

# Evolution and skeletal characteristics of European owls

Jenő (Eugen) KESSLER

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**Abstract** Owls represent typical nocturnal avian predators. They are known since the beginning of the Tertiary. Thirteen species live in Europe, but the number of extinct fossil species is only slightly above twice that number. The present genera appeared in the Neogene period. They also have a major significance regarding palaeoecology, since most of the fossilized remains of small-medium sized vertebrates are available from owl pellets. The author wishes to describe the occurrence and evolution of owls in Europe from the Cretaceous to current times, as well as to provide an osteological guide of recent species. The text is supplemented by 16 plates, 4 size charts, and extensive bibliography.

Keywords: Europe, owl, evolution, palaeoecology, osteology

**Összefoglalás** A baglyok a madárvilág jellegzetes éjjeli ragadozóit képviselik. A harmadidőszak elejétől már ismertek. Európában 13 fajuk él, de a kihalt fosszilis fajaik száma is alig éri el ennek a kétszeresét. A mai nemzetségek a Neogénben jelentek meg. Jelentőségük paleoökológiailag igen nagy, hiszen a kis-közép és kistermetű szárazföldi gerincesek fosszilis maradványainak nagy része az ő köpetelő tevékenységüknek köszönhető. A jelen tanulmányban a szerző a baglyok európai jelenlétét és evolúcióját mutatja be a Krétától napjainkig, valamint a recens fajok csonttani határozóját is megadja. A szöveget 16 táblakép, 4 mérettáblázat és irodalomjegyzék egészíti ki.

Kulcsszavak: Európa, bagoly, evolúció, paleoökológia, csonttan

Department of Paleontology, Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary, e-mail: kessler\_jeno@yahoo.com

## Introduction

The order *Strigiformes* consists of nocturnal predators, although numerous species (like Snowy Owls and Short-eared Owls) also prey and feed during the day. They are present all across the globe except Antarctica and a number of oceanic islands. They vary in size, and so do their prey (from insects to bigger birds, fawn-sized mammals). Females are typically larger than males. They nest in crevices of rocks, tree burrows, uninhabited nests and buildings, their nestlings remain in the nest. Consumed but undigested body parts (bones, feathers, hair, scales) are disposed of in the form of pellets at their resting place regularly at the same location. True owls, barn owls, and a few extinct species belong to this category. The number of extinct and identified species is more than 200 worldwide.

True owls (*Strigidae*) incorporate numerous species. Their time of appearance within the fauna is uncertain. Two giant species reported in the 1970's from the Late Cretaceous

(Maastrichtian stage) of the Hátszegi Basin in Transylvania (*Bradycneme draculae* Harrison et Walker, 1975, *Heptasteornis andrewsi* Harrison et Walker, 1975) (Harrison & Walker 1975) were not accepted and are claimed by most professionals to be Maniraptora dinosaur remains (Feduccia 1999).

Their earliest actual sign comes from the Paleocene of the USA (*Ogygopterynx wetmorei* Rich et Bohaska, 1976) and the Eocene of Germany and France (*Palaeoglaux artophpron* Peters, 1992, *P. perrierensis* Mourer-Chauviré, 1987). We know of the genera *Mioglaux* from the Miocene of France and the Czech Republic with species *M. poirrieri* (Milne-Edwards, 1863) and *M. deballatrix* (Mlíkovský, 1998), as well as *Intilula* from the Miocene of the Czech Republic and Germany with species *I. tinnipara* (Mlíkovský, 1998) and *I. brevis* (Ballmann, 1969).

Recent genera have also been found from the Miocene-Pliocene, for example the genus *Strix* from the Miocene, with species *S. dakota* (A. H. Miller, 1944) in the USA, *S. winterhofensis* (Ballmann, 1969), *S. edwardsi* (Ennouchi, 1930) in Germany; the genus *Surnia* from the Miocene, Pliocene and Pleistocene of the Czech Republic and Hungary with species *S. robusta* (Jánossy, 1977) and *S. capeki* (Jánossy, 1972); genus *Glaucidium* from the Pliocene of Hungary (Beremend, Csarnóta) with *G. baranensis* (Kessler, 2010); genus *Bubo* from the Miocene of Hungary (Csákvár) with species *B. florianne* (Kretzoi, 1957); genus *Asio* from the Miocene of Ukraine with *A. longaevus* (Umans'ka, 1979) (Bochenski 1997, Mlíkovský 2002, Kessler 2013).

Barn owls (Tytonidae) are present in recent fauna with a cosmopolitan species (*Tyto alba*) and its numerous subspecies worldwide. Their extinct genera are *Palaeotyto* from the Oligocene of France with species *P. cadurcensis* (Mourer-Chauviré, 1987), and species of the genera *Necrobyas* and *Prosybris*: *N. harpax* (Milne-Edwards, 1892), *N. arvernensis* (Milne-Edwards, 1863), *N. rossignoli* (Milne-Edwards, 1892), *P. media* (Mourer-Chauviré, 1987), *P. antiqua* (Milne-Edwards, 1863); as well as the genus *Basityto* from the Miocene of Germany with species such as *B. rummeli* (Mlíkovský, 1998), while extinct species of the recent genus are *Tyto sanctialbani* (from the Miocene and Pliocene of France, Germany and Italy), *T. campiterrae* (from the Miocene of Hungary), *T. balearica* (from the Miocene of Spain), *T. gigantea* (from the Pliocene of Italy) (Brodkorb 1971, Olson 1985, Mourer-Chauviré 1987, Bochenski 1997, Mlíkovský 1998a, 1998b, 2002).

In the extinct Protostrigidae family, *Protostrix* is represented by species *P. lydekkeri* (Shufeldt, 1913), *P. leptosteus* (Marsh, 1871), *P. saurioidosis* (Wetmore, 1921), *P. californiensis* (Howard, 1965) and genus *Eostrix* with species *E. martinelli* (Martin et Black, 1972), *E. mimica* (Wetmore, 1938) and *E. vincenti* (Harrison, 1980) from the Eocene of the USA, and *Oligostrix rupelensis* (Fischer, 1982) from the Oligocene of Germany (Brodkorb 1971, Olson 1985, Mlíkovský 2002).

The extinct Sphiornithidae family is represented by a number of extinct genera and species among the fossil record. Earliest known examples are *Berruornis orbisantaqui* (Mourer-Chauviré, 1994) from the Paleocene of France, and from the Eocene by *Sophironis quercynus* (Mourer-Chauviré, 1987) and *Palaeobyas cracrafti* (Mourer-Chauviré, 1987) (Brodkorb 1971, Olson 1985, Mourer-Chauviré 1987, Bochenski 1997, Mlíkovský 2002).

It is worth noting that there is quite a number of overlaps, renaming and synonymizing when classifying extinct genera and species to the above-mentioned families.

Newer systematic paradigms suppose kinship between owls and Caprimulgiformes (Jarvis *et al.* 2014).

## Systematics

Thirteen species are known in the recent avian fauna of Europe. They are all present in the Carpathian Basin as well, but the Snowy Owl (*Nyctea scandiaca*), the Great Grey Owl (*Strix nebulosa*) and the Northern Hawk-owl (*Surnia ulula*) only as occasional or winter guests.

The occurrence of recent genera and species at sites of the Carpathian Basin and Europe, and signs of fossilized species from the Carpathian Basin are as follows:

**Abbreviations:** **Q1-Q2** – Lower Pleistocene; **Q3 (Q3/I-Q3/II)** – Middle Pleistocene; **Q4/I** – Upper Pleistocene; **Q4/II** – Holocene; † – extinct/fossil species.

Ord. Strigiformes (Wagler)

Fam. Tytonidae Ridgway, 1914

– *Tyto alba* (Scopoli, 1769)

Known from the Carpathian Basin **Q1:** of Betfia 2 (Romania) (Kormos 1913, Čapek 1917, Lambrecht 1933, Kessler 1975, Jánossy 1977, Gál 2002); **Q3/II:** of Vindija (Croatia) (M. Malez 1961, V. Malez 1973, 1988, 1991, V. Malez & Rukavina 1975), as well as the **Q3:** of France, Greece, Malta; **Q4/I-II:** of Bosnia Herzegovina, Croatia, Czech Republic, France, Greece, Ireland, Italy, Portugal, Spain, Switzerland, United Kingdom (Tyrberg 1998).

– *Tyto* sp. indet.

Known from the Carpathian Basin **Q1:** of Beremend 17 (Hungary) (Kessler 2010), as well as the **Q3:** Italy (Tyrberg 1998).

– *Tyto* † *sanctialbani* (Lydekker, 1893)

Known from the Upper Miocene (**MN 10**) of the Carpathian Basin: Gyepűfüzes (Kohfidisch) (Austria), (Mlíkovský 2002).

– *Tyto* † *campiterrae* (Jánossy, 1991)

Known from the Upper Miocene (**MN 13**) of the Carpathian Basin: Polgárdi 4, 5 (Hungary) (Jánossy 1991, 1995, Kessler 2010).

– *Tyto* † *melitensis* (Lydekker, 1891)

Known in the European Quaternary from **Q4/II:** of Malta (Tyrberg 1998).

– *Tyto* † *balearica* Mourer-Chauviré, Alcover (Moya et Pons, 1980)

Known in the European Neogene and Quaternary from **MN 15:** of France; **Q1:** of Spain (Tyrberg 1998).

– †*Prosybris antiqua* (Milne-Edwards, 1863)

Known from the Lower Miocene (**MN 3-4**) of the Carpathian Basin: Limberg (Austria) (Mlíkovský 1998).

Fam. Strigidae Vigors

– *Otus scops* (Linnaeus, 1758)

Known from the Carpathian Basin **Q1:** of Betfia 2 (Romania) (Kormos 1913, Čapek 1917, Lambrecht 1933); **Q3/I:** of Betfia 7/4 (Romania) (Kessler 1975, Jánossy 1977, Gál 2002); **Q3/II:** of Vindija (Croatia) (M. Malez 1961, V. Malez 1973, 1988, 1991, V. Malez &

Rukavina 1975); **Q4/I:** of Pilisszántói I. Niche (Hungary) (Lambrecht 1915, 1933, Jánossy 1977, 1979, 1986), as well as the **Q1:** of Spain; **Q3:** of Azerbaijan, Italy; **Q4/I-II:** of Croatia, Czech Republic, France, Greece, Italy, Moldova, Portugal, Spain, Ukraine, United Kingdom (Tyrberg 1998).

– *Bubo bubo* (Linnaeus, 1758)

Known from the Carpathian Basin **Q1:** of Betfia 2 (Romania) (Kormos 1913, Čapek 1917, Lambrecht 1933, Kessler 1975, Jánossy 1977, Gál 2002); **Q2:** of Nagyharsányhegy 1-4 (Hungary) (Lambrecht 1916, 1933); **Q3/I:** of Vértesszőlős 2 (Hungary) (Jánossy 1990); **Q3/II:** of Vindija (Croatia) (M. Malez 1961, V. Malez 1973, 1988, 1991, V. Malez & Rukavina 1975); **Q4/I:** of Krapina (Croatia); Buják, Hámor-Herman Ottó Cave, Tokod-Nagyberek (all in Hungary); Szegyesztel-Tibocoia Cave (Sighiștel) (Romania) (Lambrecht 1912, 1915, V. Malez 1973, 1984, Jánossy 1978, 1979, Kessler 1982, 1985, M. Malez & V. Malez 1988, Gál 2002); **Q4/II:** of Teufelslucken (Austria); Csákvár-Esterházy Cave, Polgár-Csőszhalom, Tiszapolgár-Csőszhalom, Visegrád-Vár (all in Hungary); Körösrévi Caves (Vadu Crișului), Kazánszoros-Töröklik Cave (Cazanele Mari Defile), Szegyesztel-Tibocoia Cave (Sighiștel Defile) (all in Romania) (Bökönyi & Jánossy 1965, Soergel 1966, Kessler 1974a, 1982, Fischer & Stephan 1977, Jánossy 1979, 1985, Gál 2004, 2005, 2007b), as well as the **Q1-2:** of Spain; **Q3:** of Azerbaijan, France, Germany, United Kingdom; **Q4/I-II:** of Austria, Belgium, Belorussia, Bulgaria, Czech Republic, France, Georgia, Germany, Italy, Poland, Portugal, Romania, Russia, Spain, Serbia, Ukraine, United Kingdom (Tyrberg 1998).

– *Bubo/Nyctea* sp.

Known in the European Quaternary from **Q3:** of France; **Q4/I:** of Austria (Tyrberg 1998).

– *Bubo bubo* † *davidi* (Mourer-Chauviré, 1975)

Known in the European Quaternary from **Q3:** of France; **Q4/I:** of Spain (Tyrberg 1998).

– *Bubo?* † *floriana* (Kretzoi, 1957)

Known from the Upper Miocene (**MN 11**) of the Carpathian Basin: Csákvár (Hungary) (Kretzoi 1957).

– *Bubo* † *binagedensis* (Burchak-Abramovich, 1965)

Known in the European Quaternary from **Q3:** of Azerbaijan (Tyrberg 1998).

– *Bubo* † *insularis* (Mourer-Chauviré et Weesie, 1986)

Known in the European Quaternary from **Q4/I:** of France, Italy (Tyrberg 1998).

– *Bubo* sp. foss. indet.

Known from the Carpathian Basin **MN 15:** of Csarnóta 2 (Hungary) (Kretzoi 1961-62, Jánossy 1977); **MN 16:** of Osztramos 7, Villány 3 (all in Hungary) (Jánossy 1973, 1977, Kessler 2010).

– *Surnia ulula* (Linnaeus, 1758)

Known from the Carpathian Basin **Q4/I:** of Luegloch (Austria); Budapest-Remetehegyi Niche, Felsőtárkány-Peskő Cave, Gencsapáti, Hámor-Puskaporos Niche, Pilisszántói I. Niche, Répáshuta-Balla Cave, Szilvásvár-Ístállós-kői Cave, Varbó-Lambrecht Kálmán Cave (all in Hungary); Detreköszentmiklós-Pálffy Cave (Dzereva Skála) (Slovakia) (Lambrecht 1912, 1913, 1916, 1933, Jánossy 1952, 1954, 1955, 1977, 1979, 1986, Mottl 1953), as well as the **Q3:** of Germany, Italy; **Q4/I:** of Austria, France, Germany, Italy, Poland, Russia, Switzerland, Ukraine, United Kingdom (Tyrberg 1998).

– *Surnia* † *robusta* (Jánossy, 1977)

Known from the Upper Miocene (**MN 13**) of the Carpathian Basin: Polgárdi 4, 5 (Hungary) (Kessler 2010); **MN 16**: of Osztramos 7, Beremend 4, Villány 3 (all in Hungary) (Jánossy 1977); **Q1-2**: of Nagyharsányhegy 1-4, Somssich Hill 2 (all in Hungary) (Jánossy 1977, 1982, 1983, 1986).

– *Surnia* † *capeki* Jánossy, 1978

Known in the European Quaternary from **Q3**: of the Czech Republic (Jánossy 1972).

– *Glaucidium passerinum* (Linnaeus, 1758)

Known from the Carpathian Basin **Q1**: of Némétóvár (Deutsch Altenburg) (Austria); Betfia 2, 9 (Romania) (Kormos 1913, Čapek 1917, Lambrecht 1933, Jánossy 1977, 1979, 1981, Gál 2002); **Q3/I**: of Hundsheim (Austria) (Jánossy 1974, Mlikovský 2002); **Q4/I**: of Budapest-Remetehegyi Niche, Hámor-Hermann Ottó Cave (all in Hungary) (Lambrecht 1912, 1915, 1933, Jánossy 1977, 1979, 1986), as well as the **Q1-2**: of Greece, Poland; **Q3**: of the Czech Republic, Germany, Turkey; **Q4/I-II**: of the Czech Republic, France, Germany, Poland (Tyrberg 1998).

– *Glaucidium* † *baranensis* Kessler, 2010

Known from the Lower Pliocene (**MN 15**) of the Carpathian Basin: Csarnóta 2, Beremend 26 (all in Hungary) (Kessler 2010, 2013).

– *Athene noctua* (Scopoli, 1769)

Known from the Carpathian Basin **Q4/I**: of Pilisszántói I. Niche (Hungary); Barcarozsnyó-Gura Cheii Cave (Râșnov) (Romania) (Lambrecht 1915, 1933, Jánossy 1977, 1979, 1986, Gál 1998, 2002); **Q4/II**: of Balatonkeresztúr-Réti-dűlő, Pilismarót-Malompaták (Hungary); Révitzfalusi Cave (Zece Hotare), Szegyestel-Drăcoia Cave (Sighiștel Defile) (Romania) (Kessler 1982, Jánossy 1985, Gál 2007a, 2007b), as well as the **Q1-2**: of France, Ukraine; **Q3**: of Azerbaijan, Czechia, France, Greece, Italy, Ukraine; **Q4/I-II**: of Croatia, Czech Republic, France, Greece, Italy, Moldova, Portugal, Spain, Ukraine, United Kingdom (Tyrberg 1998).

– *Athene noctua* † *veta* (Jánossy, 1992) / *A. veta* (Jánossy, 1974)

Known from the Upper Miocene (**MN 13**) of the Carpathian Basin; Polgárdi 4 (Hungary) (Kessler 2010); **MN 15**: of Csarnóta 2, Beremend 26 (all in Hungary) (Kessler 2010); **MN 16**: of Osztramos 7 (Hungary) (Jánossy 1979); **Q1**: Beremend 16, 17 (Hungary) (Jánossy 1991, 1992, 1996); **Q2**: of Somssich Hill 2 (Hungary) (Jánossy 1982, 1983, 1986), as well as **MN 16**: of Poland; **Q1-2**: of Austria, Spain (Tyrberg 1998).

– *Athene noctua* † *lunellensis* Mourer-Chauviré, 1975

Known in the European Quaternary from **Q1-2**: France; **Q3**: of France (Tyrberg 1998).

– *Athene* † *cretensis* Weesie, 1982

Known in the European Quaternary from **Q4/I-II**: of Greece (Tyrberg 1998).

– *Athene* sp.

Known in the European Quaternary from **Q3**: of Italy; **Q4/I**: of Spain (Tyrberg 1998).

– *Athene* sp. foss. indet.

Known from the Upper Miocene (**MN 9**) of the Carpathian Basin: Rudabánya (Jánossy 1994).

– *Strix aluco* (Linnaeus, 1758)

Known from the Carpathian Basin **Q4/I**: of Krapina, Velika Pecina (all in Croatia); Eskülő-Igric Cave (Igrîța-Aștileu), Nándor-Nándori Cave (Curata-Nandru), Szegyesztel-Tibocociaia Cave (Sighiștel Defile) (all in Romania) (Jánossy 1965, V. Malez 1973, 1975, 1984, 1988, Fischer & Stephan 1977, Kessler 1982, 1985, Jurcsák & Kessler 1988, M. Malez & V. Malez 1988, Gál 2002, 2003); **Q4/II**: of Bodajk-Rigólyuk, Budapest-Aquincum, Ecsegfalva 23 sz., Endrőd 119, Jósvafő-Musztáng-Cave, Legény Cave, Miskolc-Felsőforrás, Visegrád Castle (all in Hungary); Felsőlubkó (Gornea), Körösbánlaci Cave (Bălnaca), Parța (Parța), Remetelórév-Bólyikő Cave (Piatra Boiului-Lorău), Körösrévi Caves (Vadu Crișului Defile), Révtizfalusi Cave (Zece Hotare), Szegyesztel-Drăcoiaia Cave (Sighiștel Defile), Szegyesztelvölgyi Caves (Sighiștel Defile), Vaskóh (Vașcău), Vársonkolyosi Caves (Șuncuiuș Defile) (all in Romania); Vlassac (Serbia) (Bökönyi & Jánossy 1965, Jánossy 1977, 1985, Kessler 1982, 1985, 2010, Kordos 1984, Kessler & Gál 1997, Gál 2004, 2007b, Pike-Tay *et al.* 2004), as well as the **Q1-2**: of Greece; **Q3**: Czech Republic, France, Georgia, Germany, Russia, Spain; **Q4/I-II**: Austria, Bosnia Herzegovina, Bulgaria, Croatia, Czech Republic, France, Germany, Italy, Moldova, Poland, Russia, Spain, Switzerland, Ukraine, United Kingdom (Tyrberg 1998).

– *Strix nebulosa* (Forster, 1772)

Known from the Carpathian Basin **Q4/I**: of Nándori Cave (Curata-Nandru) (Romania) (Jánossy 1965), as well as the **Q3**: of the Czech Republic; **Q4/I-II**: of Austria, Italy, Russia (Tyrberg 1998).

– *Strix uralensis* (Pallas, 1771)

Known from the Carpathian Basin **Q4/I**: of Budapest-Remetehegyi Niche (Hungary); Detreköszentmiklós-Pálffy (Dzereva Skála) (Slovakia) (Lambrecht 1913, 1933, Jánossy 1979, 1986); **Q4/II**: of Aggtelek Cave, Pilismarót-Malompaták (all in Hungary) (Jánossy 1977, 1985); Körösrévi Caves (Vadu Crișului Defile) (Romania) (Kessler 1982), as well as the **Q4/I-II**: of the Czech Republic, Italy, Poland (Tyrberg 1998).

– *Strix* † *intermedia* (Jánossy, 1972)

Known from the Carpathian Basin **MN 15**: of Beremend 26 (Hungary) (Kessler 2010); **MN 16**: of Villány 3 (Hungary) (Kessler 2010); **Q1**: of Beremend 16, 17 (Hungary) (Jánossy 1992, 1996); **Q3/I**: of Hundsheim (Austria) (Jánossy 1974); Tarkő 10, 11, 12, 13 (Hungary); Gombaszög (Gombasek) (Slovakia); (Jánossy 1974, 1977, 1979; Kessler 2010), as well as the **Q3**: of Czech Republic, France; **Q4/I**: of Spain (Tyrberg 1998).

– *Strix* sp.

Known in the European Quaternary from **Q4/I-II**: of France, Germany, Italy, Russia, Spain (Tyrberg 1998).

– *Aegolius funereus* (Linnaeus, 1758)

Known from the Carpathian Basin **Q1**: of Betfia 9 (Romania) (Gál 2002); **Q3/I**: of Tarkő/3, 12 (Hungary); Betfia 7/4 (Romania) (Kessler 1975, Jánossy 1979, Gál 2002); **Q4/I**: Budapest-Remetehegyi Niche, Cserépfalu-Subalyuk Cave, Hámor-Puskaporos Niche, Hámor-Herman Ottó Cave, Pilisszántói I. Niche, Szilvásvár-Ístállóskői Cave, Tatabánya-Szelim Cave (all in Hungary); Barcarozsnyó-Gura Cheii Cave (Râșnov) (Romania) (Lambrecht 1912, 1915, 1916, 1933, Jánossy 1952, 1955, 1977, 1979, 1986, Gál 1998, 2002); **Q4/II**: of Teufelslucken (Austria) (Soergel 1966), as well as the **Q3**: of Azerbaijan,

Czech Republic, France, Germany; **Q4/I-II**: of the Czech Republic, France, Greece, Germany, Italy, Poland, Russia, Ukraine, United Kingdom (Tyrberg 1998).

– ? *Aegolius* sp. foss. indet.

Known from the Carpathian Basin **MN 15**: of Csarnóta (Hungary) (Jánossy 1977, 1979, 1980); **MN 16**: of Villány 3 (Hungary) (Jánossy 1977, 1979, 1980).

– *Asio flammeus* (Pontoppidan, 1863)

Known from the Carpathian Basin **Q1**: of Osztramos 8 (Hungary) (Jánossy & Kordos 1976); Betfia 2 (Romania) (Kormos 1913, Čapek 1917, Lambrecht 1933, Kessler 1975, Jánossy 1977, Gál 2002); **Q3/I**: of Tarkő 2, Vértesszőlős 2 (all in Hungary) (Jánossy 1977, 1979); **Q3/II**: of Vindija (M. Malez 1961, V. Malez 1973, 1988, 1991, V. Malez & Rukavina 1975); Uppony 3 (Hungary) (Jánossy 1977, 1979); **Q4/I**: of Merkenstein (Austria); Bajót-Hóman-Cave, Bajót-Jankovich Cave, Budapest-Remetehegyi Niche, Hámor-Puskaporos Niche, Hámor-Herman Ottó Cave, Pilisszántói I. Niche, Répáshuta-Balla Cave, Répáshuta-Bal-lavölgyi Cave, Szilvásvárad-Istállóskői Cave, Tatabánya-Szelim Cave, Tokod-Nagyberek (all in Hungary); Körösmart (Râpa), Nándor-Nándori Cave (Curata-Nandru), Szegyesztel-Tibocoia Cave (Sighiștel Defile) (all in Romania); Detrekőszentmiklós-Pálffy Cave (Dzereva Skála), Novi I, III (all in Slovakia) (Nehring 1880, Róth 1881, Lambrecht 1912, 1915, 1916, 1933, Mottl 1941, Wettstein & Mühlhoffer 1938, Jánossy 1952, 1955, 1965, 1977, 1979a, 1986, Jánossy in Hamar & Csák 1969, Kessler 1974b, 1982, 1985, Fischer & Stephan 1977, Jurcsák & Kessler 1988, Gál 2002, 2003); **Q4/II**: of Grosse Offenbergerhöhle, Teufelslucken (all in Austria); Bégakalodva (Cladova), Parác (Parța) (all in Romania) (Soergel 1966, Bocheński & Tomek 1994, Kessler & Gál 1997, Gál 2004), as well as the **Q3**: of Azerbaijan, Czechia, France, Russia, Ukraine, United Kingdom; **Q4/I-II**: of Belgium, Bosnia Herzegovina, Czech Republic, France, Greece, Germany, Luxemburg, Moldova, Poland, Portugal, Russia, Spain, Ukraine, United Kingdom (Tyrberg 1998).

– *Asio otus* (Linnaeus, 1758)

Known from the Carpathian Basin **MN 16**: of Villány 3 (Hungary); Betfia 13 (Romania) (Kessler 1975, 2010, Gál 2002); **Q1**: of Betfia 2, 9 (Romania) (Kormos 1913, Čapek 1917, Lambrecht 1933, Kessler 1975, Jánossy 1977, Gál 2002); **Q3/II**: of Vindija (Croatia) (M. Malez 1961, V. Malez 1973, 1988, 1991, V. Malez & Rukavina 1979); **Q4/I**: of Velika Pečina (Croatia); Budapest-Remetehegyi Niche (Lambrecht 1915), Felsőtárkány-Peskő Cave (Lambrecht 1912, 1933, Jánossy 1977, 1979, 1986), Pilisszántói I. Niche (all in Hungary); Szegyesztel-Tibocoia Cave (Sighiștel Defile) (Romania) (Lambrecht 1915, 1933, V. Malez 1975, 1984, 1988, Jánossy 1977, 1979, 1986, Kessler 1982, 1985, Gál 2002); **Q4/II**: of Teufelslucken (Austria); Bodajk-Rigólyuk (Hungary); Remetelórév-Bólyikői Cave (Piatra Boiului-Lorău), Körösrévi Caves (Vadu Crișului Defile), Szkerisoara-Sasok Cave (Peștera Vulturilor-Scărișoara) (all in Romania) (Soergel 1966, Kessler 1982, Kordos 1984, Jurcsák & Kessler 1986, 1988), as well as the **Q3**: of Azerbaijan, France, Germany, Italy; **Q4/I-II**: of Austria, Belgium, Bosnia Herzegovina, Croatia, Czech Republic, France, Germany, Luxemburg, Poland, Romania, Serbia, Spain, Ukraine, United Kingdom (Tyrberg 1998).

– *Asio* sp. indet.

Known from the Carpathian Basin **Q1**: of Beremend 17 (Hungary) (Jánossy 1992, 1996), as well as the **Q4/I-II**: of Belgium, France, Germany, Moldova, Russia, Ukraine (Tyrberg 1998).

– *Nyctea scandiaca* (Linnaeus, 1758)

Known from the Carpathian Basin **Q3/II**: of Vindija (Croatia) (M. Malez 1961, V. Malez 1973, 1988, 1991, M. Malez & Rukavina 1979); **Q4/I**: of Merkenstein (Austria); Budapest-Remetehegyi Niche, Bivak Cave, Buják, Hámor-Puskaporos Niche, Varbó-Lambrecht Kálmán Cave (all in Hungary); Detreköszentmiklós-Pálffy Cave (Dzereva Skála), Novi I, III (all in Slovakia) (Nehring 1880, Róth 1881, Lambrecht 1912, 1916, 1933, Wettstein & Mülhofer 1938, Jánossy 1977, 1979, 1986); **Q4/II**: of Grosse Offenbergerhöhle, Hohlensteinhöhle (all in Austria); Csákvár-Esterházy Cave (Hungary); Kisderzsida (Derșida Mică) (Romania) (Kretzoi 1957, Bocheński & Tomek 1994, Bindea 2008), as well as the **Q1-2**: of France; **Q3**: of Azerbaijan, France, Germany, United Kingdom; **Q4/I-II**: of Austria, Belgium, Croatia, Czech Republic, France, Germany, Italy, Netherlands, Poland, Russia, Spain, Switzerland, Ukraine, United Kingdom (Tyrberg 1998).

– *Nyctea scandiaca* † *gallica* Mourer-Chauviré, 1975

Known in the European Quaternary from **Q3**: of France; **Q4/I**: of France (Tyrberg 1998).

– *Nyctea* sp.

Known from the Carpathian Basin **Q4/I**: of Velika Pecina (Croatia); Szilvásvárad-Istállóskői Cave (Hungary) (Lambrecht 1912, 1933, Jánossy 1952, 1955, 1977, 1979, 1986, V. Malez 1975, 1984, 1988), as well as the **Q3**: of France (Tyrberg 1998).

– †*Intulula* (Mlikovský, 1998)

– †*Intulula brevis* (Ballmann, 1969) / *Strix* aff. *brevis* (Ballmann, 1969)

Known from the Upper Miocene (**MN 9**) of the Carpathian Basin: Rudabánya (Hungary) (Jánossy 1993).

– Strigidae gen. et sp. foss. indet.

Known from the Middle Miocene (**MN 7/8**) of the Carpathian Basin: Felsőtárkány-Felnémet 2/3 (Hungary) (Kessler & Hír 2012).

## Palaeoecological Conclusions

The palaeoecological significance of owls is major, primarily of species living, digesting and nesting at locations where the bones in their pellets are able to fossilize and become preserved due to advantageous taphonomic conditions. Such locations are caves, crevices of rocks or cliffs of karst plateaus. Since owls usually dispose of pellets at the same location, they can accumulate, sometimes during a number of generations, forming bone breccias in sediments. The layers of these form the basis of the fine-layer segmentation of the Neogene, but mainly the Quaternary.

## Osteological characteristics of owls in Europe

Skeletal parts of owls are relatively easy to identify. On the one hand, females are typically bigger than males (thus the sizes given in the size chart are for information purposes only), and on the other, they are usually robust, apart from the Barn Owl. These are the mandible, the coracoid of the pectoral girdle, the scapula, and bones of the upper and lower limbs (apart from the fibula and certain phalanges). The skull, the sternum and the synsacrum are



also typical, although these usually did not preserve, unlike bones of the pectoral girdle and the limbs.

## Method

For every discussed skeletal part, the anatomical terminology (after: Lambrecht 1933, Ballmann 1966, 1973, 1976, Baumel *et al.* 1979, Langer 1980, Gilbert *et al.* 1981, Jánossy 1985, Kessler 2013) and method of measurement (von den Driesch 1976, Langer 1980, Gál 2002, Kessler 2013) of the bone in question is given, illustrated by the appropriate bone of the Eurasian Eagle-owl (*Bubo bubo*). Arrows indicate the coded characteristics (*Plate 1-2*) and the method of measurement (*Plate 3*).

According to skeletal parts, their characteristics are the following:

### 1. *Coracoideum* (*Plate 4*):

Generally, relatively short and stout, except for the barn owl. Under the straight and club-like *processus acrocoracoidalis* (a) the body is stout, and has a triangle-shaped pointed, but cranially curved *processus procoracoidalis* (e) extending from it, with a well-defined *foramen procoracoideus* (b) located on it. The sternal end is asymmetrically triangle-shaped.

– a: *processus acrocoracoidalis*:

– cublike: *Aegolius*, *Asio flammeus*, *A. otus*, *Athene*, *Bubo*, *Nyctea*, *Surnia*;

– medially dented: *Otus*, *Strix aluco*, *S. uralensis*, *Tyto*;

– b: *foramen procoracoideus*:

– small: *Aegolius*, *Asio otus*, *Surnia*;

– big and round: *Athene*, *Strix uralensis*;

– big and oval: *Aegolius*, *Asio flammeus*, *Bubo*, *Nyctea*, *Otus*, *Strix aluco*;

– c: *angulus medialis*:

– long and pointed: *Asio flammeus*;

– long and blunt: *Asio otus*, *Strix uralensis*, *Tyto*;

– short and pointed: *Otus*, *Nyctea*, *Strix aluco*, *Surnia*;

– short and blunt: *Aegolius*, *Athene*, *Bubo*;

– d: *processus lateralis*:

– rounded: *Aegolius*, *Otus*, *Surnia*;

– cut-off and narrow: *Asio flammeus*, *A. otus*, *Bubo*, *Nyctea*, *Strix aluco*, *S. uralensis*;

– cut-off and wide: *Tyto*

### 2. *Scapula* (*Plate 5*)

It shows few easy-to-define characteristics.

– a: *acromion*:

– rounded: *Aegolius*, *Athene*, *Glaucidium*, *Nyctea*, *Otus*, *Tyto*;

– asymmetrical: *Asio flammeus*, *A. otus*, *Bubo*, *Strix aluco*, *S. uralensis*, *Surnia*;

– b: *processus articularis humeralis*:

– rounded: *Aegolius*, *Athene*, *Glaucidium*;

- cut-off: *Asio otus*, *Otus*, *Surnia*;
- cone shaped: *Nyctea*;
- asymmetrical: *Asio flammeus*, *Bubo*, *Strix aluco*, *S. uralensis*, *Tyto*;
- c: *corpus scapulae*:
  - straight: *Glaucidium*, *Otus*, *Surnia*;
  - significantly curved: *Aegolius*, *Asio flammeus*, *Bubo*, *Nyctea*, *Strix aluco*, *S. uralensis*, *Tyto*;
  - curved at the end: *Asio otus*, *Athene*

### 3. Humerus (Plate 7)

As with other birds, it is one of the most well-diagnosable skeletal parts of owls, furthermore, this applies to both epiphyses on their own. On the proximal epiphysis, the *caput humeri* (f) is definitely cambering, *crista deltopectoralis* (g) is arched, *tuberculum dorsale* (h) and *tuberculum ventrale* (i) are well-defined, *fossa pneumotricipitalis* (j) is round, deep and there is only one, distally; *impressio coracobrachialis* (k) is wide and well-defined, however, *sulcus transversus* (l) is poorly developed.

The distal epiphysis is wide, the *fossa musculi brachialis* (m) well-developed and shaped like an equilateral triangle. The *condylus ventralis* (n) and the *condylus dorsalis* (o) are well-developed.

- a: the edge of the *crista bicipitalis* on the *caudalis* side (*crus ventrale fossae*):
  - slightly curved: *Asio otus*, *Otus*, *Strix uralensis*, *Tyto*;
  - significantly curved, protuberant: *Aegolius*, *Athene*;
  - cut-off: *Asio flammeus*, *Bubo*, *Nyctea*, *Strix aluco*;
- b: *crus dorsale fossae*:
  - sharply protruding: *Aegolius*, *Athene*, *Nyctea*, *Otus*, *Strix aluco*, *Tyto*;
  - poorly developed: *Asio flammeus*, *A. otus*, *Bubo*, *Strix uralensis*;
- c: *corpus humeri*:
  - straight: *Asio flammeus*, *A. otus*, *Bubo*;
  - slightly curved: *Athene*, *Nyctea*, *Otus*, *Strix aluco*, *S. uralensis*;
  - significantly curved: *Aegolius*;
- d: *epicondylus ventralis*:
  - protrusive: *Aegolius*, *Asio flammeus*, *Athene*, *Otus*, *Surnia*;
  - rounded: *Asio otus*, *Bubo*, *Nyctea*, *Strix aluco*, *S. uralensis*, *Tyto*;
- e: *processus supracondylaris dorsalis*:
  - well developed: *Aegolius*, *Athene*, *Bubo*, *Otus*, *Strix aluco*, *S. uralensis*, *Surnia*;
  - poorly developed: *Asio flammeus*, *A. otus*, *Nyctea*, *Tyto*

### 4. Ulna (Plate 8-9)

It is not an easy-to-define skeletal part. The proximal epiphysis, for example, practically has almost no characteristics that would help reach a certain conclusion regarding species. The *olecranon* (b) has a blunt cone shape, *cotyla ventralis* (*apophysis glenoidalis interna*) (c) is round, while the *cotyla dorsalis* (*apophysis glenoidalis externa*) (a) is straightly protruding. The *impressio brachialis* (d) is well-developed and deep. The *corpus ulnae* (e) is slightly curved, the *papillae remigialis* (*dorsalis* and *ventralis*) (f) are

weakly defined. The *condylus dorsalis ulnaris* (g) on the distal epiphysis is semi-circular, the *condylus ventralis ulnaris* (h) is a blunt cone, the *tuberculum carpale* (i) is a pointed cone, which is typical to the genera, but does not provide sufficient points for identification to the species level.

– a: *apophysis glenoidalis externa*:

– is a pointed cone: *Otus*;

– blunt cone: *Aegolius*, *Asio otus*, *A. flammeus*, *Athene*, *Bubo*, *Nyctea*, *Surnia*;

– rounded: *Strix aluco*, *S. uralensis*;

– cut-off: *Tyto*

### 5. Radius (Plate 10)

A skeletal part is less suitable for identification. On the *caput radii* forming the proximal epiphysis, only the *tuberculum bicipitale* (a) shows distinctive characteristics, the form of *corpus radii* (b) is slightly different, while on the distal epiphysis the *tuberculum aponeurosis ventrale* (c) and the *tuberculum aponeurosis dorsale* (d) can be diagnosed.

– a: *tuberculum bicipitale*:

– protrusive: *Bubo*, *Otus*, *Strix aluco*, *S. uralensis*, *Surnia*;

– underdeveloped: *Aegolius*, *Asio flammeus*, *A. otus*, *Athene*, *Nyctea*, *Tyto*;

– b: *corpus radii*:

– slightly curved: *Bubo*, *Strix aluco*;

– shaped like an elongated S: *Aegolius*, *Asio flammeus*, *A. otus*, *Athene*, *Nyctea*, *Otus*, *Strix uralensis*, *Surnia*, *Tyto*;

– c: *tuberculum aponeurosis ventrale*:

– pointening: *Asio flammeus*, *Bubo*, *Nyctea*, *Otus*, *Strix aluco*, *Strix uralensis*, *Surnia*;

– rounded: *Aegolius*, *Asio otus*, *Athene*, *Tyto*;

– d: *tuberculum aponeurosis dorsale*:

– pointening: *Asio otus*, *Athene*, *Bubo*, *Nyctea*, *Strix aluco*, *S. uralensis*, *Surnia*, *Tyto*;

– rounded: *Aegolius*, *Asio flammeus*, *Otus*

### 6. Carpometacarpus (Plate 11)

The carpometacarpus of owls is relatively robust. The *processus intermetacarpale* is missing.

– a: *processus extensorius*:

– straight blunt cone: *Otus*;

– asymmetrical oblique blunt cone: *Aegolius*, *Asio flammeus*, *A. otus*;

– straight, with a cut-off end: *Tyto*;

– oblique with a cut-off end: *Nyctea*;

– oblique with a rounded end: *Athene*;

– end curving upwards: *Bubo*, *Strix aluco*, *S. nebulosa*, *S. uralensis*, *Surnia*;

– b: *spatium intermetacarpale*:

– wide: *Aegolius*, *Nyctea*, *Otus*, *Strix aluco*, *S. nebulosa*, *S. uralensis*;

– medially wide: *Bubo*, *Asio otus*, *Tyto*;

– narrow: *Asio flammeus*, *Athene*, *Surnia*;

- c: end of the *metacarpus majus*:
  - flat: *Aegolius*, *Asio flammeus*, *A. otus*, *Athene*, *Tyto*;
  - protrusive: *Bubo*, *Nyctea*, *Otus*, *Strix aluco*, *S. nebulosa*, *S. uralensis*, *Surnia*

#### 7. *Phalanx proximalis digiti majoris* (Plate 12)

The first phalanx of the second finger of the wing was unjustly not examined by the experts, despite it being one of the easiest-to-define skeletal parts with the most typical diagnostic characteristics.

- a: proximal end:
  - straight: *Athene*, *Tyto*;
  - wavy: *Bubo*, *Nyctea*, *Otus*, *Strix uralensis*;
  - protuberant: *Aegolius*, *Asio flammeus*, *A. otus*, *Strix aluco*, *S. nebulosa*, *Surnia*;
- b: the distal end is:
  - dented: *Asio flammeus*, *A. otus*, *Bubo*, *Nyctea*, *Otus*, *Surnia*;
  - protuberant: *Aegolius*, *Athene*;
  - wavy: *Strix aluco*, *S. nebulosa*, *S. uralensis*, *Tyto*;
- c: the proximal end of the dorsal side is:
  - rounded: *Athene*, *Tyto*;
  - cut-off: *Aegolius*, *Bubo*, *Strix nebulosa*;
  - proximally provided with a pointed projection: *Asio flammeus*, *A. otus*, *Nyctea*, *Otus*, *Strix aluco*, *Strix uralensis*, *Surnia*

#### 8. *Femur* (Plate 13)

The morphological homogeneity is significant in the case of this skeletal part. Only the distal epiphysis contains characteristics fit for distinction.

- a: *condylus lateralis*:
  - laterally rounded: *Aegolius*, *Asio otus*, *Nyctea*, *Strix uralensis*, *Tyto*;
  - laterally protrusive: *Asio flammeus*, *Athene*, *Bubo*, *Glaucidium*, *Otus*, *Strix aluco*;
- b: *sulcus intercondylaris*:
  - shallow: *Aegolius*, *Athene*;
  - medially deep: *Asio flammeus*, *A. otus*, *Bubo*, *Glaucidium*, *Otus*, *Strix uralensis*, *Tyto*;
  - deep: *Nyctea*;
  - asymmetrical: *Strix aluco*

#### 9. *Tibiotarsus* (Plate 14)

The skeletal part has a high degree of homogeneity, the species can only be concluded based on its size. The fibula is typically grown to the tibiotarsus close to the distal epiphysis. On the distal epiphysis of the tibiotarsus, the *pons supratendineus* is missing, the *sulcus extensorius* (a) is wide and deep, the two *epicondylus* (*lateralis* and *medialis*) (b, c) are poorly developed, as is the *tuberculum retinaculum musculi fibularis* (d). Above the *incisura intercondylaris* (e) on the caudal side, a wide hole (*fossa flexoria*) can be found.

### 10. *Tarsometatarsus* (Plate 15)

Primarily, the *tarsometatarsus* changes relative to species. Morphological differences are less typical, and they can mostly be found on the distal epiphysis. The *trochlea metatarsi* IV. (c) has a typical shape.

- a: characteristics of the diaphysis:
  - rather short and stout: *Surnia*;
  - stout: *Aegolius*, *Bubo*, *Glaucidium*, *Nyctea*;
  - medially stout and long: *Asio flammeus*, *A. otus*, *Athene*, *Otus*, *Strix aluco*;
  - long and slim: *Tyto*;
- b: *trochlea metatarsi* II.:
  - elongated: *Strix aluco*;
  - clublike: *Glaucidium*, *Nyctea*, *Surnia*;
  - blunt cone: *Aegolius*, *Asio flammeus*, *A. otus*, *Athene*, *Bubo*, *Otus*, *Tyto*

### 11. *Distal phalanges* (Plate 16)

Since one leg contains 4 distal phalanges, those can be distinguished based on the shapes of (*cotyla articularis*) (b) as well as *tuberculum extensorium* (a) and *tuberculum flexorium* (c). Seven phalanges can also be identified in a similar manner. This, however, requires an appropriate comparative collection to accomplish. In the tables and figures, we only show a distal phalanx of each species for information purposes, without their exact classification. The available collection only made this possible in case of the Eurasian Eagle-owl (see Plate 2). The fact that the distal phalanges of the 4 toes can differ in size and somewhat in appearance has to be taken into account. Thus, the characteristics presented here are provided for information purposes only, as well as their lengths in the size table.

*Plate 3.* helps understand the size charts.

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bones	<i>Aegolius f.</i>	<i>Asio flam.</i>	<i>Asio otus</i>	<i>Athene n.</i>	<i>Bubo bubo</i>	<i>Glaucidium</i>	<i>Nyctea sc.</i>	<i>Otus scops</i>	<i>Strix aluco</i>	<i>S. nebulosa</i>	<i>S. uirens</i>	<i>Surnia ul.</i>	<i>Tyto alba</i>
<b>Coracoid A</b>	24.30–24.70	33.10–40.10	30.80–35.10	28.30	69.80	21.70–23.00	62.68	22.00–22.60	35.30–40.70	48.81	44.60–47.14	32.30	31.60–35.90
<b>B</b>	23.00–24.20	31.40–37.70	29.30–32.90	27.20	65.40	21.00–23.00	57.96	21.00–21.60	34.00–39.30	45.66	43.00–46.00	29.38	30.00–33.80
<b>C</b>	2.71–3.00	5.60	5.60	4.00	10.80	1.99	9.44	3.92–4.00	5.90	8.48	7.50–8.20	4.02	5.90
<b>D</b>	4.14	7.00	6.30	5.00	14.80	3.64–4.00	13.61	4.20–4.31	6.30	9.94	8.00–8.60	6.62	6.00
<b>E</b>	2.00–2.74	3.80–5.00	3.50–4.70	2.10	9.30	1.50–2.00	8.43	2.20–2.43	3.60–4.80	5.02	5.40–6.20	2.14	3.30–4.30
<b>F</b>	7.10–8.38	12.80–16.80	11.60–14.40	8.20	27.30	7.00–7.15	26.92	7.00–7.30	12.00–14.60	18.64	16.0–17.5	11.37	12.40–15.00
<b>G</b>	7.77	11.00–14.80	10.80–13.00	7.60	24.40	5.50–6.54	24.28	6.90	10.90–12.70	16.92	13.9–15.0	8.63	10.20–12.60
<b>Scapula A</b>	28.50–28.80	37.90–49.10	36.00–42.80	34.00	84.80	25.00–27.50	79.15	25.00–27.40	41.40–48.80	55.39	54.0–59.0	39.60–41.31	35.60–42.30
<b>C</b>	5.40–5.89	9.40–11.20	8.201–10.10	6.70	21.10	5.09–6.00	19.81	5.30–5.50	9.20–11.30	13.30	11–12.10	8.55–8.80	7.70–9.50
<b>D</b>	2.69	6.00	5.40	3.40	13.20	2.52	9.32	2.37–2.60	6.10	6.24	6.00–7.40	5.62	5.60
<b>E</b>	2.01–2.30	3.50	3.30	2.40	8.70	1.84	6.62	1.80–1.90	3.50	4.77	3.80–5.30	4.80	3.30
<b>Humerus A</b>	47.50–50.00	82.40–95.40	74.70–83.70	53.00	163.00	33.78	153.1–159.0	43.30–47.50	81.10–89–30	120.04	108–109.49	66.01	73.70–85.30
<b>B</b>	16.58	31.10	27.80	20.20	52.00	12.29	57.58	15.98	32.50	42.46	41.34	25.56	28.00
<b>C</b>	8.80–9.27	13.4–15.5	12.20–14.00	12.00	27.80	7.44–7.60	24.0–27.24	8.38–9.00	14.00–16.00	19.73	20.00	12.90	12.80–14.70
<b>D</b>	9.48	14.60–17.80	13.50–16.50	10.80	31.80	7.51	31.78	8.94	15.00–17.80	23.40	25.77	13.50	13.50–16.00
<b>E</b>	3.16–3.20	5.00–6.10	4.60–5.70	3.60	10.40	2.47–3.00	9.09–11.0	3.02–3.30	5.10–6.00	7.13	7.40	3.83–5.50	4.60–5.60
<b>F</b>	8.30–8.53	12.60–14.70	11.60–13.90	9.00	26.70	6.19	24.95–25.5	7.26–7.60	13.90–16.00	19.07	19.50	11.48–12.0	11.60–13.50
<b>G</b>	4.00–4.15	5.00	4.60	3.40	14.10	2.84	12.80–13.4	3.55–4.80	7.50	8.83	9.50	3.53–6.00	7.04
<b>Ulna A</b>	54.00–56.13	107.40	83.50–94.60	61.00	180.70	39.70	178.1–180.0	54.50–54.66	86.80–97.80	126.66	117.37–119	75.00	82.90–93.30
<b>B</b>	4.20–4.54	8.00	7.20–9.10	5.00	14.00	3.49	13.25–14.00	4.00–4.57	8.00–10.30	10.23	10.00	5.44–6.00	7.10–8.40
<b>C</b>	5.33–6.00	10.00	7.70–9.50	6.20	17.00	4.08	16.63–17.00	5.52–6.20	9.40–10.90	11.81	13.00	7.62–8.00	8.10–9.10
<b>D</b>	5.48	8.70	8.50	6.00	17.50	4.47	17.34	5.77	10.42	13.77	12.00	7.79	8.50
<b>E</b>	2.45–2.50	4.40	3.30–4.20	2.80	7.00	1.93	6.83–8.70	2.20–2.40	3.90–4.70	5.35	6.00	2.84–4.00	3.40–4.00
<b>F</b>	4.63	7.80	6.20–7.70	5.10	13.00	3.50	13.58–14.50	4.50–4.60	6.90–8.70	10.57	11.00	6.19–7.00	6.30–7.10
<b>G</b>	4.10–4.26	7.60	6.80	4.80	12.00	3.20	11.00–12.00	3.78	7.90	8.59	10.00	4.87–6.40	6.70
<b>Radius A</b>	52.00–53.56	95.50–109.6	80.30–91.20	58.40	174.50	38.25	172.11–173	52.30–52.65	83.10–95.20	121.15	111.53–114	71.78–77.00	85–40–90
<b>C</b>	3.27–3.50	5.70	5.30	3.20	8.80	2.26	9.29–9.60	3.24–3.50	6.80	6.65	8.00	5.00	3.00
<b>D</b>	2.07–2.50	3.10	3.00	2.40	5.00	1.73	5.18–5.50	2.34–3.20	3.60	4.11	4.50	3.50–3.65	3.80
<b>E</b>	1.44–1.50	1.90–2.80	1.80–2.70	1.60	4.00	1.13	3.66–4.50	1.48–1.50	2.30–3.20	3.35	3.50	1.76–2.10	1.80–2.20
<b>F</b>	3.94	5.60–8.00	5.60–6.80	4.60	12.00	3.17	11.89–12.70	4.00–4.18	6.90–8.30	9.01	10.30	5.41–6.00	5.50–6.60

**Table 1.** Size table of recent owls: *coracoidum*, *scapula*, *humerus*, *ulna*, *radius*

Abbreviations: A – total length; B – partial length; C – breadth of the distal end; H length of the symphysis of the distal end; G – thickness of the distal end; H length of the symphysis

**1. táblázat** A recens baglyok mérettáblázata: hollócsőrcont, lapockacscont, felkarcsont, síngsccont, orsócscont

Rövidítések: A – teljes hossz; B – részleges hossz; C – a proximális vég szélessége; D – proximális vég vastagsága; E – a test szélessége; F – a disztális vég szélessége; G – a disztális vég vastagsága; H – a szimfizis magassága

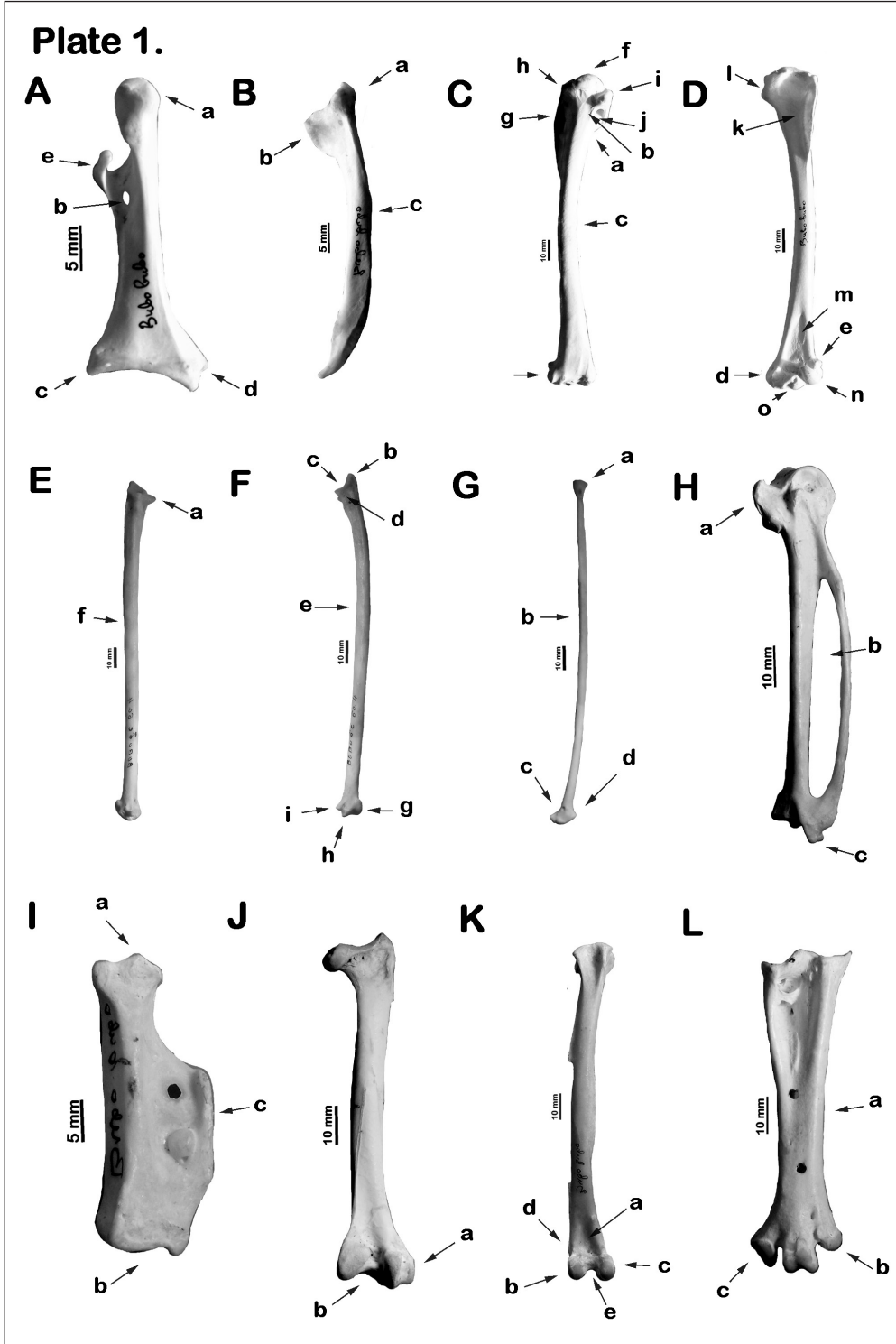
bones	<i>Aegolius f.</i>	<i>Asio flam.</i>	<i>Asio otus</i>	<i>Athene n.</i>	<i>Bubo bubo</i>	<i>Glaucidium</i>	<i>Nyctea sc.</i>	<i>Otus scops</i>	<i>Strix aluco</i>	<i>S. nebulosa</i>	<i>S. uralens.</i>	<i>Surnia ul.</i>	<i>Tyto alba</i>
<b>Carpomet.A</b>	24.00–24.39	47.20–55.30	39.20–44.00	28.80	84.30	17.67	84.12–86.00	25.57–26.00	41.20–46.80	58.01	55.00–55.23	38.00–38.40	38.90–43.80
<b>B</b>	21.17–21.40	46.00	39.60	27.20	75.80	16.04	77.45–78.00	23.00–23.37	41.40	52.27	49.00	14.48–35.00	39.80
<b>C</b>	5.50–5.86	8.60–10.30	7.90–9.10	6.50	18.50	4.39	17.00–18.12	5.96–6.00	7.90–11.00	12.81	13.00	8.30–8.50	8.10–9.80
<b>D</b>	3.16	5.60	5.70	3.80	12.00	2.85	12.21	3.69	7.00	7.46	7.30	3.88	6.00
<b>E</b>	4.35–4.40	7.30	7.10	4.40	14.00	3.32	12.00–12.71	4.00–4.13	9.00	10.47	10.50	5.40	6.40
<b>E1</b>	1.70–2.00	3.50	3.40	2.50	7.00	1.37	5.00–5.10	1.53	4.40	3.53	3.80	1.47–2.80	3.70
<b>F</b>	4.70–5.09	7.00–8.40	6.90–8.00	5.00	13.40	3.40	13.00–13.42	4.20–4.57	8.30–9.90	10.49	11.00	6.19–6.60	6.30–7.00
<b>G</b>	2.46	5.00	3.90	2.80	7.00	1.82	7.27	2.48	4.40	5.77	5.30	2.64	4.10
<b>H</b>	2.45	3.80	3.30	3.00	9.50	1.93	6.08	3.33	5.30	4.74	4.50	3.12	3.10
<b>Phalal. A.</b>	11.75	19.90–23.10	17.30–20.60	11.00	32.00		31.70	10.80	16.70–19.40	26.50	23.50	15.03	17.30–19.70
<b>C</b>	3.05	4.00	3.80	2.90	8.00	8.00	7.20	3.10	5.20	7.00	5.70	3.14	5.10
<b>E</b>	4.43	8.00	7.00	4.80	12.00	12.00	10.50	4.70	7.20	9.30	8.70	5.85	6.30
<b>F</b>	3.98	6.00	5.90	3.70	10.00		9.20	4.00	5.40	7.70	7.00	3.72	5.70
<b>Femur A</b>	36.50–37.05	51.30–60.50	48.90–57.00	41.20	103.30	26.40–32.00	89.45	29.35–33.50	57.30–73.11	80.94	77.82–79.00	47.19	46.40–53.70
<b>B</b>	35.00–37.87	49.30–57.90	47.00–55.20	39.30	98.00	25.40–30.50	84.82	27.44–31.50	54.80–69.66	78.89	75.20	45.17	44.00–51.20
<b>C</b>	7.65–8.00	8.40–10.60	8.10–9.60	7.80	22.40	4.80–5.60	16.36	5.25–5.70	10.10–12.85	13.20	15.00	8.78	8.50–10.10
<b>D</b>	4.08	5.50–6.60	4.90–6.30	5.10	13.80	3.20–4.00	12.42	3.37–3.80	6.10–8.52	8.87	9.00	5.19	4.90–6.00
<b>E</b>	2.61–3.00	3.40–4.50	3.50–4.20	3.00	9.10	1.80–2.50	7.92	2.48–3.60	4.40–5.44	5.33	6.30	2.92	3.80–4.40
<b>F</b>	5.95–6.50	8.70–10.50	8.20–9.80	7.40	22.00	4.70–6.00	18.41	5.11–6.00	9.90–13.50	14.21	15.60	8.35	8.90–10.50
<b>G</b>	5.00	7.60–9.00	6.80–8.30	6.30	17.70	3.30–5.00	14.77	4.33–5.00	7.90–11.12	13.69	13.00	6.65	7.70–9.20
<b>Tibiotars. A</b>	46.50–49.42	73.70–89.90	72.50–81.70	58.00	143.20	37.08	117.42–120		81.40–91.70	106.24	104.30–106	61.37–64.50	77.70–88.80
<b>C</b>	6.00	9.20–11.10	8.80–10.20	7.80	20.30	5.19–5.50	18.22–19.00		9.60–12.80	14.13	15.00	8.43–9.00	9.70–11.10
<b>D</b>	5.48–6.00	7.90	8.00	6.20	18.00	4.80–4.96	16.92–17.00		10.50	11.63	13.20	7.00–7.20	9.30
<b>E</b>	3.00	3.40–4.40	3.40–4.40	2.50	6.30	2.70	6.25		4.00–4.90	6.20	6.00	3.45	3.90–4.50
<b>F</b>	5.79–6.00	8.20–9.90	7.70–9.50	7.20	19.30	4.90–5.50	16.85–17.80		9.20–11.60	13.05	13.50	5.79–6.00	8.50–10.00
<b>G</b>	4.77–5.00	6.70–7.90	6.50–7.70	5.90	15.40	4.10–5.00	14.04		7.00–9.30	10.67	11.50	4.77–5.00	8.30–9.70
<b>Tarsomet.A</b>	22.75	41.10–48.70	36.80–41.50	34.50	76.00	17.51–18.00	55.40	26.00–27.86	45.00–52.20	49.42	49.00–55.4	23.80–27.00	55.40–64.60
<b>C</b>	6.05	8.10–9.80	7.60–9.10	7.50	21.00	5.38	17.40–17.70	5.81–6.20	8.90–12.00	13.08	14.50	8.52–10.00	8.40–9.90
<b>D</b>	5.76	7.20–8.10	7.40–8.50	7.00	18.00	5.28–5.50	16.40–16.63	5.20–5.33	8.30–10.70	12.15	12.00	7.21–8.00	6.80–9.20
<b>E</b>	3.58	3.70–5.10	3.80–4.80	3.40	10.80	2.30–3.23	10.00–10.16	2.60	4.70–6.00	5.93	6.20–7.40	4.67–6.20	3.50–4.30
<b>F</b>	6.50	9.10–11.10	8.70–10.60	7.40	21.60	5.25–6.00	19.00	6.20	10.30–12.40	13.33	13.20–15.0	9.00–10.30	9.50–11.20
<b>G</b>	4.80	6.60–8.10	6.40–7.60	5.40	15.40	4.19–5.00	14.00–14.60	4.57–6.00	7.80–9.90	9.98	11.50	6.64–6.90	7.50–10.50

Table 2. Size table of recent owls: *carpometacarpus*, *phalanx proximalis digiti majoris*, *femur*, *tibiotarsus*, *tarsometatarsus*

Abbreviations: A – total length; B – partial length; C – breadth of the proximal end; D – thickness of the proximal end; E – breadth of the corpus; F – total breadth of the distal end; G – thickness of the distal end; H length of the symphysis

2. táblázat A recens baglyok mérettáblázata: kézközépcsont, kézujjperc, combcsont, lábszárcsont, csüd

Rövidítések: A – teljes hossz; B – részleges hossz; C – a proximális vég szélessége; D – proximális vég vastagsága; E – a test szélessége; F – a disztális vég szélessége; G – a disztális vég vastagsága; H – a szimfízis magassága





## Plate 1.

*Bubo bubo* (Linnaeus, 1758) osteology characters:

- A. Coracoideum – a. *processus acrocoracoïdalis*; b. *foramen procoracoïdeus*; c. *angulus medialis*; d. *processus lateralis*; e. *processus procoracoïdalis*.  
 B. Scapula – a. *acromion*; b. *processus articularis humeralis*; c. *corpus scapulae*.  
 C, D. Humerus – a. *crus ventrale fossae*; b. *crus dorsale fossae*; c. *corpus humeri*; d. *epicondylus ventralis*; e. *processus supracondylaris dorsalis*; f. *caput humeri*; g. *crista deltopectoralis*; h. *tuberculum dorsale*; i. *tuberculum ventrale*; j. *fossa pneumotricipitalis*; k. *impressio coracobrachialis*; l. *sulcus transversus*; m. *fossa musculi brachialis*; n. *condylus ventralis*; o. *condylus dorsalis*.  
 E, F. Ulna – a. *apophysis glenoidalis externa*; b. *olecranon*; c. *apophysis glenoidalis interna*; d. *impressio brachialis*; e. *corpus ulnae*; f. *papillae remigialis (dorsalis and ventralis)*; g. *condylus dorsalis ulnaris*; h. *condylus ventralis ulnaris*; i. *tuberculum carpale*.  
 G. Radius – a. *tuberculum bicipitale*; b. *corpus radii*; c. *tuberculum aponeurosis ventrale*; d. *tuberculum aponeurosis dorsale*.  
 H. Carpometacarpus – a. *processus extensorius*; b. *spatium intermetacarpale*; c. *facies articularis digitalis minor*.  
 I. Phalanx proximalis digiti majoris – a. proximal end; b. distal end; c. proximal end of the lateral side.  
 J. Femur – a. *condylus lateralis*; b. *sulcus intercondylaris*.  
 K. Tibiotarsus – a. *sulcus extensorius*; b. *epicondylus lateralis*; c. *epicondylus medialis*; d. *tuberculum retinaculum musculi fibularis*; e. *incisura intercondylaris*.  
 L. Tarsometatarsus – a. *diaphysis*; b. *trochlea metatarsi II*; c. *trochlea metatarsi IV*.

## 1. táblakép

*Bubo bubo* (Linnaeus, 1758) csonttani jellegek:

- A. Hollócsőr-csont – a. *processus acrocoracoïdalis*; b. *foramen procoracoïdeus*; c. *angulus medialis*; d. *rocessus lateralis*; e. *processus procoracoïdalis*.  
 B. Lapocka – a. *acromion*; b. *processus articularis humeralis*; c. *corpus scapulae*.  
 C, D. Felkarcsont – a. *crus ventrale fossae*; b. *crus dorsale fossae*; c. *corpus humeri*; d. *epicondylus ventralis*; e. *processus supracondylaris dorsalis*; f. *caput humeri*; g. *crista deltopectoralis*; h. *tuberculum dorsale*; i. *tuberculum ventrale*; j. *fossa pneumotricipitalis*; k. *impressio coracobrachialis*; l. *sulcus transversus*; m. *fossa musculi brachialis*; n. *condylus ventralis*; o. *condylus dorsalis*.  
 E, F. Singcsont – a. *apophysis glenoidalis externa*; b. *olecranon*; c. *apophysis glenoidalis interna*; d. *impressio brachialis*; e. *corpus ulnae*; f. *papillae remigialis (dorsalis és ventralis)*; g. *condylus dorsalis ulnaris*; h. *condylus ventralis ulnaris*; i. *tuberculum carpale*.  
 G. Orsócsont – a. *tuberculum bicipitale*; b. *corpus radii*; c. *tuberculum aponeurosis ventrale*; d. *tuberculum aponeurosis dorsale*.  
 H. Kézközépcsont – a. *processus extensorius*; b. *spatium intermetacarpale*; c. a *metacarpus majus* disztális vége.  
 I. A nagy kézujj első ujjperce – a. proximális vég; b. disztális vég; c. dorsalis oldal proximális vége.  
 J. Combcsont – a. *condylus lateralis*; b. *sulcus intercondylaris*.  
 K. Lábszár-csont – a. *sulcus extensorius*; b. *epicondylus lateralis*; c. *epicondylus medialis*; d. *tuberculum retinaculum musculi fibularis*; e. *incisura intercondylaris*.  
 L. Csüd – a. diafizis; b. *trochlea metatarsi II*; c. *trochlea metatarsi IV*.

**Plate 2.**

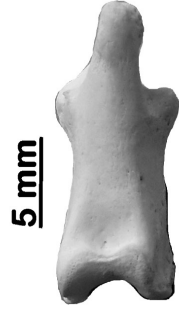
**1**



**2**



**3**



**4**



**5**



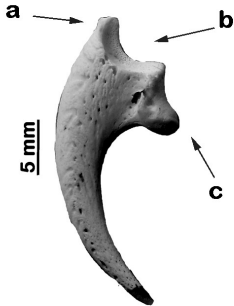
**6**



**7**



**8**



**9**



**10**



**11**



*Plate 2.*

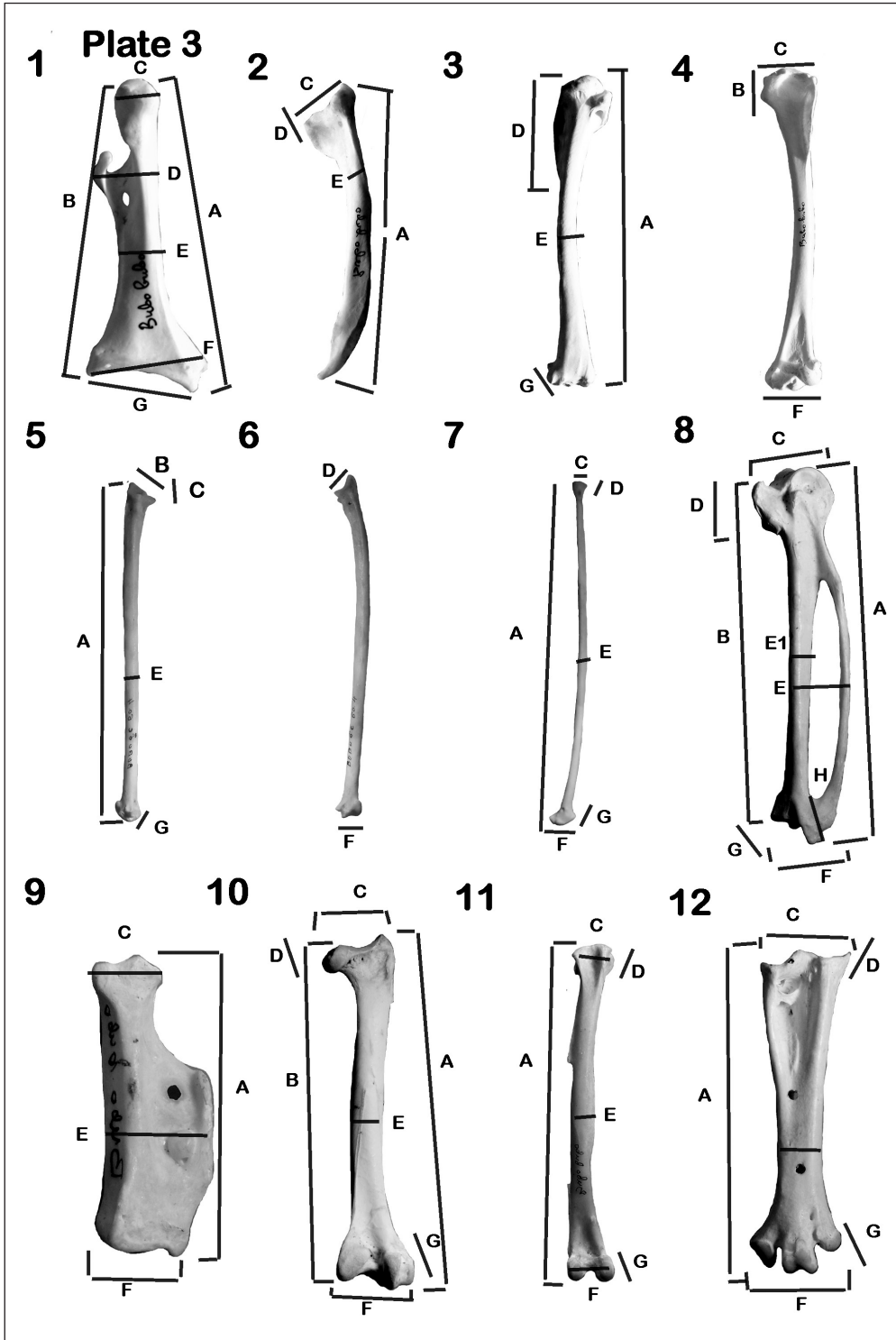
*Bubo bubo* (Linnaeus, 1758) osteology characters. Distal phalanges and claws: a. *tuberculum extensorium*; b. *cotyla articularis*; c. *tuberculum flexorium*.

Phalanx I. digiti 2.; 2. Phalanx I. digiti 3.; 3. Phalanx II. digiti 3.; 4. Phalanx I. digiti 1.; 5. Phalanx II. digiti 2.; 6. Phalanx III. digiti 3.; 7. Phalanx IV. digiti 4.; 8. Phalanx II. digiti 1.; 9. Phalanx III. digiti 2.; 10. Phalanx IV. digiti 3.; 11. Phalanx V. digiti 4.

*2. táblakép*

*Bubo bubo* (Linnaeus, 1758) csonttani jellegek. Ujjpercek és karomcsontok: a. *tuberculum extensorium*; b. *cotyla articularis*; c. *tuberculum flexorium*.

Phalanx I. digiti 2.; 2. Phalanx I. digiti 3.; 3. Phalanx II. digiti 3.; 4. Phalanx I. digiti 1.; 5. Phalanx II. digiti 2.; 6. Phalanx III. digiti 3.; 7. Phalanx IV. digiti 4.; 8. Phalanx II. digiti 1.; 9. Phalanx III. digiti 2.; 10. Phalanx IV. digiti 3.; 11. Phalanx V. digiti 4.



## Plate 3.

## Measurements methods of bones:

## 1. Coracoideum:

- A. total length;
- B. partial length;
- C. breadth of the proximal end;
- D. breadth of the corpus and *processus procoracoidalis*;
- E. breadth of the corpus;
- F. total breadth of the distal end;
- G. partial breadth of the distal end

## 2. Scapula:

- A. total length;
- B. length of the proximal end;
- C. partial length;
- D. breadth of the proximal end;
- E. breadth of the corpus

## 3-4. Humerus:

- A. total length;
- B. partial length 1.;
- C. breadth of the proximal end;
- D. partial length 2.;
- E. breadth of the corpus;
- F. breadth of the distal end;
- G. thickness of the distal end

## 5-6. Ulna:

- A. total length;
- B. length of the proximal epiphysis;
- C. breadth of the proximal end;
- D. diagonal breadth of the proximal end;
- E. breadth of the corpus;
- F. breadth of the distal end;
- G. thickness of the distal end

## 7. Radius:

- A. total length;
- B length of the proximal epiphysis;
- C. breadth of the proximal end;
- D. thickness of the proximal end;
- E. breadth of the corpus;
- F. breadth of the distal end;
- G. thickness of the distal end

## 8. Carpometacarpus:

- A. total length;
- B. partial length;
- C. breadth of the proximal end;
- D. length of the *processus extensorius*;
- E. breadth of the corpus;
- E1: breadth of the metacarpus majus;

- F. breadth of the distal end;
- G. thickness of the distal end;
- H. length of the symphysis

## 9. Phalanx proximalis digiti majoris:

- A. total length;
- C. breadth of the proximal end;
- E. breadth of the corpus;
- F. breadth of the distal end

## 10. Femur:

- A. total length;
- B. partial length;
- C. breadth of the proximal end;
- D. thickness of the proximal end;
- E. breadth of the corpus;
- F. breadth of the distal end;
- G. thickness of the distal end

## 11. Tibiotarsus:

- A. total length;
- C. breadth of the proximal end;
- D. thickness of the proximal end;
- E. breadth of the corpus;
- F. breadth of the distal end;
- G. thickness of the distal end

## 12. Tarsometatarsus:

- A. total length;
- C. breadth of the proximal end;
- D. thickness of the proximal end;
- E. breadth of the corpus;
- F. breadth of the distal end;
- G. thickness of the distal end

## 3. Táblakép

## A csontok mérési mintái:

## 1. Hollócsőrscsont:

- A. teljes hossz;
- B. részleges hossz;
- C. proximális vég szélessége;
- D. proximális vég átlós szélessége;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

## 2. Lapockacsont:

- A. teljes hossz;
- B. részleges hossz;
- C. proximális vég szélessége;
- D. proximális vég átlós szélessége;
- E. a test szélessége

## 3-4. Felkarcsont:

- A. teljes hossz;
- B. részleges hossz 1.;
- C. proximális vég szélessége;
- D. részleges hossz 2.;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

## 5-6. Singcsont:

- A. teljes hossz;
- B. részleges hossz;
- C. proximális vég szélessége;
- D. proximális vég átlós szélessége;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

## 7. Orsócsont:

- A. teljes hossz;
- B. részleges hossz;
- C. proximális vég szélessége;
- D. proximális vég vastagsága;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

## 8. Kézközépcsont:

- A. teljes hossz;
- B. részleges hossz;
- C. proximális vég szélessége;
- D. a *processus flexorius* hossza;
- E. a test szélessége;
- E1 a metacarpus majus vastagsága;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága;
- H. a szimfizis magassága

## 9. Kézujjperc (II. ujj, 1. perc):

- A. teljes hossz;
- C. proximális vég szélessége;
- E. a test szélessége;
- F. a disztális vég szélessége

## 10. Combcsont:

- A. teljes hossz;
- B. részleges hossz;
- C. proximális vég szélessége;
- D. proximális vég vastagsága;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

## 11. Lábszárcsont:

- A. teljes hossz;
- C. proximális vég szélessége;
- D. proximális vég vastagsága;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

## 12. Csüd:

- A. teljes hossz;
- C. proximális vég szélessége;
- D. proximális vég vastagsága;
- E. a test szélessége;
- F. a disztális vég szélessége;
- G. a disztális vég vastagsága

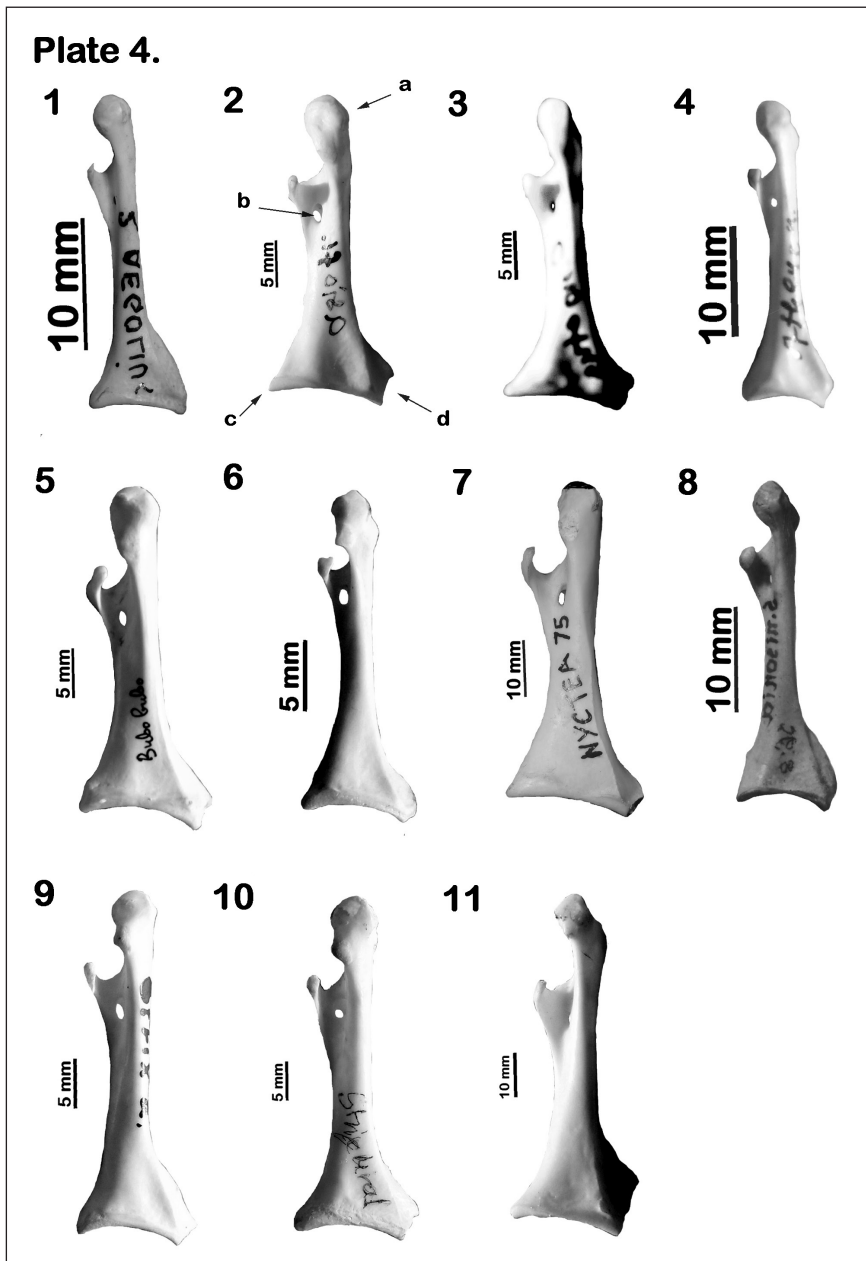


Plate 4.

Left coracoidium (ventral surface) – a. *processus acrocoracoidealis*; b. *foramen procoracoideus*; c. *angulus medialis*; d. *processus lateralis*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Surnia ulula*; 8. *Otus scops*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

4. táblakép

Bal oldali hollócsőrícsont (hasi oldal) – a. *processus acrocoracoidealis*; b. *foramen procoracoideus*; c. *angulus medialis*; d. *processus lateralis*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

## Plate 5.

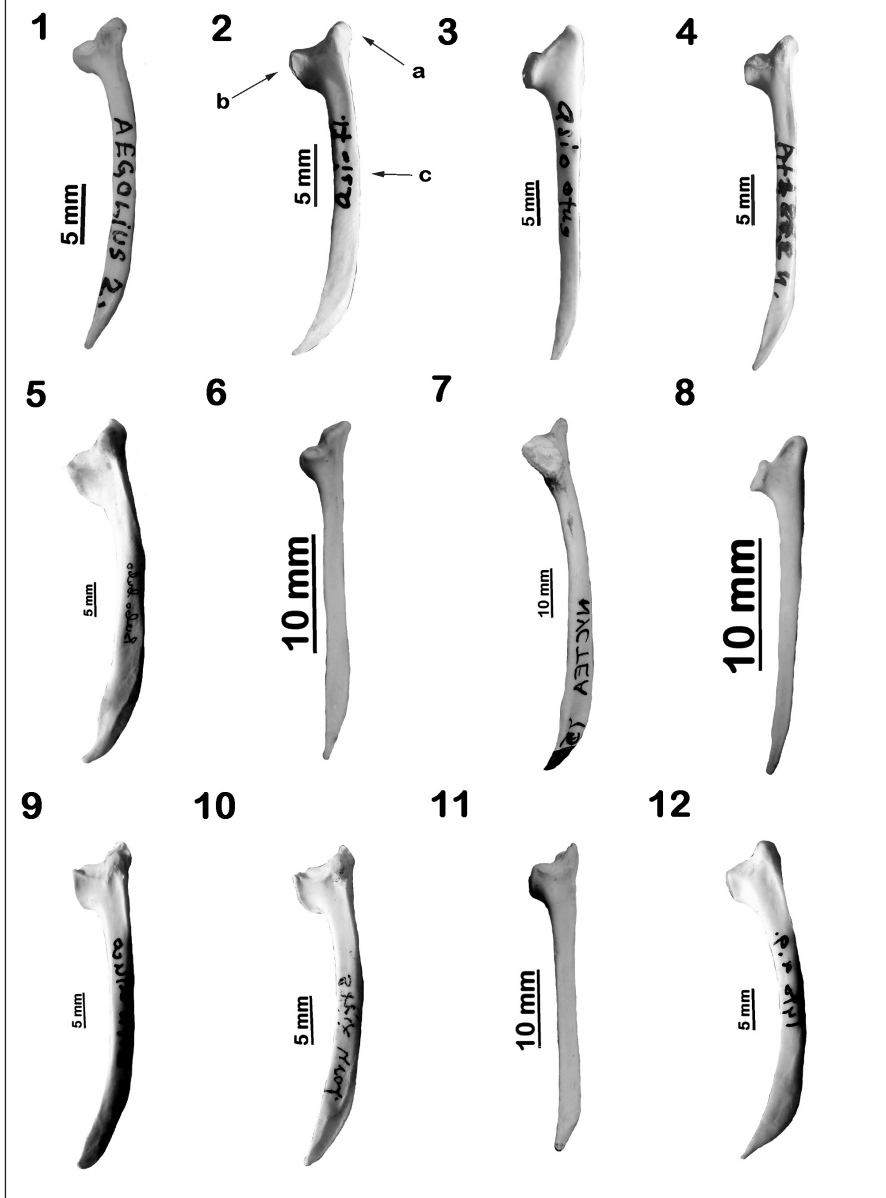


Plate 5.

Left scapula (medial surface) – a. acromion; b. processus articularis humeralis; c. corpus scapulae

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Surnia ulula*; 9. *Otus scops*; 10. *Strix aluco*; 11. *S. uralensis*; 12. *Tyto alba*

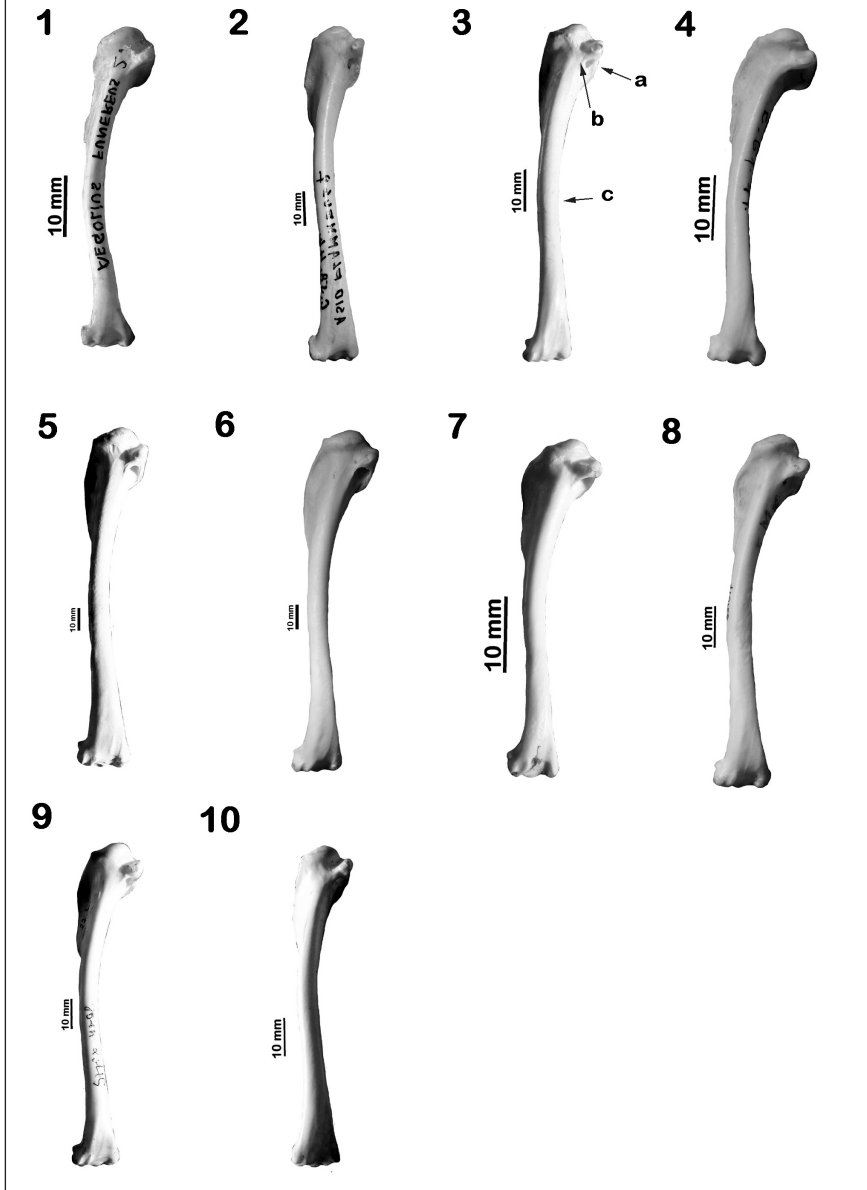
### 5. táblakép

Bal oldali lapocka csont (mediális oldal) – a. acromion; b. processus articularis humeralis; c. corpus scapulae

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Surnia ulula*; 9. *Otus scops*; 10. *Strix aluco*; 11. *S. uralensis*; 12. *Tyto alba*



**Plate 6.**



*Plate 6.*

Left humerus (caudal surface) – a. *crus ventrale fossae*; b. *crus dorsale fossae*; c. *corpus humeri*; d. *epicondylus ventralis*; e. *processus supracondylaris dorsalis*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Strix aluco*; 9. *S. uralensis*; 10. *Tyto alba*

*6. táblakép*

Bal oldali felkarcsont (palmáris oldal) – a. *crus ventrale fossae*; b. *crus dorsale fossae*; c. *corpus humeri*; d. *epicondylus ventralis*; e. *processus supracondylaris dorsalis*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Strix aluco*; 9. *S. uralensis*; 10. *Tyto alba*

## Plate 7.

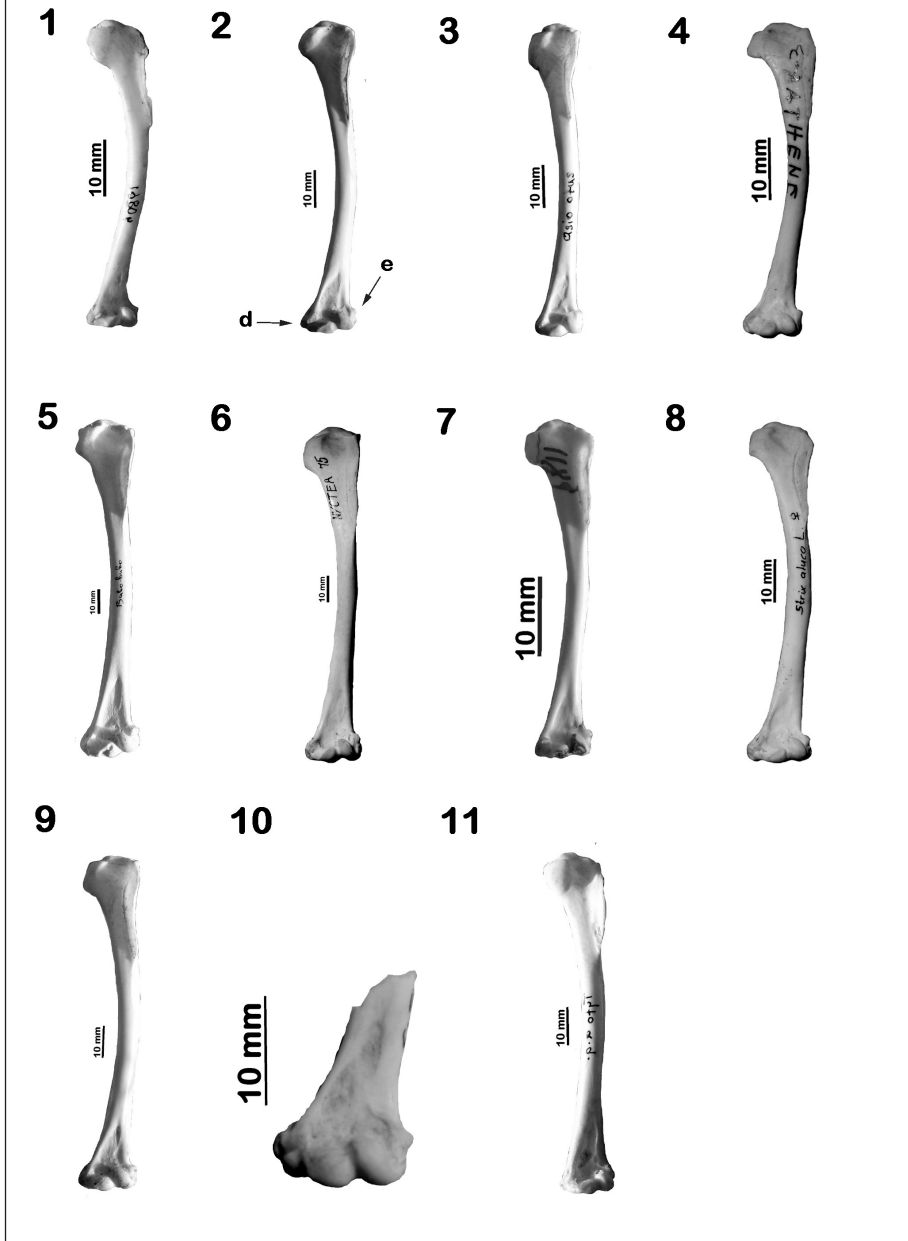


Plate 7.

Left humerus (cranial surface) – d. *epicondylus ventralis*; e. *processus supracondylaris dorsalis*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

7. táblakép

Bal oldali felkarcsont (dorzális oldal) – d. *epicondylus ventralis*; e. *processus supracondylaris dorsalis*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

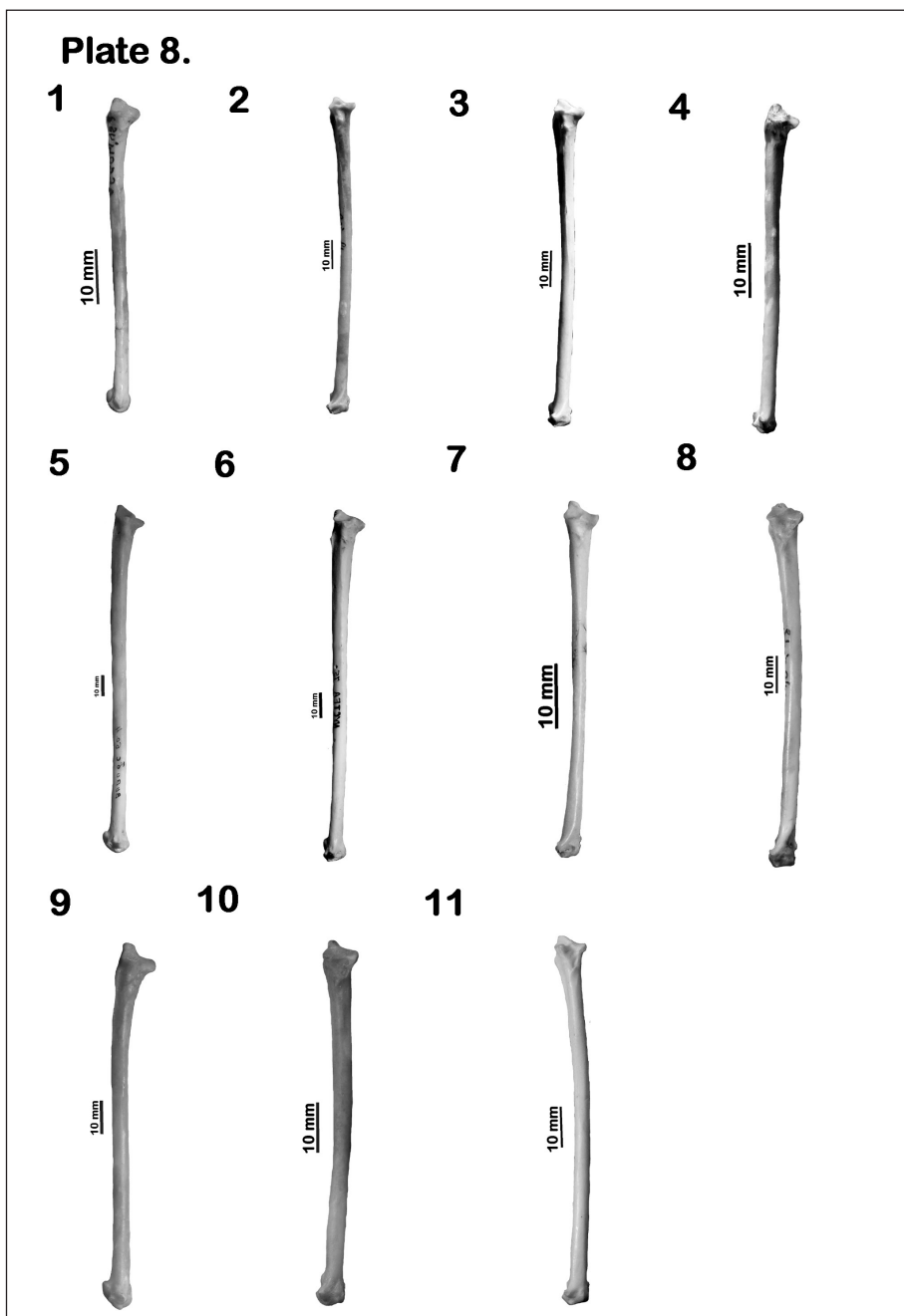


Plate 8.

Left ulna (ventral aspect) – a. *apophysis glenoidalis externa*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

8. táblakép

Bal oldali singcsont (hasi nézet) – a. *apophysis glenoidalis externa*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

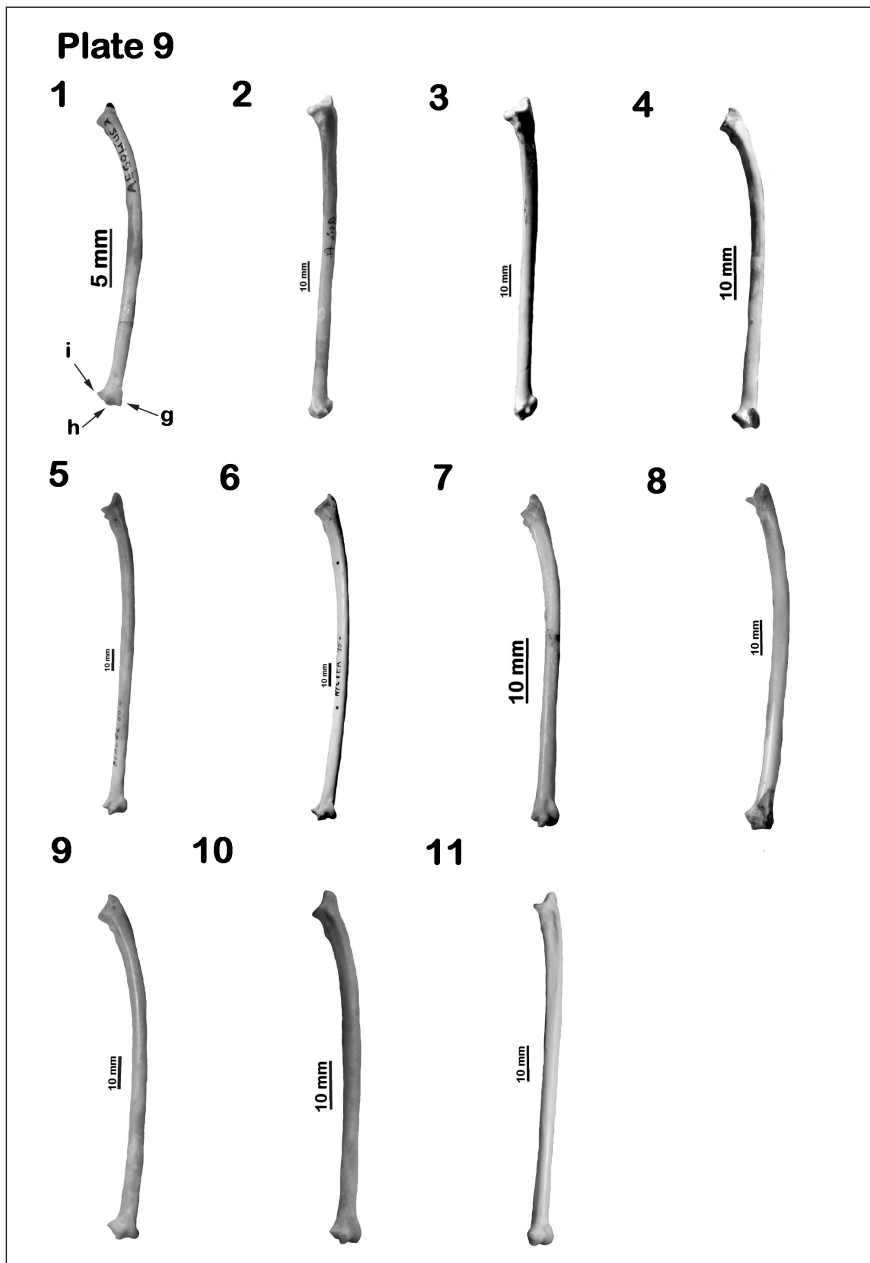


Plate 9.

Left ulna (dorsal aspect)

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

9. táblakép

Bal oldali singszont (háti nézet)

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

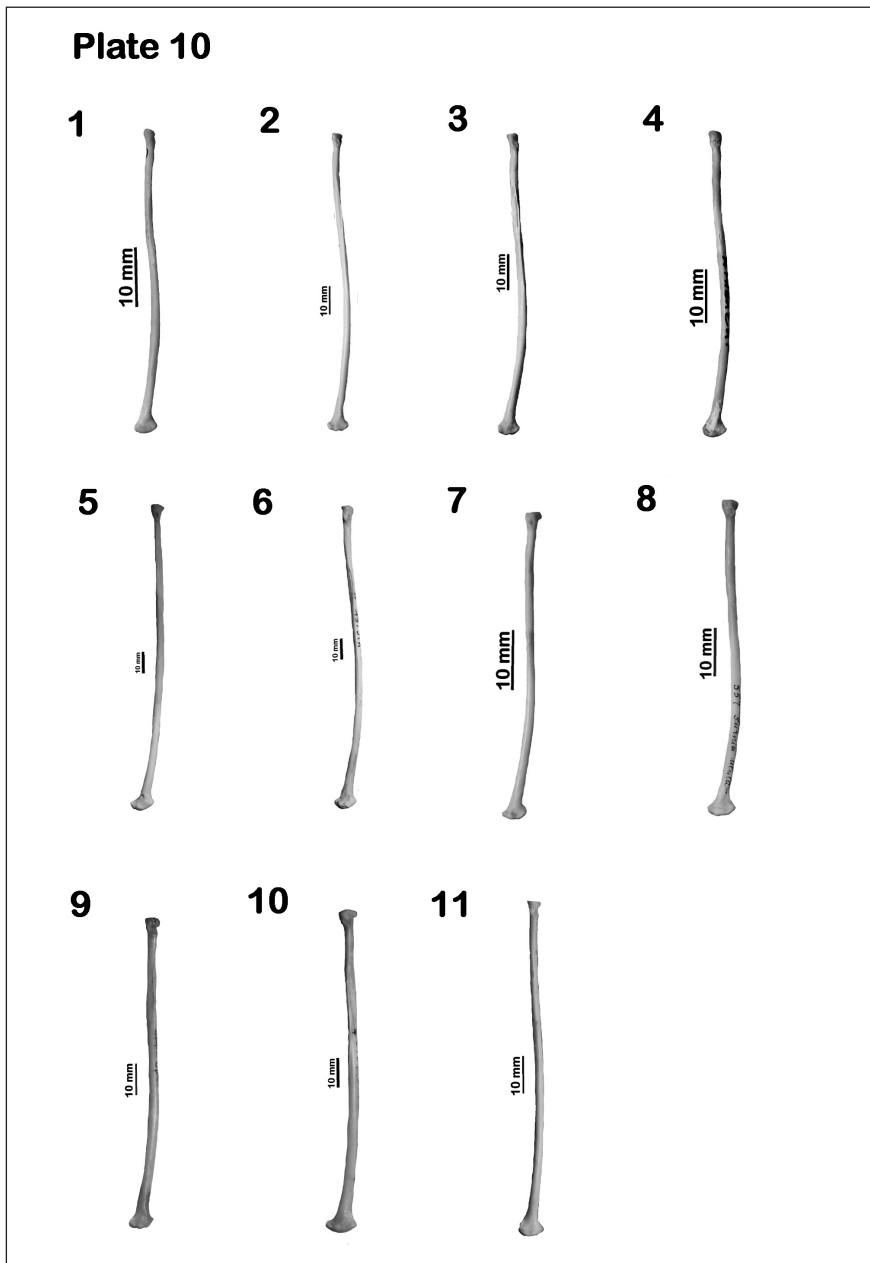


Plate 10.

Left radius (dorsal aspect) – a. *tuberculum bicipitale*; b. *corpus radii*; c. *tuberculum aponeurosis ventrale*; d. *tuberculum aponeurosis dorsale*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

10. táblakép

Bal oldali orsócsont (háti nézet) – *tuberculum bicipitale*; b. *corpus radii*; c. *tuberculum aponeurosis ventrale*; d. *tuberculum aponeurosis dorsale*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

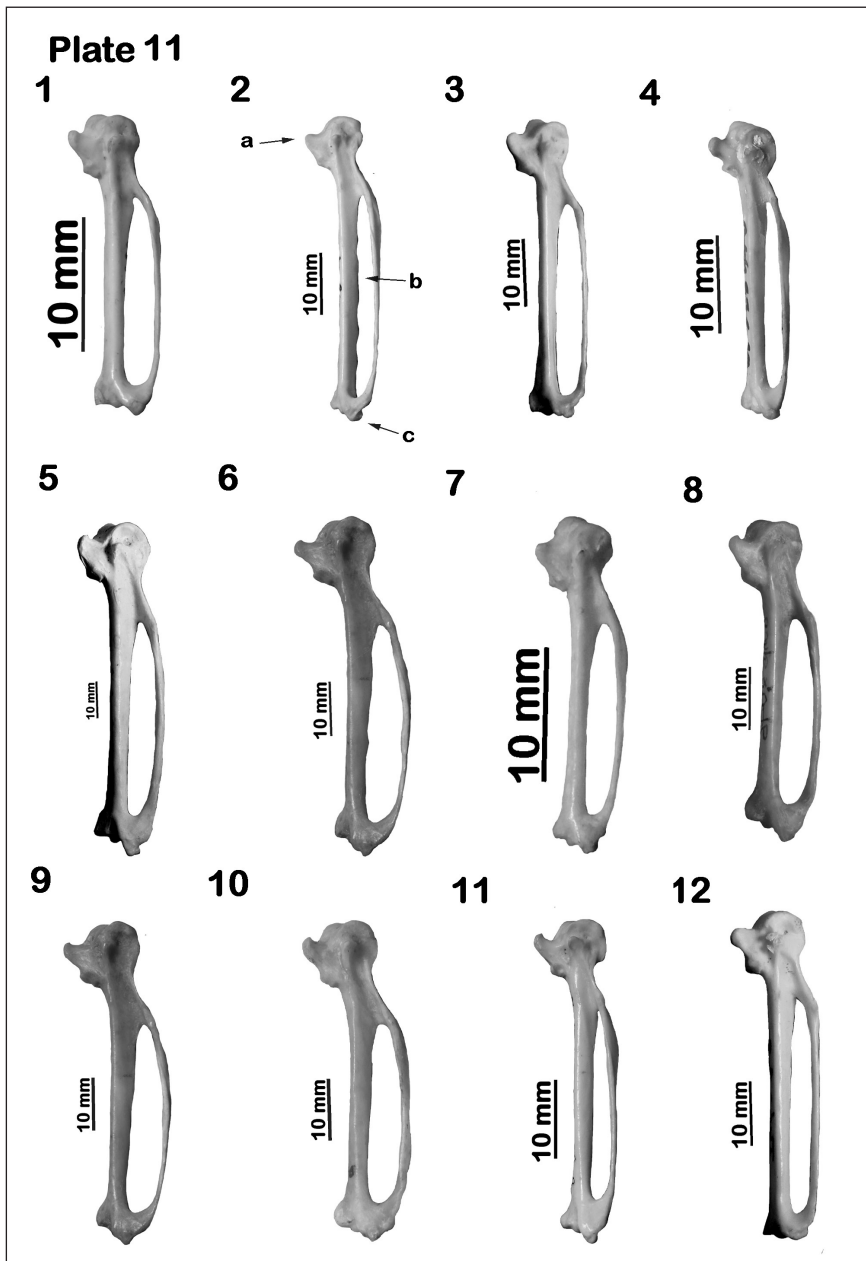


Plate 11.

Left carpometacarpus (ventral aspect) – a. *processus extensorius*; b. *spatium intermetacarpale*; c. the distal end of the *metacarpus majus*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. nebulosa*; 11. *S. uralensis*; 12. *Tyto alba*

11. táblakép

Bal oldali kézközépcsont (hasi nézet) – a. *processus extensorius*; b. *spatium intermetacarpale*; c. a *metacarpus majus* disztális vége

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. nebulosa*; 11. *S. uralensis*; 12. *Tyto alba*

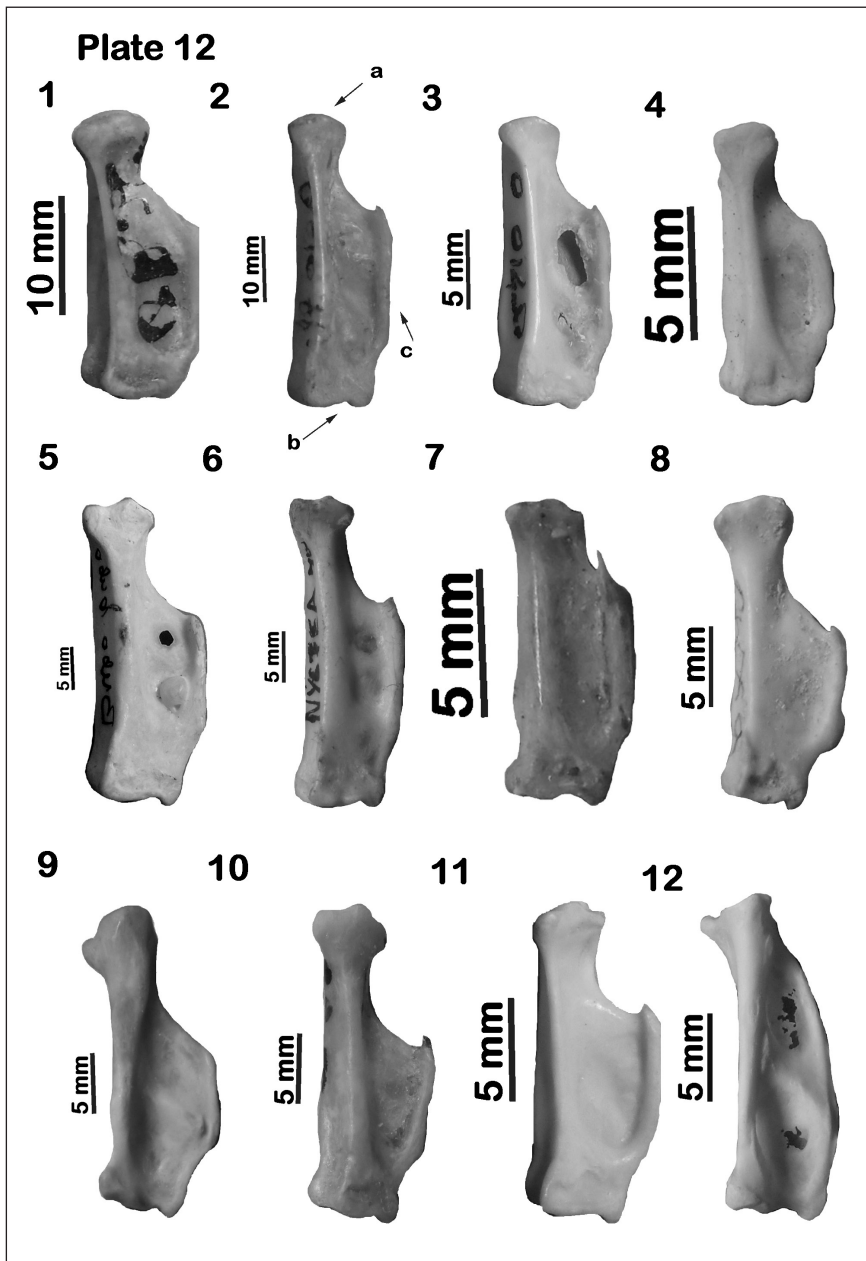


Plate 12.

Left *phalanx proximalis digiti majoris* (ventral aspect) – a. proximal end; b. distal end; c. proximal end of the lateral side

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. nebulosa*; 11. *S. uralensis*; 12. *Tyto alba*

12. táblakép

Bal oldali kézujjperc (1. ujjperc, 2. ujj, hasi nézet) – a. proximális vég; b. disztális vég; c. laterális oldal proximális vége

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Surnia ulula*; 9. *Strix aluco*; 10. *S. nebulosa*; 11. *S. uralensis*; 12. *Tyto alba*

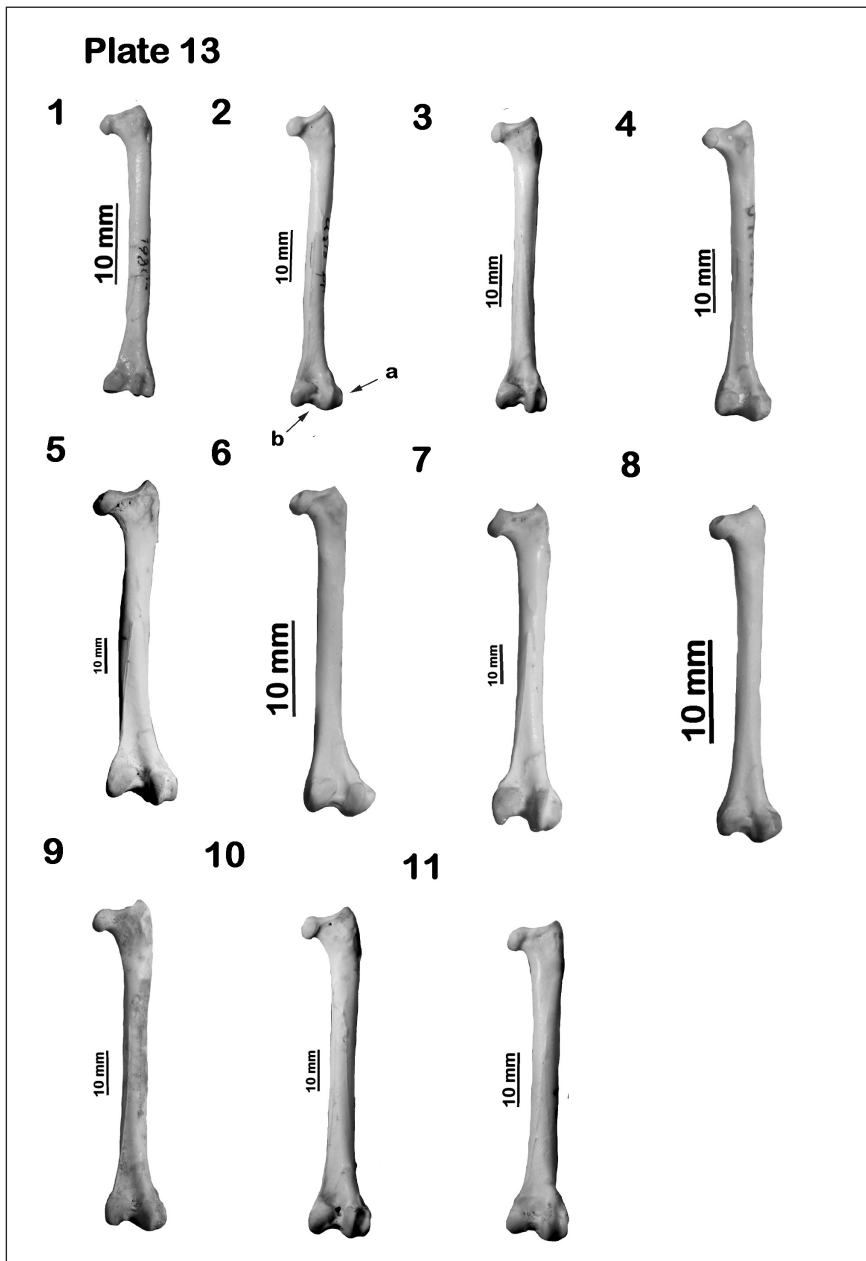


Plate 13.

Right femur (caudal aspect) – a. *condylus lateralis*; b. *sulcus intercondylaris*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Otus scops*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*

13. táblakép

Jobb oldali combcsont (palmáris nézet) – a. *condylus lateralis*; b. *sulcus intercondylaris*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Otus scops*; 9. *Strix aluco*; 10. *S. uralensis*; 11. *Tyto alba*



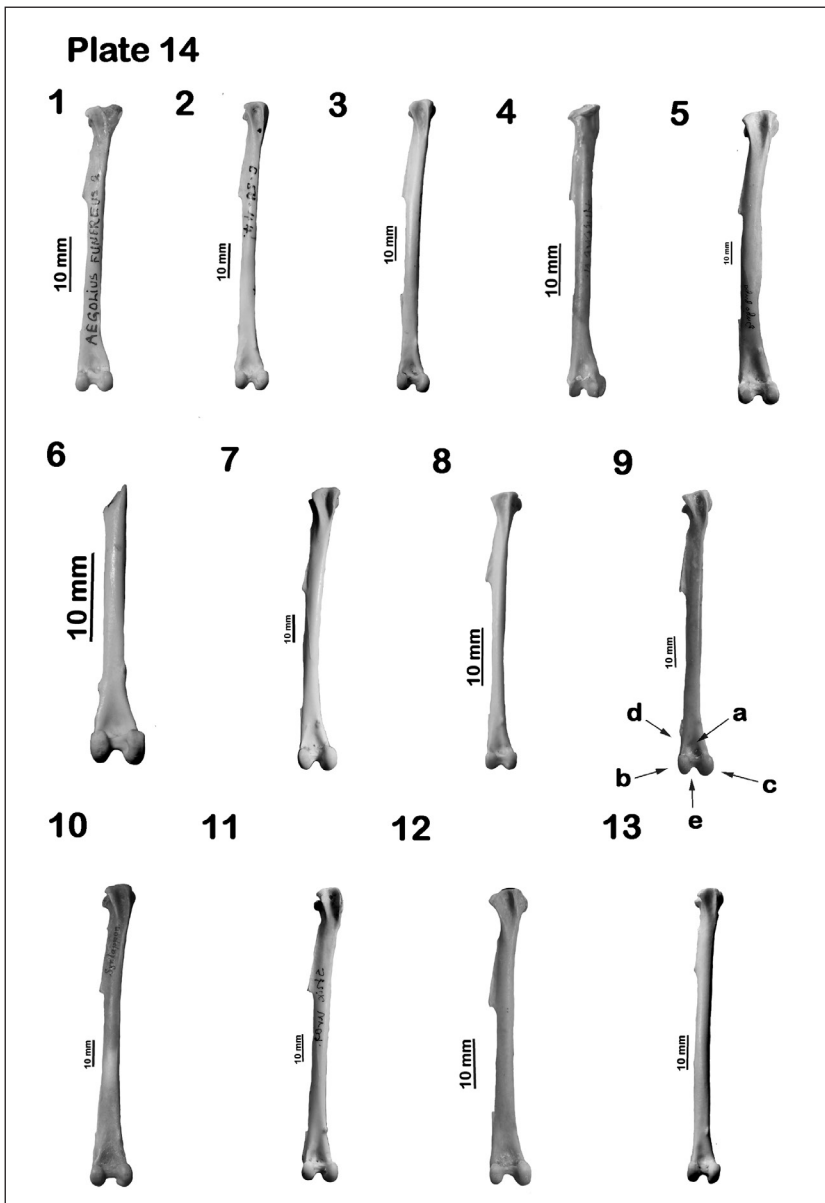


Plate 14.

Right tibiotarsus (cranial aspect) – a. *sulcus extensorius*; b. *epicondylus lateralis*; c. *epicondylus medialis*; d. *tuberculum retinaculum musculi fibularis*; e. *incisura intercondylaris*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Otus scops*; 9. *Strix aluco*; 10. *S. nebulosa*; 11. *S. uralensis*; 12. *Surnia ulula*; 13. *Tyto alba*

14. táblakép

Jobb oldali lábszárcsont (dorzális nézet) – a. *sulcus extensorius*; b. *epicondylus lateralis*; c. *epicondylus medialis*; d. *tuberculum retinaculum musculi fibularis*; e. *incisura intercondylaris*

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Otus scops*; 9. *Strix aluco*; 10. *S. nebulosa*; 11. *S. uralensis*; 12. *Surnia ulula*; 13. *Tyto alba*

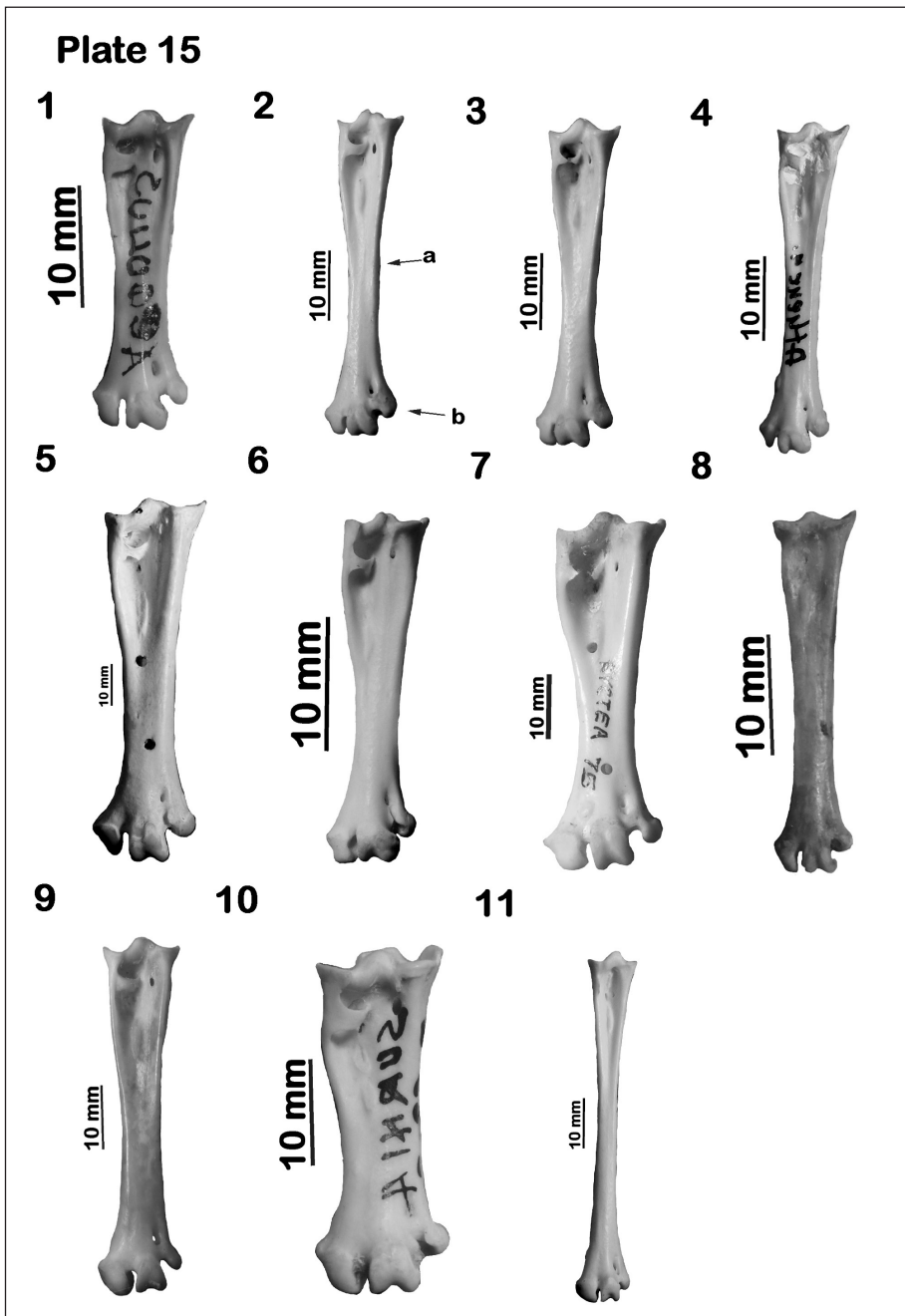


Plate 15.

Left tarsometatarsus (dorsal aspect) – a. diaphysis; b. trochlea metatarsi II.

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Otus scops*; 9. *Strix aluco*; 10. *Surnia ulula*; 11. *Tyto alba*

15. táblakép

Bal oldali csüd (háti nézet) – a. diaphysis; b. trochlea metatarsi II.

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *A. otus*; 4. *Athene noctua*; 5. *Bubo bubo*; 6. *Glaucidium passerinum*; 7. *Nyctea scandiaca*; 8. *Otus scops*; 9. *Strix aluco*; 10. *Surnia ulula*; 11. *Tyto alba*

**Plate 16.**

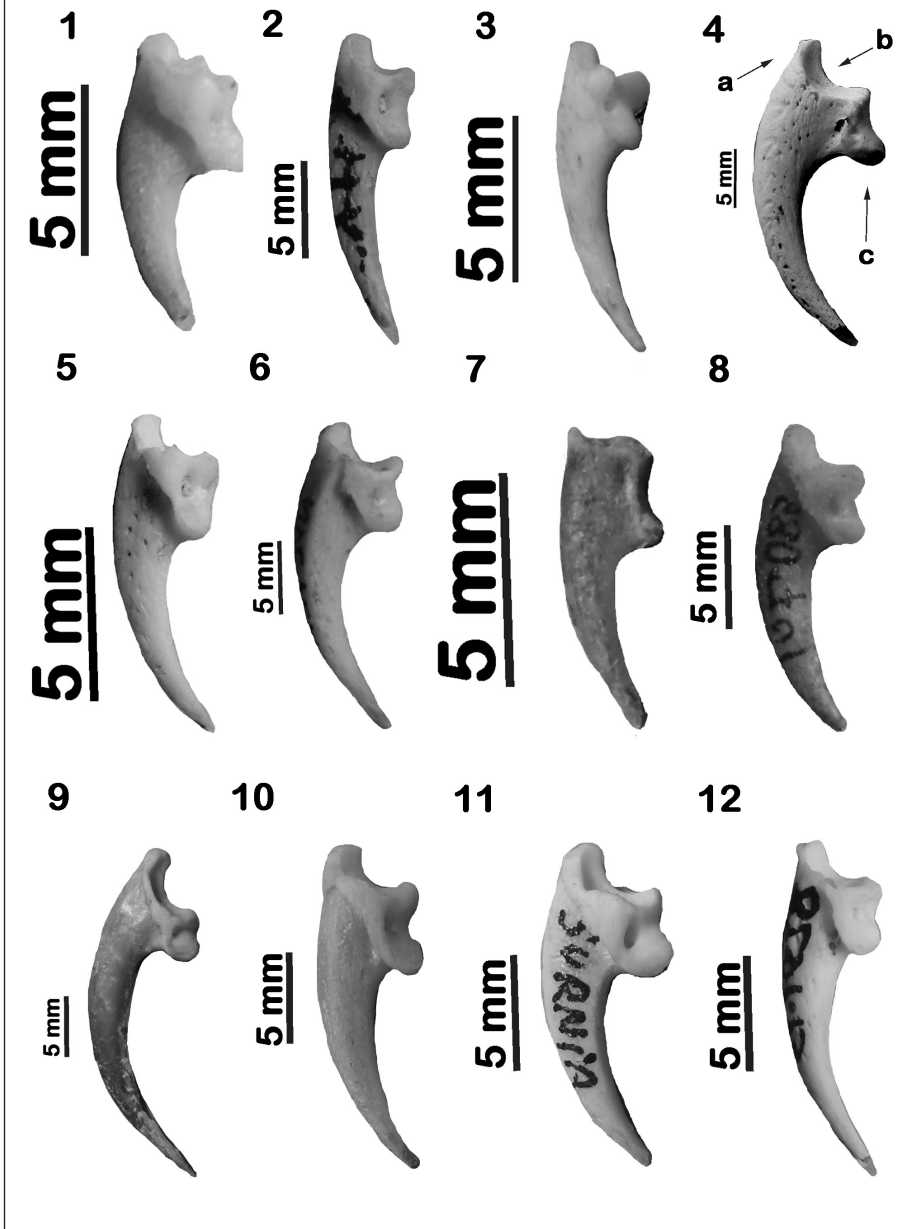


Plate 16.

*Phalanx unguis* – a. *tuberculum extensorium*; b. *cotyla articularis*; c. *tuberculum flexorium*.

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *Athene noctua*; 4. *Bubo bubo*; 5. *Glaucidium passerinum*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Strix aluco*; 9. *Strix nebulosa*; 10. *Strix uralensis*; 11. *Surnia ulula*; 12. *Tyto alba*

16. táblakép

Karomcsont – a. *tuberculum extensorium*; b. *cotyla articularis*; c. *tuberculum flexorium*.

1. *Aegolius funereus*; 2. *Asio flammeus*; 3. *Athene noctua*; 4. *Bubo bubo*; 5. *Glaucidium passerinum*; 6. *Nyctea scandiaca*; 7. *Otus scops*; 8. *Strix aluco*; 9. *Strix nebulosa*; 10. *Strix uralensis*; 11. *Surnia ulula*; 12. *Tyto alba*

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