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Assessment of small mammals on the Meathop type hectare in March 1970

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INTRODUCTION

This project (301/29), to assess the abundance of the various species of small mammals (voles, mice and shrews) on the type hectare in Meathop Wood, was requested by Dr. J. Satchell for IBP, in order to check the estimates made earlier by J. Rostron (Department of Zoology, University College, London) in 1964.

Rostron used 100 Longworth Live traps, one every 10 m in a grid of 100 x 100 m square. He trapped this grid at 4-weekly intervals between March and October 1964. His highest catch consisted of 15 woodmice (Apodemus sylvaticus), and these he caught in his first trapping in March. His second highest catch consisted of 10 woodmice, which he caught in May. In all the other trappings his captures never reached double figures. Occasionally, he also caught one or two bank voles (Clethrionomys glareolus), his general conclusion was that only woodmice were present on the hectare in any numbers and their numbers were too low to measure accurately their contribution to the total energy budget.

METHODS

Trapping took place during the period 13-20 March 1970.

The month of March was chosen for this exercise because:

1) All the species of small mammal could be assumed to be at their lowest levels of population.

2) None of the small mammals was likely to have started breeding.

3) All species should have been at a peak of activity having by that time probably exhausted most of their winter stores of food.

4) None of the ground flora had rached a stage of development where it was likely to suffer from the frequent trampling necessitated by the trapping technique.

288 Longworth Live traps were used in this operation, two traps being placed at intervals of 10 m in a grid 120 x 120 m square (144 trap points). The traps were put down and prebaited for three days before being set. They were then visited every evening and morning for the next four days. Each day's trapping consisted of one evening and morning round. The mice and voles caught, were sexed, marked individually by toe-clipping, weighed and measured (nose to anus length) before being released.

POPULATION ESTIMATION

Total population numbers of woodmice and bank voles were determined by both Hayne's (1949) regression method and the Lincoln Index (capture/recapture) method (Fig. 2). In the former calculations, because the slopes were steep, due to 78.7% of all the woodmice and 76.6% of all the bank voles being caught on the first day, the regression line between numbers of new individuals caught and the accumulating total captures could be drawn by eye when determining the population size without introducing any errors greater than $\pm$ 2.

For the Lincoln Index estimates only the first and second day's capture data were used; the other two days added little further information. The results (Fig. 2), when compared, show remarkable agreement between the two methods and there is no suggestion of any trap bias in the results.

EDGE EFFECT

In order to achieve an accurate assessment of the small mammal density on the hectare, an attempt was made to measure the edge effect both in space and time, so that it could be eliminated from the subsequent analyses.

To measure the effect in space, the grid was designed to consist of 12 columns and 12 rows. This permitted an independent analysis to be undertaken on each of 6 concentric squares of trap points, each square being in a different position from the others, relative to the edge of the grid.

To measure effect in time, trapping was continued for four days; new immigrants were detectable because, having marked all the resident mice and voles earlier when they were first caught, the immigrants, arriving later were still unmarked when trapped.

RESULTS

Total catch:	103	A. sylvaticus
	47	C. glareolus
	1	Sorex araneus
	1	Mustella erminea

The woodmouse was, beyond doubt, the dominant species of small mammal on the site at the time of trapping; its distribution was however clumped (Fig. 1) in contrast to the bank voles, which were thinly spread throughout the area.

Only one species of shrew (S. araneus) was recorded. Compared with the frequency with which they were trapped in the Wytham woods (Berkshire) shrews appear to be surprisingly uncommon(perhaps there is competition for invertebrate food between the shrews and the woodmice in this type of situation?).

The stoat (M. erminea) was caught and released alive, after being examined in a plastic bag. It showed signs of partial winter albinism with a white muzzle, ears and tail, being otherwise brown with the usual black tip to its tail.

INTERPRETATION OF DISTRIBUTION AND EDGE EFFECT

On the face of it the numbers of mice and voles per trap point resulting from an analysis by squares, appears to demonstrate undoubted and extensive immigration on to the site during the trapping with an almost perfect gradient from 1.55 captures per point on the outer edge of the grid to 0 captures per point around the central square.

This result could be interpreted as indicating that before trapping commenced, there were no small mammals on the site. As soon as baited traps were placed on the site all the mice and voles in the vicinity were attracted to the supplementary feed and invaded the grid. The numbers of traps, however, were just sufficient to catch all the invaders before they reached the central square.

There are, however, two facts which contradict this interpretation.

1. The habitat surrounding the site was indistinguishable from that within the grid. There were therefore no obvious areas of better habitat within at least 100 m from which the invaders might have come.

2. More than 75% of both species were trapped on the first day and 8 out of 10 mice and 4 out of 8 voles caught after the second day were all caught in traps on the perimeter square, which suggests that immigration was no longer dynamic across the grid, but only occurring locally by the time trapping began; and the original distribution of the migrants was apparently stabilised throughout the trapping period, despite increasing quantities of food and reduced competition for it the nearer they approached the centre of the grid.

In my opinion the more likely explanation is that only the perimeter was affected by immigrants from outside the grid, and the distribution within the rest of the grid was not, and may be interpreted as follows.

Quite by chance the central square of the grid (6) happened to be located in an area unsuitable as habitat for any species of small mammal. The traps on the next square outwards (5), adjacent to this uninhabited area, caught few animals because only some of the trap positions were near or lay within the limits to centres of population (Fig. 1). The next three squares (4, 3 and 2) were probably all equally inhabited by resident groups, and the differences in numbers captured reflect slight but genuine differences in dispersion and density.

Lastly, though trapping on the outermost square (1) was almost certainly affected by immigrants, so few were captured after the first day (14 of 47 woodmice, 5 of 21 bank voles) that it seems reasonable to suppose that later captures must have belonged to home ranges adjacent to or overlapping that square, and were not drawn into the grid from very far away.

There was one other point of interest in this connection. Whereas it is often thought that the immigrants are more likely to be dominant males, in this instance, though the figures are small, the sex ratios of both species, caught after the first day, were actually less in favour of males on the edge of the grid than within it.

Sex ratio, ♂♂: ♀♀ of animals caught after the first day (days 2-4)

	Edge of grid	Within the grid
Woodmice	2.5 :1 (10:4)	7.0:1 (7:1)
Bank voles	0.25:1 (1:4)	1.0:1 (3:3)

The sex ratios, ♂♂: ♀♀ for animals on the whole grid excluding the perimeter square (days 1-4) were:

Woodmice 1.24:1 (31:25)
Bank voles 1.17:1 (14:12)

The sex ratios, ♂♂: ♀♀ for animals on the whole grid including the perimeter square (days 1-4) were:

Woodmice 1.45:1 (61:42)
Bank voles 0.96:1 (23:24)

DENSITY ON HECTARE

In order to calculate the average density of each species on the site, the trapping results from all the trap points on the edge of the grid were excluded; it was hoped this would eliminate any bias due to immigration.

Allowing that a distance of 5 m was covered by each trap point (half the distance between traps), the area assumed to have been covered by the remaining 100 traps points was exactly 1 ha. Total numbers caught on this area amounted to 61 woodmice and 26 bank voles.

Total numbers estimated by Hayne's method were 56 woodmice and 24 bank voles; and by the Lincoln Index method there were 55 woodmice and again 24 bank voles (Fig. 2).

WEIGHT AND LENGTH CLASSES

All individuals were weighed and measured when caught for the first time. The data are in Table 2. The distribution of the class frequencies are all normal and can be used in the calculation of biomass on the hectare without having to be corrected.

ESTIMATION OF ENERGY FLOW

/ For References, see:

Petrusewicz, K. (ed) (1967). Secondary productivity of Terrestrial Ecosystems (Principles and Methods) Vol. 1. 1-379. Warsaw. /

Clearly, few of the authors contributing to the discussions at the meeting held in Jablonna in 1966, thought their researches had reached the stage where accurate estimates of energy flow or production were possible or such estimates were even meaningful.

Golley, for instance stating that "energy flow in individuals varies for physiological reasons related to their specific function in a population and, possibly also for ecological reasons associated with the size and condition of the population of which they are a part", in effect summed up the enormous problem of overcoming variability.

There are for instance the problems not only of relating biomass to energy flow, but also to the specific function of the animal in the ecosystem. As pointed out by Schwarz, "Biomass only indicates the value of the energy content of body tissues and does not give any indication of the role of the given species population in the energy flow of the ecosystem".

Buechner and Golley also emphasized how misleading measurements of biomass could be if not converted into Energy flow units. Three of the species they quoted as illustrations gave the following values:

Species	Standing crop of energy Kcals/sq m	Energy flow Kcal/sq m/year
White-tailed deer	1.3	43.1
Uganda kob	3.1	62.4
African elephant	7.1	23.3

Gorecki was more concerned with the calorific determination of biomass itself. He had found that the calorific values (assumed to be a constant in relation to biomass by most authors) varied not only between seasons, but also between species. These values of biomass taken from many rodent species and seasons ranged between 1301 and 1693 cal/g. The yearly mean for all these species was 1502 cal/g. This was slightly higher than Golley's (1960) determination for Microtus pennsylvanicus (1.4 kcal/g). There are no figures for any of the British small mammals.

Even in the laboratory, where conditions might be thought to be under better control, variations in production between populations have been enormous. For instance, Walkowa and Petrusewicz found that production could vary between populations by as much as three times (8.2 kg - 28.1 kg) during a period of 43 months. Production was higher during the increase and lower during the decrease in population numbers, and the larger the population, the faster was its weight increase.

In the field, estimates of population size are probably going to introduce the most serious errors. Grodzinski and Gorecki gave several examples of daily energy budgets and values (DEB) for various small rodents under caged conditions, but added as a word of warning - "In introducing the DEB to the balance of energy flow through the population of rodents it is necessary to remember that the estimations of numbers, rather than the energy budgets of animals, will always be charged with the greatest error. Omission of one mouse or vole in the census of population causes an error considerably exceeding the difference between models based on ADNR or BMR." They could also have warned other workers in this field of the still greater errors involved in under- or over- estimating population turnover. Even Ryszkowski and Petrusewicz, the chief architects of this part of the IBP, wrote "Since all estimations of energy flow come from calculations of at least two and quite often four and more components we can expect a summing of errors. These can cause, in consequence, inaccuracies so significant that it is impossible to draw conclusions or compare the conclusions with other estimates".

Nevertheless, if 'guesstimates' of energy flow through the small mammals in Meathop are wanted, these two authors give adequate details for both Apodemus and Clethrionomys, so that this can be done.

ACKNOWLEDGEMENTS

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Mr. J. M. Sykes and his two assistants Mr. Martin Wyatt and Mr. Niel Chard, who helped mark out the trapping grid; Mr. M. Smith who helped to place all the traps for prebaiting, and Mr. M. W. Shaw, who helped with the trapping each morning assisted by Mr. Philip Bassett who recorded all the data for us.

TABLE 1. Numbers of trap points and mice and voles per point according to position of the square in relation to the rest when the whole grid is analysed as six concentric squares.

Square	No.	No. of trap points	No. of mice and voles/ trap point
Perimeter	1	44	1.55
	2	36	1.03
	3	28	0.71
	4	20	1.0
	5	12	0.42
Centre	6	4	0
Total	6	144	1.04

Table 2. Weight and length class structure

Body length (mm) class frequencies

	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
Apodemus																									
Males					1	1	1	2	-	1	1	5	6	5	3	3	8	7	3	3	3	1	2	-	1
Females	1	1	2	-	2	3	2	5	4	2	5	3	2	4	1	1	-	-	1						
Clethrionomys																									
Males							2	1	2	1	5	1	3	1	1	-	-	2	-	-	1				
Females		1	1	1	1	-	4	4	1	3	2	1	2	3											

Live weight (gm) class frequencies

	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Apodemus																			
Males					2	3	4	2	1	3	8	10	6	4	6	3	5	1	1
Females			3	1	3	6	10	7	3	3	2	1	1	-	1				
Clethrionomys																			
Males	1	-	1	-	6	4	7	1	-	2									
Females		4	4	11	3	-	1	-	1										

Fig 1 Grid on type hectare in Meathop Wood showing positions of the trapping points and the numbers mice (upper symbols) and voles (lower symbols) caught at each point and the day of capture (see ke

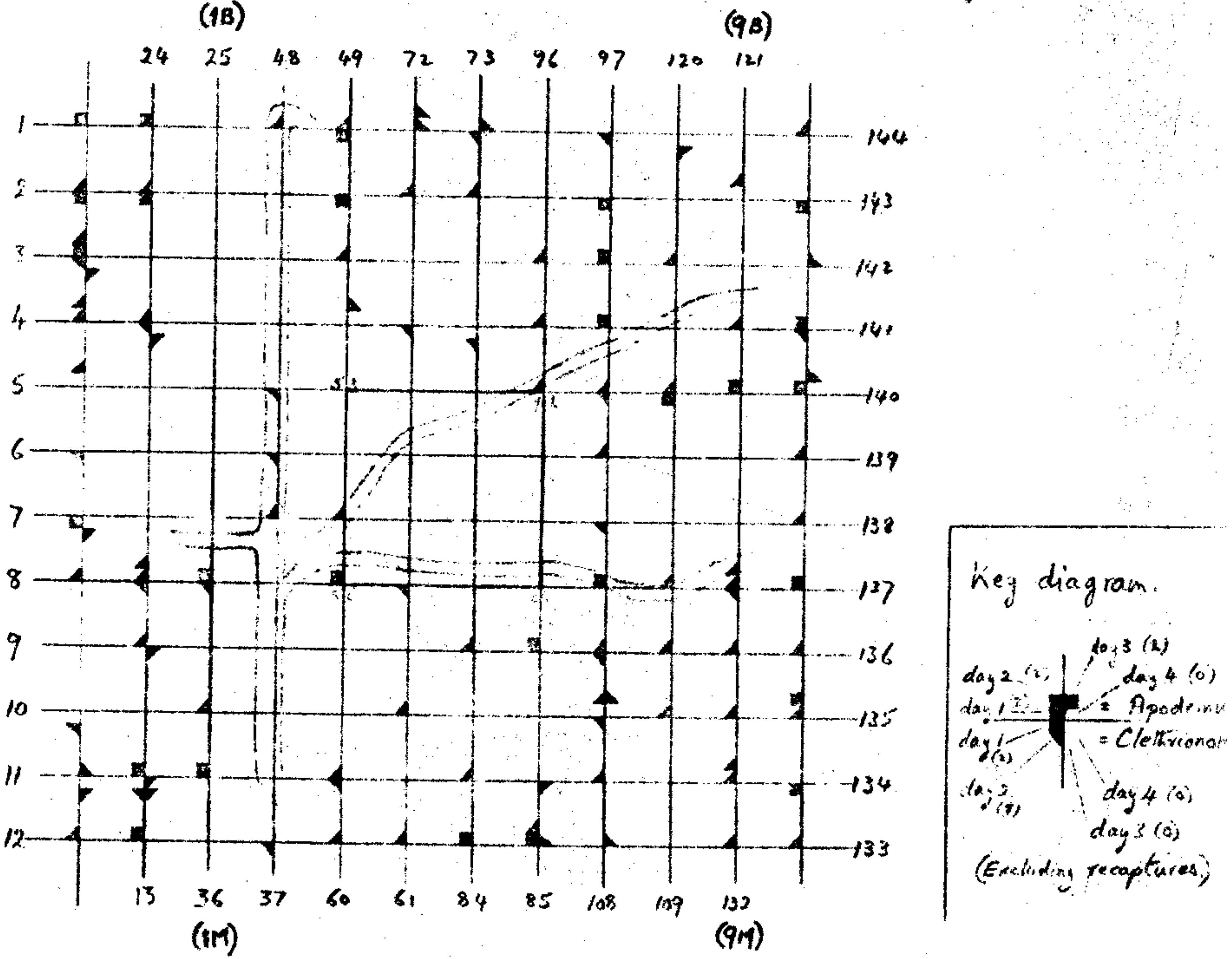

Figure 2 a. Number of new captures related to accumulating total of captures, to estimate population size (Hayne's method).

Apodemus sylvaticus.

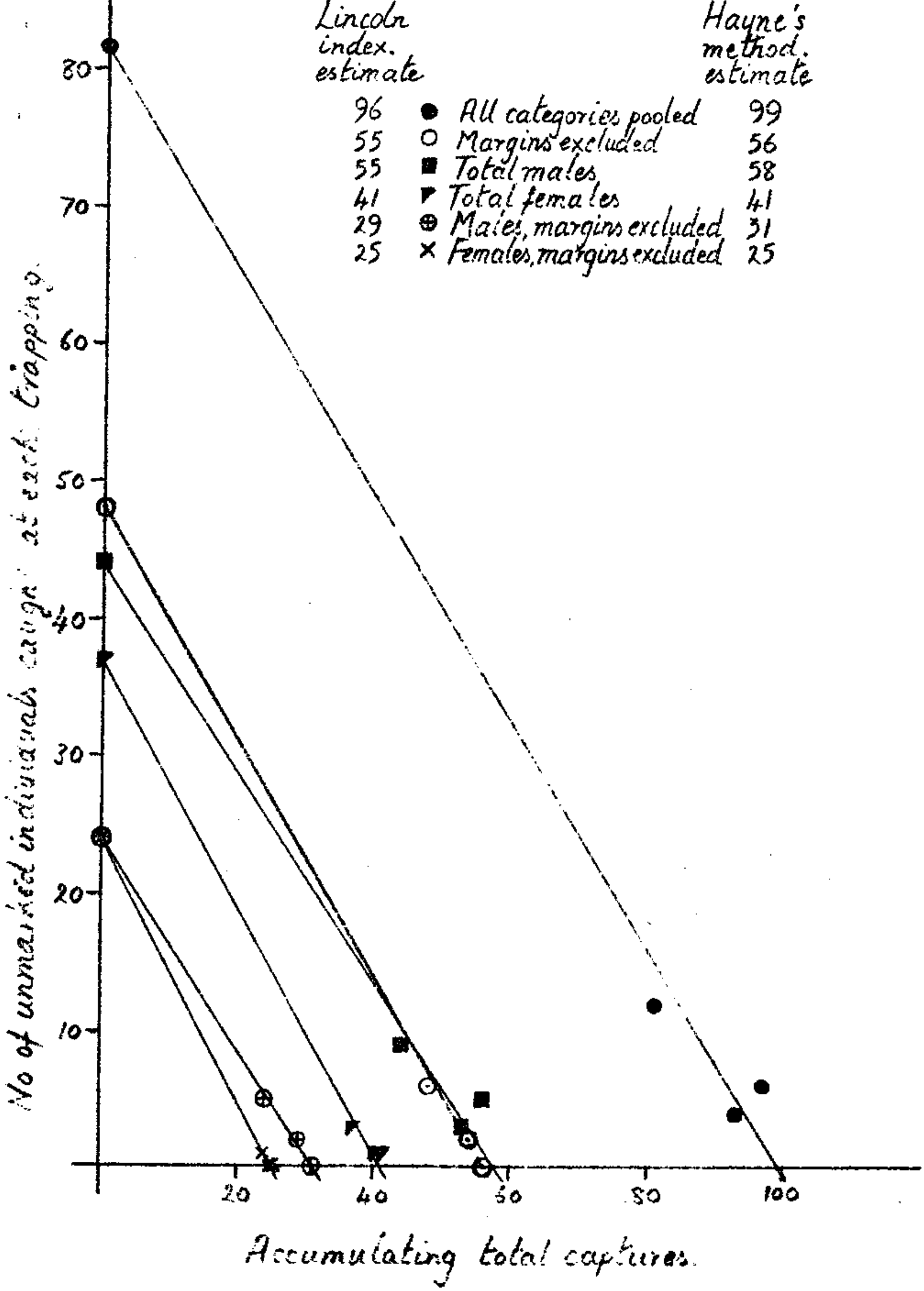

Figure 2 b. Number of new captures related to accumulating totals of captures, to estimate population size (Hayne's method).