

## CONTRIBUTIONS TO THE MORPHOLOGICAL STUDY OF THE COXAL BONE OF 11 BAT SPECIES (MAMMALIA: CHIROPTERA) FROM ROMANIA\*

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**Abstract.** It is described the coxal bone of 11 European bat species of the families Rhinolophidae and Vespertilionidae. The material originates in the Maramureș Depression, Dobrogea, Banat and Bucharest. Coxal bones have specific structures, which allow the identification of the species, especially when there are only skeletal remains of the pelvic girdle. In the future, on the base of the coxal bone study, the identification keys of the bat species will be completed. Thus, the paper becomes necessary both to the mammalogists and the ornithologists who study the food of some birds of prey and also to the palaeontologists who want to establish the faunal structure of some fossil deposits.

**Résumé.** On décrit l'os coxal des 11 espèces de chauve-souris européennes des familles Rhinolophidae et Vespertilionidae. Le matériel a été collecté dans la Dépression Maramureș, Dobrogea, Banat et Bucarest. L'os coxal a une structure spécifique qui permet l'identification de l'espèce, en particulier quand on a les restes de la ceinture pelvienne. A l'avenir, conformément à l'étude de l'os coxal la clé d'identification des espèces de chauve-souris sera complétée. Donc, le travail deviendra utile pour les mammalogistes ainsi que pour les ornithologistes qui étudient la nourriture des oiseaux de proie et pour les paléontologistes qui souhaitent établir la structure faunistique des certaines sédiments fossiles.

**Key words :** coxal bone, morphology, description, Chiroptera, Rhinolophidae and Vespertilionidae.

Up to this paper, studies of comparative anatomy in mammals were made for: the spine by Dornescu & Nițescu (1965), Nițescu (1966), the pelvic girdle by Herăñ (1968), the turbinated bones by Andreescu-Nițescu (1970), the coxal bone by Nițescu-Andreescu, (1971), the shoulder bone by Žalman (1971), the postcranial skeleton by Červený & Žalman (1974), Červený (1978), coxal bone of 6 South American bat species by Răduleț & Murariu (2000); measurements of the coxal bones by Herăñ (1967).

The knowledge of the coxal bone morphology allows the identification of the species after the skeletal remains from pelets or found in caves, atticks, etc. The paper is necessary to the mammalogists, ornithologists and palaeontologists. In the future, on the base of the coxal bone study, the identification keys of the bat species will be completed.

We present the coxal bone of 11 bat species of the families Rhinolophidae and Vespertilionidae.

### MATERIAL AND METHODS

The studied specimens are collected from the Maramureș Depression, Dobrogea, Banat and Bucharest. The material was obtained by maceration, mechanical processing, than it was treated with perhydrol, and finally studied using the stereomicroscope and drawn using the camera lucida.

\* English translation by Mihaela Barcan Achim.

The study was made on the following species:

- *Rhinolophus ferrumequinum* (Schreber, 1774)
- *Rhinolophus hipposideros* (Bechstein, 1800)
- *Myotis blythii* (Tomes, 1857)
- *Myotis capaccinii* (Bonaparte, 1837)
- *Myotis mystacinus* (Kuhl, 1819)
- *Eptesicus serotinus* Schreber, 1774
- *Nyctalus noctula* (Schreber, 1774)
- *Nyctalus leisleri* (Kuhl, 1818)
- *Pipistrellus pipistrellus* (Schreber, 1774)
- *Plecotus austriacus* (Fischer, 1829)
- *Miniopterus schreibersi* (Kuhl, 1819)

#### RESULTS

The description of the coxal bone morphology in the 11 species

Coxal bone in *Rhinolophus ferrumequinum* (Schreber, 1774) (Fig. 1) has: *facies glutea* (FG) concave; *ala ossis ilii* (AI) lamellar, thin; *corpus ossis ilii* (COI) developed; *eminentia iliopubica* (EIP) in outer lateral view, slightly directed outerly with the terminal part vertical, upwards, flattened tip in the antero-posterior view; *incisura praeacetabularis* (IPA) semicircular, wide; *fossa acetabuli* (FA) deep, bounded by *facies lunata* (FL); *incisura acetabuli* (IA) wide; *ramus caudalis ossis pubis* (RCOP) as a thin blade, wide; *ramus ossis ischii* (ROI), together with *tabula ossis ischii* (TAI), forms a wide blade (ca. 2 mm), thin; *foramen obturatum* (FO) oval; *symphysis pubica* (SP) long; *tuber ischiadicum* (TI) thicker than *tuberculum pubicum* (TP).

In *Rhinolophus hipposideros* (Bechstein, 1800) (Fig. 2) the coxal bone resembles very much with that of *Rh. ferrumequinum*, but smaller, with: a lamellar *ala ossis ilii* (AI), very thin; *facies glutea* (FG) concave; *incisura praeacetabularis* (IPA) as a wide hook; *corpus ossis ilii* (COI) very developed, *fossa acetabuli* (FA) eaves-like, above, of a middle depth; *facies lunata* (FL) half-moon shaped; *incisura acetabuli* (IA) very wide; *eminentia iliopubica* (EIP) well developed, with flattened tip, directed to the pelvic cavity; *ramus caudalis ossis pubis* (RCOP) thin, wide (ca. 0.75 mm), oblique to the pelvic cavity; *ramus ossis ischii* (ROI), together with *tabula ossis ischii* (TAI), forms a thin wide bony blade, with the lower terminal margin thick, rugged, bent outerly; *foramen obturatum* (FO) ellipsoidal; *symphysis pubica* (SP) short; *tuber ischiadicum* (TI) thick, rounded, rugged; *tuberculum pubicum* (TP) short, thick, in a 90° angle, directed to the pelvic cavity.

In the species *Myotis blythii* (Tomes, 1857) (Fig. 3) *crista iliaca* (CI) slightly concave; *facies glutea* (FG) slightly convex; *spina iliaca dorsalis cranialis* (SIDRC) and *spina iliaca ventralis* (SIV) well developed; *eminentia iliopubica* (EIP) short, pyramidal and with the tip flattened antero-posteriorly; *corpus ossis ilii* (COI) prominent; *incisura praeacetabularis* (IPA) semicircular; *fossa acetabuli* (FA) deep, bordered by *facies lunata* (FL) almost reniform; *incisura acetabuli* (IA) wide; *ramus caudalis ossis pubis* (RCOP) wider than *ramus ossis ischii* (ROI) and convex towards outside, the terminal inferior part of ROI thick as a sole; *tabula ossis ischii* (TAI) thick, rugged; *foramen obturatum* (FO) cordiform; *symphysis pubica* (SP) short, thick; *tuber ischiadicum* (TI) almost in a right angle; *tuberculum pubicum* (TP) thick, towards inside, and in the adult individuals, fused and ossified.

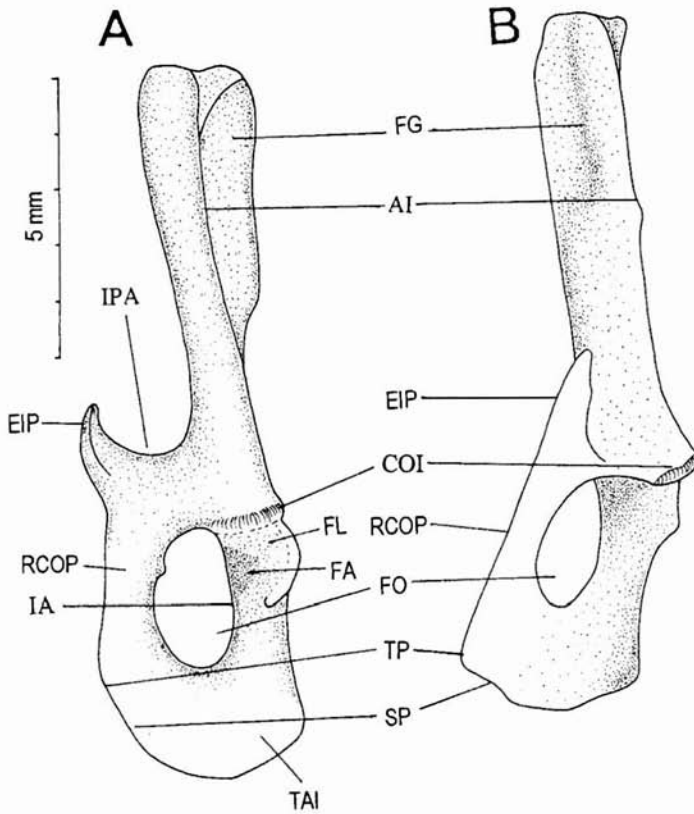


Fig. 1 – Left coxal bone in *Rhinolophus ferrumequinum* (Schreber, 1774): A, external lateral view; B, anteroposterior view (profile).

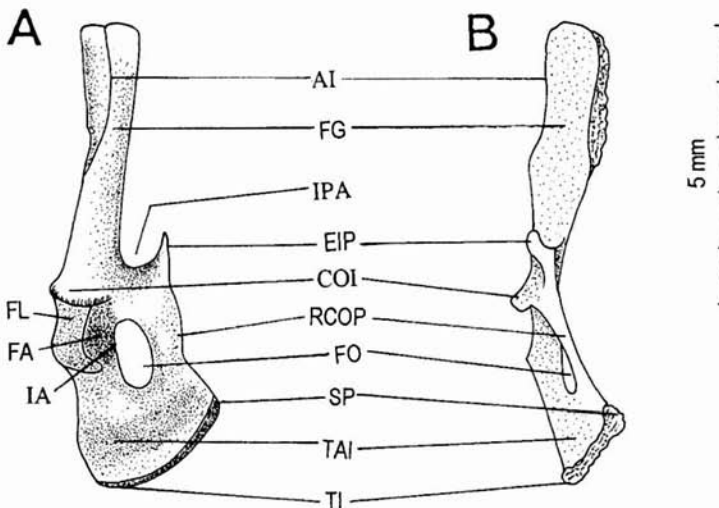


Fig. 2 – Right coxal bone in *Rhinolophus hipposideros* (Bechstein, 1800): A, external lateral view; B, anteroposterior view (profile).

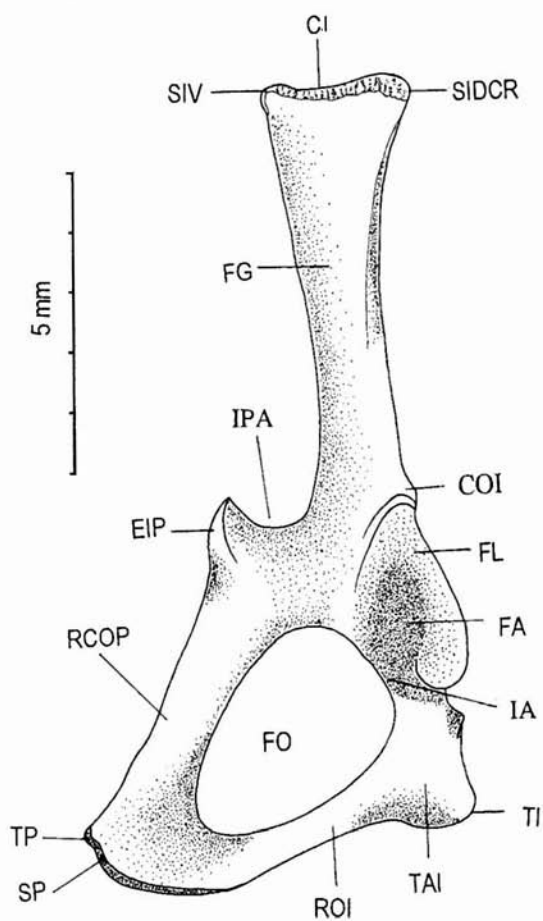


Fig. 3 – *Myotis blythii* (Tomes, 1857), external lateral view of the left coxal bone.

in transversal section; *ramus ossis ischii* (ROI) narrow, thinner than RCOP; *tabula ossis ischii* (TAI) small, rugged; *incisura acetabuli* (IA) narrow; *foramen obturatum* (FO) cordiformly elongated; *symphysis pubica* (SP) short of about 1 mm, but thick; *tuber ischiadicum* (TI) rounded, thick, rugged; *tuberculum pubicum* (TP) rounded, thick, innerwardly directed.

*Eptesicus serotinus* Schreber, 1774 (Fig. 6) has a *facies glutea* slightly convex; *eminentia iliopubica* (EIP) short, cone-shaped with a rounded tip; *incisura praeacetabularis* (IPA) semicircular; *fossa acetabuli* (FA) deep; *facies lunata* (FL) slightly reniform; *incisura acetabuli* (IA) wide; *ramus caudalis ossis pubis* (RCOP) and *ramus ossis ischii* (ROI) thick, narrow, slightly curved outwardly; *tabula ossis ischii* (TAI) thick; *foramen obturatum* (FO) cordiform widely rounded; *symphysis pubica* (SP) short, thick; *tuber ischiadicum* (TI) developed, rounded; *tuberculum pubicum* (TP) rounded, innerly directed.

*Myotis capaccinii* (Bonaparte, 1837) (Fig. 4) has: *facies glutea* (FG) convex; *corpus ossis ilii* (COI) prominent; *eminentia iliopubica* (EIP) short, flattened and antero-posteriorly directed; *incisura praeacetabularis* (IPA) hook-shaped; *fossa acetabuli* (FA) deep; *facies lunata* (FL) reniform; *incisura acetabuli* (IA) narrow; *ramus caudalis ossis pubis* (RCOP) thick, oblique, wider than *ramus ossis ischii* (ROI) which is thin, outerly convex, and in its lower part sole-like widened; *tuber ischiadicum* (TI) rounded, but as *tabula ossis ischii* (TAI) thick and rugged; *foramen obturatum* (FO) cordiformly elongated; *symphysis pubica* (SP) short, wide; *tuberculum pubicum* (TP) rounded, innerly directed.

*Myotis mystacinus* (Kuhl, 1819) (Fig. 5) has: *crista iliaca* (CI) flat; *facies glutea* (FG) convex; *corpus ossis ilii* (COI) outwardly prominent; *eminentia iliopubica* (EIP) pyramidal (in outer lateral view) with its tip vertically upwardly directed; *incisura praeacetabularis* (IPA) hook-like; *fossa acetabuli* (FA) deep, bordered by *facies lunata* (FL); *ramus caudalis ossis pubis* (RCOP) narrow, thick and ovoid

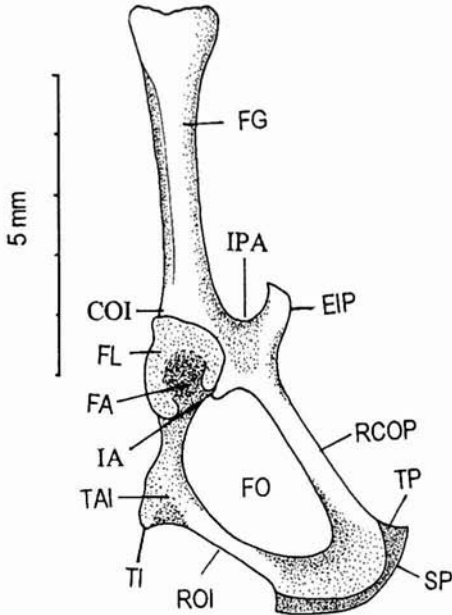


Fig. 4 – *Myotis capaccinii* (Bonaparte, 1837), external lateral view of the right coxal bone.

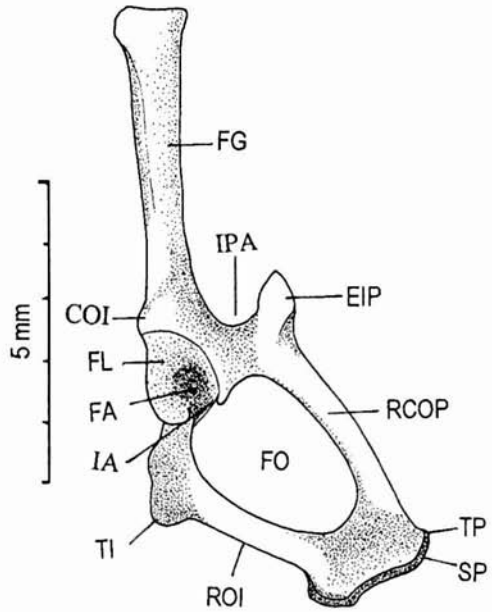


Fig. 5 – *Myotis mystacinus* (Kuhl, 1819), external lateral view of the right coxal bone.

In *Nyctalus noctula* (Schreber, 1774) (Fig. 7) it can be observed: *facies glutea* (FG) slightly convex; *corpus ossis ilii* (COI) well developed and outerly directed; *eminentia iliopubica* (EIP) pyramidal with the sharp tip upwardly directed; *incisura praeacetabularis* (IPA) almost semicircular; *fossa acetabuli* (FA) deep, bordered by *facies lunata* (FL); *ramus cranialis ossis pubis* (RCROP) wide; *ramus caudalis ossis pubis* (RCOP) as a convex blade outwards and wider than *ramus ossis ischii* (ROI) which is slightly thicker and also convex outwards; *tabula ossis ischii* (TAI) and *tuber ischiadicum* (TI) thick and rugged; *foramen obturatum* (FO) cordiform; *symphysis pubica* (SP) long, and *tuberculum pubicum* (TP) rounded.

In *Nyctalus leisleri* (Kuhl, 1818) (Fig. 8) *facies glutea* (FG) is flat; *corpus ossis ilii* (COI) prominent; *eminentia iliopubica* (EIP) short, prismatic, flattened antero-posteriorly; *incisura*

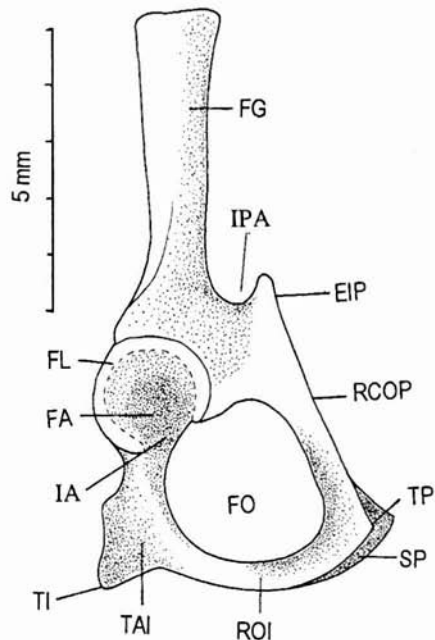


Fig. 6 – *Eptesicus serotinus* Schreber, 1774, external lateral view of the right coxal bone.

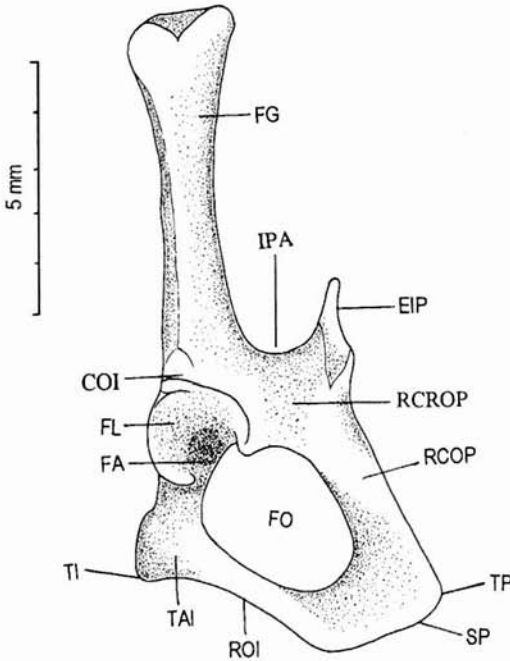


Fig. 7 – *Nyctalus noctula* (Schreber, 1774), external lateral view of the right coxal bone.

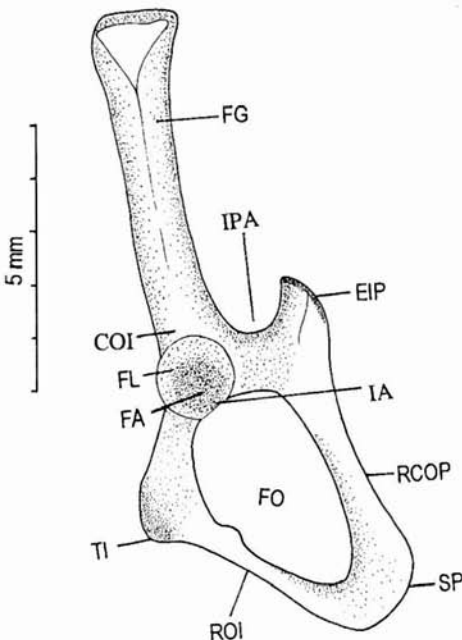


Fig. 8 – *Nyctalus leisleri* (Kuhl, 1818), external lateral view of the right coxal bone.

*praeacetabularis* (IPA) semicircular; *fossa acetabuli* (FA) deep; *facies lunata* (FL) circular; *incisura acetabuli* (IA) narrow; *ramus caudalis ossis pubis* (RCOP) thick, wide (ca. 1 mm), arranged obliquely towards pelvic cavity; *ramus ossis ischii* (ROI) thin, narrow, convex outwardly; *tabula ossis ischii* (TAI) big, thick, rugged; *foramen obturatum* (FO) cordiformly elongated; *symphysis pubica* (SP) long; *tuber ischiadicum* (TI) thick, rounded;

*Pipistrellus pipistrellus* (Schreber, 1774) (Fig. 9) *crista iliaca* (CI) convex; *facies glutea* (FG) convex; *corpus ossis ilii* (COI) prominent; *eminentia iliopubica* (EIP) short, with a rounded tip; *incisura praeacetabularis* (IPA) semicircular; *fossa acetabuli* (FA) deep, bordered by *facies lunata* (FL); *incisura acetabuli* (IA) wide; *ramus caudalis ossis pubis* (RCOP) slightly wider and thicker than *ramus ossis ischii* (ROI), but both are convex outwardly; *tabula ossis ischii* (TAI) small, thick; *foramen obturatum* (FO) cordiformly elongated; *symphysis pubica* (SP) short; *tuber ischiadicum* (TI) rounded; *tuberculum pubicum* (TP) rounded innerly directed.

Characteristic to the species *Plecotus austriacus* (Fischer, 1829) (Fig. 10) *facies glutea* (FG) convex; *corpus ossis ilii* (COI) prominent; *eminentia iliopubica* (EIP) short, flattened antero-posteriorly; *incisura praeacetabularis* (IPA) hook-shaped; *fossa acetabuli* (FA) deep; *facies lunata* (FL) reniform; *incisura acetabuli* (IA) wide; *ramus caudalis ossis pubis* (RCOP) and *ramus ossis ischii* (ROI) thick, narrow, oblique innerwardly; *tabula ossis ischii* (TAI); *foramen obturatum* (FO) almost ellipsoidal;

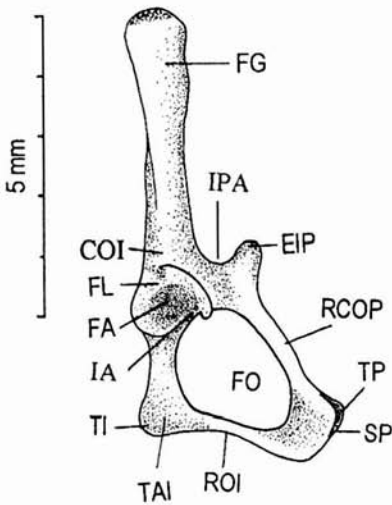


Fig. 9 - *Pipistrellus pipistrellus* (Schreber, 1774), external lateral view of the right coxal bone.

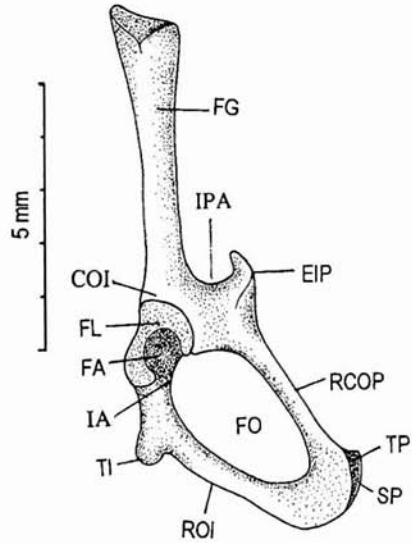


Fig. 10 - *Plectotus austriacus* (Fischer, 1829), external lateral view of the right coxal bone.

*symphysis pubica* (SP) short; *tuber ischiadicum* (TI) thick, prominent; *tuberculum pubicum* (TP) rounded.

For the species *Miniopterus schreibersi* (Kuhl, 1819) (Fig. 11) the following features are characteristic: *facies glutea* (FG) flat; *eminentia iliopubica* (EIP) with a flattened tip antero-posteriorly and directed towards the pelvic cavity; *incisura praeacetabularis* (IPA) hook-shaped; *fossa acetabuli* (FA) deep; *facies lunata* (FL) well delimited; *incisura acetabuli* (IA) wide; *ramus caudalis ossis pubis* (RCOP) slightly wider than *ramus ossis ischii* (ROI), convex outwardly, and ROI has the terminal inferior part thick, rugged; *tuber ischiadicum* (TI) rounded and together with *tabula ossis ischii* (TAI) thick and rugged; *foramen obturatum* (FO) oval asymmetrical; *symphysis pubica* (SP) short and thick; *tuberculum pubicum* (TP) thick, innerly directed.

The main structures (FG, EIP, COI, FA, FL, RCOP, ROI, FO, TAI, TI,

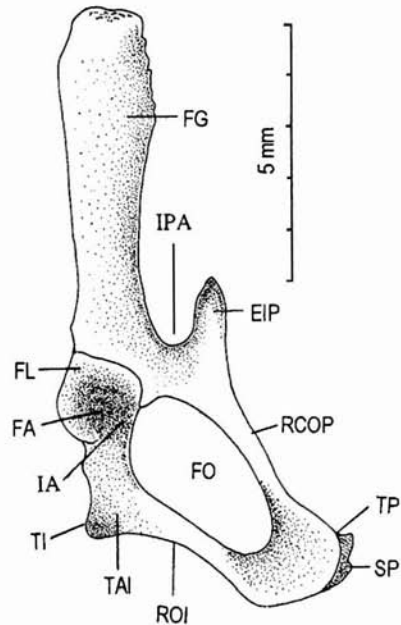


Fig. 11 - *Miniopterus schreibersi* (Kuhl, 1819), external lateral view of the right coxal bone.

TP, SP) are different from a species to another by size, shape, position, thickness, direction to one another. Thus, the coxal bone is characteristic to every species thus it can be taken into consideration in any identification key for bats, and not only for them, but also for all mammals. This paper will be useful for mammalogists, ornithologists and palaeontologists.

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### CONTRIBUȚII LA STUDIUL MORFOLOGIEI OSULUI COXAL DE LA 11 SPECII DE LILIECI (MAMMALIA: CHIROPTERA) DIN ROMÂNIA

#### REZUMAT

În lucrare se prezintă osul coxal de la 11 specii de lilieci din România: *Rhinolophus ferrumequinum* (Schreber, 1774), *Rhinolophus hipposideros* (Bechstein, 1800), *Myotis blythii* (Tomes, 1857), *Myotis capaccinii* (Bonaparte, 1837), *Myotis mystacinus* (Kuhl, 1819), *Eptesicus serotinus* Schreber, 1774, *Nyctalus noctula* (Schreber, 1774), *Nyctalus leisleri* (Kuhl, 1818), *Pipistrellus pipistrellus* (Schreber, 1774), *Plecotus austriacus* (Fischer, 1829), *Miniopterus schreibersi* (Kuhl, 1819). Studiul a fost realizat pe baza materialului colectat din Depresiunea Maramureș, Dobrogea, Banat și București. Pentru fiecare specie se prezintă desene ale osului coxal cu părțile componente și explicațiile necesare, corespunzătoare "Nomina anatomica veterinaria", Červený (1978). Cunoașterea osului coxal, în viitor, va completa cheile de determinare a speciilor de mamifere și va fi de un real ajutor pentru mamalogii, ornitologii care studiază hrana unor păsări răpitoare și paleontologilor.

#### LITERATURE CITED

- ANDREESCU-NIȚESCU, I., 1970 - Étude comparative des cornetes nasaux chez: *Talpa europaea* L., *Crociodura leucodon* Herm., *C. suaveolens* Pall., *Sorex araneus* L., et *Neomys fodiens* Schreb. (Ord. Insectivora) de Roumanie. Travaux du Muséum d'Histoire Naturelle "Grigore Antipa", 10: 359-363.
- ČERVENÝ, J., 1978 - Comparative anatomy of large bones in three models of european bats (*Rhinolophus*, *Myotis*, *Tadarida*) Vestnik Československé Společnosti. Zoologické, 42 (3): 161-171.
- ČERVENÝ, J., J. ŽALMAN, 1974 - Diagnostiké znaky na kostech přední končetiny vrápenců. Lynx Museum Nationale. Praha, 16: 86-100.
- DORNESCU, TH., I. NIȚESCU, 1965 - Anatomie comparée de la colonne vertébrale chez plusieurs espèces de rongeurs de Roumanie. Travaux du Muséum d'Histoire Naturelle "Grigore Antipa", 5: 423-441.
- HERÁŇ, I., 1967 - K rozdílu v morfologii pánve sviště horského (*Marmota marmota* L.) veverky obecné (*Sciurus vulgaris* L.) a sysla obecného (*Citellus citellus* L.) Lynx Museum Nationale, Praha, 8: 7-14.
- HERÁŇ, I., 1968 - Diagnostiké znaky na pánvích šelem. Lynx Museum Nationale, Praha, 9: 25-3.
- NIȚESCU, I., 1966 - Anatomie comparée de la colonne vertébrale chez *Ondatra zibethica* L., *Apodemus agrarius* Pall. et *Spalax leucodon* Nordmann. Travaux du Muséum d'Histoire Naturelle "Grigore Antipa", 6: 345-356.
- NIȚESCU-ANDREESCU, I., 1971 - Contributions a l'étude de la morphologie du squelette des Mammifères de petite taille. Travaux du Muséum d'Histoire Naturelle "Grigore Antipa", 11: 417-427.
- RĂDULEȚ, N., D. MURARIU, 2000 - Taxonomical value of the morphological differences of the coxal bone in six South-American bat species (Chiroptera: Emballonuridae, Mormoopidae and Phyllostomidae). Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa", 42: 225-234.
- ŽALMAN, J., 1971 - Diagnostische merkmale an den schulterblättern einiger fledermäuse der familie Rhinolophidae Bell, 1836 und Vespertilionidae Gray, 1821. Vestnik Československé Společnosti. Zoologické, 35 (4): 311-319.

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