QUANTITATIVE METHODS IN COLLECTING GRASSHOPPERS.

By: JÁNOS BALOGH.

(From the Hungarian Biological Research Institute, Tihany, Lake Balaton.)

One of the principal duties of quantitative biosociology is to establish the exact numerical abundance of animals on a given territory. In hydrobiology and phytosociology several quantitative methods are in use, but in terrestrial biocenology not many are known. The collection and counting of terrestrial animals, principally the Arthropoda, also involve many technical difficulties not easy of solution. Most methods so far have been merely "quasi quantitative" (BLAKE, 1926), as the quantitative results obtained were unreliable. A wider knowledge of these methods can be got from P. Palmgren's "Quantitative Untersuchungen über die Vogelfauna in den Wäldern Südfinnlands" (p. 46—54), and will therefore not be dealt with more fully here.

To eliminate some of the faults of these methods, I worked out a new one by which the density of grasshoppers can be established with complete exactitude. I called the method the rectangular-band method (German Quadratbandmethode), as it really consists in a transition between the linear appraisement (Linientaxierung) and the netted square methods (Netzquadratmethode). The new method, as will appear below, is extraordinarily simple, the counting can be done quickly, and the results thereby obtained are very exact, that is to say, absolute quantitative values.

For the survey I used a rectangular band outlined in light-coloured twine, consisting of 10 successive squares 1x1 m in dimension. This outline I stretched out on the area under investigation, directly on the ground, by means of iron or wooden pegs, and then left the place for 5–10 minutes. This is necessary for the grasshoppers disturbed by these preparations to grow quiet again and the designated territory to acquire its original grasshopper population once more. When the 5—10 minutes had elapsed I went circumspectly back to the rectangular band and looked through the squares, one after the other. During the examination the grasshoppers jumped from the squares, so that I had

only to count the animals which jumped out and note their number separately for each square.

The work of counting naturally demands great attentiveness. In the first place, care must be taken to determine whether the grasshoppers which jumped were inside or beyond the limits of the square, so as not to count the animals outside it. Observation must be made too of the animals which jump from the square under consideration into the next one, not yet examined. In this case the animal or animals which have jumped out must be left out of consideration. Finally, note must be taken of the more easily frightened, more lively or more agile grasshoppers which may jump out too soon on our approach, even before one had begun the examination of their square.

This apparently complicated task can be accurately accomplished if a small-scale drawing of the netted rectangle (that is, 10 squares drawn in a line) is kept in the hand, with a pencil, and the numbers of grasshoppers noted, not only those that jump out from the square under immediate examination, but from the following squares as well. The more of these bands we can examine at a time during the investigation of a biocenosis, possibly 3—5, the more the results will approach the ideal condition. In this way, by counting 30—50 m^2 we can calculate the average sample/m^2, with accurate results.

With this method, however, only the abundance of the grasshoppers can be established, as it is often impossible to determine the species of the jumping animals. So the composition of the grasshopper population as to species must be determined indirectly. This is done by catching any considerable number, if possible more than 100, of grasshoppers on the same field, carefully avoiding any unintentional selection and actually catching every animal at random. The identification can be made at home and from it percentual frequencies of the species established.

The rectangular band method can be carried out by one person and faultlessly if the grasshopper abundance in the area is not greater than 2—6 specimens per m^2. If it is greater, then 2 persons can manage it, by advancing closely one after the other, each counting the animals jumping from half a square (50x100 cm^2) and at the end putting their results together. The following record was made with this system.

Fumana vulgaris — Festuca vaginata — Cladonia faliacea — Magyarica sociation, Szigetmonostor, 7. VII. 1946:

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Band N° I.	11	13	9	6	9	7	10	11	8	10
„ „ II.	9	11	12	8	7	11	7	10	11	12
„ „ III.	10	11	9	8	4	12	10	7	7	8
„ „ IV.	9	9	11	12	8	8	7	10	9	9
„ „ V.	11	10	8	7	7	9	10	8	4	6

As we see, from the 9/m² value, the maximum deviation varies between +0.8 and —1.0, therefore the limit of error on the basis of 10 squares is about 10%. Counted on the basis of the first 2 bands (that is 20 squares) the average value is 9.6/m², the difference being therefore +0.6; on the basis of 30 squares 9.1/m², the difference therefore +0.1; on the basis of 40 squares 9.2/m², the difference being +0.2. With the increase in rectangular bands therefore we continually draw closer to the ideal average value. According to my experience, with 3—5 rectangular bands, that is, with the examination of 30—50 square metres, the values are practically exact, so that it is not worth while investigating any larger number. The survey of 3—5 such rectangular bands together with their preparation takes about 15—30 minutes, so that though the work is very exact it goes very fast.

With this method in the past 3 years I have counted the grasshopper populations of many phytocenoses and obtained extremely valuable results. If the numerical results are combined with the weight, that is, if the average weight of the species is established, we arrive at an exact estimation of the weight of the grasshopper population of the phytocenosis on a given territory (as for example 1 ha.). Such investigations give a very instructive picture of the significance of the grasshopper population of the phytocenosis in question and if the surveys are carried out several times between spring and autumn, of the fluctuations in the entire population as to weight and numbers.

Grateful acknowledgment is made to Mrs. J. Thompson Vass for the English translation.

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