OPOSSUM DENSITY ASSESSMENT USING THE BAIT INTERFERENCE METHOD

G. T. JANE*

ABSTRACT

During the past three years the bait interference method of opossum density assessment has been developed as the main tool for assessing both opossum densities and the success of aerial poisoning operations in exotic forests within the Rotorua Conservancy. Although there have been a few problems in the application of the method, results obtained have been in good agreement with field observations and other density estimates.

INTRODUCTION

The bait interference method uses the proportion of baits eaten at a number of points (bait stations) to estimate animal numbers. The method was developed by Bamford (1970) as a fast and simple method of assessing opossum densities before and after aerial poisoning operations, and thus the success of the control work. Two main problems arose: (1) when baits were placed on the ground, rats and other animals had access to them; and (2) if baits were placed too close together, opossums followed the lines of baits. The first problem was overcome by a simple bait station design incorporating a rat guard and using a flour/soya bean oil mixture as a bait. In terms of the second problem, trials established that a spacing of 40 m between bait stations reduced to a low level the probability of animals following the lines.

The percentage of takes on the lines continued to rise on consecutive nights, however. Bamford identified this as a random encounter process by which opossums were able to remember, or at least reidentify, the location of bait stations found on previous nights. This problem cannot be overcome by any change in sample method. Bamford's solution was to bait the stations for a large number of nights prior to poisoning. He then estimated the proportion of the population killed by expressing the ratio of takes for the last few nights before the poison drop to the lowest take after the poisoning. The

*N.Z. Forest Service, P.O. Box 1340, Rotorua.

technique still involved a considerable amount of field work and did not appear mathematically sound. Further consideration of the mathematical model (Jane, 1976) showed that a simple extension of the formula used would allow this re-identification of baits to be taken into account.

MODEL

It can be shown (Bamford, 1970) that bait assessment is similar mathematically to trap assessment. For each of them, relative density—a parameter enabling direct comparison of populations—can be estimated over one time interval (night) as:

$$\text{Relative density} = -\log_e (1 - f)$$

where f is the proportion of traps sprung or baits taken. Now if the proportion of takes is accumulated from night to night —as occurs when opossums "remember" the location of bait stations—the process resembles that for estimating mass from rate of radioactive decay. The number of time intervals (t), in this case nights, must then be included in the formula; so:

$$\text{Relative density} = 1/t. (-\log_e (1 - f)) \times 100$$

where t is the number of nights the bait stations have been in place at that point. In this way several estimates of relative density can be made on the same lines on consecutive nights.

The relative density so obtained is a Poisson statistic which has a high variance (Johnson and Kotz, 1969), and the confidence limits are directly dependent on the sample size alone. Twenty-five stations give approximate 95% confidence limits ±50% of the mean; 100 stations ±20% of the mean; 200 stations ±15% of the mean; 500 stations ±10%; and 1000 stations ±6% of the mean. This knowledge is important in determining sample design.

METHODS

A number of variations in sample layout are possible, but sampling using lines of bait stations has been developed as the simplest design. There are two main constraints to this layout. On the one hand there is a need to use a basic sample unit which is large enough to identify variations in animal density due to variations in habitat (such as between mature stands of conifers and recent cutover), or other factors; and on the other hand there is a need to limit the work content of the sample unit. At Kaingaroa these factors, especially stand size, limit the length of the sample line to about 1 km. In indigenous forests in the Rotorua Conservancy, physical factors suggest a similar limit. In pastoral areas where a trail bike can be utilised, lines of up to 2 km are possible. Since bait stations must be placed at a minimum of 40 m apart, sample lines are of either 25 or 50 bait stations, for convenience.

Night-to-night variation in animal activity, especially at low animal densities, can cause large variations in the estimate of relative density. This is overcome in two ways: first by setting the bait stations only in periods of fine weather, and secondly by setting them over three or more nights. In normal practice the bait stations are set for three fine nights, but if takes are less than 15% on the third night the baits are set for further nights. If the takes exceed 90% on any night, density estimates for subsequent nights are ignored until after the poison operation, since the logarithmic conversion used becomes unreliable as takes approach 100%. If takes on many lines exceed 90% by the second night, an alternative method of opossum density estimation, such as the pellet density method (Bell, 1974), is used.

EXAMPLE

The most common use of the method has been to estimate the success of an aerial poisoning operation. For example, 4 lines of 50 bait stations were baited freshly for three consecutive nights before a poison operation, uplifted and reset for a further three nights following the poisoning. Table 1 sets out the takes on separate lines and Table 2 the relative densities.

Data from separate lines can be meaned, but if first plotted on a map of the area may reveal differences in opossum density related to differences in habitat. This may indicate

TABLE 1: PERCENTAGE OF BAITS TAKEN BY LINES AND NIGHTS

Night	*Lines*				*Mean*
	1	*2*	*3*	*4*	
1	16	16	14	12	14.5
2	22	26	30	20	24.5
3	34	38	44	32	37.0
4	12	6	2	6	6.5
5	20	10	6	4	10.0
6	24	12	6	6	12.0

TABLE 2: RELATIVE DENSITIES BY LINES AND NIGHTS

Night	*Lines* 1	2	3	4	*Mean*
1	17.4	17.4	15.1	12.8	15.7
2	12.4	15.0	17.8	11.2	14.1
3	13.8	14.9	19.3	12.9	15.4
4	3.2	1.5	0.5	1.5	1.7
5	4.5	2.1	1.2	0.8	2.1
6	4.6	2.1	1.0	1.0	2.1

the need to stratify the data. For this simple example, however, the three mean figures for the three nights before poisoning are added and meaned, and the density after poisoning is similarly meaned. Thus mean density before poisoning is 15.1, and after poisoning 2.0.

The approximate 95% confidence limits are ±15% of the mean for a sample of 200 bait stations. Hence, before poisoning, density is 15.1 ±2.3, and after poisoning 2.0 ±0.3. The kill estimate then is: (1 —(1.97/15.06)) × 100 = 86.9%, with confidence limits from 81.5 to 90.4%.

CALIBRATION

At Kaingaroa the success of the aerial poison operations in 1976 and 1977 were assessed using three methods: (1) Spotlights counts were made along fixed routes, before and after

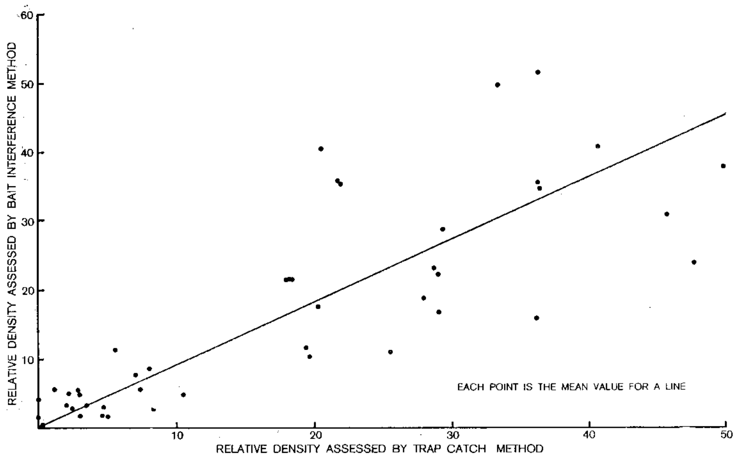

FIG. 1: *Opossum relative densities. Regression of values assessed by bait interference method on those assessed by trap catch method* (r = *0.71*).

poisoning, and (2) trap lines and (3) bait interference lines were laid close together and also assessed before and after poisoning. The spotlight counts gave a very high kill estimate, with the trap and bait interference estimates being lower and very similar to one another. The spotlight counts are biased owing to the area capable of being sampled; in most forest areas only road edges or young stands can be sampled using the spotlight. Opossums congregate in these areas to feed and play on fine nights, but in adverse weather may avoid them completely. Thus the counts can be very erratic and highly biased.

The trap catch and bait interference estimates of relative density rely on the same basic mathematical model (Bamford, 1970) and so might be expected to be linearly related. When the data available from several different stand types at Kaingaroa are plotted (Fig. 1), the relationship is seen to be approximately linear (r = 0.71 for 40 d.f.). Trap catch data can be converted to numbers of opossums per acre (Batchelor *et al.*, 1967). Using their formula and Fig. 1, it can be shown that multiplying the relative density by 0.93 gives an approximate value for number of opossums per hectare. At Kaingaroa, opossum numbers range up to 1.0 animal/ha, and in indigenous forest at Lake Taupo 1.7 opossums/ha have been found within the forest and 3.2/ha on the forest/farm edge.

PROBLEMS

Although bait stations placed clear of obstructions and overhanging vegetation are free from interference by rats and mice, interference from a number of animals has been noted. Rabbits will push the bait stations over to get at the baits, and larger animals such as deer and cattle will take baits. When deer or cattle interference is evident from tracking near the stations, a modified bait station design can be used. In open areas birds, possibly sparrows, will interfere with a few bait stations and can be detected by the beak marks left in the baits. In some forest areas, however, wekas will clear a whole bait line almost as soon as it is laid (J. D. Coleman, pers. comm.). In those cases, and at high opossum densities, the faecal pellet density method of opossum density assessment must be used.

CONCLUSIONS

The bait interference method can be used to assess the effectiveness of aerial poisoning operations and to obtain an estimate of opossum numbers, provided that opossums are the only animals taking the baits. This means that the observers must be aware of other animals present in the sample area capable of interfering with the bait stations and must take appropriate precautions.

REFERENCES

Bamford, J., 1970. Evaluating opossum poisoning operations by interference with non-toxic baits. *Proc. Ecol. Soc., 17*: 118-25.

Batchelor, C. L.; Darwin, J. H.; Pracy, L. T., 1967. Estimation of opossum (*Trichosurus vulpecula*) populations and results of poison trials from trap data. *N.Z. Jl Sci., 10*: 97-114.

Bell, B., 1974. Assessment of an aerial poisoning operation against opossums in the Taramakau. *N.Z.F.S., F.R.I. Protection Forestry Branch Report 150* (unpubl.).

Jane, G. T., 1976. Some further thought on the application of the bait inteference method of opossum assessment. *N.Z.F.S. Rep.* (unpubl.).

Johnson, N. L.; Kotz, S., 1969. *Discrete Distributions.* John Wiley & Sons, New York, 382 pp.