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**Taxonomic Value of Mandible Measurements in the Genus
Plecotus Geoffroy, 1818**

[With 2 Figs. & 1 Table]

The variability in the mandible dimensions has been investigated in bats of the genus *Plecotus* Geoffroy, 1818 from Central Europe. The material consisted of 100 individuals of *P. auritus* and 100 individuals of *P. austriacus*. The variability in the mandible length appeared to be relatively low in both species ($Cv = 3.41 - 3.99$), whereas that in the height of the *ramus mandibulae* was slightly higher ($Cv = 4.93 - 8.62$). For both species the common values of the measurements of the mandible length are found in 10.8—11.0 mm classes, which contain 4 per cent of *P. auritus* and 18 per cent of *P. austriacus*. As to the height of the *ramus mandibulae*, the common range for both species falls to the 3.2 mm class (3 per cent of *P. auritus* and 4 per cent of *P. austriacus*). A complete separation of both species can be done by simultaneous comparison of two dimensions using the diagram of their correlation considering morphological characteristics of the mandible. This method may find practical application in indentifying fossil materials or those in owl pellets.

I. INTRODUCTION

Although European species of bats, namely *Plecotus auritus* (Linnaeus, 1758) and *Plecotus austriacus* Fischer, 1829, may be considered as a typical pair of similar species, they nevertheless show some morphological differences. The number of characteristics distinguishing the two species seems to be definitely established (Topál, 1958; Bauer, 1960; Lanza, 1960; Hanák, 1962) and in the course of time their usefulness was confirmed by various authors (König & König, 1961; van Bree & Dulić, 1963; Corbet, 1964; Saint Giron, 1964; Hanák, 1966; Piechocki, 1966; Šachlová, 1966; Stebbings, 1967).

Identification of species based on conventional craniometric characters depends on the state of skulls. Therefore it seems reasonable to examine the taxonomic value of an element which cannot be easily damaged. In bats the mandible fulfills this condition, since despite frequent deficiencies in teeth it may remain undamaged in fossil materials or in owl pellets.

Two basic dimensions, the height of the *ramus mandibulae* and the mandible length have been used as complementary characteristics (König & König, 1961; Hanák, 1962; Beaucornu, 1963; Richter, 1965; Ruprecht, 1965; Schmidt, 1967). In both species, however, the intervals of their variability overlap somewhat.

Having adequate comparative material at my disposal I made a new analysis of the applicability of those characteristics treating them jointly.

II. MATERIAL AND METHODS

The investigations were conducted on a series of skulls of *P. auritus* (n = 100) and *P. austriacus* (n = 100) taken from Polish and Czechoslovak collections, but coming from Poland, Czechoslovakia and Bulgaria (Table 1). Three measurements were taken from each skull by means of vernier calipers: (1) the length of the maxillary tooth-row from C¹ — M³, (2) the length of the mandible from the anterior

Table 1.
Variability of mandible measurements (in mm) in middle European representatives of *Plecotus*.

Species	Locum	n	Length of mandible			Height of ramus mandibulae		
			min.-max.	$\bar{x} \pm SD$	Cv	min.-max.	$\bar{x} \pm SD$	Cv
<i>P. auritus</i>	Poland	54	9.4—10.9	10.29±0.37	3.63	2.6—3.2	2.87±0.14	4.93
	Czechoslovakia	46	9.4—11.0	10.31±0.41	3.99	2.6—3.1	2.84±0.24	8.62
<i>P. austriacus</i>	Poland	25	10.8—11.6	11.22±0.39	3.45	3.3—3.7	3.43±0.17	5.05
	Czechoslovakia	66	10.8—11.9	11.34±0.44	3.94	3.2—3.7	3.40±0.17	5.09
	Bulgaria	9	11.0—11.7	11.34±0.39	3.41	3.3—3.6	3.45±0.22	6.48

edges of the alveolae I¹ to the end of the *proc. condyloideus, s. articularis*, (3) the height of the *ramus mandibulae* from the *inc. praeangularis mandibulae* to the top of the *proc. coronoideus, s. muscularis* (Ruprecht, 1965). The accuracy of the measurements amounted to 0.1 mm. Mean values computed for both species from different populations were examined statistically by Student's *t*-test, for comparing means of independent groups.

III. RESULTS

The results obtained indicate that in both species the extreme lengths of the maxillary tooth-row are not overlapping. The boundary class being 5.6 mm, but 6 per cent of *P. auritus* is found in the 5.5 mm class, and 5 per cent of *P. austriacus* belongs to the 5.6 mm class. This does not exclude the possibility that some extreme specimens belonging to one of the two species may exceed the value 5.6 mm (cf. also Lanza, 1960; Saint Girons, 1964).

The ranges of the mandible length and of the height of the *ramus mandibulae* overlap in both species (Table 1, Fig. 1). It has been stated, however, that the values of the mandible length does not overlap to the extent observed by Hanák (1962). The common values of mandibular length are in the 10.8—11.0 mm classes, which embrace 4 per cent of *P. auritus* and 18 per cent of *P. austriacus* (Fig. 1).

The 3.2 mm height of the *ramus mandibulae* is in a class common to both species. This class contains 3 per cent of *P. auritus* and 4 per cent of *P. austriacus* (Fig. 1).

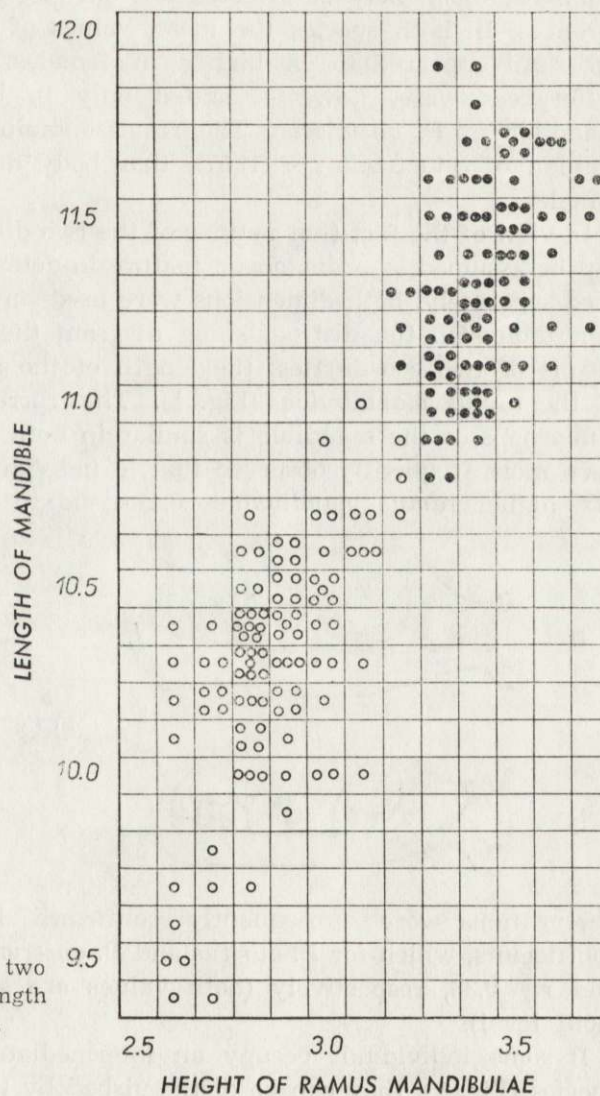


Fig. 1. Correlation between two mandible measurements (length and height) in *Plecotus*.

● — *P. austriacus*,
○ — *P. auritus*.

In the populations of both species investigated the ranges of the coefficient of variation show a relatively small variability in the length of the mandible ($Cv = 3.41 - 3.99$) and a somewhat greater one in the height of the *ramus mandibulae* ($Cv = 4.93 - 8.62$).

The mean values of three measurements for different populations show no statistically significant differences (Table 1). The variability in the dimensions of the skull, analysed in geographical aspects (cf. Hanák, 1966), may be affected not only by age but also by sex differences. In both species the mean values of the three dimensions of the skull appeared to be higher in females. Statistically significant differences were, however, stated only in both dimensions of the mandible in *P. austriacus*. The results obtained seem to confirm the opinion of Stebbings (1967), that body dimensions are greater in females.

In view of the fact that neither of the two dimensions of the mandible can be assumed as a diagnostic feature in determining the species when used separately, both dimensions were used simultaneously in a correlation table. On the distinguishing diagram the specimen is defined by means of two coordinates: the length of the mandible and the height of the *ramus mandibulae* (Fig. 1). The correlation between the two dimensions of the mandible is similar in both species. It has, however, been more frequently observed that in individuals belonging to *P. auritus*, higher *ramus mandibulae* correspond to longer mandibles. Those

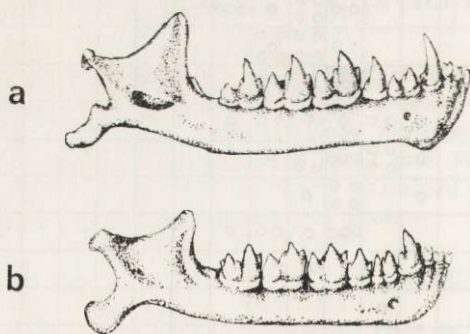


Fig. 2. The shape of the mandible in *Plecotus*. a — *P. austriacus*, b — *P. auritus*.

observations were subsequently confirmed by computed correlation coefficients, which for *P. auritus* and *P. austriacus* amounted to $r = 0.61$ and $r = 0.38$, respectively (both values are statistically significant at 0.001 level).

If some individuals occupy an intermediate zone between the two species (Fig. 1), they can be distinguished by the following morphological characters:

P. austriacus — *proc. angularis mandibulae* long, distinctly directed outward, blunt, median portion with a well-marked horn.

P. auritus — *proc. angularis mandibulae* short, less distinctly directed outward, ending with a club-shaped widening, its median portion does not possess a distinct horn (Fig. 2; Ruprecht, 1965).

IV. DISCUSSION

As reported by Hanák (1966) the representatives of the genus *Plecotus* are characterized by geographical variability in the condylo-basal length and *bulla tympanica* length. It seems probable that other dimensions of the skull may illustrate geographical variability of both species, depending on the degree of their correlation with the condylo-basal length.

The analysis to which the material investigated has been subjected, shows that bats from Poland, Czechoslovakia and Bulgaria are not highly differentiated (Table 1). None of the differences in the dimensions of the mandible investigated in different populations of both species appeared statistically significant. The data obtained confirm the low morphologic variability in Central European populations of the genus *Plecotus* (cf. also Hanák, 1966).

The relationship between the condylo-basal length and the mandible length (*P. auritus* — $r = 0.7665$, *P. austriacus* — $r = 0.8042$) is of a great importance in practical application of the distinguishing diagram, especially since, according to Šachlová (1966), the effect of size on body proportions is identical in both species. In practical application of the diagram it should be realized that populations of both *P. auritus* and *P. austriacus* may show brachycephalic or dolichocephalic tendencies within their geographical ranges (Hanák, 1966), these may be associated with proportional decrease or increase in mandible measurements.

Considering the weak differentiation between the Central European populations of both species, it seems that the distinguishing diagram will find its practical application at least in Central Europe.

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TAKSONOMICZNA WARTOŚĆ POMIARÓW ŻUCHWY PRZEDSTAWICIELI RODZAJU *PLECOTUS* GEOFFROY, 1818

Zbadano zmienność wymiarów żuchwy nietoperzy z rodzaju *Plecotus* Geoffroy, 1818, z obszaru Europy środkowej ($n = 100$ *P. auritus* i $n = 100$ *P. austriacus*). U obu gatunków stwierdzono stosunkowo małą zmienność długości żuchwy ($Cv = 3,41 - 3,99$) i nieco wyższą w wysokości *ramus mandibulae* ($Cv = 4,93 - 8,62$). Wartości pomiaru długości żuchwy są wspólne dla obu gatunków w klasach 10,8—11,0 mm, zawierających 4% *P. auritus* i 18% *P. austriacus*. W wysokości *ramus mandibulae*, wspólny zakres dla obu gatunków przypada na klasę 3,2 mm (3% *P. auritus* i 4% *P. austriacus*). Całkowite rozdzielenie obu gatunków umożliwia równoczesne porównanie dwu pomiarów przy pomocy diagramu ich korelacji, z uwzględnieniem cech opisowych żuchwy. Metoda ta może znaleźć praktyczne zastosowanie dla oznaczania materiałów kopalnych, względnie pochodzących z wypluwek sów.