SOME OBSERVATIONS ON THE USE OF SIGHT COUNTS IN ESTIMATING POPULATIONS OF THE RABBIT, *ORYCTOLAGUS CUNICULUS* (L.)*

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Counts of rabbits taken after their emergence above ground, and before they disperse to feed, would be very useful in field investigations if one could be confident that they provided a reasonable approximation to the actual populations of the warrens. Southern (1948), in his careful study of a warren population, using individually marked rabbits, showed that "during a period of normal activity some 30 per cent. of the population was usually above ground, and on less frequent occasions, such as just before a thunderstorm, when they were all feeding hard, this proportion might be increased".

In the course of our first large-scale myxomatosis experiment at Gunbower, Victoria, in 1950, when an undisturbed warren-dwelling rabbit population was kept under very close observation, we gained the impression that when conditions favoured normal activity virtually the whole of a warren colony would emerge before dark, and could be counted before movement confused the situation. During irrigation operations in April, we took the opportunity of checking this impression by estimating the numbers of rabbits inhabiting 13 small warrens which were about to be flooded.

Counts were taken by three different observers for three consecutive evenings during the period of emergence of the rabbits from their warrens. The days were pleasant and warm and rabbit activity appeared to be quite normal. The situation was unusual in that the rabbits had not been previously disturbed in any way for some time and were unaware of the observers who took up their positions behind trees each day before the afternoon period of emergence commenced. On the fourth day irrigation of the pastures proceeded and all the rabbits flooded from their burrows were caught in entrance nets. The results are set out in Table 1.

Three warrens were dug out as a check. There were no dead rabbits within. Since they were all adults there was little reason to expect that many would remain within the burrows to drown.

When these observations were carried out, although kittens had not started to appear, breeding activities had commenced and there seemed to be a movement of odd rabbits from larger to smaller warrens. Some discrepancy between the observed and actual populations of warrens was therefore to be expected. Nevertheless, the estimates of the numbers of rabbits in the two largest warrens, made by separate observers, appear to be very accurate; and the total estimation of 90 per cent. can be regarded as satisfactory and as confirming our impression that virtually all the warren inhabitants could be observed and counted at the time of emergence.

Since the Gunbower experiment, sight count data have been collected by two colleagues in the Wildlife Survey Section (Dunnet and Rowley, personal communications). In the course of a poisoning experiment in Tasmania, Rowley made

* Manuscript received July 22, 1957.

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emergence counts on four successive evenings on a large warren that was exceptionally well situated for observation. The counts ranged from 55 to 63 per cent. of the subsequently determined population of the colony, which comprised over 300 adults and young.

In the course of a study carried out in the Australian Capital Territory, Dunnet found that substantial variations in the time-table of emergence were liable to occur, often unpredictably, and that kittens were much more erratic in their behaviour than adults (Dunnet 1957). His emergence counts were made on two warrens which

TABLE 1

ESTIMATE OF WARREN-DWELLING RABBITS BY SIGHT COUNTS

Observer	Number of Rabbits Estimated*	Number of Rabbits Recovered
A	23	23
	4	5
	1	0
	1	1
	4	6
	4	4
	2	3
B	4	6
	2	3
	2	2
	4	5
	2	3
C	12	12
Totals	65	73

* Highest of the three days' counts.

were subsequently dug out and found to have populations of approximately 120 and 60, including a high proportion of young. In the counts, 55–60 per cent. of the population of the larger warren was recorded. The counts on the smaller warren varied widely over the six days' observations: 100 per cent. of the adult inhabitants were recorded on one occasion, the best estimate of the total population being 75 per cent.

It is apparent from the data available that there is an inverse relation between the accuracy of emergence-count population estimates on the one hand, and warren size and the presence of young on the other. The difference between sighted and actual populations must be accounted for by rabbits which stay underground until after dark; and it seems reasonable to suppose that a large warren colony would develop a more complex emergence behaviour pattern than a small one, particularly if it contained litters of various ages.

Sometimes there will be no practicable alternative to emergence sight counts for estimating a rabbit population and its changes. As it is obvious that such counts

must be interpreted with great caution, they should probably only be attempted when conditions are exceptionally favourable, i.e. on a non-breeding population inhabiting small to medium-sized warrens, after careful observation has indicated that the emergence behaviour has become stabilized, as was the case at Gunbower. Under these circumstances, sight counts on warrens could be of considerable value.

The Gunbower counts were made by Mr. F. N. Ratcliffe (observer C), Mr. B. V. Fennessy (observer B), and the author, all of Wildlife Survey Section, C.S.I.R.O., on the property of Mr. C. R. G. Reid, "Gunbower Estate", Gunbower, Vic. The cooperation of Dr. G. M. Dunnet and Mr. Ian Rowley, in making available unpublished data, is gratefully acknowledged.

References

DUNNET, G. M. (1957).—Notes on emergence behaviour of the rabbit, *Oryctolagus cuniculus* (L.), and its bearing on the validity of sight counts for population estimates. *C.S.I.R.O. Wildl. Res.* **2**: 85–89.

SOUTHERN, H. N. (1948).—Sexual and aggressive behaviour in the wild rabbit. *Behaviour* **1**: 173–94.

The component parts of one trap are:

1 net frame, $\frac{1}{4}$ in. mild steel rod, with semicircular (or rectangular) frame welded to |____| -shaped base.
1 main spike, $\frac{5}{8}$ in. mild steel rod, with $\frac{3}{4}$ in. nut on end (for hammering), and 3 by 2 in. metal base plate welded on side.
4 holding spikes, $\frac{1}{2}$ in. mild steel rod, 12 in. long with $\frac{1}{2}$ in. open eye.
2 extension springs, 4 in. long, extending to 9 in. with 3 lb load.
1 net, $\frac{1}{2}$ in. (or larger) mesh, cone-shaped; nylon is preferable.
1 net peg, *c.* 6 in. of 10 or 12 gauge wire.
1 "Selfset" mousetrap, mounted on base plate.
1 bridle bar, rectangular strip of metal to fit under release bar of mousetrap.
50 yd rot-proof fishing-line, for trap and distant release.

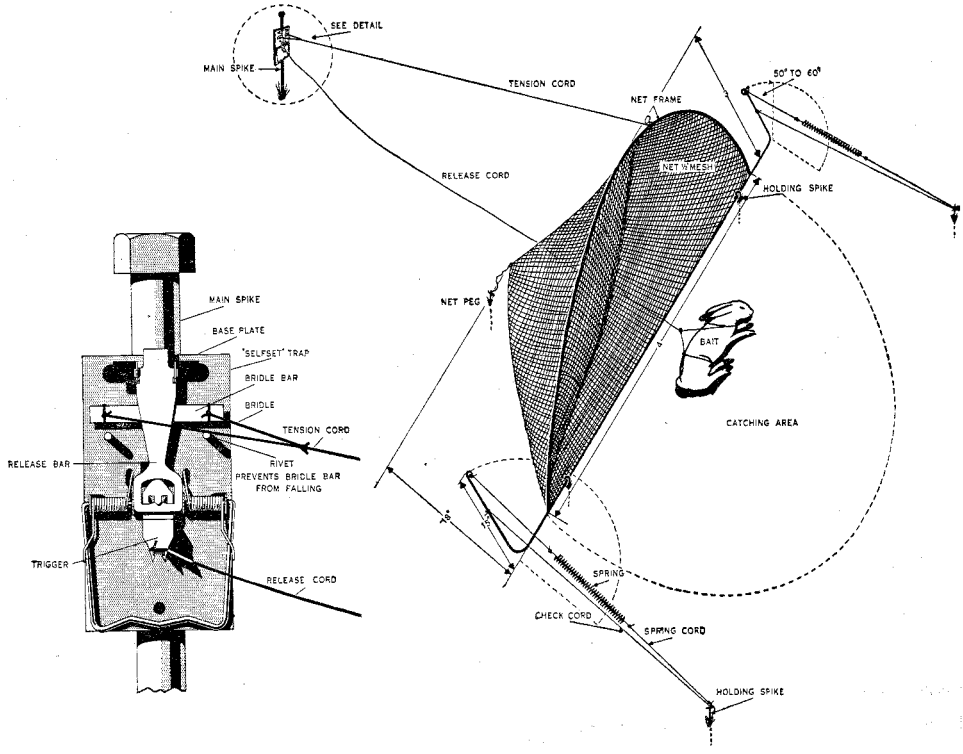

Fig. 1.—Live-trap in set position with detail of release mechanism.

To set the trap:

(i) Lay the frame on flat ground and anchor with two holding spikes.

(ii) Drive the other two holding spikes into the ground so that there is slight tension on the springs when their cords are tied.

(iii) Drive the main spike into the ground 3 or 4 ft behind the trap and leaning slightly towards it.

(iv) Lift the frame almost vertical, place the bridle bar under the release bar, set the trigger, and tie the tension cord so that it pulls on the net frame.

(v) Tie the bait (or perch, treadle, etc.) to the release cord, which is left just slack. The forward pull on the release cord, away from the main spike, by which the trigger is tripped, is provided by a bird which attempts to drag away the prey, or by the weight of birds on a perch alongside the bait. The perch can be propped up so that any desired weight is necessary to depress it.

(vi) Tie the wind-check cord so that it pulls against the tension cord but leaves some tension on the springs.

(vii) Prevent the net from flapping or from blowing inside-out by attaching the apex to the net peg which is pressed so lightly into the ground that it is pulled out when the trap is sprung.

During January 12 to February 12, 1957, four of these traps were tested at Woodbury, Tas., the aim being to catch swamp-harriers for banding. Each trap was baited with a rabbit carcass and remained at the same site; it was visited twice daily. The four traps were in operation for 18, 12, 10, and 5 days respectively, and 6 trap-days were lost before check cords were fitted, which leaves 39 effective trap-days. Fourteen swamp-harriers were caught, two were recaptured, and only one false release occurred. No other species of birds were caught.

Since this paper was written, the author has seen a description of a similar bow-net used by Tordoff (1954)* to catch raptores, using live sparrows and mice as decoys, and with a trigger-release mechanism above the decoy platform.

The author is indebted to Dr. R. Carrick of the Wildlife Survey Section, C.S.I.R.O., Canberra, for assistance in the preparation of this paper, and to Mr. L. A. Marshall, who drew the figure.

* Tordoff, H. B. (1954).—An automatic live-trap for raptorial birds. *J. Wildl. Mgmt.* **18**: 281–4.

Corrigenda

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Page 13, line 5: *for* 0·5 g *read* 0·5 mg

Page 49, Section VI. Acknowledgments: *for* Miss D. Jones *read* Miss D. Johns

Page 59, reference to Mathews and Iredale: *for* *Ibis* **3** *read* *Ibis* (ser. 10) **3**