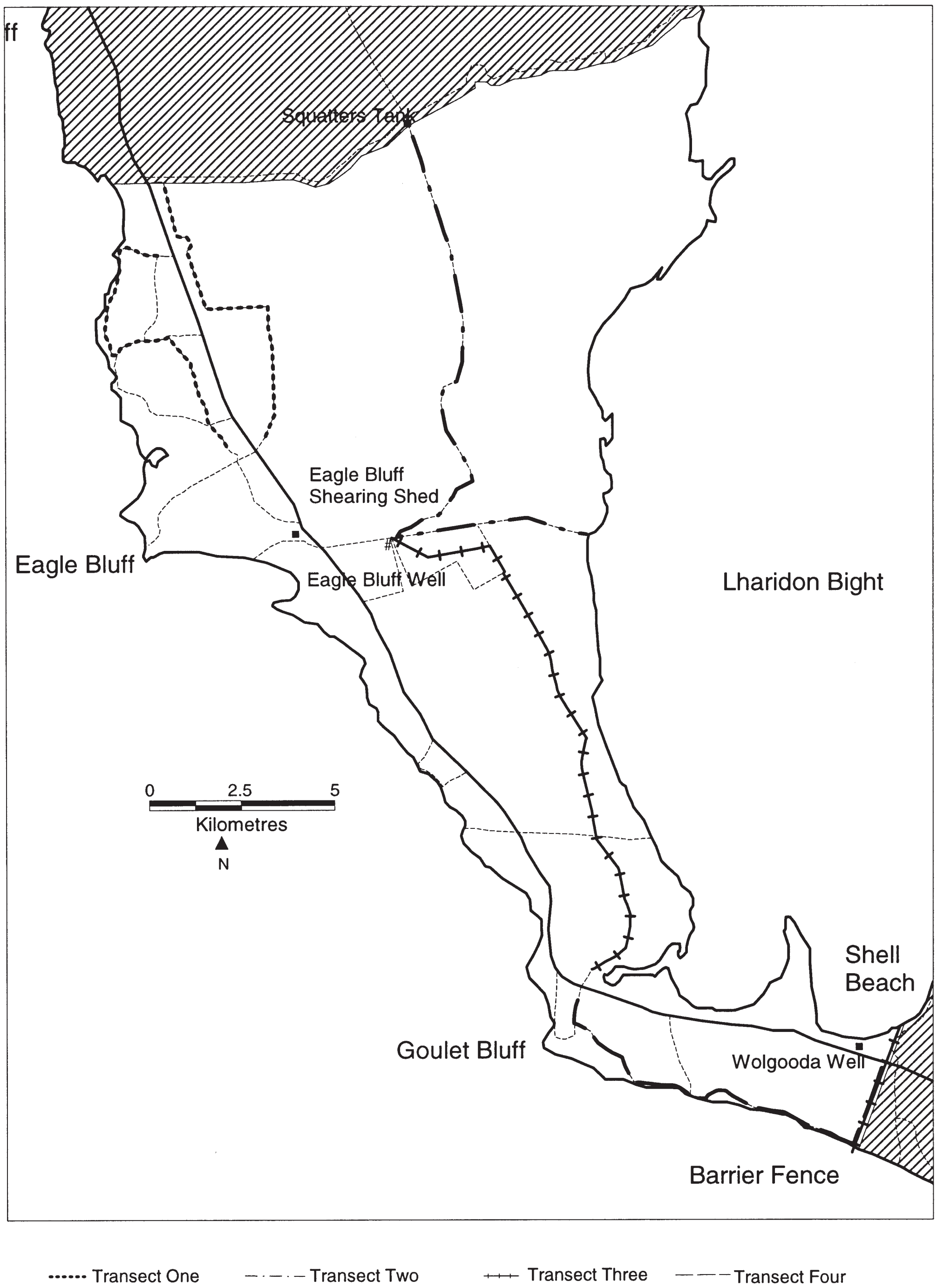

Figure 4. Zone Four.

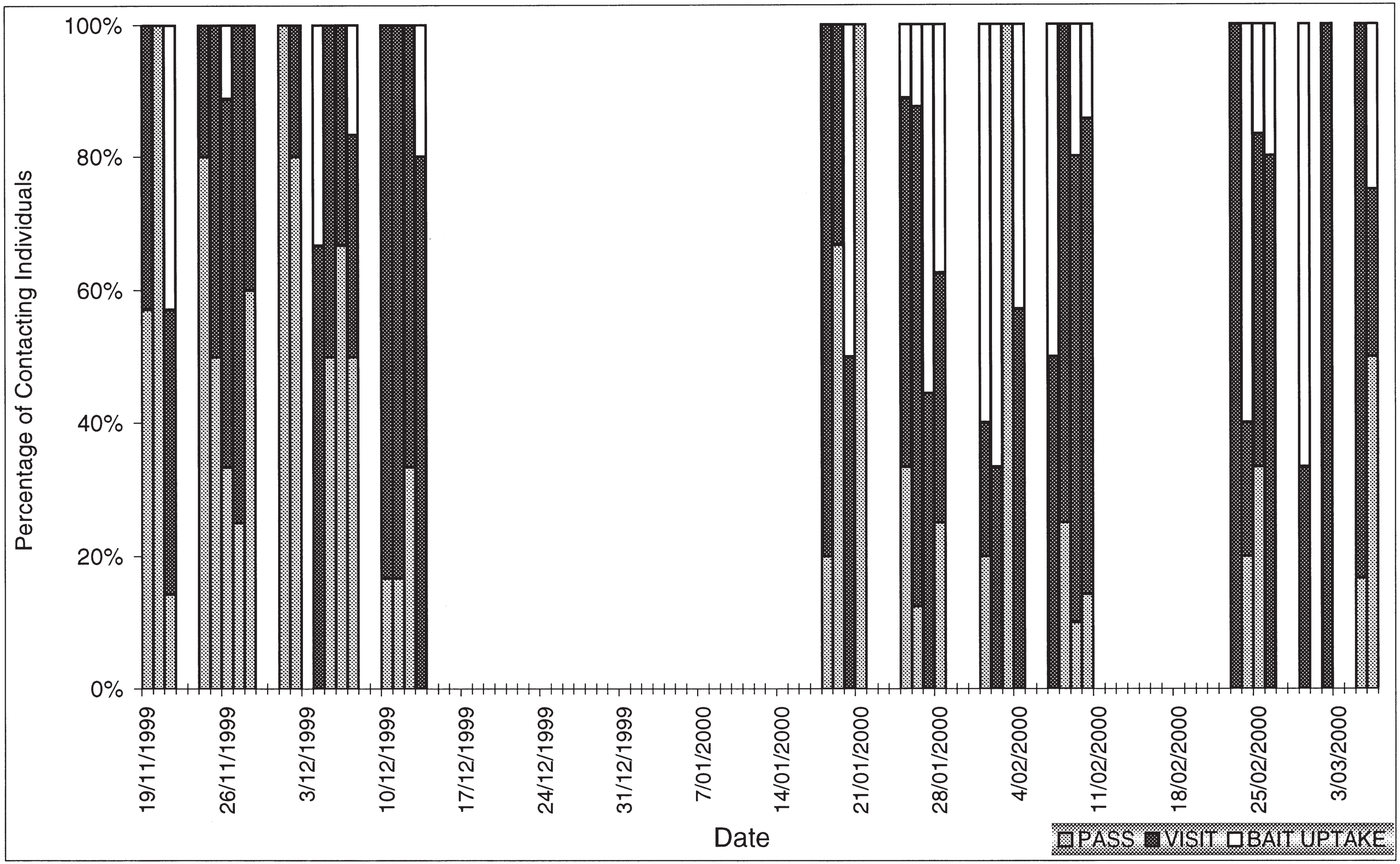

Figure 5. Bait interactions for the entire sampling period (probable uptake categorized as visit).

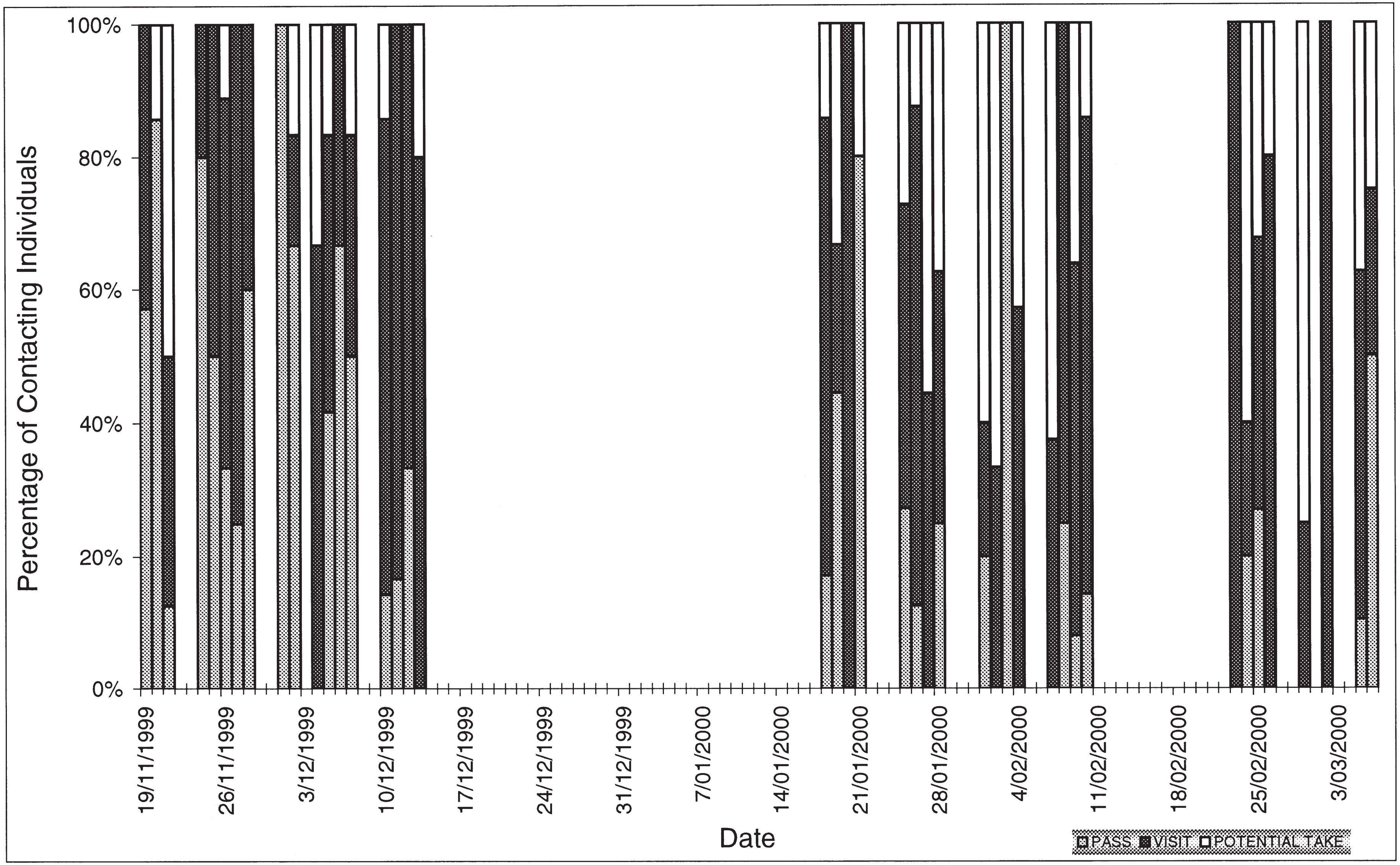

Figure 6. Bait interactions for the entire sampling period (probable uptake categorized as uptake).

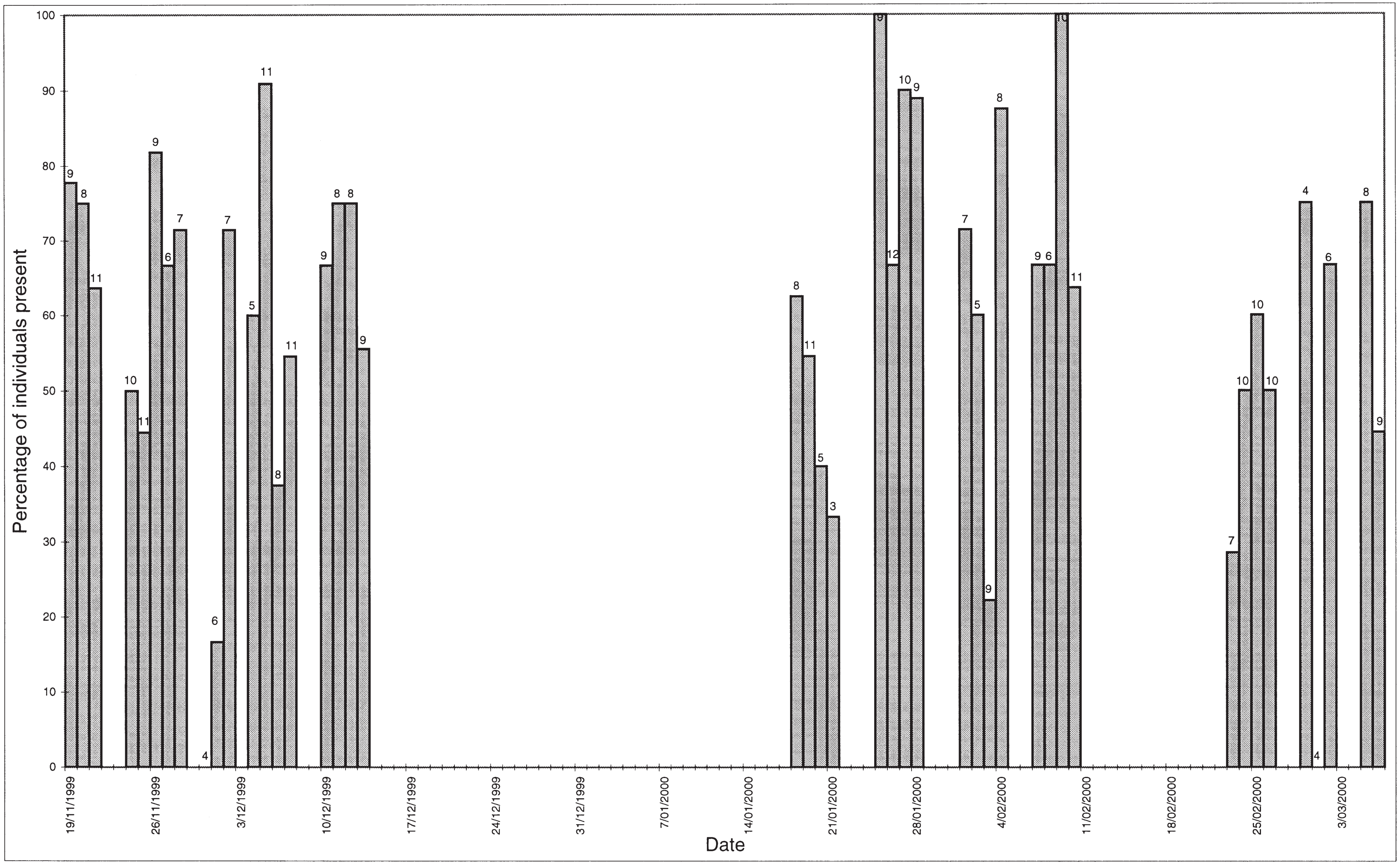

Figure 7. Percentage of individuals recorded on the transect that contacted a bait station.

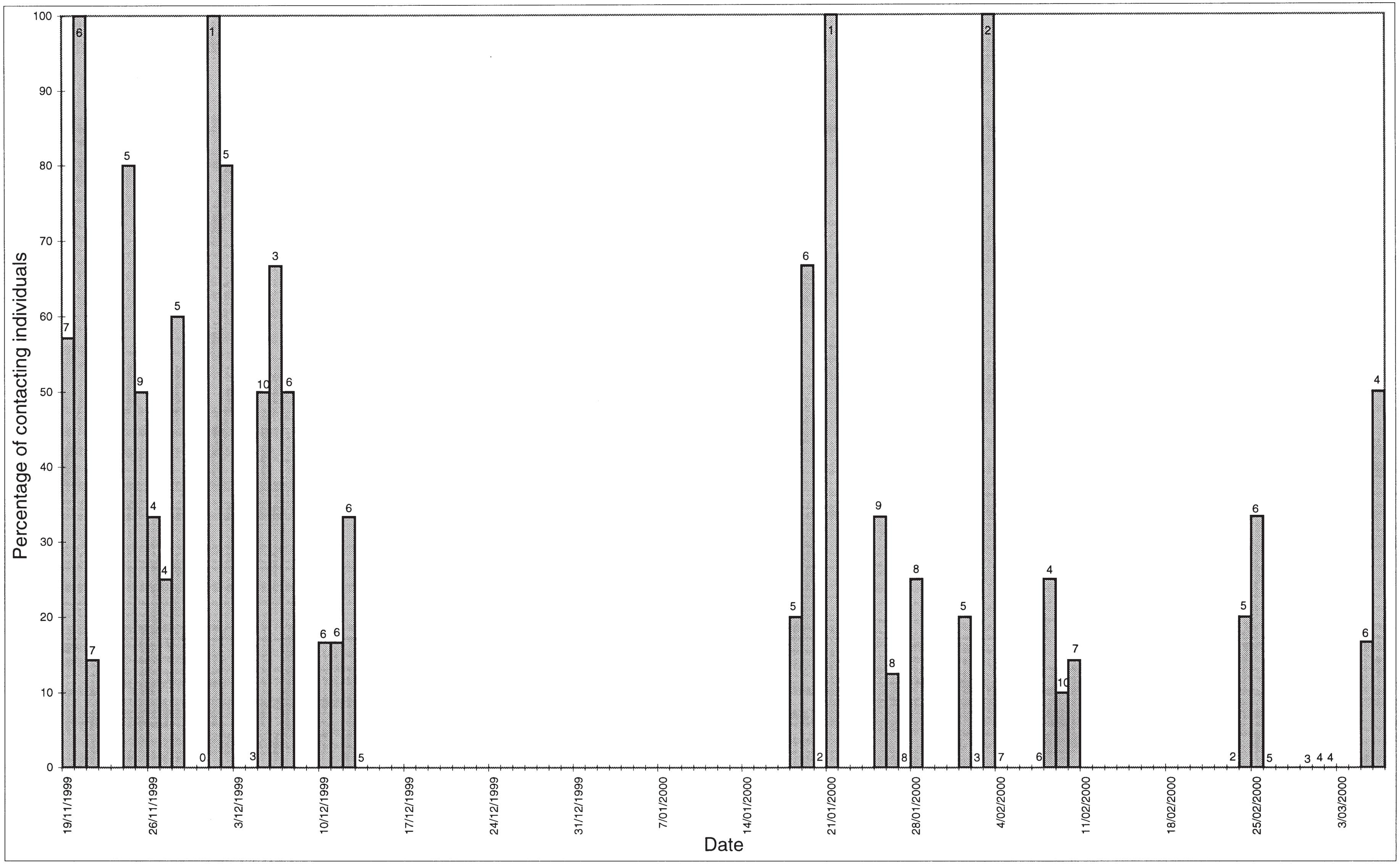

Figure 8. Percentage of contacting individuals that passed a bait station.

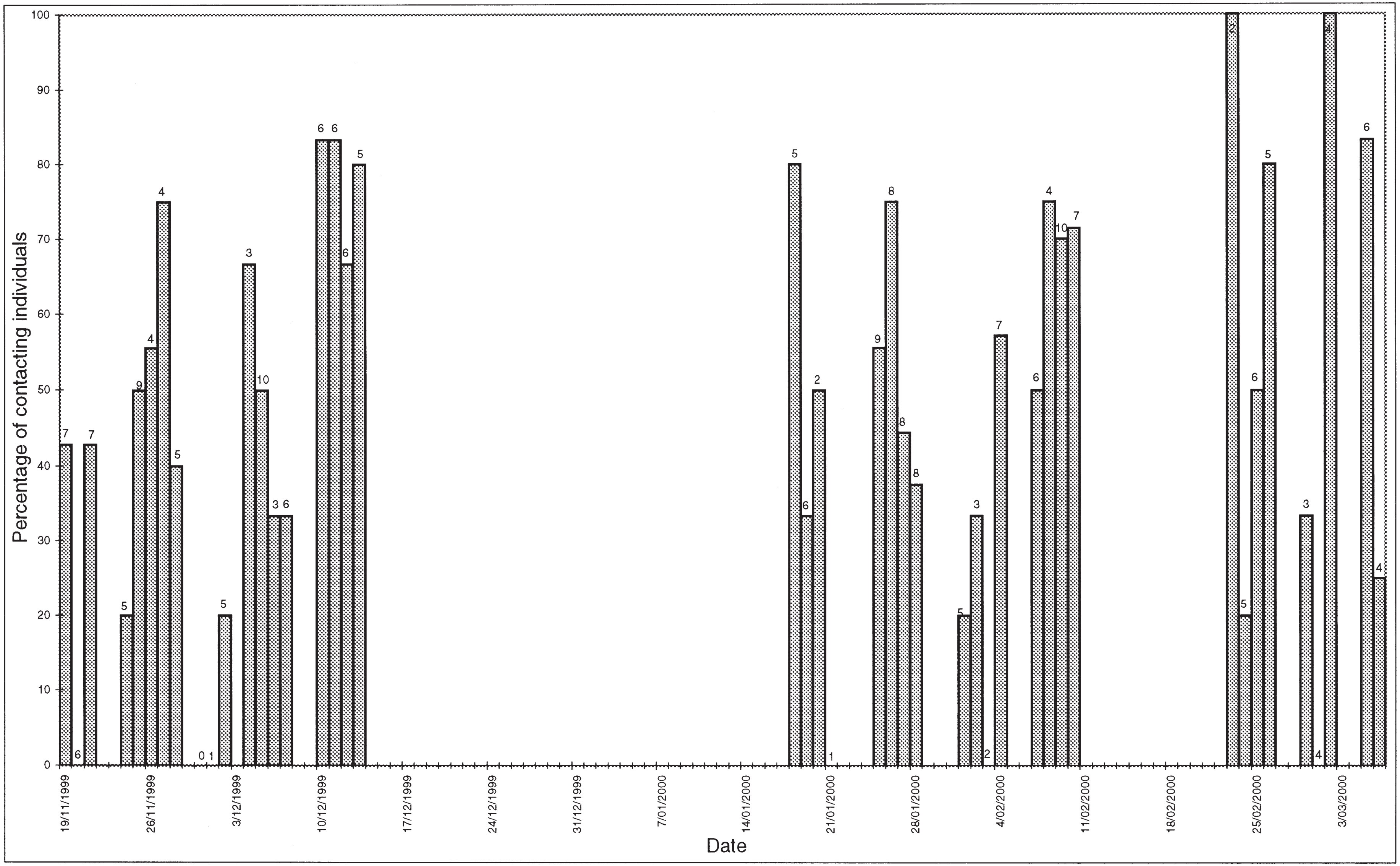

Figure 9. Percentage of contacting individuals that visited a bait station.

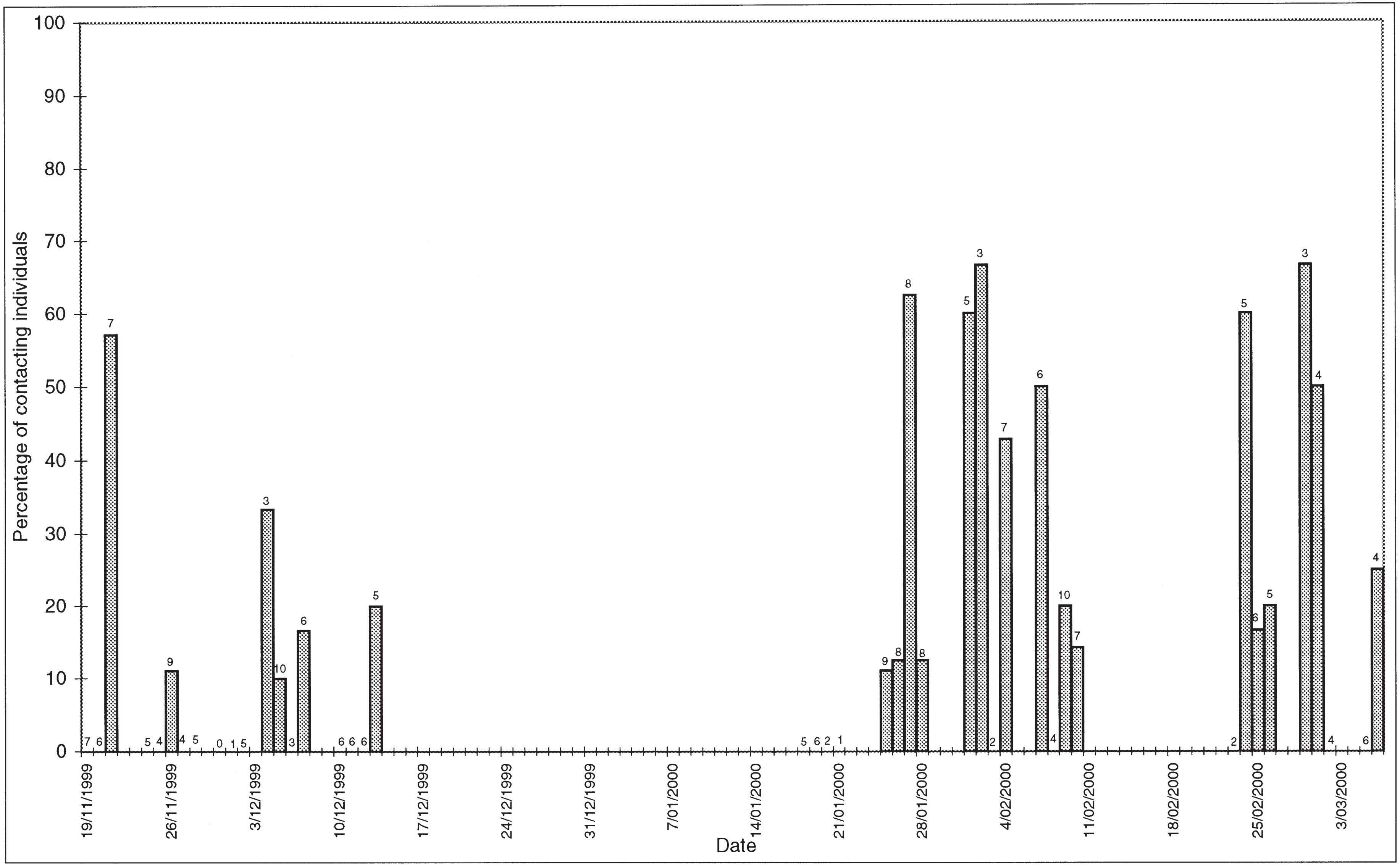

Figure 10. Bait uptake by contacting individuals.

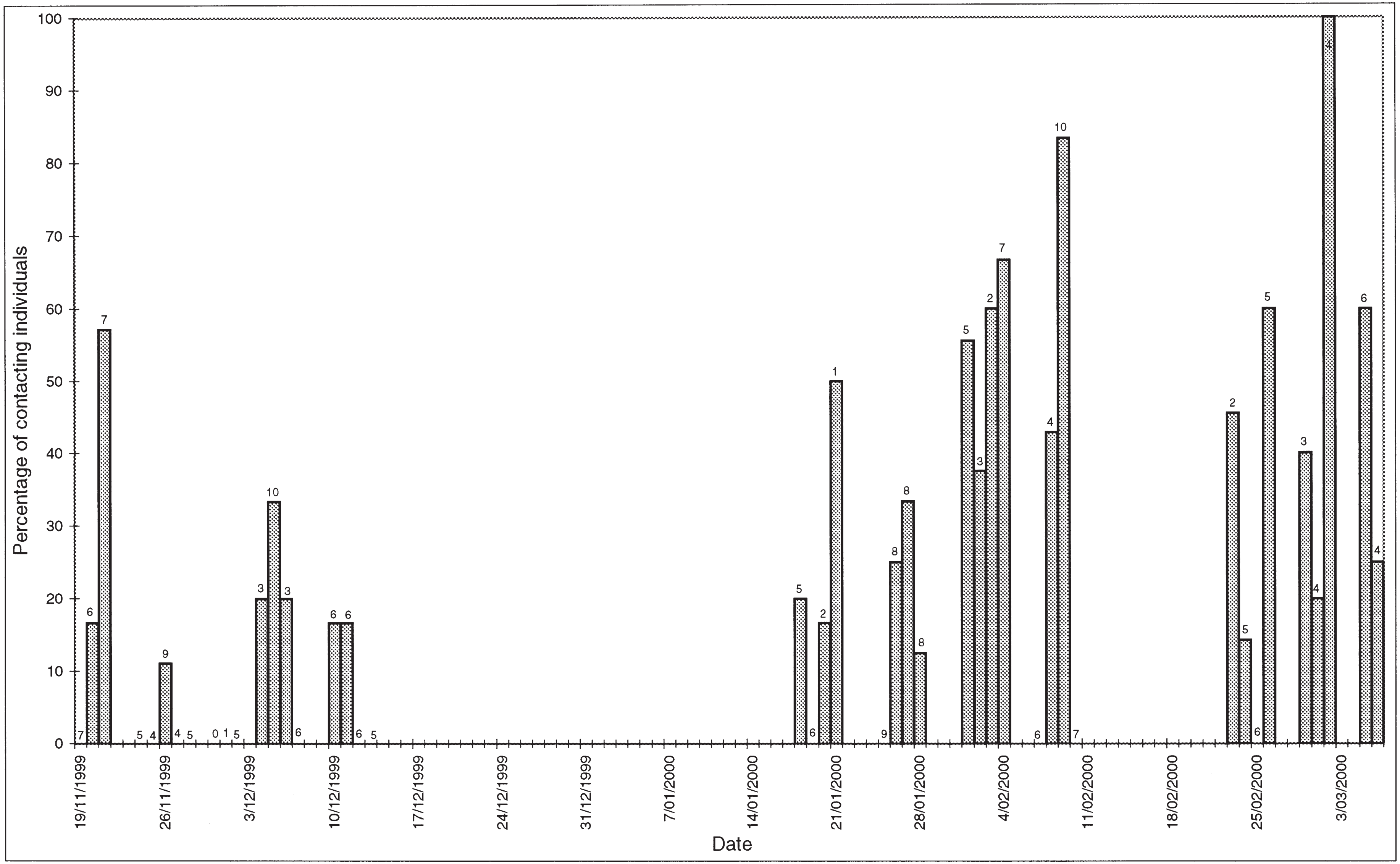

Figure 11. Potential uptake by contacting individuals.

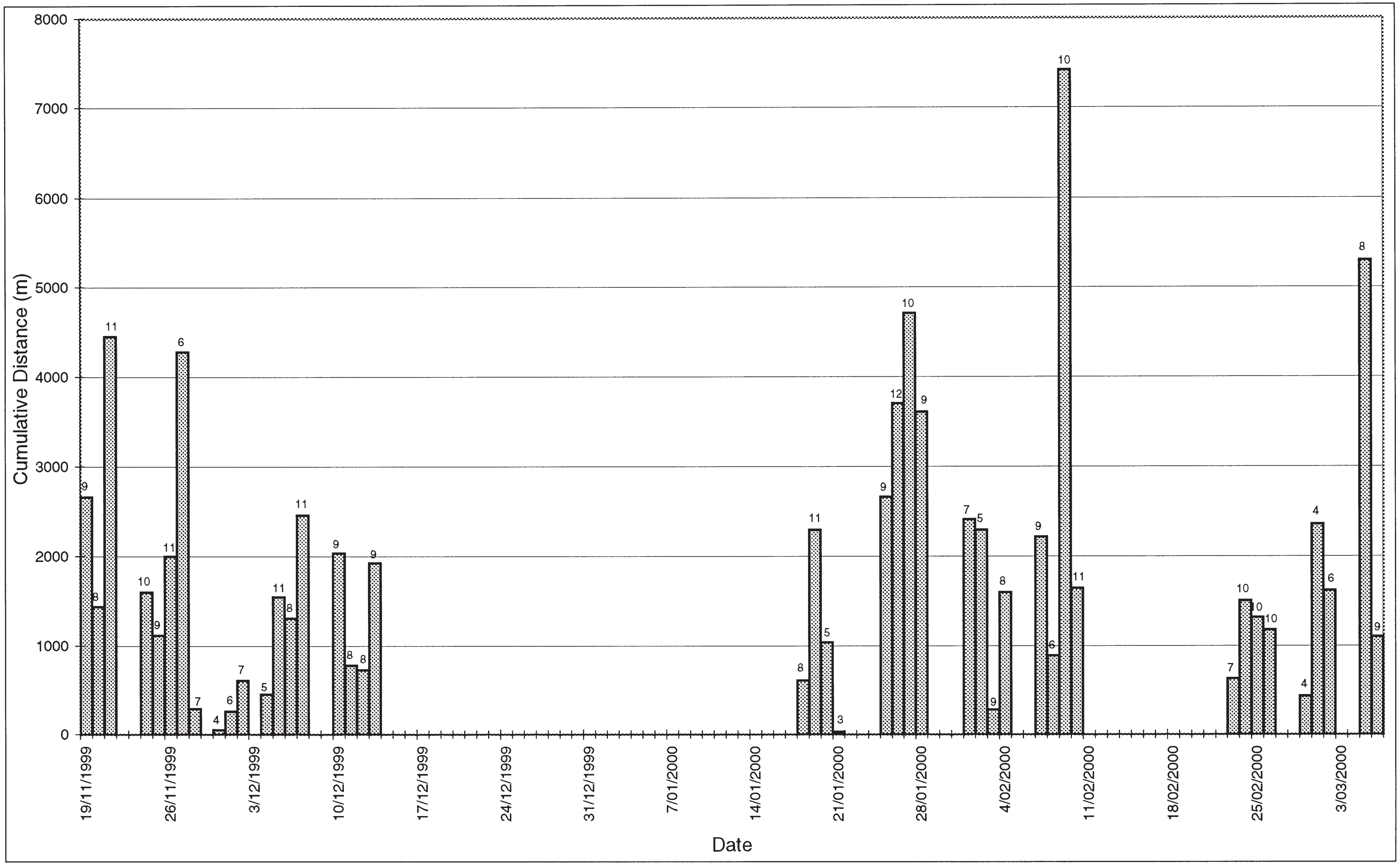

Figure 12. Cumulative daily on-track distances travelled.

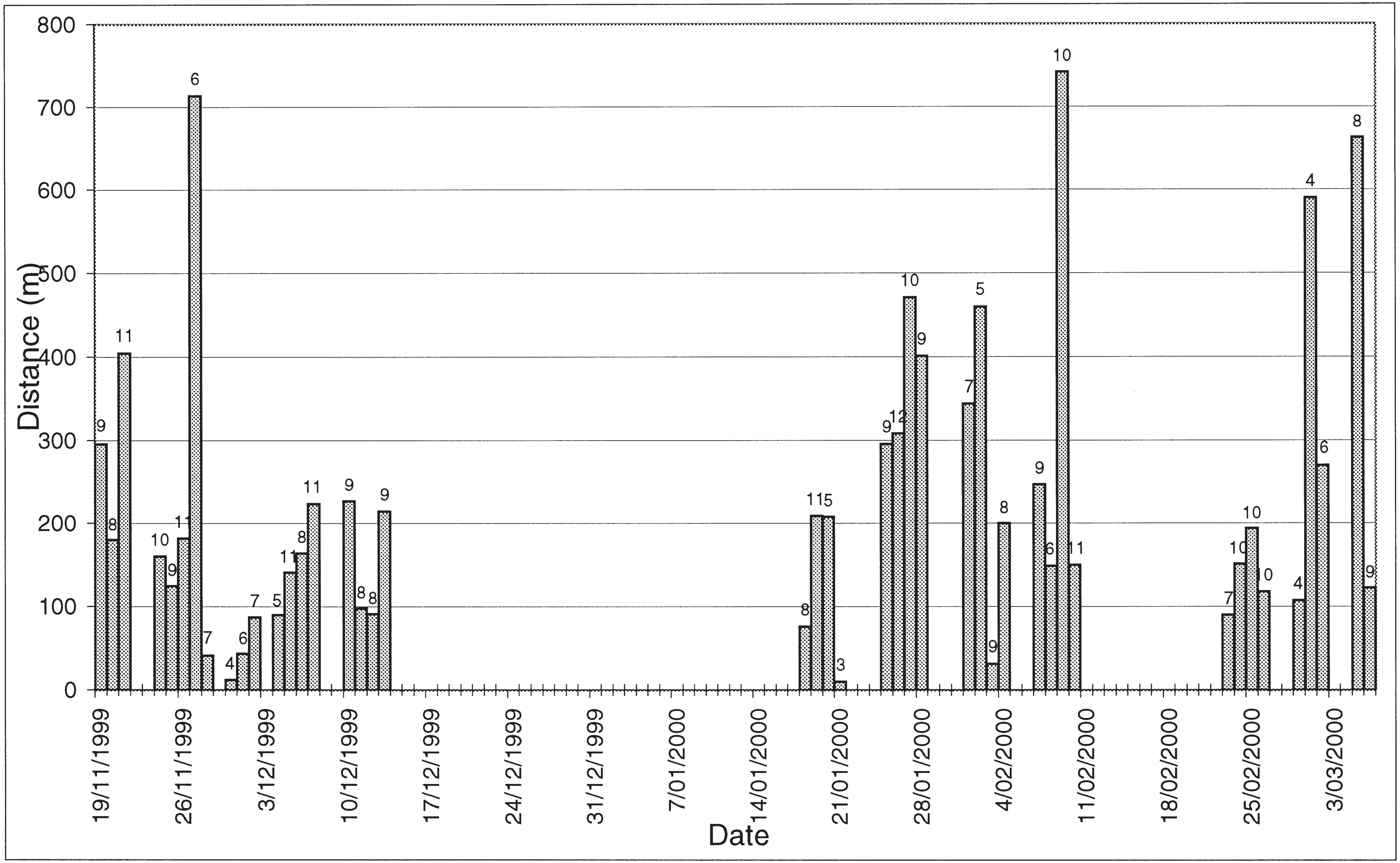

Figure 13. Mean daily on-track distances travelled.

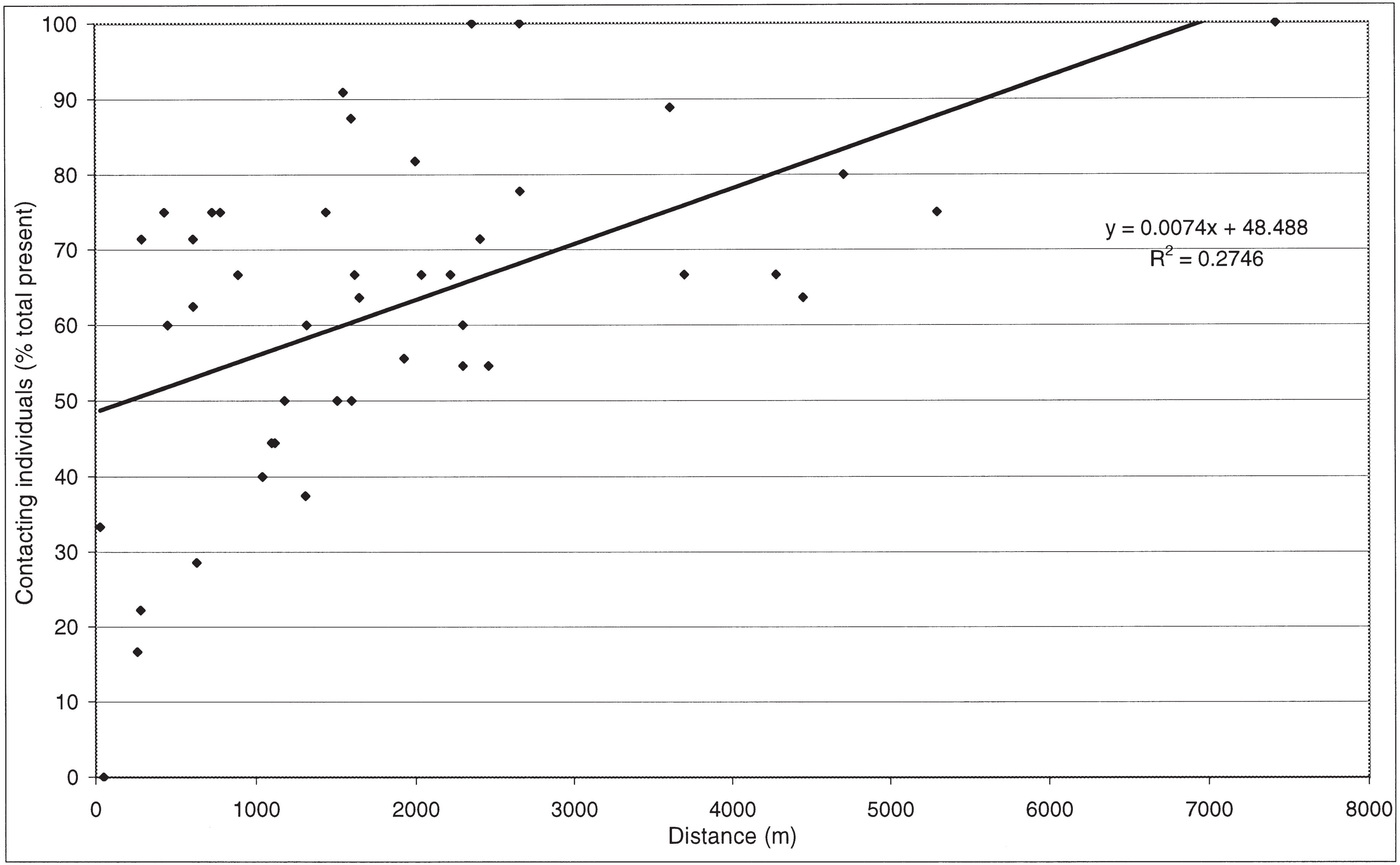

Figure 14. Cumulative on-track distances travelled v rate of contact (entire sampling period).

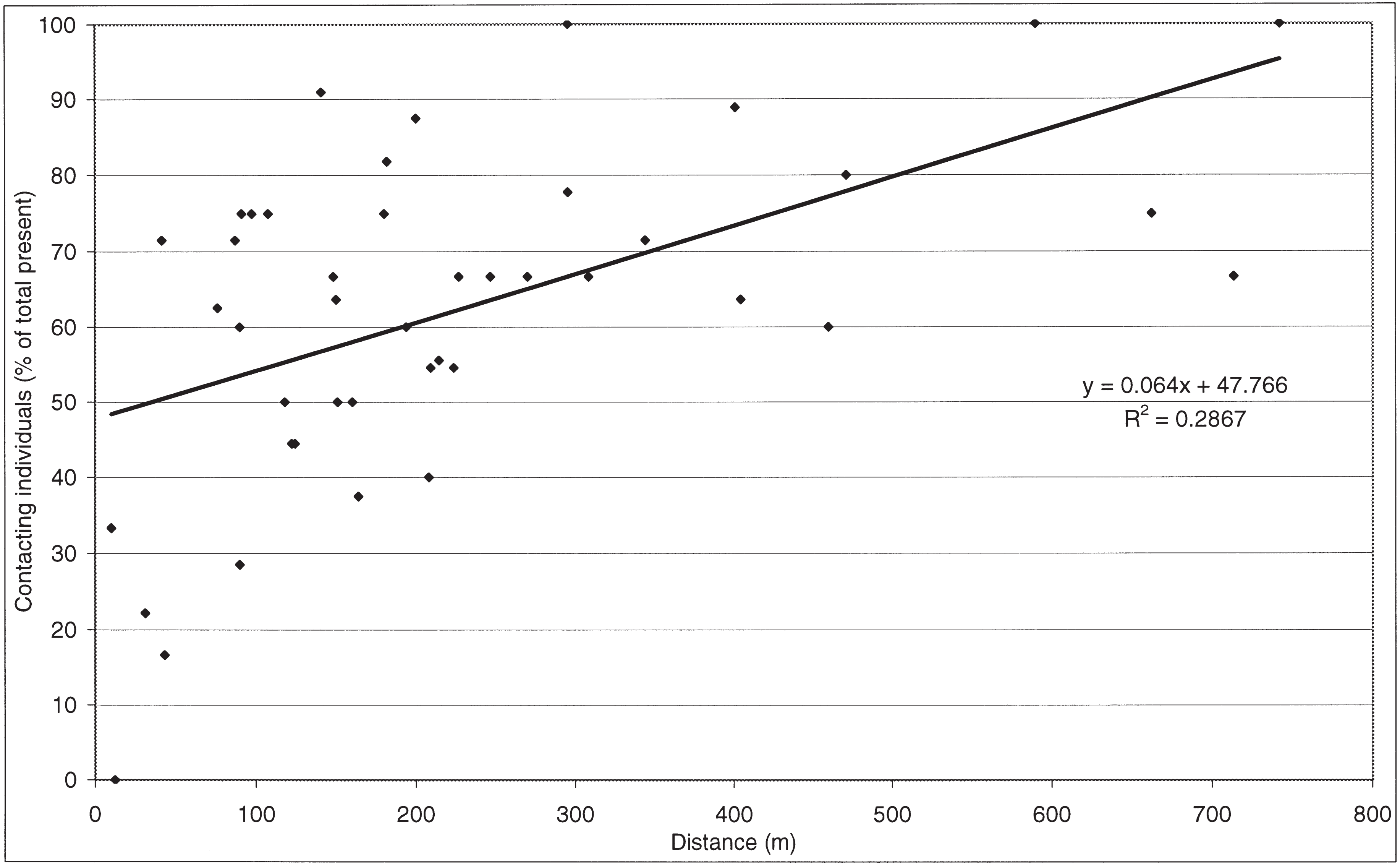

Figure 15. Mean daily on-track distances travelled v rate of contact (entire sampling period).

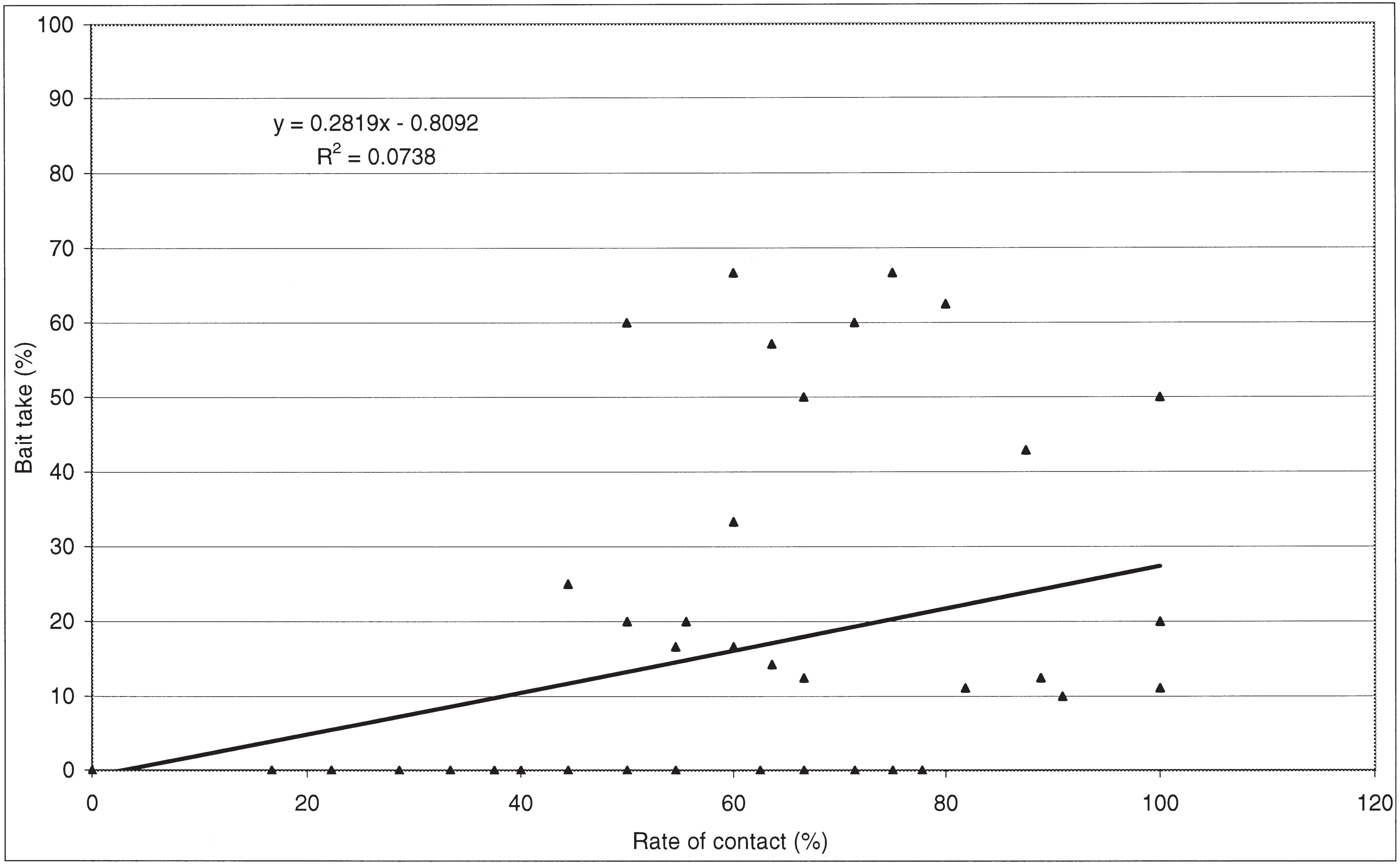

Figure 16. Rate of contact v rate of bait uptake (entire sampling period).

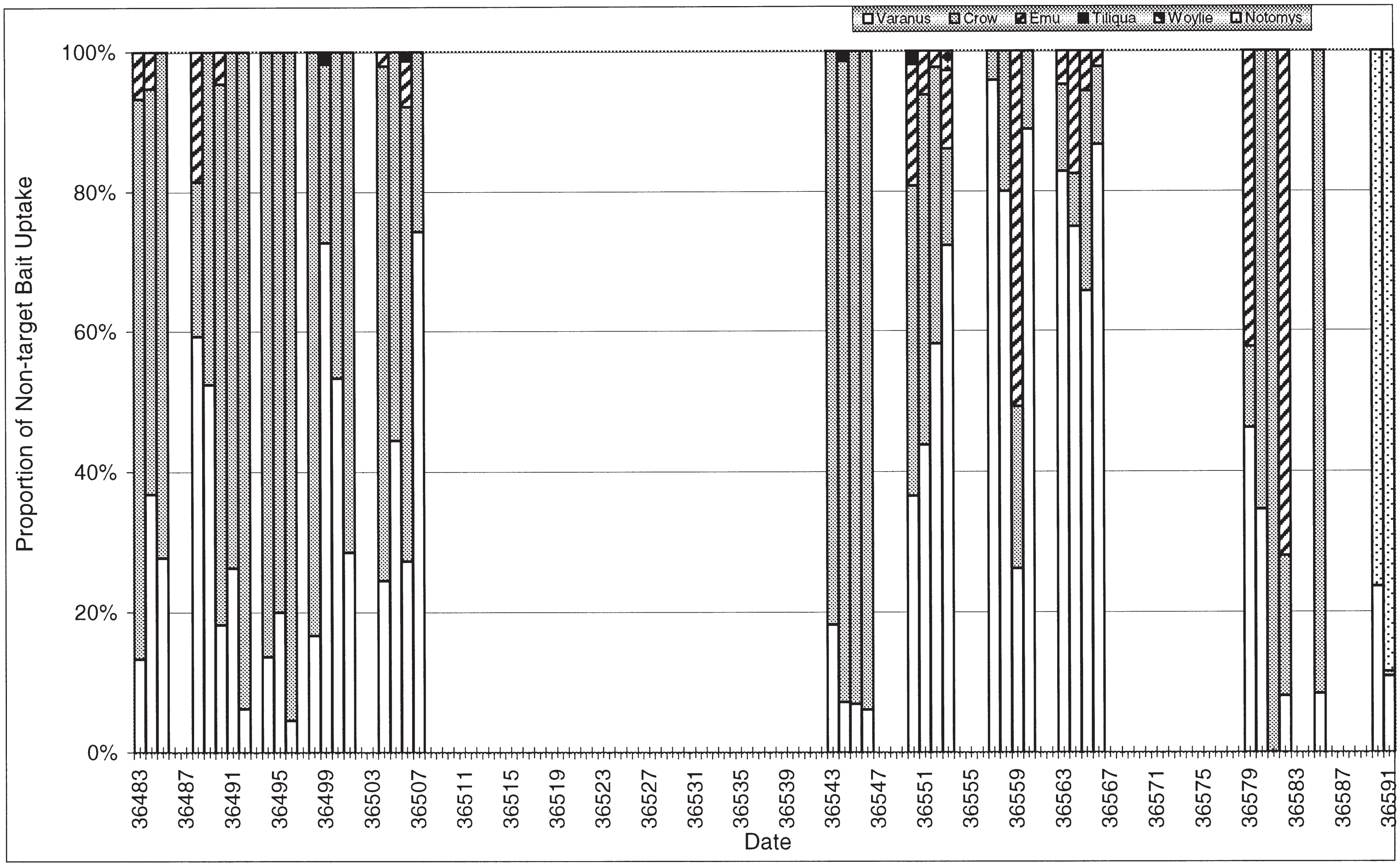

Figure 17. Relative frequency of bait uptake by non-target species.

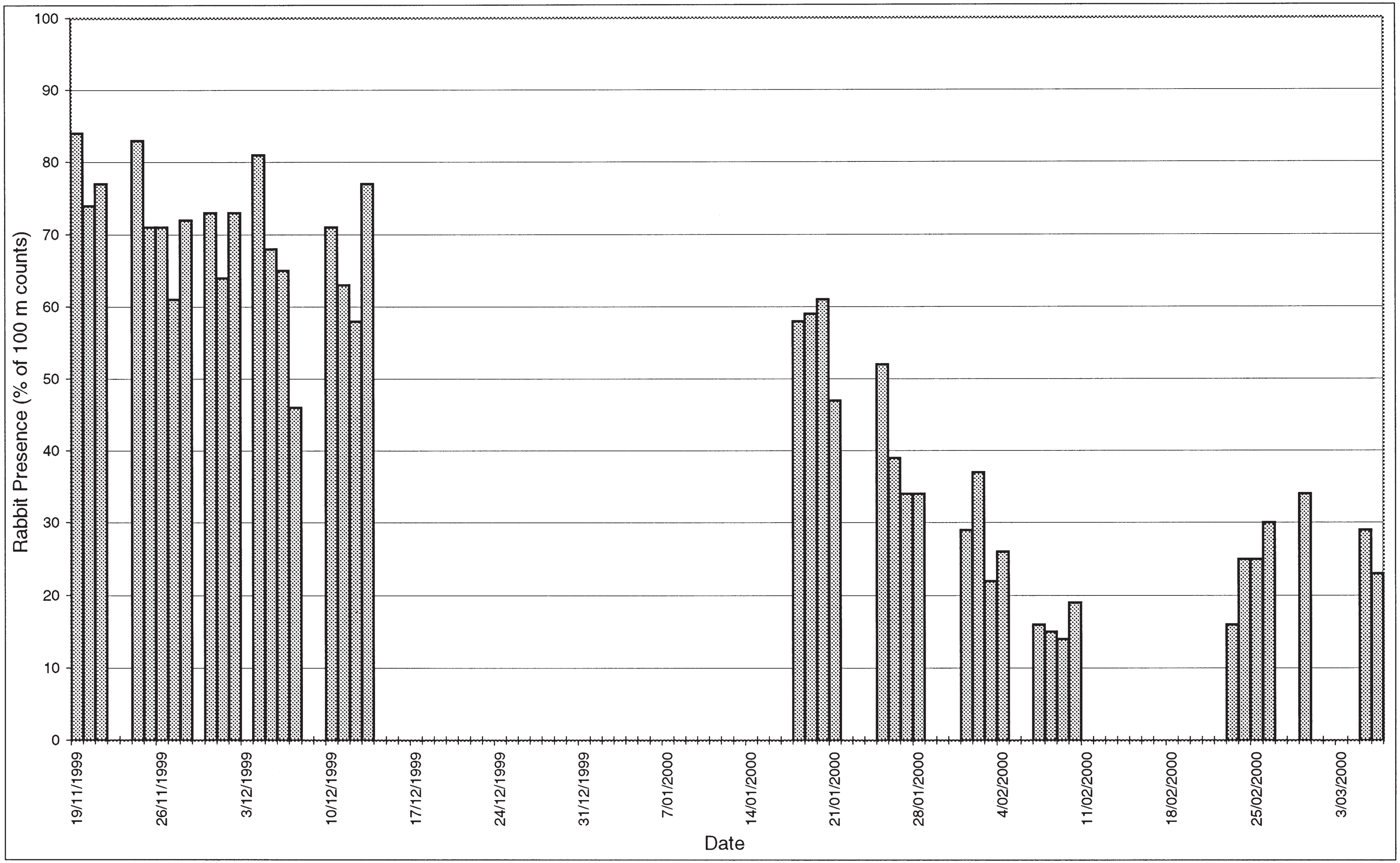

Figure 18. Rabbit presence on bait uptake transects.

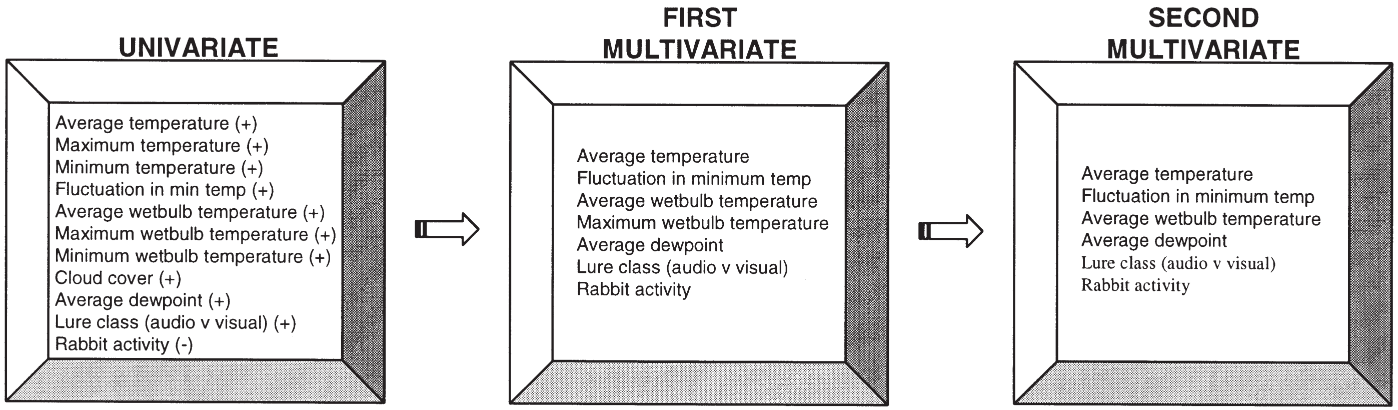

Figure 19. Regression model building steps for bait uptake (entire sampling period).

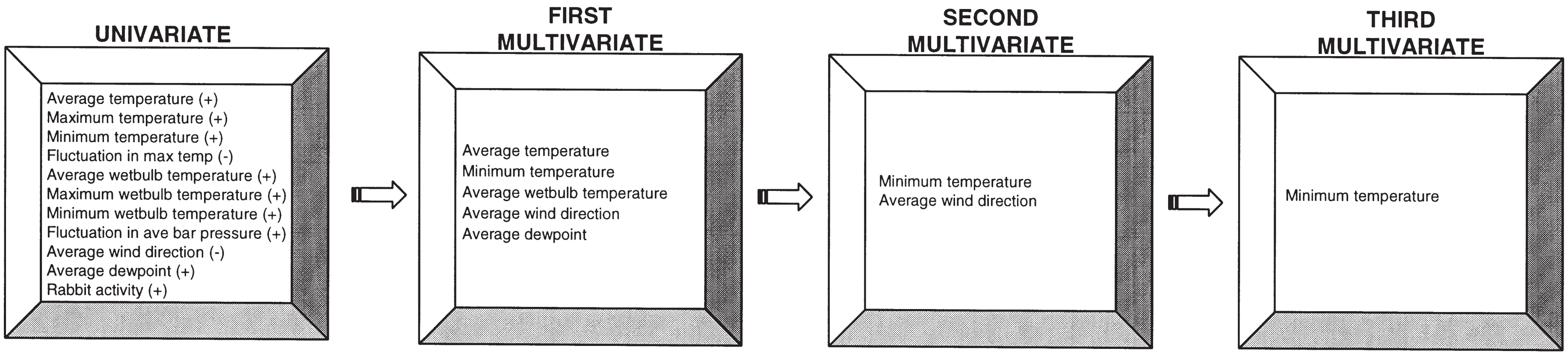

Figure 20. Regression model building steps for potential bait uptake (entire sampling period).

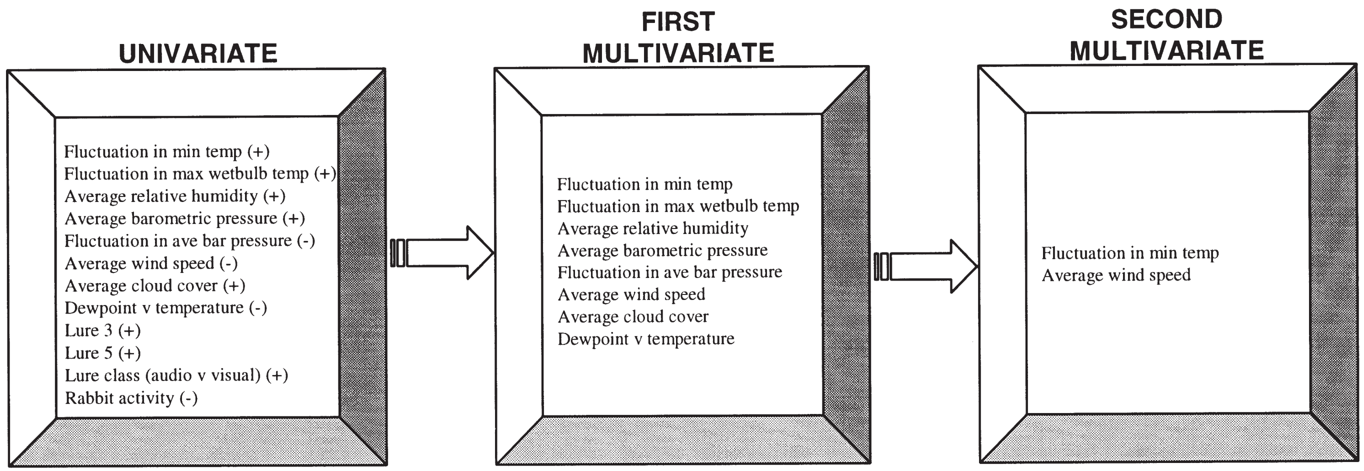

Figure 21. Regression model building steps for bait uptake (post 25 January).

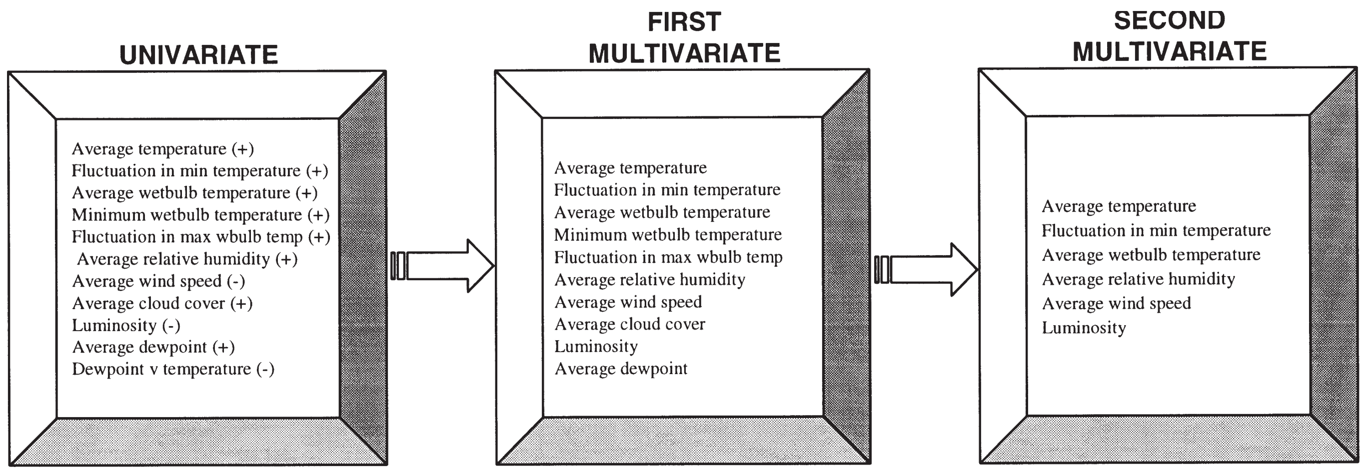

Figure 22. Regression model building steps for potential bait uptake (post 25 January).