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Department of Statistics and Modelling, Institute of Ecology,
Dziekanów Leśny near Warsaw

Teresa WIERZBOWSKA

STATISTICAL ESTIMATION OF HOME RANGE SIZE OF SMALL RODENTS

(Ekol. Pol. 20: 781–831). The study presents a method for estimating the size of the home range by means of the number of traps coming within its limits. This method was verified, and then home range size estimated for three species of small forest rodents, *Apodemus flavicollis* (Melch.), *A. agrarius* (Pall.) and *Clethrionomys glareolus* (Schreb.).

Determination of the extent of the area systematically covered by an animal in its search for food and in order to satisfy other basic vital requirements is one of the most important elements in ecological research. The above area is termed the home range [definition given by Burt (1943)]. The extent of the given species, depending on ecological conditions. Exact definition of home range size may be of assistance in estimating many important ecological characteristics of animal populations living during the study period. Such characteristics include population numbers, the social structure of the population, habitat capacity and others.

Home range size can be estimated for the period in which the animal "reveals" the area it covers. It is possible to ascertain the limits of the area, and consequently to find its dimensions on the basis of recording the places in which the given animal was seen.

Comparison of these places is possible by means of direct observations of the animal or the traces characteristics of it, or by drawing conclusions as to the animal's presence in given places in the study area on the basis of data obtained by appropriate observations of the population studied. Direct observations are difficult in the case of animals leading a hidden way of life, particularly small forest rodents. It is in addition difficult to reach conclusions as to the presence of representatives of many species of animals (including small rodents) in a given area on the basis of the traces they leave. The size of the home range of small forest rodents can therefore be made on the basis of results obtained from captures made in the following way: one or more live traps are placed within a given area on sites chosen at random, or on the intersection points of a grid divided into squares.

Among those in favour of the second method are Polish ecologists. In the case of either method the traps are set to snap shut at regular intervals of time, over a period of several hours. The rodents caught are given a number by suitable marking and are released on the capture site. This number serves to identify the rodent each time it is recaptured, when the number of the trap in which it is caught is also recorded. The density of the grid on which the traps are set is chosen in such a way that at least several of them came within the boundaries of the presumed home range of the rodent, while the interval between trapping series was chosen in such a way that the rodent moving over the area had the chance of being caught at least several times during the course of the experiment.

Among the methods used for estimating the size of the home range based on empirical data, obtained in the way described above, it is possible to distinguish some which are most often employed by ecologists. They can be divided in the most general sense into those which give home range size on the basis of information regarding trapping sites (termed trapping points) on which the given rodent was caught (which were thus "revealed" by the rodent), and those methods which are based on information as to the number of captures of a rodent on different trapping points.

The so-called polygon method belongs to the first group. The field of the smallest convex area containing all the trapping points of the rodent was taken as a measure of the area covered by the animal. This method was subsequently slightly modified, the least convex area containing all trapping points being increased by a group of points not further from it than half the distance between neighbouring traps in the grid, and the extent of increased area being taken as a measure of home range size.

The second method belonging to this group suggests that home range is measured by means of the maximum distance between two of the rodent's trapping points. The modification of this method consists in increasing the maximum distance between two of the rodent's trapping points by a sector equal to half the distance between neighbouring traps in the grid. The length of the sector obtained is taken as the measure of home range size.

The second group includes methods which define home range size on the basis of information as to the number of captures of a rodent on the trapping points Hayne (1949) introduced the so-called rodent's centre of activity, assuming that this is the point with co-ordinates equal to the arithmetical mean of the co-ordinates of trapping points for the given rodent. He also defined intensity of movement by the rodent over different parts of its home range by means of frequency of the rodent's capture in traps. Taking the most significant regularities observed by Hayne as their starting point, later authors (Dice, Clark 1953) constructed a mathematical model describing intensity of movements over the home range. Calhoun assumed that the distance of the rodent's trapping points from the centre of activity so-called trapping radius is a random variable with density:

$$f(r) = \frac{r}{\sigma^2} e\left(-\frac{r^2}{2\sigma^2}\right), \tag{1}$$

where σ is the standard deviation of the marginal distribution of each of the co-ordinates of trapping points.

Length of the trapping radius equal to one standard deviation was taken as a measure of home range size. Other authors, accepting Hayne's model, suggested defining the size of the area covered by rodents by means of the area of a circle with radius equal to 2.5 σ (Harrison 1958) or 3 σ (Calhoun, Casby 1958).

Calhoun's model, assuming two-dimension distribution normal for random points of the home range, and consequently assuming the existence within the home range of one centre of activity identified with the centre of gravity of the trapping points, was also accepted in the study by Mazurkiewicz (1969), except that the area of the ellipse containing 95% of captures was taken as the area of the home range. Criticism of the model accepting a circular shape for the home range and the proposal that an elliptical shape should be accepted, giving the way in which home range size was calculated, has also been presented in the study by Jenurich, Turner (1969).

Many studies have contained the criticism that suppositions of models of the Calhoun type are inadequate for representing actual situations, and the chief object of criticism was the concept of the centre of activity (Blair 1951, Kaye 1961, Miller 1957, Tanaka 1961, Tanaka 1963). The arbitrary nature of definition of home range size with the given method has also been criticised as leading to different estimates of this range (Tanaka 1963), since home range size has been defined as an area covering 90%, 95% and 99% of captures.

The basic objection, however, consists in the fact that information obtained by long-term observations of a rodent is necessary for estimating home range size, so that assumptions reached as the result of accepting a given model may not be fulfilled. It has been found (Tanaka 1963) that a rodent changes the area over which it moved and that the shape and size of this area are subject to alterations in time, depending on given ecological conditions. It was therefore a question of finding a method which would permit of estimating home range size on the basis of data from a sufficiently short period (in which the rodent was caught several times) to make it possible to assume that the suppositions of the proposed model could be fulfilled. In addition it may be necessary to estimate home range size on the basis of a relatively small number of captures of the rodent. The number of captures depends on the rodent's lenght of stay in the area containing traps and on probability of the rodent's capture in a trap during the time it remains set. Both values are very labile depending on given ecological conditions.

In the light of the foregoing it would be convenient to find a method which would permit of estimating home range size on the basis of several captures of a rodent, for this method to be free of suppositions as to the existence within the rodent's home range of a centre of activity and for it to be free of suppositions as to the shape of this range.

An attempt of this kind for empirical data obtained by trapping rodents by the method used by Warsaw ecologists has been made in the present study.

I. CONSTRUCTION OF A STATISTICAL MODEL FOR ESTIMATING THE HOME RANGE OF SMALL RODENTS

The number of traps situated within the area of the rodent's movements was taken to be the measure of a home range. The following symbols have been introduced for the purpose of estimating the above size:

D – experimental area,

G – area covered by the given rodent's movements,

I – set of traps in area D,

I_G – set of traps in area G,

$|I_G| = r$ (measure of home range is number of traps, r situated within the home range),

E_i – event consisting in occupation of trap i by a rodent as the result of its being caught (trap i belongs to the set of traps in the home range, which is recorded as $i \in I_G$),

k – number of captures of the rodents.

Let us assume that:

1) $G \subset D$ (whole area of home range is situated within the experimental area),

2) $P(E_i) = \frac{1}{r}$ for $i \in I_G$ (the rodent has uniform probability of being caught in each of the traps in its home range),

3) for each sequence of traps $i_1, i_2, \ldots, i_k$, where $i_j \in G$ ($j = 1, 2, \ldots, k$) events $E_{i_1}, E_{i_2}, \ldots, E_{i_k}$ are independent (captures of the rodent are independent in relation to traps).

Let $X_{k,r}$ be the random variable defining the number of different trapping points, (traps), which the rodent "reveals" in k successive captures, from among r trapping points situated in its home range.

The variable $X_{k,r}$ is defined on distributions of events:

$$(E_{i_1}, E_{i_2}, \ldots, E_{i_k}),$$

where $E_{i_j} \in E = (E_1, E_2, \ldots, E_r)$, $j = 1, 2, \ldots, k$ and obtains integer values s ($s = 1, 2, 3, \ldots, \min.(r, k)$).

Let us indicate:

$$P(X_{k,r} = s) = P_k(r, s).$$

The distribution of probability $P_k(r, s)$ must comply with recurrence equations:

$$P_1(r, s) = \begin{cases} 1 & \text{for } s = 1, \\ 0 & \text{for } s > 1, \end{cases}$$

$$P_k(r, s) = \begin{cases} P_{k-1}(r, s)\frac{1}{r} & \text{for } k > 1 \text{ and } s = 1, \\ P_{k-1}(r, s)\frac{s}{r} + P_{k-1}(r, s-1)\frac{r-s+1}{r} & \text{for } k > 1 \text{ and } s > 1. \end{cases} \tag{2}$$

For natural k, r, s the function $P_k^1(r, s)$ is defined as follows:

$$P_k^1(r, s) = \begin{cases} \binom{r}{s} r^{-k} (-1)^s \sum_{v=1}^{s} (-1)^v \binom{s}{v} v^k & \text{for } s \leqslant \min(r, k), \\ 0 & \text{for } s > \min. r, k. \end{cases} \quad (3)$$

It has been proved (the proof has been omitted from the present study) that the following equation applies to all natural numbers k, r, s:

$$P_k(r, s) = P_k^1(r, s) \quad (4)$$

and thus that the distribution of the number of different trapping points which the rodent "reveals" in k successive captures, from among r trapping points situated in its home range, is defined by means of function (3). This was proved by induction in respect of the number k, the following cases being considered in this connection:

(a) $s = 1$,

(b) $1 < s \leqslant \min. (r, k)$,

(c) $\min. (r, k) < s \leqslant \min. (r, k+1)$,

(d) $s = r + 1$, $s > \min. (r, k+1)$,

(e) $s \neq r + 1$, $s > \min. (r, k+1)$.

In proving equation (4) the following lemma was used for natural k, s:

$$\sum_{v=1}^{s} (-1)^v \binom{s}{v} v^k = 0, \qquad \text{for } s > k.$$

Proof of the lemma was made by induction.

The distribution of probability defined by means of function (3) was tabulated for $k = 1, 2, \ldots, 20$ and $r = 1, 2, \ldots 30$ (Tab. I – at the end of the paper).

The average value and variance of the random variable $X_{k,r}$ which was indicated respectively by the symbols $E(X_{k,r})$, $D^2(X_{k,r})$, were calculated introducing random variables:

$Z_i^{(k)} =$ 1 when the rodent was caught in i trap in k trappings, 0 when the opposite event took place,

$Z_{ij}^{(k)} =$ 1 when the rodent was caught in k trappings in traps i or j, 0 when the opposite event took place,

$Z_i^{(k)} Z_j^{(k)} =$ 1 when the rodent was caught in trap i and in trap j in k trappings, 0 when the opposite event took place, $(i, j \in I_G)$.

Further use was made of the relation:

$$X_{k,r} = \sum_{i=1}^{r} Z_i^{(k)},$$

$$X_{k,r}^2 = \sum_{i=1}^{r} \left(Z_i^{(k)} \right)^2 + 2 \sum_{i \neq j} Z_i^{(k)} Z_j^{(k)},$$

$$E\left(Z_i^{(k)} Z_j^{(k)} \right) = 1 - P\left(Z_i^{(k)} = 0 \right) - P\left(Z_j^{(k)} = 0 \right) + P\left(Z_{ij}^{(k)} = 0 \right) \text{ for } i \neq j.$$

Finally it was found that the average and variance of the random variable $X_{k,r}$ are:

$$E\left(X_{k,r} \right) = r\left[1 - \left(\frac{r-1}{r} \right)^k \right], \tag{5}$$

$$D^2 \left(X_{k,r} \right) = r(r-1)\left(\frac{r-2}{r} \right)^k - r\left(\frac{r-1}{r} \right)^k \cdot \left[r\left(\frac{r-1}{r} \right)^k - 1 \right]. \tag{6}$$

Values $E(X_{k,r})$ and $D^2(X_{k,r})$ were tabulated for $k = 2, 3, \ldots, 20$, $r = 2, 3, \ldots, 30$ (Tab. II – at the end of the paper).

The distribution of the random variable $X_{k,r}$ and the characteristics of this distribution (expected value and variance) depend on the unknown value of parameter r. The value of this parameter was estimated on the basis of a sample consisting of rodents which were caught on the experimental area. Rodents which were caught at least k times were chosen from this, group, and their number indicated by N_k ($k = 2,3,4,\ldots$). The number of "revealed" points in k first captures (k determined) was counted for each rodent belonging to the group obtained in this way. An estimate was then made on the basis of this sample of the unknown parameter r by maximum likelihood method. The finding of r is equal to solving the equation:

$$\frac{d \log L}{d r} = \sum_{p=1}^{m} \frac{1}{(r-p+1)} \sum_{s=p}^{m} N_k^{(s)} - \frac{k N_k}{r} = 0, \tag{7}$$

where N_k – number of rodents which were caught at least k times,

$N_k^{(s)}$ – number of rodents, which "revealed" s trapping points in k trappings,

m – maximum value of random variable $X_{k,r}$ observed in the sample.

The solution of the equation (7) is the estimator of maximum likelihood of parameter r. This is indicated by the symbol $\hat{\hat{r}}$. It is however troublesome to obtain this estimator by calculation, and may even prove to be extremely laborious for biologists.

In view of this inconvenience parameter r was estimated by means of the moment method. The value of estimator $\hat{r}$ obtained by this method does not differ in practice from the value of the estimator of maximum reliability $\hat{\hat{r}}$.

In addition to the point estimation of home area size parameter r an interval estimation was made, assuming that the arithmetical average of the number of "revealed" points $\overline{X}_{k,r}$ in k trappings, accepting the values $\bar{x}_k = \frac{1}{N_k} \sum_{i=1}^{N_k} x_k^{(i)}$, $x_k^{(i)}$ – number of "revealed" points in k trappings by i rodent has an asymptotic normal distribution with expected value $E(X_{k,r})$ (5), and standard deviation $\frac{D(X_{k,r})}{\sqrt{N_k}}$ [value $D^2(X_{k,r})$ is given in equation (6)]. For the established numbers k, N_k, α and the natural r we found the upper $G_{k,N_k,\alpha}(r)$ and lower $g_{k,N_k,\alpha}(r)$ limit of the average $\bar{x}_k$ from the equation:

$$G_{k,N_k,\alpha}(r) = E(X_{k,r}) + t_\alpha \frac{D(X_{k,r})}{\sqrt{N_k}},$$

$$g_{k,N_k,\alpha}(r) = E(X_{k,r}) - t_\alpha \frac{D(X_{k,r})}{\sqrt{N_k}}, \qquad (8)$$

t_α occurring in these equations was determined from the condition:

$$\frac{1}{\sqrt{2\pi}} \int_0^{t_\alpha} e^{-\frac{t^2}{2}} dt = \frac{1-\alpha}{2}.$$

In order to illustrate the construction of confidence intervals for parameter r the case was considered in which the number of rodents with at least two captures was 100, and thus $k = 2$, $N_2 = 100$. Assuming $\alpha = 0.05$, $t_{0.05} = 1.96$ obtainted from tables of normal distribution.

Therefore equations (8) take on the form as follows:

$$G_{2,100,0.05}(r) = E(X_{2,r}) + \frac{1.96\, D(X_{2,r})}{10},$$

$$g_{2,100,0.05}(r) = E(X_{2,r}) - \frac{1.96\, D(X_{2,r})}{10}. \qquad (9)$$

Using values $F(X_{2,r})$ and $D(X_{2,r})$ (Tab. II) given in the line of this table at $k = 2$ depending on value r and placing them in equation (9) a diagram was made illustrating the construction of the confidence interval for parameter r (Fig. 1).

It can be seen from this diagram that when the observed average number of points revealed by 100 rodents during two of their trappings is $\bar{x}_2 = 1.80$, then the confidence interval is [4.7].

Fig. 1. Construction of confidence intervals for parameter r

r — number of traps inside home range, $\bar{x}_2$ — mean no. of "revealed" points in 2 captures (observed)

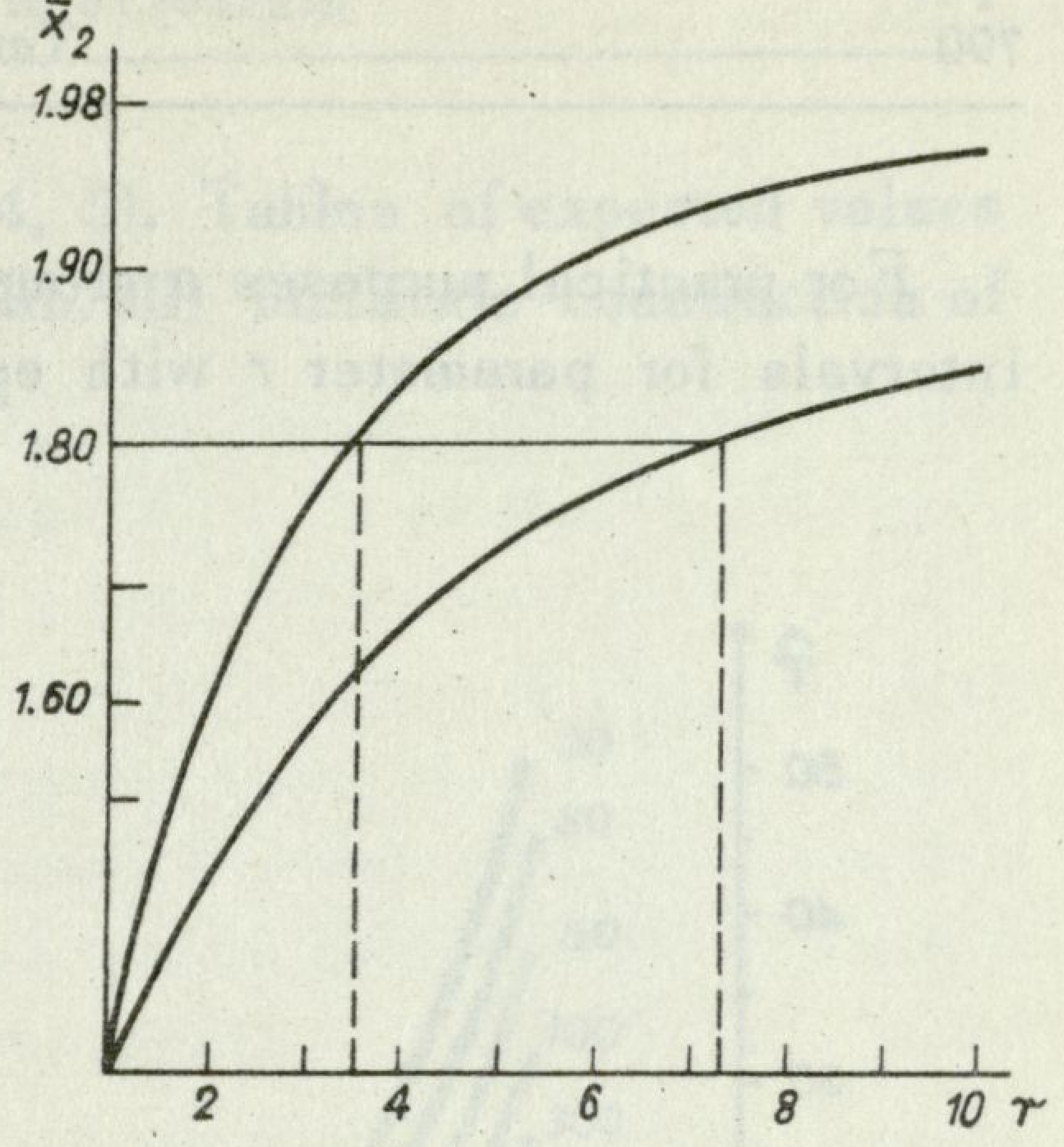
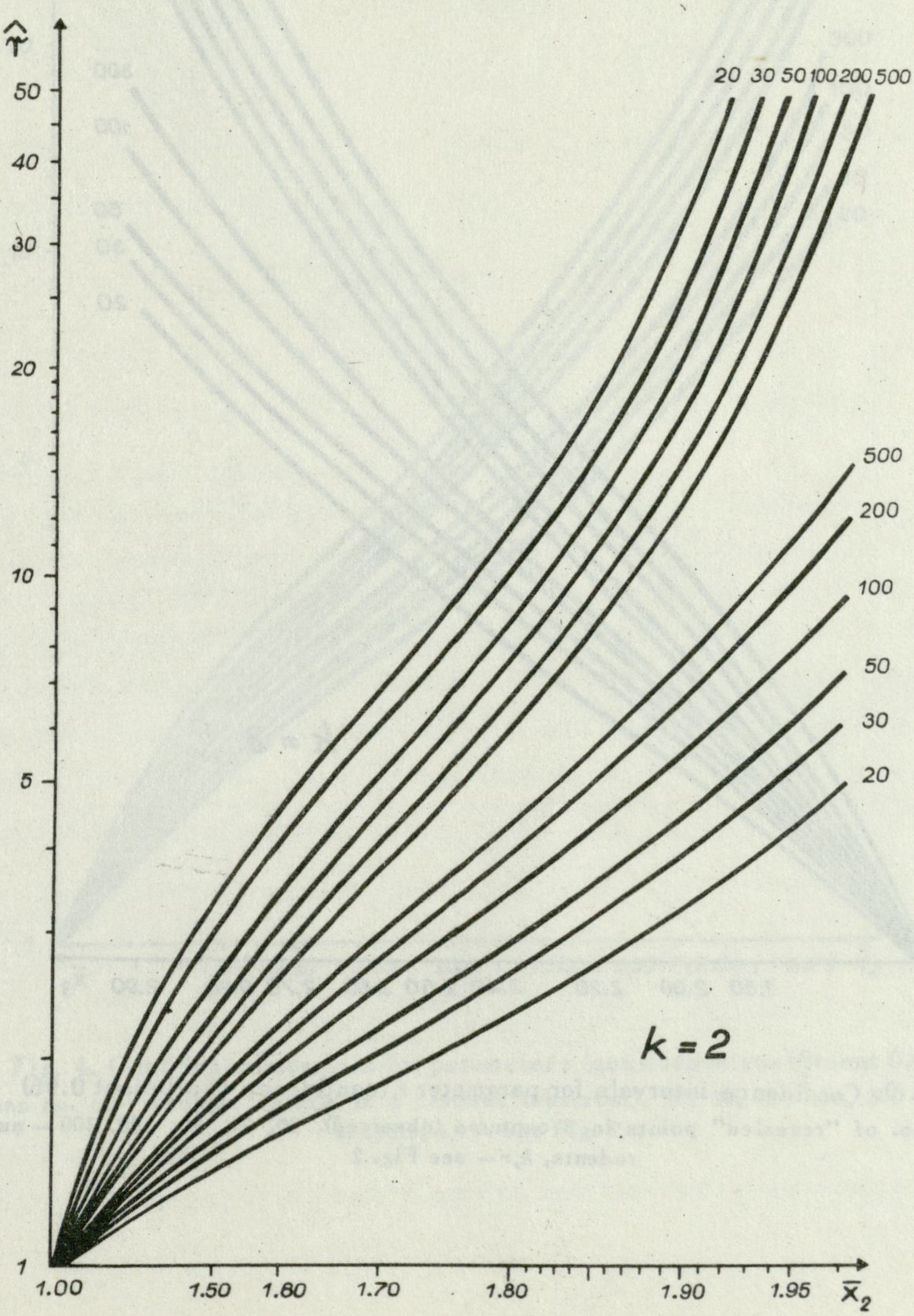


Fig. 2. Confidence intervals for parameter r (confidence coefficient 0.95)

k — number of captures, $\hat{r}$ — estimator for a parameter r [(first sample moment was taken as an estimate of expected value $E(X_{k,r})$]

20, 30, 50, 100, 300 — number of rodents, $\bar{x}_2$ — see Fig. 1



For practical purposes a group of figures was made to determine confidence intervals for parameter r with established values $\alpha = 0.05$, $k = 2,3,4,5$ and

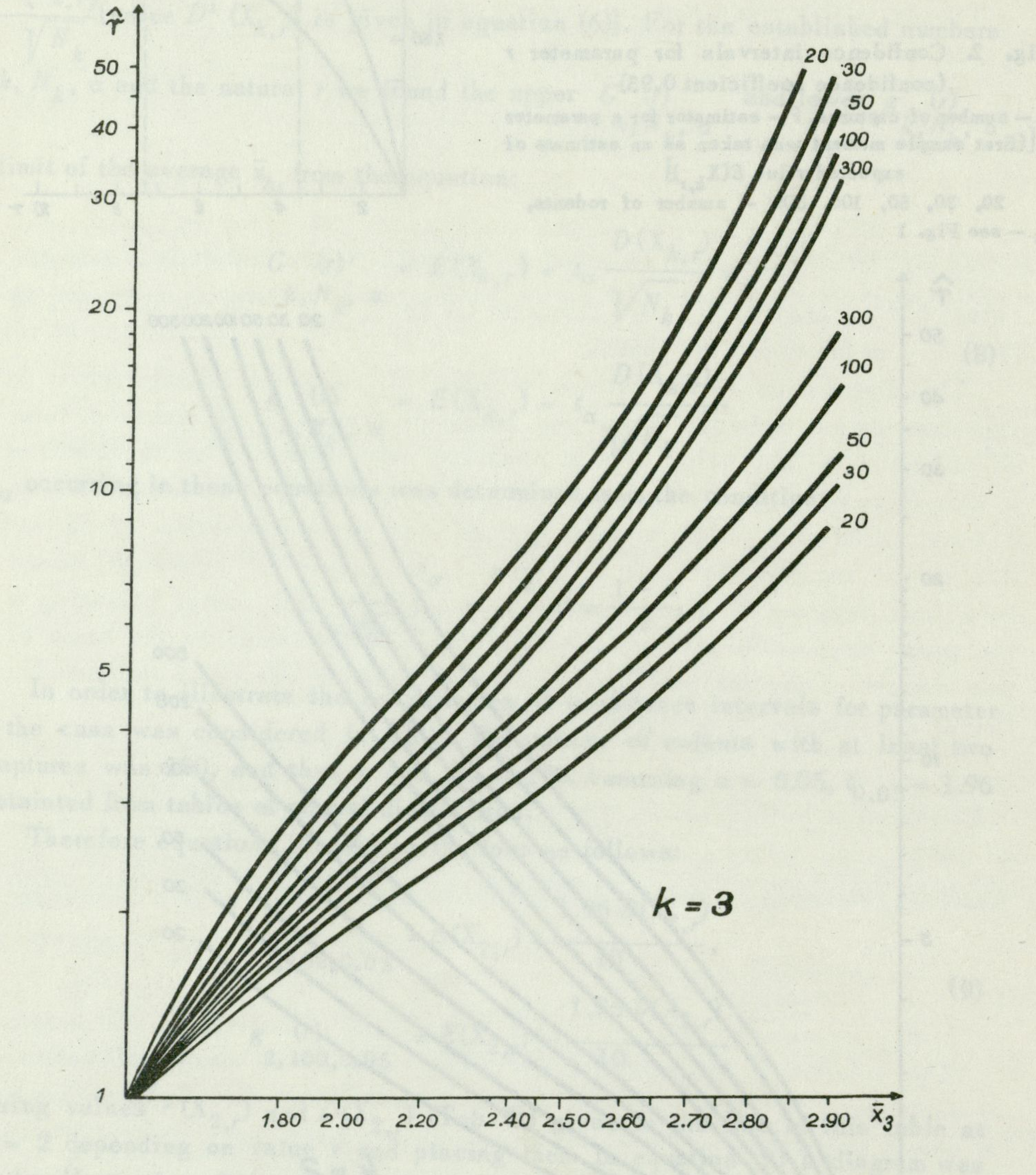


Fig. 3. Confidence intervals for parameter r (confidence coefficient 0.95)
$\bar{x}_3$ – mean no. of "revealed" points in 3 captures (observed), 20, 30, 50, 100, 300 – number of rodents, k, r – see Fig. 2

N_k = 20, 30, 50, 100, 200, 500 (Fig. 2, 3, 4, 5). Tables of expected values and standard deviations of variable $X_{k,r}$ (Tab. II) facilitate construction of confidence intervals for other values k, and N_k.

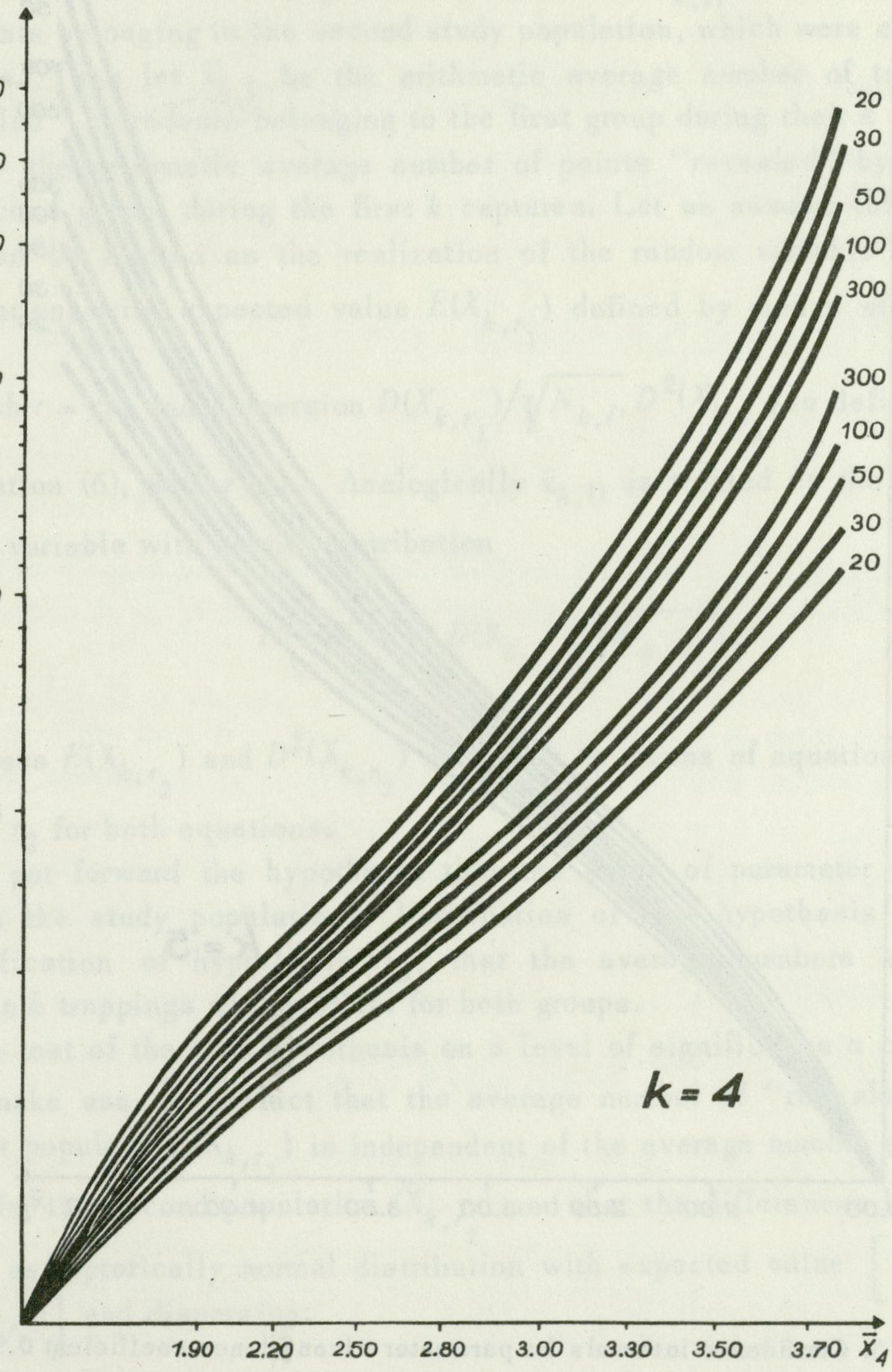


Fig. 4. Confidence intervals for parameter r (confidence coefficient 0.95)
$\bar{x}_4$ – mean no. of "revealed" points in 4 captures (observed), 20, 30, 50, 100, 300 – number of rodents, k, r – see Fig. 2

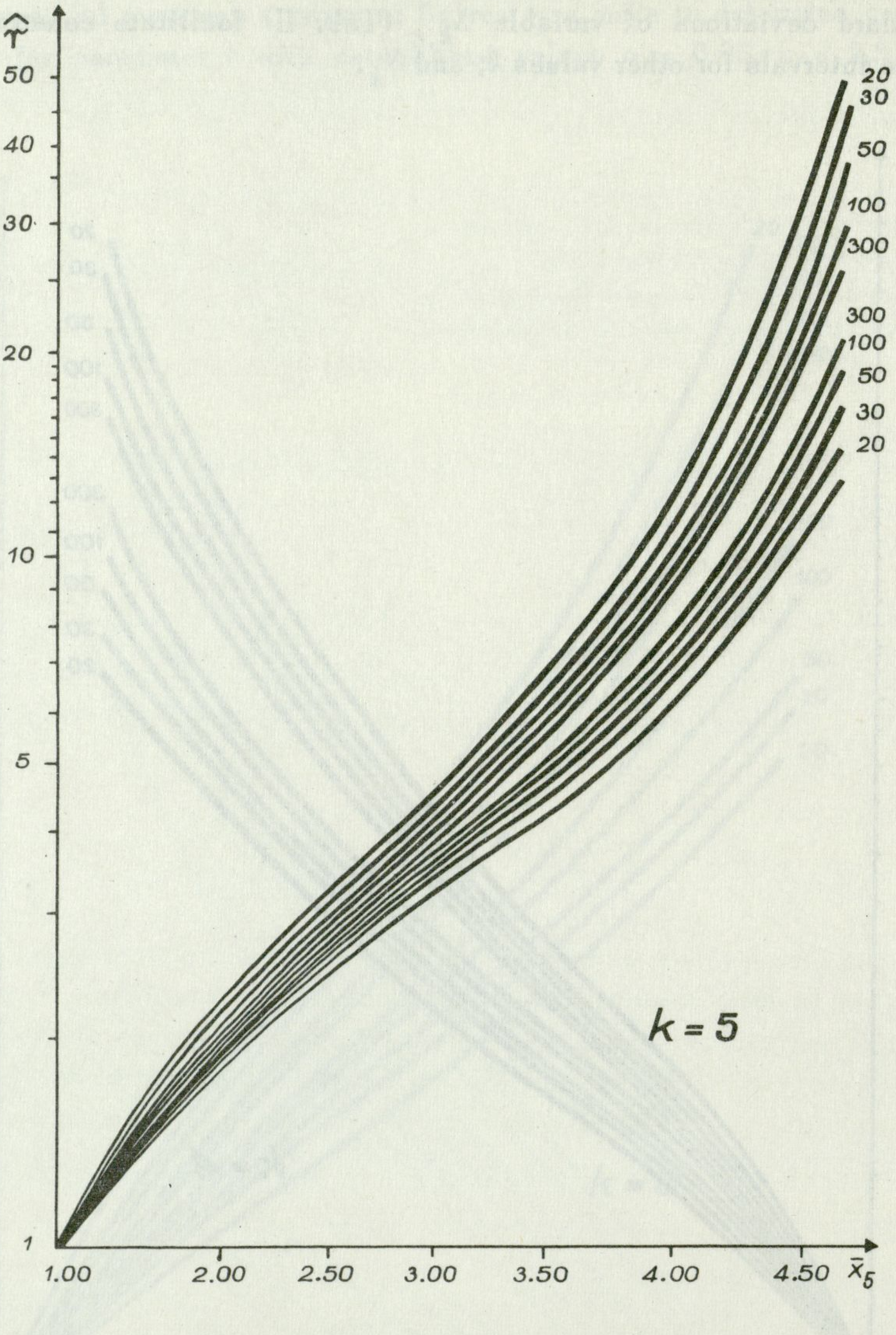


Fig. 5. Confidence intervals for parameter r (confidence coefficient 0.95)
$\bar{x}_5$ – mean no. of "revealed" points in 5 captures observed, 20, 30, 50, 100, 300 – number of rodents, k,r – see Fig. 2

II. TESTING THE HYPOTHESIS OF EQUALITY OF HOME RANGE SIZE OF TWO RODENT POPULATIONS

Let $N_{k,\mathrm{I}}$ be the numbers of the group of rodents belonging to the first study population, which were caught at least k times. $N_{k,\mathrm{II}}$ – numbers of the group of rodents belonging to the second study population, which were caught at least k times. Then let $\bar{x}_{k,\mathrm{I}}$ be the arithmetic average number of trapping points "revealed" by rodents belonging to the first group during their k first captures, $\bar{x}_{k,\mathrm{II}}$ – the arithmetic average number of points "revealed" by rodents from the second group, during the first k captures. Let us assume that the average $\bar{x}_{k,\mathrm{I}}$ can be treated as the realization of the random variable with a normal distribution, with expected value $E(X_{k,r_1})$ defined by means of equation (5),

in which $r = r_1$, and dispersion $D(X_{k,r_1})/\sqrt{N_{k,I}}$, $D^2(X_{k,r_1})$ is defined by means

of equation (6), with $r = r_1$. Analogically $\bar{x}_{k,\mathrm{II}}$ is treated as the realization of

random variable with normal distribution

$$N\left(E(X_{k,r_2}),\ D(X_{k,r_2})/\sqrt{N_{k,\mathrm{II}}}\right)$$

Values $E(X_{k,r_2})$ and $D^2(X_{k,r_2})$ are given by means of aquations (5) and (6), with $r = r_2$ for both equations.

We put forward the hypothesis that the value of parameter r is identical in both the study populations. Verification of this hypothesis is equivalent to verification of hypothesis H_0, that the average numbers of "revealed" points in k trappings are identical for both groups.

The test of the zero hypothesis on a level of significance α can be defined if we make use of the fact that the average number of "revealed" points for the first population $(\bar{X}_{k,r_1})$ is independent of the average number of "revealed" points for the second population $(\bar{X}_{k,r_2})$ and that the differences between these has an asymptotically normal distribution with expected value $\left[E(X_{k,r_1}) - E(X_{k,r_2})\right]$ and dispersion:

$$\sqrt{\frac{D^2(X_{k,r_1})}{N_{k,\mathrm{I}}} + \frac{D^2(X_{k,r_2})}{N_{k,\mathrm{II}}}}$$

If hypothesis H_0 is correct, than the expected value and standard deviation of the random variable $\left(\bar{X}_{k,r_1} - \bar{X}_{k,r_2}\right)$ are respectively 0, $\sqrt{\frac{D^2\left(X_{k,r_1}\right)}{N_{k\mathrm{I}}} + \frac{D^2\left(X_{k,r_2}\right)}{N_{k,\mathrm{II}}}}$.

In practice $N_{k,\mathrm{I}}$ and $N_{k,\mathrm{II}}$ are large, and therefore as estimates of unknown values of variance $D^2\left(X_{k,r_1}\right)$ and $D^2\left(X_{k,r_2}\right)$ we accepted the variances from the sample which were respectively S^2_{k,r_1}, S^2_{k,r_2}.

We indicate by $\left(x^{(1)}_{k,\mathrm{I}}, x^{(2)}_{k,\mathrm{I}}, \ldots, x^{(N_{k,\mathrm{I}})}_{k,\mathrm{I}}\right)$

and by $\left(x^{(1)}_{k,\mathrm{II}}, x^{(2)}_{k,\mathrm{II}}, \ldots, x^{(N_{k,\mathrm{II}})}_{k,\mathrm{II}}\right)$,

the results $N_{k,\mathrm{I}}$ and $N_{k,\mathrm{II}}$ of independent random variables results of number of "revealed" traps by $N_{k,\mathrm{I}}$ from the first group and by $N_{k,\mathrm{II}}$ of rodents from the second group.

We define the critical set by selecting such a number λ, that for the set of forms:

$$W = \left\{\left(x^{(1)}_{k,\mathrm{I}}, x^{(2)}_{k,\mathrm{I}}, \ldots, x^{(N_{k,\mathrm{I}})}_{k,\mathrm{I}}, x^{(1)}_{k,\mathrm{II}}, x^{(2)}_{k,\mathrm{II}}, \ldots, x^{(N_{k,\mathrm{II}})}_{k,\mathrm{II}}\right) \lambda < \left|\bar{x}_{k,\mathrm{I}} - \bar{x}_{k,\mathrm{II}}\right|\right\}.$$

We obtain equation:

$$P\{W|(r_1, r_2) \in H_o\} = \alpha.$$

For $\alpha = 0.01$ we find that:

$$\lambda = 2.56\sqrt{S^2_{k,r_1} / N_{k,\mathrm{I}} + S^2_{k,r_2} / N_{k,\mathrm{II}}}.$$

For $\alpha = 0.05$:

$$\lambda = 1.96\sqrt{S^2_{K,r_1} / N_{k,\mathrm{I}} + S^2_{k,r_2} / N_{k,\mathrm{II}}}.$$

To conclude the theoretical reasonings on estimation of home range size we must add that the statistics $X_{k,r}$ defining the number of different points are statistics sufficient for parameter r, and therefore contains all the information to be found in the sample. The sample obtained by k independent captures provides us with information such as:

(1) how many times a rodent was caught in the given trap,

(2) in which trappings was the given trap "revealed",

(3) how many traps were there which the rodent "revealed", a given number of times,

(4) how many different traps did the rodent "reveal"?

The last information is sufficient for estimating home range size, while the information at (1), (2), and (3) does not permit of a better estimate of parameter r.

Proof of sufficiency can be made on the basis of the criterion of factorization: probability of distribution in space of samples can be presented in the form of the product:

$$\binom{r}{s} r^{-k} = \left[\binom{r}{s} r^{-k} (-1)^s \sum_{v=1}^{s} (-1)^v \binom{s}{v} v^k\right] \cdot \left[(-1)^s \sum_{v=1}^{s} (-1)^v \binom{s}{v} v^k\right]^{-1} .$$

The first of the factors contained in the square brackets depends on parameter r and on statistics $X_{k,r}$, the second factor contained in the second square bracket does not depend on parameter r.

Thus estimator $X_{k,r}$ contains all the information to be found in a sample for assessing home range size of parameter r.

III. VERIFICATION OF THE MODEL AND NUMERICAL ILLUSTRATION

The method proposed for estimating home range size was applied to three species od small forest rodents, *Apodemus flavicollis* (Melchior), *A. agrarius* (Pall.) and *Clethrionomys glareolus* (Schreb.). Estimation were made separately for males and females. The information provided by the above elaboration was obtained by carrying out trapping of rodents in two forest areas: the first of these, measuring 2.835 ha, was covered by a grid of 150 traps, the lenght of the side of each square making up the grid being 15 m. Traps were placed in ten rows. Trapping was carried out once a week, and traps inspected twice daily. The experiment lasted 6 years (1955–1961). The second area measuring 4.095 ha, was covered by a grid of 210 traps arranged in 15 rows. The squares

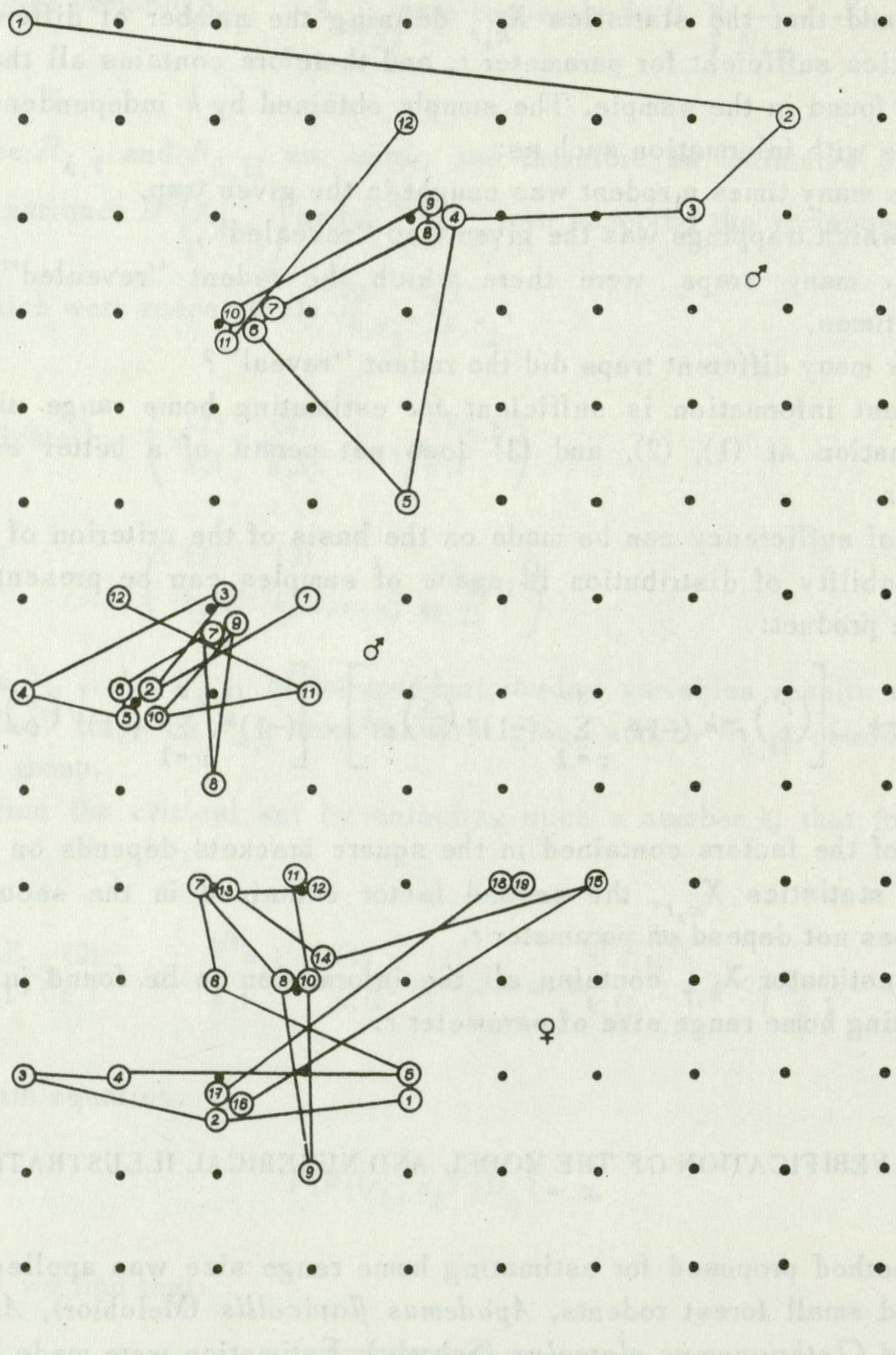


Fig. 6. Diagram showing movements of mice

● – trap, ①, ②, ..., ⑲ – successive captures

forming the grid were the same size as in the first area. Trapping lasted 43 days (Sept. 3rd* – Oct. 15th) and traps were inspected once daily. Home range size was estimated on the basis of data from the second area only for the species *Apodemus agrarius*, owing to the very small numbers in which the other species of rodents occurred.

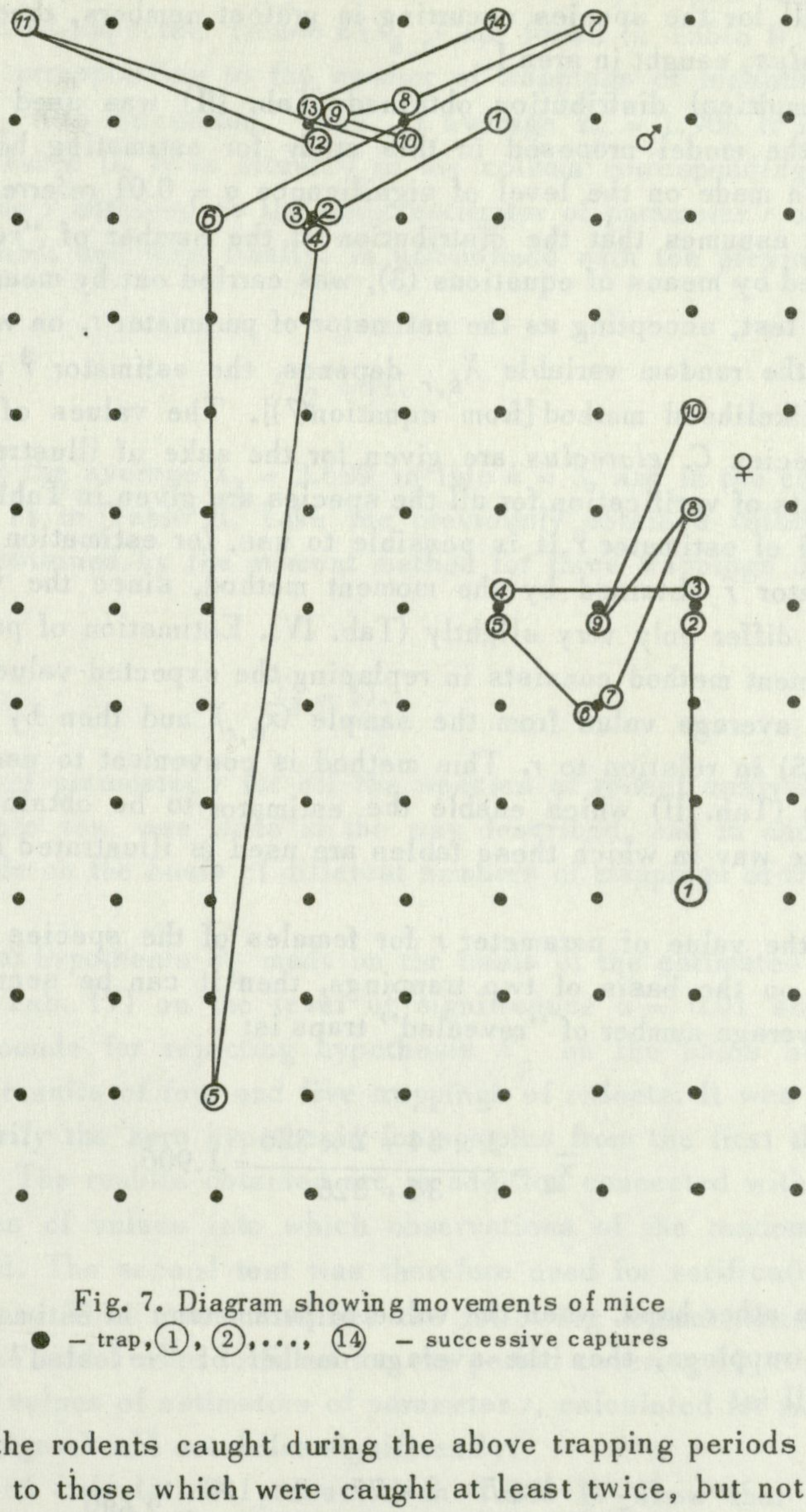


Fig. 7. Diagram showing movements of mice
● – trap, ①, ②, ..., ⑭ – successive captures

Among all the rodents caught during the above trapping periods consideration was given to those which were caught at least twice, but not more than 10 times. A picture of successive trappings of selected rodents is given in Figures 6, 7 for purposes of illustration.

The number of points which a rodent "revealed" in successive trappings were counted for each animal. Thus for a determined number of captures k we obtained the empirical distribution of the number of trapping points which the rodents "revealed" in k successive trappings. This distribution is presented in Table III for the species occurring in gratest numbers, that is, *Clethrionomys glareolus*, caught in area I.

The empirical distribution obtained (Tab. III) was used as a basis for verifying the model proposed in this study for estimating home range size. Verification made on the level of significance $\alpha = 0.01$ referred to hypothesis H_0, which assumes that the distribution of the number of "revealed" points is described by means of equations (3), was carried out by means of Pearson's chi-square test, accepting as the estimator of parameter r, on which the distribution of the random variable $X_{k,r}$ depends, the estimator $\hat{\hat{r}}$ obtained by the maximum likelihood method [from equation(7)]. The values of this parameter for the species *C. glareolus* are given for the sake of illustration (Tab. IV), while results of verification for all the species are given in Table III.

Instead of estimator $\hat{\hat{r}}$ it is possible to use, for estimation of parameter r, the estimator $\hat{r}$ obtained by the moment method, since the values of these estimators differ only very slightly (Tab. IV). Estimation of parameter r made by the moment method consists in replacing the expected value $E(X_{k,r})$ by the arithmetic average value from the sample $(\bar{x}_{k,r})$ and then by the solution of equation (5) in relation to r. This method is convenient to use on account of the tables (Tab. II) which enable the estimator to be obtainted quickly and easily. The way in which these tables are used is illustrated by the following example.

When the value of parameter r for females of the species *C. glareolus* is estimated on the basis of two trappings, then it can be seen from Table III that the average number of "revealed" traps is:

$$\bar{x}_2 = \frac{1 \times 34 + 2 \times 326}{34 + 326} = 1.906.$$

On the other hand, when the value of parameter r is estimated on the basis of three trappings, then the average number of "revealed" traps from data in Table III is:

$$\bar{x}_3 = \frac{1 \times 5 + 2 \times 77 + 3 \times 198}{5 + 77 + 198} = 2.689.$$

Average values from the sample were calculated in an analogical way on the basis of the greater number of trappings and results of calculations for the three species of rodent studied, divided into the two sexes, given in Table IV.

The arithmetic average values $x_{k,r}$ obtained in this way, which are estimators from the sample of expected values $E(X_{k,r})$ are found in Table II in the line with a number corresponding to the number of trappings of rodents for which the average $x_{k,r}$ was calculated. Thus, if average $x_2 = 1.906$ it is found in line $k = 2$, in Table II. It is situated in the column corresponding to $r = 11$. We take the value $\hat{r}$ obtained as the point estimator of parameter r obtained by the moment method, and thus finally, in accordance with the previous indications:

$$\hat{r}_2 = 11.$$

Similarly we find the average $\bar{x}_3 = 2.689$ in line $k = 3$, and in the column with the number $r = 11$ in Table II. Like the previously obtained value it is the point estimator obtained by the moment method for three trappings of rodents, and is thus:

$$\hat{r}_3 = 11.$$

An estimate of parameter r for all the species of rodent analyzed in this study, divided into sex, was made in the way described, and in addition this estimate was made on the basis of different numbers of trappings of the rodents (Tab. IV).

Verification of hypothesis H_0 made on the basis of the estimates obtained of parameter r (Tab. IV) on the level of significance $\alpha = 0.01$ showed that there are no grounds for rejecting hypothesis H_0 on the basis of samples representing the results of four and five trappings of rodents. It was of course impossible to verify the zero hypothesis for samples from the first three trappings of rodents. The results obtained are in addition connected with arbitrary choice of classes of values into which observations of the random variable $X_{k,r}$ were divided. The second test was therefore used for verification of the model assumptions. This test introduces the following argumentation: if the assumptions of the model were fulfilled for the period covering 10 trappings of rodents, then the values of estimators of parameter r, calculated for two, three, four... ten trappings should not differ significantly.

The results of calculations presented in Table IV show that a certain bias is observable in estimation of value of parameter r for males of the species *C. glareolus* during the period covering the last three trappings, but no distinct tendencies are observed in the remaining cases.

In order to make a more detailed analysis of the phenomenon observed parameter r was estimated on the basis of samples representing the results

Distribution of number of "revealed" points and results of testing this distribution of *C. glareolus*

Tab. III

Sex	♀♀																	
k / s	2		3		4		5		6		7		8		9		10	
	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$
1	34	33	5	3	2		1		1									
2	326	327	77	76	20	15	5	3	2		3							
3			198	201	88	98	36	34	14	10	6	2	3		2			
4					117	114	81	96	48	52	23	19	16	6	7	2	8	1
5							67	57	58	72	44	52	25	28	22	15	10	8
6									35	24	35	47	25	43	18	34	19	25
7											10	11	26	23	23	30	17	33
8													8	3	16	9	21	17
9															4	1	8	3
10																	4	
N_k	360		280		227		190		158		131		103		92		87	
χ^2 emp.					4.31		4.774		12.139		17.400		12.93		30.691		26.65	
$\chi^2_{0.01}$					6.635		6.636		9.210		9.210		6.635		9.210		9.210	

Sex	♂♂																	
k	2		3		4		5		6		7		8		9		10	
s	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$	$N_{k,s}$	$N'_{k,s}$
1	44	44	4	3														
2	437	437	85	84	20	15	4	2	2		1							
3			277	279	100	113	31	30	14	6	6	1	1		1		1	
4					159	151	102	109	36	45	25	16	12	4	4	1	2	
5							91	87	83	93	38	56	27	24	22	9	13	3
6									58	49	60	67	35	54	18	32	13	15
7											33	23	40	46	31	45	18	34
8													24	11	27	24	32	35
9															13	5	15	15
10																	10	2
N_k	481		366		279		228		193		163		139		116		104	
χ^2emp.					3.587		2.569		2.740		5.190		27.96		43.553		18.273	
$\chi^2$0.01					6.635		6.635		6.635		9.210		9.210		9.210		9.210	

$N_{k,s}$ – empirical no. of rodents which "revealed" s points in k captures,
$N'_{k,s}$ – theoretical no. of rodents which "revealed" s points in k captures,
N_k – no. of rodents for which there are at least k captures,
s,k – see Tab. I.

Results of analysis of

Area	I										
Species	*C. glareolus*								*A. agra*		
Sex	♀♀				♂♂				♀♀		
k	N_k	$\bar{x}_k$	$\hat{r}_k$	$\hat{\hat{r}}_k$	N_k	$\bar{x}_k$	$\hat{r}_k$	$\hat{\hat{r}}_k$	N_k	$\bar{x}_k$	$\hat{r}_k$
2	360	1.906	11	11	481	1.909	11	11	331	1.879	8
3	280	2.689	10	10	366	2.746	12	12	229	2.642	8
4	227	3.410	10	10	279	3.498	11	11	172	3.360	9
5	190	4.095	10	10	228	4.228	12	12	144	4.007	9
6	158	4.677	10	10	193	4.938	13	13	120	4.625	9
7	131	5.237	10	11	163	5.528	12	13	102	5.157	9
8	103	5.777	11	11	139	6.245	14	14	79	5.709	10
9	92	6.304	11	11	116	6.784	14	14	71	6.296	10
10	87	6.839	11	12	104	7.413	15	15	67	6.523	10

$\bar{x}_k$ – mean no. of "revealed" points in k captures (observed)

$\hat{r}_k$ – estimator for a parameter r (first sample moment was taken as an estimate of expected

$\hat{\hat{r}}_k$ – maximum likelihood estimator for parameter r,

k, r – see Tab. I.

N_k – see Tab. III.

Results of estimation of parameter r

		♀♀									
		1		2		3		4		5	
	No. of captures	$\bar{x}_2$	$\hat{r}_2$	$\bar{x}_2$	$\hat{r}_2$	$\bar{x}_2$	$\hat{r}_2$	$\bar{x}_2$	$\hat{r}_2$	$\bar{x}_2$	$\hat{r}_2$
♂♂	1			1.906	11	1.905	10	1.909	11	1.901	10
	2	1.909	11			1.911	11	1.905	10	1.913	11
	3	1.912	11	1.908	11			1.915	12	1.910	11
	4	1.923	13	1.917	12	1.909	11			1.909	11
	5	1.917	12	1.917	12	1.917	12	1.909	11		
	6	1.928	14	1.909	11	1.914	12	1.916	12	1.909	11
	7	1.929	11	1.924	13	1.924	13	1.917	12	1.913	11
	8	1.933	15	1.923	13	1.918	12	1.903	10	1.901	10
	9	1.934	15	1.915	12	1.925	13	1.908	11	1.917	12
	10	1.937	16	1.928	14	1.928	14	1.923	13	1.909	11

r – see Tab. I,

$\hat{r}_2$, $\bar{x}_2$ – see Tab. IV.

estimation of parameter r

Tab. IV

									II		
rius			*A. flavicollis*						*A. agrarius*		
♂♂			♀♀			♂♂			♀♀ + ♂♂		
N_k	$\overline{x}_k$	$\hat{r}_k$	N_k	$\overline{x}_k$	$\hat{r}_k$	N_k	$\overline{x}_k$	$\hat{r}_k$	N_k	$\overline{x}_k$	$\hat{r}_k$
457	1.920	13	190	1.937	16	238	1.954	19	111	1.865	7
310	2.748	11	137	2.825	16	154	2.818	17	81	2.543	7
227	3.471	10	92	3.554	13	106	3.604	15	68	3.236	7
181	4.122	10	71	4.366	14	82	4.463	15	64	3.688	7
152	4.855	11	51	4.980	14	62	5.145	16	58	4.100	7
118	5.492	12	39	5.769	15	46	5.870	17	43	4.731	8
101	6.158	13				36	5.639	18	37	4.993	7
83	6.711	11							37	5.620	8
75	7.080	11							29	6.210	9

value $E(X_{k,r})$,

of *C. glareolus* (for pair captures)

Tab. V

6		7		8		9		10	
$\overline{x}_2$	$\hat{r}_2$	$\overline{x}_2$	$\hat{r}_2$	$\overline{x}_2$	$\hat{r}_2$	$\overline{x}_2$	$\hat{r}_2$	$\overline{x}_2$	$\hat{r}_2$
1.917	12	1.910	11	1.917	12	1.921	13	1.924	13
1.908	10	1.918	12	1.924	13	1.917	12	1.922	13
1.912	11	1.901	10	1.916	12	1.909	11	1.901	10
1.910	11	1.902	10	1.911	11	1.900	10	1.901	10
1.917	12	1.908	11	1.918	12	1.901	10	1.908	11
		1.901	10	1.909	11	1.908	11	1.903	10
1.908	11			1.923	13	1.917	12	1.915	12
1.902	10	1.917	12			1.901	10	1.909	11
1.910	11	1.917	12	1.901	10			1.918	12
1.916	12	1.910	11	1.917	12	1.910	11		

♀♀

♂♂

of each two trappings of rodents among ten consecutive trappings (Tab. V). It can be seen from this table that for ♂♂ *C. glareolus* the value of the estimator increases with increaing distance from the diagonal of Table V. This regularity

Standard deviations of variable ($\overline{X}_{k,r_1} - \overline{X}_{k,r_2}$)

Tab. VI

Species	Sex	*C. glareolus* ♀♀	*C. glareolus* ♂♂	*A. agrarius* ♀♀	*A. agrarius* ♂♂	*A. flavicollis* ♀♀
C. glareolus	♀♀					
	♂♂	0.0777				
A. agrarius	♀♀	0.08617	0.07954			
	♂♂	0.0881	0.08112	0.0898		
A. flavicollis	♀♀	0.1065	0.1003	0.1074	0.1086	
	♂♂	0.0965	0.0901	0.0980	0.0993	0.1157

$\overline{X}_{k,r_1}$ – mean no. of "revealed" points in k captures (for first group),
$\overline{X}_{k,r_2}$ – mean no. of "revealed" points in k captures (for second group).

occurs for the first two columns (Tab. V). If we combine the results in this table with the results obtained from Table IV it may be assumed that the area covering the first few trappings of a rodent (approximately 5) is partly deserted by rodents, the size of the home range over which rodents move during the period covering the following 5 trappings not differing from the area over which they moved during the initial period.

The values of differences between each two values of estimator $\hat{r}$ (from Tab. V) proved, however, statistically non-significant on the level of significance of $\alpha = 0.05$. The values of the differences were verified by means of the test described in this study.

The results obtained by verification of the model justify accepting the value of the estimator of parameter r, obtained by the moment method ($\hat{r}$) for the first five trappings of a rodent, as the point estimator of home range size. Estimator $\hat{r}$ attains maximum value for species *A. flavicollis*, lesser for *C. glareolus* and least for *A. agrarius*. The value of the estimator for males is greater than for females in all the species of rodent analyzed. Verification

Results of testing hypothesis that the two parameters r are the same ($\alpha = 0.05$)

Tab. VII

Species	Sex	*C. glareolus* ♀♀ $\bar{x}_{5,I}-\bar{x}_{5,II}$	*C. glareolus* ♀♀ λ	*C. glareolus* ♂♂ $\bar{x}_{5,I}-\bar{x}_{5,II}$	*C. glareolus* ♂♂ λ	*A. agrarius* ♀♀ $\bar{x}_{5,I}-\bar{x}_{5,II}$	*A. agrarius* ♀♀ λ	*A. agrarius* ♂♂ $\bar{x}_{5,I}-\bar{x}_{5,II}$	*A. agrarius* ♂♂ λ	*A. flavicollis* ♀♀ $\bar{x}_{5,I}-\bar{x}_{5,II}$	*A. flavicollis* ♀♀ λ
C. glareolus	♀♀										
	♂♂	0.1333	0.1523								
A. agrarius	♀♀	0.0878	0.1689	0.2211	0.1558						
	♂♂	0.0269	0.1727	0.1065	0.1589	0.1146	0.1760				
A. flavicollis	♀♀	0.2715	0.2087	0.1381	0.1966	0.3593	0.2105	0.2446	0.2128		
	♂♂	0.3687	0.1891	0.3600	0.1766	0.4565	0.1921	0.3419	0.1946	0.1648	0.2267

α – significance level, λ – critical number,

$\bar{x}_{5,I}$ – mean no. of "revealed" points observed in 5 captures for first group,

$\bar{x}_{5,II}$ – mean no. of "revealed" points observed in 5 captures for second group,

r – see Tab. I.

of differences between the values obtained for estimator r made by means of the test given shows, however, that the home range of the species *A. flavicollis* is significantly different from the home range of the remaining species, but only within a given sex. When estimators for *C. glareolus* and *A. agrarius* were compared significant differences were observed only between males of the first and females of the second species, whereas differences between males and females of each species were considered non-significant. The results of the above verification are given in Table VI and VII. In addition to point estimations confidence intervals are given for parameter r (Tab. VIII).

Confidence limits of parameter r (significance level 0.05)

Tab. VIII

Area	I						II
Species	*C. glareolus*		*A. agrarius*		*A. flavicollis*		*A. agrarius*
Sex / k	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀ + ♂♂
2	8–14	8–14	7–10	9–15	10–20	12–25	5–8
3	7–11	10–13	7–10	10–14	12–20	12–22	5–8
4	9–11	10–12	8–10	9–12	10–16	12–22	6–9
5	9–10	11–13	9–10	10–11	12–19	14–22	6–9

r, k – see Tab. I.

In the above discussion home range size is defined by means of the number of traps situated within the home range from among all the traps set on the experimental area.

If we assume that the range of "action" of each trap is 225 m², and thus covers the area of a square in the middle of which there is the trap counted as being in the home range, then we can accept the following value as the area of the home range:

$$P = r \cdot 225 \text{ m}^2.$$

As an example the size of the home range of females of the species *C. glareolus* is then:

$$P = 2250 \text{ m}^2.$$

Probability distribution of random variable $X_{k, r}$

Tab. I

k	s \ r	2	3	4	5	6
2	1	0.5000	0.3333	0.2500	0.2000	0.1667
	2	0.5000	0.6667	0.7500	0.8000	0.8333
3	1	0.2500	0.1111	0.0625	0.0400	0.0278
	2	0.7500	0.6667	0.5625	0.4800	0.4167
	3		0.2222	0.3750	0.4800	0.5556
4	1	0.1250	0.0370	0.0156	0.0080	0.0046
	2	0.8750	0.5185	0.3281	0.2240	0.1620
	3		0.4444	0.5625	0.5760	0.5556
	4			0.0938	0.1920	0.2778
5	1	0.0625	0.0123	0.0039	0.0016	0.0008
	2	0.9375	0.3704	0.1758	0.0960	0.0579
	3		0.6173	0.5859	0.4800	0.3858
	4			0.2344	0.3840	0.4630
	5				0.0384	0.0926
6	1	0.0312	0.0041	0.0010	0.0003	0.0001
	2	0.9687	0.2551	0.0908	0.0397	0.0199
	3		0.7407	0.5273	0.3456	0.2315
	4			0.3809	0.4992	0.5015
	5				0.1152	0.2315
	6					0.0154
7	1	0.0156	0.0014	0.0002	0.0001	0.0000
	2	0.9844	0.1728	0.0461	0.0161	0.0068
	3		0.8258	0.4409	0.2312	0.1290
	4			0.5127	0.5376	0.4501
	5				0.2150	0.3601
	6					0.0540
8	1	0.0078	0.0005	0.0001	0.0000	0.0000
	2	0.9922	0.1161	0.0233	0.0065	0.0023
	3		0.8834	0.3538	0.1484	0.0690
	4			0.6229	0.5225	0.3646
	5				0.3226	0.4501
	6					0.1140
9	1	0.0039	0.0002	0.0000	0.0000	0.0000
	2	0.9961	0.0777	0.0117	0.0026	0.0008
	3		0.9221	0.2769	0.0929	0.0360

Tab. I (contin.)

k \ s r		2	3	4	5	6
9	4			0.7114	0.4774	0.2776
	5				0.4271	0.4966
	6					0.1890
10	1	0.0020	0.0001	0.0000	0.0000	0.0000
	2	0.9980	0.0519	0.0058	0.0010	0.0003
	3		0.9480	0.2135	0.0573	0.0185
	4			0.7806	0.4191	0.2031
	5				0.5225	0.5064
	6					0.2718
11	1	0.0010	0.0000	0.0000	0.0000	0.0000
	2	0.9990	0.0346	0.0029	0.0004	0.0001
	3		0.9653	0.1631	0.0350	0.0094
	4			0.8340	0.3582	0.1446
	5				0.6064	0.4897
	6					0.3562
12	1	0.0005	0.0000	0.0000	0.0000	0.0000
	2	0.9995	0.0231	0.0015	0.0002	0.0000
	3		0.9769	0.1238	0.0213	0.0048
	4			0.8748	0.3006	0.1011
	5				0.6780	0.4563
	6					0.4378
13	1	0.0002	0.0000	0.0000	0.0000	0.0000
	2	0.9998	0.0154	0.0007	0.0001	0.0000
	3		0.9846	0.0936	0.0129	0.0024
	4			0.9057	0.2490	0.0698
	5				0.7381	0.4139
	6					0.5139
14	1	0.0001	0.0000	0.0000	0.0000	0.0000
	2	0.9999	0.0103	0.0004	0.0000	0.0000
	3		0.9897	0.0705	0.0078	0.0012
	4			0.9291	0.2043	0.0477
	5				0.7879	0.3682
	6					0.5828
15	1	0.0001	0.0000	0.0000	0.0000	0.0000
	2	0.9999	0.0069	0.0002	0.0000	0.0000
	3		0.9931	0.0531	0.0047	0.0006
	4			0.9467	0.1666	0.0324
	5				0.8288	0.3227
	6					0.6442

Tab. I (contin.)

k	s \ r	2	3	4	5	6
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	1.0000	0.0046	0.0001	0.0000	0.0000
16	3		0.9954	0.0399	0.0028	0.0003
	4			0.9600	0.1351	0.0219
	5				0.8621	0.2798
	6					0.6980
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	1.0000	0.0030	0.0000	0.0000	0.0000
17	3		0.9970	0.0300	0.0017	0.0002
	4			0.9700	0.1092	0.0148
	5				0.8891	0.2404
	6					0.7446
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	1.0000	0.0020	0.0000	0.0000	0.0000
18	3		0.9980	0.0225	0.0010	0.0001
	4			0.9775	0.0880	0.0099
	5				0.9109	0.2053
	6					0.7847
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	1.0000	0.0014	0.0000	0.0000	0.0000
19	3		0.9986	0.0169	0.0006	0.0000
	4			0.9831	0.0708	0.0067
	5				0.9286	0.1744
	6					0.8189
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	1.0000	0.0009	0.0000	0.0000	0.0000
20	3		0.9991	0.0127	0.0004	0.0000
	4			0.9873	0.0569	0.0045
	5				0.9427	0.1475
	6					0.8480
k	**s \ r**	**7**	**8**	**9**	**10**	**11**
2	1	0.1429	0.1250	0.1111	0.1000	0.0909
	2	0.8571	0.8750	0.8889	0.9000	0.9091

Tab. I (contin.)

k	r / s	7	8	9	10	11
	1	0.0204	0.0156	0.0123	0.0100	0.0083
3	2	0.3673	0.3281	0.2963	0.2700	0.2479
	3	0.6122	0.6563	0.6914	0.7200	0.7438
	1	0.0029	0.0020	0.0014	0.0010	0.0008
4	2	0.1224	0.0957	0.0768	0.0630	0.0526
	3	0.5248	0.4922	0.4609	0.4320	0.4057
	4	0.3499	0.4102	0.4609	0.5040	0.5409
	1	0.0004	0.0002	0.0002	0.0001	0.0001
	2	0.0375	0.0256	0.0183	0.0135	0.0102
5	3	0.3124	0.2563	0.2134	0.1800	0.1537
	4	0.4998	0.5127	0.5121	0.5040	0.4918
	5	0.1499	0.2051	0.2561	0.3024	0.3442
	1	0.0001	0.0000	0.0000	0.0000	0.0000
	2	0.0111	0.0066	0.0042	0.0028	0.0019
	3	0.1606	0.1154	0.0854	0.0648	0.0503
	4	0.4641	0.4166	0.3699	0.3276	0.2906
	5	0.3213	0.3845	0.4268	0.4536	0.4694
	6	0.0428	0.0769	0.1138	0.1512	0.1878
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0032	0.0017	0.0009	0.0006	0.0004
	3	0.0768	0.0482	0.0317	0.0217	0.0153
7	4	0.3570	0.2804	0.2213	0.1764	0.1422
	5	0.4284	0.4486	0.4426	0.4234	0.3983
	6	0.1285	0.2019	0.2655	0.3175	0.3585
	7	0.0061	0.0192	0.0379	0.0605	0.0853
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0009	0.0004	0.0002	0.0001	0.0001
	3	0.0352	0.0193	0.0113	0.0070	0.0045
8	4	0.2479	0.1703	0.1195	0.0857	0.0628
	5	0.4590	0.4206	0.3688	0.3175	0.2716
	6	0.2326	0.3196	0.3737	0.4022	0.4128
	7	0.0245	0.0673	0.1180	0.1693	0.2173
	8		0.0024	0.0084	0.0181	0.0310
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0003	0.0001	0.0000	0.0000	0.0000
	3	0.0157	0.0076	0.0039	0.0022	0.0013
	4	0.1617	0.0973	0.0606	0.0392	0.0261
9	5	0.4341	0.3480	0.2713	0.2102	0.1634

Tab. I (contin.)

k	r / s	7	8	9	10	11
9	6	0.3305	0.3974	0.4131	0.4001	0.3733
	7	0.0577	0.1388	0.2164	0.2794	0.3259
	8		0.0108	0.0337	0.0653	0.1016
	9			0.0009	0.0036	0.0085
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0001	0.0000	0.0000	0.0000	0.0000
	3	0.0069	0.0029	0.0013	0.0007	0.0004
	4	0.1014	0.0534	0.0296	0.0172	0.0104
10	5	0.3794	0.2661	0.1844	0.1286	0.0909
	6	0.4073	0.4286	0.3959	0.3451	0.2927
	7	0.1049	0.2208	0.3060	0.3556	0.3770
	8		0.0282	0.0781	0.1361	0.1924
	9			0.0047	0.0163	0.0346
	10				0.0004	0.0015
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0030	0.0011	0.0005	0.0002	0.0001
	4	0.0619	0.0285	0.0140	0.0078	0.0040
11	5	0.3144	0.1930	0.1189	0.0746	0.0479
	6	0.4575	0.4212	0.3459	0.2714	0.2093
	7	0.1631	0.3003	0.3700	0.3870	0.3730
	8		0.0558	0.1374	0.2156	0.2770
	9			0.0134	0.0419	0.0808
	10				0.0020	0.0077
	11					0.0001
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0013	0.0004	0.0002	0.0001	0.0000
	4	0.0371	0.0149	0.0065	0.0031	0.0015
	5	0.2511	0.1349	0.0738	0.0417	0.0244
12	6	0.4820	0.3883	0.2834	0.2001	0.1403
	7	0.2285	0.3681	0.4031	0.3794	0.3325
	8		0.0933	0.2043	0.2885	0.3371
	9			0.0286	0.0808	0.1417
	10				0.0062	0.0217
	11					0.0008
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0006	0.0002	0.0001	0.0000	0.0000
13	4	0.0220	0.0077	0.0030	0.0013	0.0006

Tab. I (contin.)

k \ r s		7	8	9	10	11
13	5	0.1953	0.0918	0.0447	0.0227	0.0121
	6	0.4849	0.3418	0.2218	0.1409	0.0898
	7	0.2973	0.4192	0.4080	0.3457	0.2754
	8		0.1393	0.2712	0.3447	0.3661
	9			0.0513	0.1305	0.2078
	10				0.0143	0.0455
	11					0.0028
14	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0002	0.0001	0.0000	0.0000	0.0000
	4	0.0129	0.0040	0.0014	0.0005	0.0002
	5	0.1489	0.0612	0.0265	0.0121	0.0059
	6	0.4714	0.2908	0.1677	0.0959	0.0556
	7	0.3666	0.4522	0.3912	0.2983	0.2160
	8		0.1917	0.3317	0.3794	0.3664
	9			0.0815	0.1863	0.2699
	10				0.0273	0.0791
	11					0.0069
15	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0001	0.0000	0.0000	0.0000	0.0000
	4	0.0075	0.0020	0.0006	0.0002	0.0001
	5	0.1119	0.0403	0.0155	0.0064	0.0028
	6	0.4466	0.2410	0.1236	0.0636	0.0335
	7	0.4339	0.4684	0.3602	0.2472	0.1627
	8		0.2482	0.3818	0.3930	0.3450
	9			0.1183	0.2436	0.3207
	10				0.0460	0.1210
	11					0.0141
16	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0043	0.0010	0.0003	0.0001	0.0000
	5	0.0831	0.0262	0.0089	0.0033	0.0013
	6	0.4148	0.1959	0.0893	0.0414	0.0198
	7	0.4977	0.4701	0.3213	0.1985	0.1188
	8		0.3068	0.4194	0.3886	0.3101
	9			0.1607	0.2978	0.3565
	10				0.0703	0.1683
	11					0.0251

Tab. I (contin.)

k	s \ r	7	8	9	10	11
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0025	0.0005	0.0001	0.0000	0.0000
	5	0.0612	0.0169	0.0051	0.0017	0.0006
17	6	0.3793	0.1567	0.0635	0.0265	0.0115
	7	0.5570	0.4603	0.2797	0.1555	0.0846
	8		0.3656	0.4442	0.3704	0.2687
	9			0.2073	0.3458	0.3763
	10				0.1001	0.2178
	11					0.0404
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0014	0.0003	0.0001	0.0000	0.0000
	5	0.0448	0.0108	0.0029	0.0009	0.0003
18	6	0.3426	0.1239	0.0446	0.0167	0.0066
	7	0.6112	0.4420	0.2387	0.1194	0.0591
	8		0.4231	0.4570	0.3430	0.2262
	9			0.2567	0.3853	0.3811
	10				0.1347	0.2664
	11					0.0602
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0008	0.0001	0.0000	0.0000	0.0000
	5	0.0326	0.0069	0.0017	0.0004	0.0001
19	6	0.3064	0.0970	0.0310	0.0105	0.0038
	7	0.6601	0.4177	0.2005	0.0903	0.0406
	8		0.4783	0.4593	0.3102	0.1860
	9			0.3075	0.4154	0.3735
	10				0.1732	0.3115
	11					0.0845
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0005	0.0001	0.0000	0.0000	0.0000
	5	0.0237	0.0044	0.0009	0.0002	0.0001
20	6	0.2720	0.0753	0.0214	0.0065	0.0021

Tab. I (contin.)

k \ s \ r		7	8	9	10	11
20	7	0.7039	0.3897	0.1663	0.0674	0.0275
	8		0.5306	0.4528	0.2753	0.1500
	9			0.3585	0.4359	0.3563
	10				0.2147	0.3511
	11					0.1128

k \ s \ r		12	13	14	15	16
2	1	0.0833	0.0769	0.0714	0.0667	0.0625
	2	0.9167	0.9231	0.9286	0.9333	0.9375
3	1	0.0069	0.0059	0.0051	0.0044	0.0039
	2	0.2292	0.2130	0.1990	0.1867	0.1758
	3	0.7639	0.7811	0.7959	0.8089	0.8203
4	1	0.0006	0.0005	0.0004	0.0003	0.0002
	2	0.0446	0.0382	0.0332	0.0290	0.0256
	3	0.3819	0.3605	0.3411	0.3236	0.3076
	4	0.5729	0.6008	0.6254	0.6471	0.6665
5	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0080	0.0063	0.0051	0.0041	0.0034
	3	0.1326	0.1155	0.1015	0.0899	0.0801
	4	0.4774	0.4622	0.4467	0.4314	0.4166
	5	0.3819	0.4160	0.4467	0.4745	0.4999
6	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0014	0.0010	0.0007	0.0006	0.0004
	3	0.0398	0.0320	0.0261	0.0216	0.0180
	4	0.2586	0.2311	0.2074	0.1869	0.1692
	5	0.4774	0.4799	0.4786	0.4745	0.4686
	6	0.2228	0.2560	0.2872	0.3164	0.3437
7	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0002	0.0002	0.0001	0.0001	0.0001
	3	0.0111	0.0082	0.0062	0.0048	0.0038
	4	0.1160	0.0957	0.0798	0.0671	0.0570
	5	0.3713	0.3446	0.3191	0.2953	0.2734
	6	0.3899	0.4135	0.4307	0.4429	0.4511
	7	0.1114	0.1378	0.1641	0.1898	0.2148

Tab. I (contin.)

k \ s \ r		12	12	14	15	16
8	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0030	0.0020	0.0014	0.0010	0.0008
	4	0.0470	0.0358	0.0277	0.0217	0.0173
	5	0.2321	0.1988	0.1709	0.1476	0.1281
	6	0.4116	0.4029	0.3897	0.3740	0.3571
	7	0.2599	0.2969	0.3282	0.3543	0.3759
	8	0.0464	0.0636	0.0820	0.1012	0.1208
9	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0008	0.0005	0.0003	0.0002	0.0001
	4	0.0179	0.0126	0.0090	0.0066	0.0049
	5	0.1280	0.1012	0.0808	0.0652	0.0530
	6	0.3412	0.3083	0.2769	0.2480	0.2220
	7	0.3574	0.3768	0.3868	0.3898	0.3876
	8	0.1393	0.1762	0.2110	0.2430	0.2718
	9	0.0155	0.0245	0.0352	0.0472	0.0604
10	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0002	0.0001	0.0001	0.0000	0.0000
	4	0.0065	0.0042	0.0028	0.0019	0.0014
	5	0.0653	0.0476	0.0353	0.0266	0.0203
	6	0.2453	0.2046	0.1706	0.1427	0.1197
	7	0.3791	0.3689	0.3516	0.3307	0.3083
	8	0.2418	0.2823	0.3139	0.3375	0.3540
	9	0.0580	0.0847	0.1130	0.1417	0.1699
	10	0.0039	0.0075	0.0126	0.0189	0.0264
11	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0001	0.0000	0.0000	0.0000	0.0000
	4	0.0023	0.0014	0.0009	0.0006	0.0004
	5	0.0316	0.0213	0.0146	0.0103	0.0074
	6	0.1607	0.1237	0.0958	0.0748	0.0588
	7	0.3438	0.3088	0.2733	0.2399	0.2097
	8	0.3191	0.3440	0.3552	0.3564	0.3504
	9	0.1241	0.1672	0.2072	0.2425	0.2726
	10	0.0177	0.0319	0.0493	0.0693	0.0909
	11	0.0006	0.0017	0.0036	0.0063	0.0099

Tab. I (contin.)

k	s \ r	12	13	14	15	16
12	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0008	0.0005	0.0003	0.0002	0.0001
	5	0.0147	0.0091	0.0058	0.0038	0.0026
	6	0.0988	0.0702	0.0505	0.0368	0.0271
	7	0.2809	0.2329	0.1914	0.1568	0.1285
	8	0.3560	0.3542	0.3396	0.3180	0.2932
	9	0.1994	0.2481	0.2854	0.3118	0.3285
	10	0.0458	0.0760	0.1092	0.1432	0.1760
	11	0.0035	0.0088	0.0169	0.0277	0.0409
	12	0.0001	0.0003	0.0008	0.0017	0.0031
13	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0003	0.0001	0.0001	0.0000	0.0000
	5	0.0067	0.0038	0.0023	0.0014	0.0009
	6	0.0580	0.0380	0.0254	0.0173	0.0119
	7	0.2132	0.1632	0.1246	0.0952	0.0732
	8	0.3544	0.3255	0.2898	0.2532	0.2189
	9	0.2682	0.3080	0.3291	0.3355	0.3314
	10	0.0880	0.1348	0.1800	0.2202	0.2537
	11	0.0109	0.0250	0.0445	0.0681	0.0941
	12	0.0003	0.0016	0.0043	0.0087	0.0151
	13		0.0000	0.0001	0.0003	0.0008
14	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0001	0.0000	0.0000	0.0000	0.0000
	5	0.0030	0.0016	0.0009	0.0005	0.0003
	6	0.0329	0.0199	0.0123	0.0078	0.0051
	7	0.1534	0.1084	0.0768	0.0548	0.0395
	8	0.3251	0.2756	0.2279	0.1859	0.1506
	9	0.3193	0.3384	0.3357	0.3195	0.2958
	10	0.1404	0.1984	0.2461	0.2810	0.3036
	11	0.0246	0.0522	0.0864	0.1233	0.1599
	12	0.0013	0.0053	0.0132	0.0251	0.0407
	13		0.0001	0.0007	0.0020	0.0044
	14			0.0000	0.0000	0.0001

Tab. I (contin.)

k	s \ r	12	13	14	15	16
15	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000	0.0000
	5	0.0013	0.0006	0.0003	0.0002	0.0001
	6	0.0182	0.0102	0.0058	0.0035	0.0021
	7	0.1059	0.0691	0.0454	0.0303	0.0204
	8	0.2806	0.2196	0.1686	0.1284	0.0975
	9	0.3478	0.3403	0.3135	0.2784	0.2417
	10	0.1968	0.2567	0.2957	0.3151	0.3192
	11	0.0460	0.0900	0.1382	0.1841	0.2237
	12	0.0033	0.0130	0.0298	0.0530	0.0805
	13		0.0006	0.0025	0.0068	0.0138
	14			0.0001	0.0003	0.0010
	15				0.0000	0.0000
16	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000	0.0000
	5	0.0006	0.0003	0.0001	0.0001	0.0000
	6	0.0098	0.0051	0.0027	0.0015	0.0009
	7	0.0709	0.0427	0.0261	0.0162	0.0103
	8	0.2312	0.1670	0.1191	0.0846	0.0602
	9	0.3544	0.3200	0.2738	0.2270	0.1847
	10	0.2510	0.3022	0.3231	0.3214	0.3052
	11	0.0750	0.1354	0.1930	0.2400	0.2735
	12	0.0071	0.0258	0.0552	0.0915	0.1303
	13		0.0015	0.0066	0.0165	0.0313
	14			0.0002	0.0012	0.0034
	15				0.0000	0.0001
	16					0.0000
17	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000	0.0000
	5	0.0002	0.0001	0.0000	0.0000	0.0000
	6	0.0052	0.0025	0.0012	0.0006	0.0003
	7	0.0463	0.0257	0.0146	0.0085	0.0050

Tab. I (contin.)

k \ s \ r	s	12	13	14	15	16
17	8	0.1837	0.1225	0.0811	0.0538	0.0359
	9	0.3429	0.2858	0.2270	0.1757	0.1340
	10	0.2978	0.3309	0.3286	0.3051	0.2716
	11	0.1106	0.1843	0.2440	0.2832	0.3025
	12	0.0134	0.0446	0.0887	0.1372	0.1832
	13		0.0035	0.0140	0.0326	0.0580
	14			0.0007	0.0033	0.0089
	15				0.0001	0.0006
	16					0.0000
18	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000	0.0000
	5	0.0001	0.0000	0.0000	0.0000	0.0000
	6	0.0028	0.0012	0.0006	0.0003	0.0001
	7	0.0296	0.0152	0.0080	0.0043	0.0024
	8	0.1417	0.0872	0.0536	0.0332	0.0208
	9	0.3184	0.2450	0.1807	0.1305	0.0933
	10	0.3339	0.3425	0.3158	0.2736	0.2284
	11	0.1510	0.2323	0.2856	0.3094	0.3098
	12	0.0226	0.0696	0.1283	0.1853	0.2319
	13		0.0070	0.0257	0.0557	0.0929
	14			0.0017	0.0074	0.0186
	15				0.0003	0.0016
	16					0.0000
19	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000	0.0000
	6	0.0014	0.0006	0.0003	0.0001	0.0001
	7	0.0187	0.0088	0.0043	0.0022	0.0011
	8	0.1068	0.0607	0.0346	0.0200	0.0117
	9	0.2860	0.2031	0.1391	0.0938	0.0629
	10	0.3578	0.3388	0.2901	0.2346	0.1836
	11	0.1940	0.2756	0.3146	0.3181	0.2986
	12	0.0352	0.1000	0.1712	0.2307	0.2708
	13		0.0123	0.0422	0.0853	0.1335
	14			0.0036	0.0144	0.0337
	15				0.0008	0.0039
	16					0.0001

Tab. I (contin.)

k \ r / s		12	13	14	15	16
	1	0.0000	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000	0.0000
	6	0.0007	0.0003	0.0001	0.0000	0.0000
	7	0.0116	0.0051	0.0023	0.0011	0.0005
20	8	0.0790	0.0414	0.0220	0.0118	0.0065
	9	0.2501	0.1640	0.1043	0.0656	0.0412
	10	0.3697	0.3232	0.2569	0.1939	0.1422
	11	0.2375	0.3114	0.3301	0.3115	0.2741
	12	0.0514	0.1347	0.2141	0.2694	0.2964
	13		0.0200	0.0636	0.1201	0.1762
	14			0.0066	0.0248	0.0545
	15				0.0018	0.0078
	16					0.0004

k \ r / s		17	18	19	20
2	1	0.0588	0.0556	0.0526	0.0500
	2	0.9412	0.9444	0.9474	0.9500
	1	0.0035	0.0031	0.0028	0.0025
3	2	0.1661	0.1574	0.1496	0.1425
	3	0.8304	0.8395	0.8476	0.8550
	1	0.0002	0.0002	0.0001	0.0001
4	2	0.0228	0.0204	0.0184	0.0166
	3	0.2931	0.2798	0.2677	0.2565
	4	0.6839	0.6996	0.7138	0.7268
	1	0.0000	0.0000	0.0000	0.0000
	2	0.0029	0.0024	0.0021	0.0018
5	3	0.0718	0.0648	0.0587	0.0534
	4	0.4023	0.3887	0.3757	0.3634
	5	0.5230	0.5441	0.5635	0.5814
	1	0.0000	0.0000	0.0000	0.0000
6	2	0.0003	0.0003	0.0002	0.0002

Tab. I (contin.)

k	s \ r	17	18	19	20
6	3	0.0152	0.0130	0.0111	0.0096
	4	0.1538	0.1403	0.1285	0.1181
	5	0.4615	0.4534	0.4449	0.4361
	6	0.3692	0.3930	0.4152	0.4360
7	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0030	0.0024	0.0020	0.0016
	4	0.0487	0.0420	0.0364	0.0318
	5	0.2533	0.2351	0.2185	0.2035
	6	0.4560	0.4585	0.4589	0.4579
	7	0.2389	0.2620	0.2841	0.3052
8	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0006	0.0004	0.0003	0.0003
	4	0.0139	0.0113	0.0093	0.0077
	5	0.1118	0.0980	0.0863	0.0763
	6	0.3398	0.3226	0.3060	0.2900
	7	0.3934	0.4075	0.4187	0.4273
	8	0.1405	0.1601	0.1794	0.1984
9	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0001	0.0001	0.0001	0.0000
	4	0.0037	0.0029	0.0022	0.0018
	5	0.0435	0.0360	0.0301	0.0253
	6	0.1988	0.1783	0.1602	0.1442
	7	0.3819	0.3736	0.3636	0.3525
	8	0.2976	0.3202	0.3400	0.3571
	9	0.0744	0.0889	0.1039	0.1190
10	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0010	0.0007	0.0005	0.0004
	5	0.0157	0.0122	0.0097	0.0077
	6	0.1009	0.0855	0.0727	0.0622
	7	0.2859	0.2641	0.2436	0.2243
	8	0.3647	0.3706	0.3728	0.3720
	9	0.1969	0.2224	0.2460	0.2678
	10	0.0350	0.0445	0.0547	0.0655

Tab. I (contin.)

k	s \ r	17	18	19	20
11	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0002	0.0002	0.0001	0.0001
	5	0.0053	0.0039	0.0030	0.0022
	6	0.0467	0.0373	0.0301	0.0245
	7	0.1830	0.1597	0.1395	0.1221
	8	0.3398	0.3261	0.3108	0.2946
	9	0.2973	0.3171	0.3324	0.3437
	10	0.1133	0.1359	0.1583	0.1800
	11	0.0144	0.0198	0.0259	0.0327
12	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0001	0.0000	0.0000	0.0000
	5	0.0018	0.0012	0.0009	0.0006
	6	0.0202	0.0153	0.0117	0.0090
	7	0.1056	0.0870	0.0720	0.0598
	8	0.2675	0.2425	0.2190	0.1972
	9	0.3373	0.3397	0.3374	0.3315
	10	0.2065	0.2340	0.2582	0.2791
	11	0.0560	0.0725	0.0900	0.1080
	12	0.0051	0.0077	0.0109	0.0147
13	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0006	0.0004	0.0002	0.0002
	6	0.0084	0.0060	0.0043	0.0032
	7	0.0566	0.0440	0.0345	0.0273
	8	0.1880	0.1610	0.1377	0.1178
	9	0.3202	0.3046	0.2866	0.2675
	10	0.2802	0.2999	0.3135	0.3218
	11	0.1213	0.1483	0.1744	0.1990
	12	0.0233	0.0333	0.0448	0.0575
	13	0.0015	0.0026	0.0040	0.0059
14	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000

Tab. I (contin.)

k	s \ r	17	18	19	20
14	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0002	0.0001	0.0001	0.0000
	6	0.0034	0.0023	0.0016	0.0011
	7	0.0287	0.0211	0.0157	0.0118
	8	0.1217	0.0984	0.0798	0.0648
	9	0.2690	0.2417	0.2154	0.1910
	10	0.3155	0.3189	0.3158	0.3080
	11	0.1938	0.2239	0.2495	0.2703
	12	0.0593	0.0799	0.1017	0.1240
	13	0.0080	0.0130	0.0192	0.0268
	14	0.0004	0.0007	0.0013	0.0021
15	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0001	0.0000	0.0000	0.0000
	6	0.0013	0.0008	0.0005	0.0004
	7	0.0140	0.0097	0.0068	0.0049
	8	0.0742	0.0567	0.0435	0.0336
	9	0.2069	0.1755	0.1482	0.1249
	10	0.3122	0.2980	0.2796	0.2591
	11	0.2553	0.2786	0.2940	0.3027
	12	0.1103	0.1403	0.1693	0.1961
	13	0.0236	0.0360	0.0506	0.0670
	14	0.0022	0.0041	0.0070	0.0108
	15	0.0001	0.0002	0.0003	0.0006
16	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000
	6	0.0005	0.0003	0.0002	0.0001
	7	0.0066	0.0043	0.0029	0.0020
	8	0.0431	0.0311	0.0226	0.0166
	9	0.1488	0.1192	0.0954	0.0763
	10	0.2810	0.2533	0.2252	0.1982
	11	0.2938	0.3027	0.3027	0.2960
	12	0.1679	0.2019	0.2307	0.2539

Tab. I (contin.)

k \ r s		17	18	19	20
16	13	0.0504	0.0728	0.0970	0.1220
	14	0.0073	0.0132	0.0212	0.0310
	15	0.0004	0.0011	0.0021	0.0037
	16	0.0000	0.0000	0.0001	0.0002
	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000
	6	0.0002	0.0001	0.0001	0.0000
	7	0.0030	0.0019	0.0012	0.0008
17	8	0.0242	0.0165	0.0114	0.0079
	9	0.1016	0.0769	0.0583	0.0443
	10	0.2353	0.2004	0.1687	0.1411
	11	0.3058	0.2976	0.2819	0.2619
	12	0.2222	0.2523	0.2732	0.2855
	13	0.0880	0.1198	0.1514	0.1808
	14	0.0179	0.0305	0.0462	0.0644
	15	0.0017	0.0038	0.0072	0.0121
	16	0.0001	0.0002	0.0005	0.0011
	17	0.0000	0.0000	0.0000	0.0000
	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0'0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000
	6	0.0001	0.0000	0.0000	0.0000
	7	0.0014	0.0008	0.0005	0.0003
	8	0.0132	0.0085	0.0055	0.0037
18	9	0.0666	0.0476	0.0342	0.0247
	10	0.1862	0.1498	0.1195	0.0949
	11	0.2948	0.2709	0.2431	0.2146
	12	0.2648	0.2839	0.2912	0.2892
	13	0.1326	0.1707	0.2042	0.2318
	14	0.0354	0.0570	0.0819	0.1084
	15	0.0046	0.0100	0.0179	0.0284
	16	0.0003	0.0008	0.0020	0.0039
	17	0.0000	0.0000	0.0001	0.0002
	18		0.0000	0.0000	0.0000

Tab. I (contin.)

k \ s \ r		17	18	19	20
	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000
	6	0.0000	0.0000	0.0000	0.0000
	7	0.0007	0.0004	0.0002	0.0001
	8	0.0070	0.0043	0.0026	0.0017
19	9	0.0422	0.0285	0.0194	0.0133
	10	0.1409	0.1070	0.0809	0.0610
	11	0.2674	0.2321	0.1973	0.1655
	12	0.2909	0.2946	0.2863	0.2701
	13	0.1793	0.2179	0.2470	0.2663
	14	0.0604	0.0917	0.1248	0.1570
	15	0.0104	0.0210	0.0357	0.0538
	16	0.0008	0.0024	0.0054	0.0102
	17	0.0000	0.0001	0.0004	0.0010
	18		0.0000	0.0000	0.0000
	19			0.0000	0.0000
	1	0.0000	0.0000	0.0000	0.0000
	2	0.0000	0.0000	0.0000	0.0000
	3	0.0000	0.0000	0.0000	0.0000
	4	0.0000	0.0000	0.0000	0.0000
	5	0.0000	0.0000	0.0000	0.0000
	6	0.0000	0.0000	0.0000	0.0000
	7	0.0003	0.0001	0.0001	0.0000
	8	0.0037	0.0021	0.0012	0.0007
20	9	0.0261	0.0166	0.0107	0.0070
	10	0.1028	0.0737	0.0528	0.0378
	11	0.2310	0.1894	0.1526	0.1215
	12	0.2998	0.2867	0.2639	0.2365
	13	0.2227	0.2556	0.2745	0.2811
	14	0.0919	0.1319	0.1700	0.2031
	15	0.0198	0.0379	0.0610	0.0875
	16	0.0020	0.0056	0.0121	0.0216
	17	0.0001	0.0004	0.0012	0.0029
	18		0.0000	0.0001	0.0002
	19			0.0000	0.0000
	20				0.0000

r — number of traps inside home range,
k — number of captures,
s — number of "revealed" points (observed).

Expected values $E(X_{k,r})$ and standard deviations $D(X_{k,r})$ of randon variable $X_{k,r}$

Tab. II

k \ r	1		2		3		4		5		6	
	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$
2	1.000	0.000	1,500	0.500	1.667	0.471	1.750	0.433	1.800	0.400	1.833	0.373
3	1.000	0.000	1.750	0.433	2.111	0.567	2.313	0.583	2.440	0.571	2.528	0.552
4	1.000	0.000	1.875	0.331	2.407	0.562	2.734	0.643	2.952	0.668	3.107	0.669
5	1.000	0.000	1.938	0.242	2.605	0.514	3.051	0.651	3.362	0.714	3.589	0.740
6	1.000	0.000	1.969	0.174	2.737	0.449	3.288	0.627	3.689	0.725	3.991	0.778
7	1.000	0.000	1.984	0.124	2.824	0.384	3.466	0.585	3.951	0.713	4.326	0.792
8	1.000	0.000	1.992	0.088	2.883	0.323	3.599	0.536	4.161	0.686	4.605	0.787
9	1.000	0.000	1.996	0.062	2.922	0.269	3.699	0.483	4.329	0.650	4.837	0.769
10	1.000	0.000	1.988	0.044	2.948	0.222	3.775	0.432	4.463	0.608	5.031	0.742
11	1.000	0.000	1.999	0.031	2.965	0.183	3.831	0.382	4.571	0.564	5.193	0.709
12	1.000	0.000	1.999	0.022	2.977	0.150	3.873	0.337	4.656	0.519	5.327	0.672
13	1.000	0.000	2.000	0.016	2.985	0.123	3.905	0.296	4.725	0.475	5.439	0.633
14	1.000	0.000	2.000	0.011	2.990	0.101	3.929	0.259	4.780	0.433	5.533	0.593
15	1.000	0.000	2.000	0.008	2.993	0.082	3.947	0.226	4.824	0.393	5.611	0.553
16	1.000	0.000	2.000	0.006	2.995	0.067	3.960	0.197	4.859	0.356	5.676	0.515
17	1.000	0.000	2.000	0.004	2.997	0.055	3.970	0.171	4.887	0.321	5.730	0.477
18	1.000	0.000	2.000	0.003	2.998	0.045	3.977	0.149	4.910	0.290	5.775	0.441
19	1.000	0.000	2.000	0.002	2.999	0.037	3.983	0.129	4.928	0.261	5.812	0.408
20	1.000	0.000	2.000	0.001	2.999	0.030	3.987	0.112	4.942	0.235	5.844	0.376

Tab. II (contin.)

k \ r	7		8		9		10		11		12	
	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$
2	1.857	0.350	1.875	0.331	1.889	0.314	1.900	0.300	1.909	0.288	1.917	0.276
3	2.592	0.531	2.641	0.511	2.679	0.493	2.710	0.475	2.736	0.459	2.757	0.445
4	3.222	0.659	3.311	0.646	3.381	0.631	3.439	0.615	3.487	0.560	3.527	0.585
5	3.761	0.748	3.897	0.745	4.006	0.738	4.095	0.727	4.170	0.715	4.233	0.702
6	4.224	0.805	4.410	0.816	4.561	0.819	4.686	0.815	4.791	0.808	4.881	0.799
7	4.621	0.838	4.858	0.864	5.054	0.878	5.217	0.884	5.355	0.883	5.474	0.880
8	4.961	0.852	5.251	0.894	5.492	0.920	5.695	0.935	5.868	0.943	6.018	0.945
9	5.252	0.851	5.595	0.908	5.882	0.947	6.126	0.972	6.335	0.988	6.516	0.997
10	5.502	0.840	5.895	0.910	6.229	0.961	6.513	0.996	6.759	1.021	6.973	1.038
11	5.716	0.820	6.159	0.903	6.536	0.965	6.862	1.011	7.145	1.044	7.392	1.068
12	5.899	0.794	6.389	0.888	6.810	0.961	7.176	1.016	7.495	1.058	7.776	1.089
13	6.056	0.763	6.590	0.867	7.054	0.950	7.458	1.014	7.814	1.064	8.128	1.103
14	6.191	0.730	6.766	0.842	7.270	0.933	7.712	1.006	8.103	1.064	8.451	1.110
15	6.307	0.695	6.921	0.814	7.462	0.913	7.941	0.993	8.367	1.059	8.747	1.112
16	6.406	0.659	7.056	0.783	7.633	0.889	8.147	0.976	8,606	1.048	9.018	1.108
17	6.491	0.623	7.173	0.751	7.785	0.862	8.332	0.956	8.824	1.034	9.266	1.100
18	6.563	0.587	7.277	0.718	7.920	0.833	8.499	0.932	9.022	1.017	9.494	1.088
19	6.626	0.552	7.367	0.685	8.040	0.804	8.649	0.907	9.201	0.997	9.703	1.073
20	6.679	0.518	7.446	0.652	8.147	0.773	8.784	0.881	9.365	0.974	9.894	1.056

Tab. II (contin.)

k \ r	13		14		15		16		17		18	
	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$
2	1.923	0.267	1.929	0.258	1.933	0.249	1.938	0.242	1.941	0.235	1.944	0.229
3	2.775	0.431	2.791	0.419	2.804	0.408	2.816	0.397	2.827	0.387	2.836	0.378
4	3.562	0.570	3.592	0.557	3.618	0.544	3.640	0.532	3.661	0.521	3.679	0.510
5	4.288	0.689	4.335	0.676	4.376	0.663	4.413	0.651	4.445	0.639	4.475	0.627
6	4.958	0.789	5.025	0.778	5.085	0.767	5.137	0.755	5.184	0.744	5.226	0.733
7	5.577	0.873	5.666	0.865	5.746	0.856	5.816	0.847	5.879	0.837	5.936	0.826
8	6.148	0.944	6.262	0.939	6.363	0.934	6.453	0.927	6.533	0.919	6.606	0.910
9	6.675	1.001	6.814	1.002	6.938	1.000	7.049	0.996	7.149	0.991	7.239	0.984
10	7.161	1.048	7.328	1.054	7.476	1.056	7.609	1.056	7.728	1.053	7.837	1.049
11	7.610	1.085	7.804	1.096	7.977	1.103	8.133	1.107	8.274	1.108	8.401	1.107
12	8.025	1.113	8.247	1.130	8.446	1.142	8.625	1.150	8.787	1.154	8.935	1.157
13	8.408	1.133	8.658	1.156	8.883	1.173	9.086	1.185	9.270	1.194	9.438	1.199
14	8.761	1.147	9.039	1.175	9.290	1.197	9.518	1.214	9.725	1.227	9.914	1.236
15	9.087	1.154	9.394	1.188	9.671	1.216	9.923	1.237	10.153	1.254	10.363	1.267
16	9.388	1.157	9.723	1.197	10.026	1.229	10.303	1.255	10.556	1.276	10.787	1.293
17	9.666	1.154	10.028	1.200	10.358	1.237	10.659	1.268	10.935	1.293	11.188	1.314
18	9.922	1.148	10.312	1.199	10.667	1.241	10.993	1.276	11.291	1.306	11.566	1.330
19	10.159	1.139	10.575	1.194	10.956	1.241	11.306	1.281	11.627	1.314	11.924	1.343
20	10.378	1.126	10.820	1.186	11.226	1.238	11.599	1.282	11.943	1.319	12.262	1.351

Tab. II (contin.)

k \ r	19		20		21		22		23		24	
	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$
2	1.947	0.223	1.950	0.218	1.952	0.213	1.955	0.208	1.957	0.204	1.958	0.200
3	2.845	0.370	2.853	0.362	2.859	0.354	2.866	0.347	2.872	0.340	2.877	0.334
4	3.695	0.500	3.710	0.490	3.723	0.481	3.735	0.472	3.747	0.464	3.757	0.456
5	4.501	0.616	4.524	0.606	4.546	0.596	4.566	0.586	4.584	0.577	4.600	0.568
6	5.264	0.722	5.298	0.711	5.330	0.701	5.358	0.690	5.384	0.681	5.409	0.671
7	5.987	0.816	6.033	0.806	6.076	0.796	6.115	0.786	6.150	0.776	6.183	0.767
8	6.672	0.901	6.732	0.892	6.786	0.882	6.837	0.873	6.883	0.864	6.926	0.854
9	7.321	0.977	7.395	0.969	7.463	0.961	7.526	0.952	7.584	0.944	7.637	0.935
10	7.935	1.044	8.025	1.038	8.108	1.032	8.184	1.025	8.254	1.017	8.319	1.009
11	8.518	1.104	8.624	1.100	8.722	1.096	8.812	1.090	8.895	1.084	8.972	1.077
12	9.069	1.157	9.193	1.156	9.306	1.153	9.411	1.149	9.508	1.145	9.598	1.140
13	9.592	1.203	9.733	1.204	9.863	1.204	9.984	1.202	10.095	1.199	10.199	1.196
14	10.087	1.243	10.247	1.247	10.394	1.249	10.530	1.250	10.656	1.249	10.774	1.247
15	10.556	1.277	10.734	1.284	10.899	1.289	11.051	1.292	11.193	1.293	11.325	1.292
16	11.001	1.306	11.198	1.316	11.379	1.324	11.549	1.329	11.706	1.333	11.853	1.335
17	11.422	1.330	11.638	1.344	11.838	1.355	12.024	1.365	12.197	1.374	12.359	1.383
18	11.821	1.350	12.056	1.366	12.274	1.379	12.477	1.388	12.667	1.394	12.844	1.397
19	12.198	1.366	12.453	1.386	12.690	1.402	12.910	1.415	13.116	1.426	13.309	1.433
20	12.556	1.378	12.830	1.401	13.085	1.419	13.323	1.434	13.546	1.444	13.754	1.449

Tab. II (contin.)

k \ r	25		26		27		28		29		30	
	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$	$E(X_{k,r})$	$D(X_{k,r})$
2	1.960	0.196	1.962	0.192	1.963	0.189	1.964	0.186	1.966	0.183	1.967	0.180
3	2.882	0.328	2.886	0.322	2.890	0.317	2.894	0.312	2.898	0.307	2.901	0.302
4	3.766	0.448	3.775	0.441	3.783	0.434	3.791	0.428	3.798	0.422	3.804	0.415
5	4.616	0.559	4.630	0.551	4.643	0.543	4.655	0.536	4.667	0.528	4.678	0.521
6	5.431	0.662	5.452	0.653	5.471	0.645	5.489	9.636	5.505	0.629	5.522	0.621
7	6.214	0.757	6.242	0.748	6.269	0.739	6.293	0.731	6.316	0.722	6.338	0.714
8	6.965	0.845	7.002	0.836	7.036	0.827	7.068	0.818	7.098	0.810	7.126	0.802
9	7.687	0.926	7.733	0.918	7.776	0.909	7.816	0.901	7.854	0.892	7.889	0.884
10	8.379	1.001	8.435	0.993	8.488	0.985	8.537	0.977	8.583	0.969	8.626	0.960
11	9.044	1.070	9.111	1.063	9.173	1.056	9.232	1.048	9.287	1.040	9.338	1.033
12	9.682	1.131	9.761	1.125	9.834	1.118	9.902	1.111	9.967	1.103	10.027	1.096
13	10.295	1.187	10.385	1.182	10.469	1.175	10.549	1.168	10.623	1.161	10.693	1.153
14	10.883	1.244	10.986	1.240	11.082	1.235	11.172	1.230	11.257	1.224	11.336	1.218
15	11.448	1.307	11.563	1.310	11.671	1.314	11.773	1.317	11.868	1.321	11.959	1.326
16	11.990	1.335	12.118	1.334	12,239	1.332	12.352	1.329	12.459	1.325	12.560	1.319
17	12.510	1.384	12.652	1.390	12.786	1.395	12.911	1.402	13.030	1.409	13.141	1.417
18	13.010	1.405	13.166	1.407	13.312	1.409	13.450	1.410	13.580	1.411	13.703	1.413
19	13.490	1.440	13.659	1.444	13.819	1.448	13.970	1.449	14.112	1.450	14.246	1.449
20	13.950	1.448	14.134	1.440	14.307	1.425	14.471	1.401	14.625	1.365	14.772	1.317

r, *k* – see Tab. I.

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STATYSTYCZNA OCENA AREAŁU DROBNYCH GRYZONI LEŚNYCH

Streszczenie

Przedstawiona w tej pracy metoda oceny wielkości areału drobnych gryzoni leśnych daje możliwość dokonania oceny dla okresu obejmującego kilka złowień gryzonia (co najmniej dwa). Istnienie takiej możliwości jest ważne z punktu widzenia potrzeb ekologicznych.

Metoda ta jest wolna ponadto od założenia o istnieniu w obrębie areału jednego środka aktywności. Założenie to zostało podważone w wielu pracach (Blair 1951, Kaye 1961, Miller 1957, Tanaka 1961, 1963). Przyjęty w tej pracy model po-

ruszania się gryzoni po powierzchni areału jest bliski ostatnim koncepcjom biologicznym dotyczacym intensywności penetracji przez gryzonie różnych części ich areału.

Przyjęcie jako miary areału liczby punktów łownych (r) znajdujących się w obszarze penetracji gryzonia należącego do badanej populacji, bądź pola tego obszaru równego $r \cdot d^2$, gdzie d jest odległością sąsiednich pułapek siatki, daje możliwość oceny areału niezależnie od jego kształtu. Jest to tym bardziej ważne, że zgodnie z danymi z literatury (Tanaka 1963) kształt areału gryzonia zależy od warunków ekologicznych.

Przedstawiona metoda oszacowania wielkości areału jest poza tym łatwa z punktu widzenia opracowania numerycznego, dzięki tablicom dołączonym do tej pracy. Przygotowanie materiałów empirycznych w postaci dogodnej do korzystania z tablic nie powinno nastręczać biologom specjalnych trudności.

Przedstawiona metoda została zweryfikowana i zilustrowana numerycznie przy pomocy danych osiągniętych z odłowu gryzoni z dwóch powierzchni leśnych. Sposób rozstawienia pułapek na obu powierzchniach był identyczny, różnice wynikały jedynie z częstości przeglądania pułapek.

Osobniki łowione w okresie odłowów podzielono według gatunków i płci. Podziału tego nie dokonano dla gryzoni łowionych na drugiej powierzchni ze względu na nieliczną grupę łowionych osobników. Założenia modelu zostały sprawdzone dla danych dotyczących najliczniej występującego gatunku *C. glareolus* przy pomocy statystyki χ^2 Pearsona (tab. III) oraz testu weryfikującego założenia modelu poprzez ocenę różnic między wartościami estymatorów parametru r otrzymanymi na podstawie analizy rozkładu liczby pułapek „ujawnionych" przez gryzonie w dwóch złowieniach spośród kolejnych dziesięciu. Wartości otrzymanych estymatorów podano w tabeli V. Obliczono ponadto wartości estymatorów parametru r dla kolejnych dwóch, trzech,..., dziesięciu złowień gryzoni (tab. IV).

W wyniku przeprowadzonej weryfikacji modelu stwierdzono, że areał samic nie zmienia się w okresie czasu obejmującym 10 złowień. Na podstawie wyników weryfikacji różnic między otrzymanymi wartościami estymatorów dla samców można przypuszczać, że obszar penetrowany przez samca w okresie obejmującym pierwsze kilka złowień spośród kolejnych dziesięciu jest w następnym okresie częściowo opuszczony, przy czym wielkość areału penetrowana w początkowym okresie jest taka sama jak w okresie późniejszym. Tego typu interpretacja może pozostać jednak w formie przypuszczenia ze względu na brak istotnych różnic między wartościami estymatorów. Wynik taki może być jednak spowodowany wielkością prób, na podstawie których dokonano ocen. Wartości estymatorów, otrzymane na podstawie prób obejmujących 5 złowień gryzoni, dla wszystkich gatunków porównano między sobą. Istotne różnice znaleziono dla samców *A. flavicollis* oraz samic i samców pozostałych gatunków (tab. VII). Areał samic *A. flavicollis* różni się istotnie jedynie od areału samic *C. glareolus*. Istotną różnicę w wielkości areałów samic i samców wszystkich gatunków łącznie, znaleziono dopiero dla okresu obejmującego 10 złowień gryzoni.

AUTHOR'S ADDRESS:
Dr. Teresa Wierzbowska
Instytut Ekologii PAN,
Dziekanów Leśny k. Warszawy,
Poland.