REFERENCES


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TAXONOMIC VALUE OF M1 MEASUREMENTS IN MICROTUS AGRESTIS (LINNAEUS, 1761) AND MICROTUS ARVALIS (PALLAS, 1779)

TAKSONOMICZNA WARTOŚĆ POMIARÓW M1 U MICROTUS AGRESTIS (LINNAEUS, 1761) I MICROTUS ARVALIS (PALLAS, 1779)

An analysis was made of the variations in the measurements of M1 teeth and position of foramen mandibulare in two species of voles, M. agrestis (n = 272) and M. arvalis (n = 118). The weight of M1 is of some assistance. M1 teeth weighing > 10.3 mg correspond to 47.9% of the individuals of M. agrestis, while M1 < 7.3 mg — 53.4% of M. arvalis. The relationship between the weight and height of crown of M1 on a correlation diagram, make it possible to distinguish 68.8% of M. agrestis and 64.1% of M. arvalis. This method may be of practical assistance in identifying fossil material or material originating from owl pellets.

The two species of voles — M. agrestis and M. arvalis, differ in respect of skull dimensions and certain descriptive characters of the teeth and mandible (cf. Zimmermann, 1955). Morphological characters are not, however, permanent and vary to a greater or lesser degree (cf. Rörgig & Börner, 1905; Reichstein & Reise, 1965). In two other species of European voles, it is known that they show additional triangles on their M2 (Kowalski, 1957; Ruprecht, 1967), however, this characteristic has never been found in the aboral end of this tooth, as it was sometimes observed in M. arvalis. On the other hand in M. agrestis a tendency has been observed to reduction of this part of M2. The position of foramen mandibulare also cannot always be considered reliable in identification of these two species on account of the occurrence of intermediate variations (cf. Krommenhoek & Slob, 1967; Dienske, 1969). Difficulties of a taxonomic nature increase with the degree of damage to the bone material, which may occur in fossil material or that obtained from owl pellets. Therefore Krommenhoek & Slob (1967) and Dienske (1969) considered both the size, and descriptive characters of the skull, mandible and teeth to differentiate between M. agrestis and M. arvalis.
The purpose of this study was to assess the usefulness of $M_1$ measurements in distinguishing between these two species in sympatric populations.

![Diagram](image)

Fig. 1. Explanations of $M_1$ measurements.  
1 — length of the crown, 2 — height, 3 — breadth.

The material available consisted of skulls of *M. agrestis* ($n = 272$) and *M. arvalis* ($n = 118$), obtained from the Białowieża National Park and Białowieża Glade (52°42'N, 23°50'E). Analysis was made of variations in measurements of $M_1$ and position of *foramen mandibulare*. $M_1$ were removed after boiling whole mandibles in 6% NaHCO$_3$ water solution. The air dried teeth were weighed on an analytical balance with accuracy to 0.1 mg and the length, height and breadth of the crown measured with accuracy to 0.1 mm (Fig. 1). The teeth were stored for several months, and during this time, their weight did not vary.

### Table 1
Variations in the position of *foramen mandibulare* in sympatric populations of *M. agrestis* and *M. arvalis*.

<table>
<thead>
<tr>
<th>Species</th>
<th>Arrangement:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical +</td>
<td>Intermediate +</td>
<td>Atypical —</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td><em>M. agrestis</em></td>
<td>250</td>
<td>91.9</td>
<td>18</td>
</tr>
<tr>
<td><em>M. arvalis</em></td>
<td>107</td>
<td>90.7</td>
<td>10</td>
</tr>
</tbody>
</table>

### Table 2
Variations in values of measurements of $M_1$ in sympatric populations of *M. agrestis* and *M. arvalis*.

<table>
<thead>
<tr>
<th>Measurement of the crown of $M_1$</th>
<th><em>Microtus agrestis</em> ($n=269$)</th>
<th><em>Microtus agrestis</em> ($n=108$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{x} \pm SD$</td>
<td>C.V.</td>
</tr>
<tr>
<td>Weight in mg</td>
<td>10.4 ± 1.5</td>
<td>14.8</td>
</tr>
<tr>
<td>Height, mm</td>
<td>3.8 ± 0.3</td>
<td>7.6</td>
</tr>
<tr>
<td>Length, mm</td>
<td>2.6 ± 0.2</td>
<td>8.8</td>
</tr>
<tr>
<td>Breadth, mm</td>
<td>1.2 ± 0.1</td>
<td>8.6</td>
</tr>
</tbody>
</table>
The position of *f. mandibulare* did not completely separate the two species of voles. A typical arrangement was observed in 91.9% of the *M. agrestis* individuals, and in 90.7% of *M. arvalis* individuals. An intermediate and atypical arrangement in the *f. mandibulare* was found in 8.1% of the individuals of *M. agrestis*; these showed 4-triangled enamel of *M*. This unusual position of the *f. mandibulare* was also recorded in 9.3% of the individuals of *M. arvalis*, and these had 3-triangled enamel of *M*. (Table 1). The position of the *f. mandibulare* can thus be used only as a supplementary aid to identification.

*Mj* exhibits some differentiation of size in both species. In *M. agrestis* these teeth are on an average heavier, higher, longer and broader than the corresponding dimensions in *M. arvalis* (Table 2). Maximum variation was observed in the case of weight (C. v. = 14.8—15.4%) and

![Fig. 2. Variations in weight of *Mj* in *M. agrestis* and *M. arvalis*. The zone where values of measurements in classes 7.5—10.5 mg overlap each other is indicated by double shading.](image)

None of the four measurements or indices based on these measurements applied individually provide a satisfactory means of distinguishing between the two species of voles.

The weight of *Mj* is, however, of some assistance (Fig. 2). The common range of values of this measurement falls in both species in the middle classes 7.5—10.5 mg (extreme values of these classes come within limits of 7.3—10.7 mg). On the basis of this character weights of *Mj* > 10.3 mg apply to 47.9% of the individuals of *M. agrestis*, while weights of
M₃ < 7.3 mg — to 53.4% of M. arvalis. The application of two dimensions of the teeth — weight and height of crown of M₃, on the correlation table, where the position of the given individual is defined by the values of these two parameters, enables 68.8% of M. agrestis and 64.1% of M. arvalis to be distinguished (Fig. 3).

The results obtained confirmed our original assumption that M. agrestis, being the larger of the two species of voles, would possess the larger teeth. On the other hand, the considerable degree of overlapping of measurements in both species indicates that the size of teeth is of little taxonomic value (cf. also Haitlinger & Ruprecht, 1967). The

Fig. 3. Relationship of the weight and height of the crown of M₃ in M. agrestis — *, and M. arvalis — O.

degree of overlapping of dimensions found in the two species is very similar to the overlapping of skull measurements obtained by Krommenhoek & Slobo (1967) and Dienske (1969).

Analysis of the descriptive and measurement characters (Dienske, 1969) gave more satisfactory results. This author obtained almost complete separation of these two species as the result of the statistical calculations based on discrimination analysis which he made of the material.
Our results also show that simple measurements of $M_1$, when treated jointly, can be useful in examining the bone fragments of *M. agrestis* and *M. arvalis* in owl pellets and fossil material, although this is possible in only about 50% of the specimens.

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