Ornis Hungarica 2014. 22(2): 65–125.
DOI: 10.2478/orhu-2014-0019

Fossil and subfossil bird remains and faunas from the Carpathian Basin

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Abstract The author summarizes the knowledge of fossil and subfossil bird life from the Carpathian Basin, of all geological ages, site by site. After a historical overview, he presents the Mesozoic, Tertiary and Quaternary bird fauna, based on a holistic reference material consisting of 196 titles indicated in the bibliography, including papers in English (64), Hungarian (50), German (46), Romanian (26), Croatian (9) and Polish (1) languages. The text is supplemented with maps of fossiliferous sites from different ages and a list from 341 paleontological and archaeological sites on species of the Carpathian Basin, respectively. The number of taxa reaches 845, including 189 extinct taxa (two orders, four families, nine genera – five ichnotaxa of which (154 species, five ichnotaxa and 10 subspecies) were described from the Carpathian Basin, primarily. Most significant records include the Mesozoic taxa *(Eurolimnornis, Palaeocursornis, Elopteryx)*, the new Neogene songbirds species and the presence of predecessors of recent European grouses, Bustards and Corvidae species from the Pliocene and Early Pleistocene in the Carpathian Basin.

Keywords: Carpathian Basin, paleo-ornithological studies, fossil sites, evolution

Összefoglalás A szerző összefoglalja a Kárpát-medence fosszilis és szubfosszilis madárvilágáról szóló ismereteket, mind koronként, mind lelőhelyenként. A történelmi visszatekintés után ismerteti a mezozoikumi, a harmad- és negyedidőszaki lelőhelyek madárfaunáját egy teljességre törekvő, angol (64), magyar (50), német (46), román (26), horvát (9) és lengyel (1) nyelvű, 196 tételből álló hivatkozáslista alapján. A kréta és harmadidőszaki, a kora- és középső-pleisztocén, a késő-pleisztocén, valamint a késő-glaciális és holocén kori lelőhelyek térképei, valamint (mellékletként) a meghatározott taxonok rendszertani és időrendbeli táblázata egészíti ki a tanulmány szövegét. A Kárpát-medencéből 341 őslénytani és régészeti lelőhelyről ismerünk fosszilis és szubfosszilis madármaradványokat. A taxonok száma eléri a 845-öt. Ebből 189 kihalt taxon (két rend, négy család, kilenc genus – ebből öt ichnotaxon (154 faj, öt ichnotaxonnal és 10 alfaj) először a Kárpát-medencéből került leírásra. Legjelentősebb leletek a mezozoikumiak *(Eurolimnornis, Palaeocursornis, Elopteryx)*, de igen fontos a neogen kori énekesek és a recens európai fajdok, túzokok és varjúfélék fosszilis elődjei jelenlétének kimutatása is a Kárpát-medence pliocénjében és kora-pleisztocénjében.

Kulcsszavak: Kárpát-medence, madárőslénytani kutatások, madárfosszíliák, evolúció, fosszília-lelőhelyek

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Introduction

The paleogeographic conditions in the Carpathian Basin's ancient area (the tectonic plates which constitute the actual territory were not necessarily on their present-day place all the time) are believed to have provided adequate conditions for bird life, presumably, in the time when they appeared on the Earth. The area was covered by more or less widespread masses of water (lakes, inland and open seas) from the Triassic to the Neogene period, but sometimes it had vast littoral zones with lagoons and archipelagos

as well. We have a lot of evidence of continental life already from the Triassic for both the plant and animal kingdoms. There are well-known plant marks and relics developed in the Mecsek and Királyerdő Mountains (Munţii Pădurea Craiului) from the Early Jurassic. However, animal remains such as footprints of dinosaurs in Mecsek, nothosaurs described in the Báród Basin, a sea-protocrocodile skeleton in Gerecse, Early Cretaceous remains of vertebrates of Cornet in Királyerdő, fossils of dinosaurs, crocodiles, lizards but even Mammalia from the Late Cretaceous in Erdély (Transylvania) and in the Bakony. As a consequence of paleogeographic conditions, terrestrial life forms are poorly represented (e.g. there are fewer bird fossils).

This is plausible because the Carpathian Basin did not even exist at that time. It was represented by islands or microcontinents located on three tectonic plates between Europe and Africa. Plant fossils indicate that climate was warmer than in the rest of Europe, but their area has limited both the variety of forms of life and the possibilities of fossilization. From the Neogene and especially after the formation of the basin in the present-day location, during and following the uprising of the ring of mountains and the formation of the internal sea which later became a lake, in many places, there appeared adequate conditions for fossilization. As a consequence, in many places, even bones of birds could be found. From the beginning of the Quaternary, the life forms in the Carpathian Basin became more and more similar to the present-day ones. This flora and fauna had many similarities to those described in other parts of Europe but also had a lot of endemic species. From the Mesozoic, even the occurrence of dwarfism, a characteristic of archipelagos, is demonstrated.

In this region, another characteristic of that 200 million years long period between the Triassic and the Quaternary was a warmer climate. This can be seen from the composition of both the flora and vertebrate fauna. For example, several vertebrates, which today are characteristic to the tropics (primeval reptiles, crocodiles, turtles, birds and even mammals), lived here. The diverse and lush vegetation with its insects, as well as the fauna of the vast aquatic surroundings, provided rich food sources for many, including birds, allowing them to exist. Their presence is indicated by findings already from the Mesozoic, but we have plentiful fossils from the Tertiary and especially from the Neogene. As a consequence of the extensive karstification, in numerous caves, rich bird fossils from the Quaternary were discovered. These fossils allow us to easily trace the changes of the avifauna during the succeeding glacial and interglacial periods, up to the present situation.

We discuss in this paper the evolution of this avifauna based on the available literature and the bird fossils examined and determined by us.

List of collections:

GIB = Geological Institute Bucureşti, Romania

IPUW = Institute of Paleontology, University of Wien, Austria

EMNH = Eötvös Museum of Natural History, Eötvös Loránd University, Budapest, Hungary

LPUB = Laboratory of Paleontology, University Bucureşti, Romania

MÁFI = Magyar Állami Földtani Intézet (Geological Institute of Hungary, new Geological and Geophysical Institute of Hungary: GGIH, Budapest, Hungary)

MEMEK = Museum 'Erdélyi Múzeum Egylet' Kolozsvár, Romania

MMB = Moravian Museum Brno, Czech Republic
MMP = Museum Municipal Pásztó, Hungary
MPUBBC = Museum of Paleontology University 'Babeș-Bolyai' Cluj – Kolozsvár, Romania
MTM = Magyar Természettudományi Múzeum (Department of Paleontology and Geology of the Hungarian Natural History Museum, Budapest, Hungary – HNHM)
MȚCO = Museum 'Țării Crișurilor Oradea', Nagyvárad, Romania
NHML = Natural History Museum, London, England
NHMW = Natural History Museum Wien, Austria

The short history of avian paleontology in the Carpathian Basin

According to the earliest known data (Neugeboren 1850), Michael Ackner collected songbird remains around the middle of the nineteenth century from the Popláka chasm near Sibiu in Transylvania. The next finding, an imprint of a feather, was reported from the Miocene of Oltszakadát and Brașov in 1855 (Andrae 1855). Hermann von Meyer described a finch *(Fringilla radobojensis)* from the Miocene of Radoboj, Croatia (von Meyer 1865). A few years later, Samu Róth excavated caves I. and III. of Novi Hill in Szepes (Spiš) County, Slovakia, and Antal Cave in Ružín (1879-1880). The remains found were classified and published by Alfred Nehring (Nehring 1880, 1881). In the second half of the nineteenth century, Gábor Téglás, an archeologist from Déva, gathered material from the Hátszeg (Haţeg) Basin and Apuseni Mountains, both in Transylvania. He mentioned several species while identifying the findings from the Nándori Cave (Téglás 1880). With paleontological research making rapid headway in the late ninetieth-early twentieth century, the year 1904 was a significant one regarding avian paleontology, when Mihály Tóth discovered the site on the southwest versant of Somló Hill near Oradea. Excavation of the remains of the cave system formerly known as Püspökfürdő, then as Betfia, was initiated by Tivadar Kormos. He was also the one to publish the avian fossils' preliminary classification (Kormos 1911, 1913). In-depth classification was made by Waclav Čapek Czech osteologist (Čapek 1917). In 1905, Zoltán Szilády gathered material (avian bones among others) from the Lucsia Cave near Aranyos-Szohodol in Transylvania. These remains have only been found in 2000 in the collection of the Department of Geology and Paleontology of the Hungarian Natural History Museum by Erika Gál and identified recently (Gál 2002a). Bones found in the cavern of Dealul Șprenghi in Brașov were classified by Ferenc Toula (Toula 1909). A few years later, Gyula Éhik studied the same site (Éhik 1913). In 1915, Ottokár Kadić gathered material from Zoltán Cave in Băile Herculane, Romania. Findings of the latter two excavations mentioned were also classified by Erika Gál (Gál 2002a). Several fossils collected in the meantime have been transported to foreign museums. From the material purchased from Ferenc Nopcsa and originating from the Late Cretaceous layers of the Hátszeg Basin, Charles William Andrews English paleontologist identified a much-debated ibis-like species (*Elopteryx nopcsai* Andrews, 1913) (Andrews 1913, Lambrecht 1933). Between 1911 and 1917, Tivadar Kormos and Ottokár Kadić gathered rich findings from numerous sites in Transylvania, North Hungary, Croatia and Hun-

gary, classified and published by Kálmán Lambrecht (Lambrecht 1912a,b, 1913, 1915, 1916a), including the avian fossils found in the bituminous sand of Tataros in Partium (Lambrecht 1916b). This became possible because he had established the comparative collection in the Ornithological Centre in Budapest, consisting of more than 1400 skeletons. Due to his role during the Soviet regime, Lambrecht could not continue his researches in Hungary until 1926, when he became a librarian under Ferenc Nopcsa in the Hungarian Geological Institute. He presented material gathered after World War I. on the XXVIII. Ornithological World Congress held in Budapest (Lambrecht 1929). Finally, in Berlin in 1933, Lambrecht's major comprehensive work, referred to and used to this day, the 'Handbuch der Palaeornithologie' was published, summarizing the paleornithological literature of the day, along with findings in foreign collections examined and classified by Lambrecht himself. Sadly, fate did not give him much more time to work thereafter, and in 1936, Kálmán Lambrecht, one of the most significant figures of Hungarian and international avian paleontology, died. Findings and descriptions following his death were sparse. From the 1930's, Mária Mottl collected and classified inter alia bird fossils from Hungarian, Transylvanian and, later, Austrian caves. From the late thirties, Miklós Kretzoi got engaged in avian paleontology. From 1941, he gathered bird remains from several Transylvanian and North Hungarian sites, such as from older and more recent parts of Püspökfürdő. He registered a few species in his preliminary report (Kretzoi 1941). The new name of the site, Betfia, can also be credited to him. As a result of his study of ample small mammal findings, he established the Biharian stage and the Betfian faunal level. From 1951 to 1960, Kretzoi has classified and published avian bones from sites at Csákvár, Kisláng, Southern Baranya and from newer sites of Betfia (Kretzoi 1961-1962). In 1953, the first work of Dénes Jánossy regarding avian paleontology was published, describing material from the cave of Istállóskő. Until the end of the 90's he wrote papers one after the other not only on Hungarian, but also on Slovakian, Transylvanian and German sites. In 1985, László Kordos published his work on footprints (on birds' prints, among others) found at Ipolytarnóc. In later essays (working either with Jánossy or alone), he published lists of species from cavernous sites from the Quaternary of Hungary. Meanwhile, from 1961, Mirko and Vesna Malez classified and published the bird fauna of states of former Yugoslavia in numerous works. At the same time, in the former Czechoslovakia, Ian Horáček, Oldřich Fejfar, Robert Musil, Petr Svec, then in the last decade mainly Jirí Mlikovskỳ, reported several avian findings from Slovakia, Austria and Croatia. In Austria, at the same time Otto Wettstein, Elsbeth Soergel, Johann Nepomuk Woldrich, Franz Bachmayer, Ursula Göhlich, Gernot Rabeder and others have collected and classified remains, but Kálmán Lambrecht, Dénes Jánossy and Jíri Mlikovskỳ also had a significant role in the classification of the material. The Kessler's first work on the history of avian paleontological research in Romania was published in 1973 in Romania in cooperation with Tibor Jurcsák. This was followed by the classification and publication of material found in Romanian collections by himself and also with co-authors (note that only Erika Gál and Tibor Jurcsák have made effective avian paleontological research, other co-authors only described either the geological features of the sites or other fossil re-

mains in their works). Tibor Jurcsák paleontologist, who had laid the foundation of paleornithological research in the 'Ţara Crişurilor' Museum (collecting fossils, creating a comparative bone collection, obtaining literature), passed away in 1992. The author, having become a professor of the 'Babeş-Bolyai' University of Cluj-Napoca, began working with Erika Gál in 1994, who in her PhD thesis (Gál 2002a) discussed the Pleistocene avian fauna of Romania. Since 2002, they both continued their research in Hungary. In the last decade with the retirement of Miklós Kretzoi and Dénes Jánossy, and their death in 2005, a very significant and fertile era of Hungarian paleontology has ended. However, with the moving of the Hungarian Natural History Museum's Department of Paleontology and Geology, the creation of suitable research conditions could begin. Ever since the Late Pleistocene, the presence of man has on the one hand influenced the very existence of birds (being responsible for the lapsing and even the extinction of many species), but on the other hand with storing up uneaten bones around their habitats, they contributed to the remains' going down to posterity. Even material from Palaeolith sites is considerable, but mainly bones from the Holocene Mesolithic, Neolithic, Metal Age and historical times indicate human customs of hunting and breeding birds. Since parts undigested by predators (found mainly in caves) have been piled up in parallel with bones in the cesspool of humans, their classification, which is a task of zooarchaelogy, provides information on the avifauna of the past few thousand years. Experts of zooarchaeology were mainly those mentioned in the field of Paleornithology. This also indicates the peculiarity of classifying avian remains. It was Gábor Téglás who reported archaeozoological bird fossils from the area of the Carpathian Basin from the second half of the 19th century, followed by Kálmán Lambrecht, Mária Mottl and the above-mentioned Austrian researchers between the two World Wars. In the second half of the twentieth century, Sándor Bökönyi, István Vörös and László Bartosiewitz registered bird findings in Hungary, but most of them have been classified by Dénes Jánossy. In Romania, Erika Gál and the author did the same and the former has continued her activity in Hungary as well. There are far more than a hundred zooarchaeology sites in Hungary, Austria, Romania, Serbia, and Slovakia, providing numerous remains of wild fowl species. It can be noted in the light of the description above that as of yet no avian fossils or subfossils are known from sites in the Carpathian regions of Slovenia and Ukraine (Kessler 2013a).

The mesozoic bird life of the Carpathian Basin

Among vertebrates of the Upper Triassic – Lower Jurassic living in shallow coastal lagoons, the reptiles ruled. This is evidenced by the *Notosaurus* and *Tanystropheus* from the Upper Triassic of Bárod Basin in Transylvania, the dinosaur footprints from the Lower Jurassic of Mecsek Mountains, and the sea crocodilian skeleton from Gerecse Hill. Ancestral bird remains are not found, but their presence can not be excluded. Nevertheless, they are only known from the Cretaceous. The Cretaceous sites from the Carpathian Basin are clustered in three areas:

1. The oldest (Berriasian, Lower Cretaceous, 145 million years) is a Transylvanian Cornet bauxite mine in the Királyerdő Mountains. These fossils were collected in 1978-1980, together with several dinosaurs and pterosaurs remains. Between 1982 and

1986, the author and Tibor Jurcsák identified three bird taxa here: – aff. *Archaeopteryx* sp., *Eurolimnornis corneti* Kessler and Jurcsák, 1984 (new ordo, family, genus and species) and *Palaeocursornis biharicus* Kessler and Jurcsák, 1986 (also new ordo, family, genus and species). Their true bird character was much doubted (Benton *et al.* 1997, Feduccia 1999 and other authors). Based on the recently completed revision (Dyke *et al.* 2010): 'Aside from their phylogenetic affinities, these unique Romanian fossils are also important because of their age; in particular, very few birds are known globally from the earliest Cretaceous. Reexamination of collections in Oradea (Nagyvárad) confirms the presence of both birds and pterosaurs in the Cornet bauxite: although the fragmentary bird remains are mostly indeterminate, one record of a hesperornithiform is confirmed. These records are extremely significant because of the age of the Cornet deposit. The fossil birds from this site are just a few million years younger than *Archaeopteryx* (Aves) from the Late Jurassic of Germany.' On the one hand, it was proved that they are among the oldest bird remains; on the other hand, erroneously was treated as '*nomina dubia*' Deposited in MȚCO.

2. Iharkút opencast bauxite mine, Bakony Mountains, Hungary (Upper Cretaceous, Santonian, Csehbánya Formation, 80 million years). The sites were identified by Attila Ősi in the previous decade and furnished many turtle, lizard, crocodile, dinosaur and pterosaur remains. Next to them were Enantiornithes bones as well. A new genus and species: *Bauxitornis mindszentyae* was described here (Dyke & Ősi 2010). In addition, Enantiornithes indet and Aves indet were also recorded. Deposited in HNHM.

3. Szentpéterfalva (Sînpetru), Hátszeg (Haţeg) Basin, Romania (Upper Cretaceous, Maastrichtian, 65 million years). In 1904, Baron Ferenc Nopcsa began the collection in this site. Besides dinosaur remains, he also discovered avian bones. These were identified by Charles William Andrews in 1913 as the new bird taxon *Elopteryx nopcsai.* This resulted in much discussion, but in 2005, at the same site, a new bone was discovered, which confirmed the previous determination (Kessler *et al.* 2005). Deposited in NHML and LPUB.

4. Valiora (Vălioarea). Hátszeg (Haţeg) Basin, Romania (Upper Cretaceous, Maastrichtian, 65 million years). Here in 1990, D. Grigorescu discovered problematic bird bones, which were published as Ornithurinae birds (Wang *et al.* 2011), but in my opinion, they are Enantiornithes. Deposited in LPUB.

5. Szászsebes (Sebeș), Alba County, Romania (Upper Cretaceous, Maastrichtian, 65 million years). In 2011 Mátyás Vremir discovered an entire nesting colony (with eggs and embryos). After Gareth Dyke, these are derived from Enantiornithes. Deposited in MEMEK.

Tertiary avian remains and localities of the Carpathian Basin:

After the extinction of the Theropods and Sauriurae birds, the Ornithurae bird fauna underwent an explosive development. However, the numbers of Paleogene fossils are not too many in the Carpathian Basin due to paleogeographic reasons. In contrast, the number found in Neogene sites is much higher.

A. Paleogene localities:

1. Kolozsmonostor (Cluj-Mănăștur), Romania (Middle Eocene, MP 13). Was discovered by Antal Koch and described by Kálmán Lambrecht as *Eostega lebedinskyi* Lambrecht, 1929, based on a partial mandible. The genus and species was described in

the new family Elopterygidae (Lambrecht 1929), but it appears that it is in fact a typical member of the modern family Sulidae (Mlikovskỳ 2007). Deposited in NHMW.

2. Kolozsvár – Fellegvár (Cluj-Cetăţuie), Romania (Lower Oligocene, MP 24).

– *Rallicrex kolozsvariensis* Lambrecht, 1933, based on the partial skeleton of a new rail genus and species (Lambrecht 1933). It was discovered by János Tulogdy. Deposited in MÁFI.

– Anseridarum gen. et sp. indet. based on a partial lower limb imprint; was discovered by Mátyás Vremir (Kessler *et al.* 1998). Deposited in MPUBBC.

3. Budapest – Újhely Clay Open pit mine in Szépvölgy, Hungary (Lower Oligocene, MP 24; Kiscell Clay Formation). The discovery of an almost complete wing skeleton, assigned to the petrel-like new fossil bird *Diomedeoides harmathi* Kessler, 2009. The slab including the fossil specimen was collected by István Harmat in 1923. This is the oldest modern bird species (Ornithurine) found in the present-day territory of Hungary. The presence of this aquatic bird belonging to the order of Procellariformes is in accordance with presumed deep-sea conditions in the Carpathian Basin during the Miocene (Kessler 2009c). Deposited in HNHM.

4. Petrozsény (Petroșani) – Câmpul lui Neag, Romania (Upper Oligocene, MP 25). Footprints of *Charadriipedia limosa* Radan et Brustur, 1993 (Rădan & Brustur 1993). Deposited in GIB.

5. Máriahalom – Hungary (Upper Oligocene, MP 25, Mány Formation). The remains were discovered by Zoltán Evanics and partially determined by the authors as: aff. *Gavia* sp., aff. *Grallavis edwardsi* (Lydekker 1891) *Mionetta robusta* (Milne-Edwards 1868), *Pandion* sp. foss., aff. *Balearica excelsa* (Milne-Edwards 1868), Aves indet. (Kessler & Rabi manuscript). The bird fauna indicates a freshwater environment. Deposited in EMNH.

B. Neogene localities:

The Neogene avifauna of the Carpathian Basin is incomparably richer than the Paleogene one. Footprints, feather imprints, eggshell pieces and, of course, primarily bones occur. Almost all geological periods are represented.

Miocene:

a) Lower Miocene

MN 1-4:

1. Erősd (Ariușd), Romania – with problematic? *Haliaeetus* sp. (Lambrecht 1929). Its whereabouts are unknown.

2. Ipolytarnóc, Hungary – footprints discovered in 1900. László Kordos described, in 1983, four birds, ichnotaxa: *Avidactyla media* Kordos, 1983, *Ornithotarnocia lambrechti* Kordos, 1983, *Passeripedia ipolyensis* Kordos, 1987, *Tetraornithopedia tasnadii* Kordos, 1983 (Kordos 1985, 1987). Deposited in MÁFI.

3. Piski (Simeria), Romania – unidentified feather imprints were collected by János Mallász (Lambrecht 1929). Their location is unknown.

MN 3-4:

4. Limberg, Austria – the partial skeleton imprint and feather imprints were collected in the XIX. century and identified as: *Prosybris antiqua* (Milne-Edwards 1863) by Jiri Mlíkovskỳ (Bachmayer 1980, Mlikovskỳ 2002). Deposited in NHMW.

MN 4:

5. Grund – Molasse Basin, Austria – the bird remains were determined by Ursula Göhlich as: *Microsula pygmaea* (Milne-Edwards 1874); *Phalacrocorax intermedius* (Milne-Edwards 1867); cf. *Palaeortyx*

intermedia Ballmann, 1969; Laridae indet.; Aves indet. (Göhlich 2003). Deposited in NHMW.

6. Oberdorf, Austria – the few fragments were collected from a coal mine of Graz Basin and determined by Jiri Mlikovskỳ as: Anatidae gen. et sp. indet. and Passeriformes fam. indet. (Mlikovskỳ 1998b). Deposited in NHMW.

MN 5:

7. Borosd (Weingraben), Austria – the feather imprints attributed to the Podicipedidae, Phalacrocoracidae, Ardeidae and Anatidae from Burgenland are signalled by Bachmayer (1964) and Mlikovskỳ (1996). Deposited in NHMW.

8. Litke 2, Hungary – discovered in 1998 by János Hír, the fossiliferous site furnished a rich bird bone material, determined by the author as: *Cygnopterus neogradensis* Kessler and Hír, 2009; *Palaeortyx* aff. *Phasianoide;, Palaeortyx gallica*; *Rallicrex litkensis* Kessler and Hír, 2012; *Corvus* sp. indet.; *Galerida cserhatensis* Kessler and Hír, 2012; *Cinclus major* Kessler andt Hír, 2012; *Turdicus minor* Kessler and Hír, 2012; *Luscinia praeluscinia* Kessler and Hír, 2012; *Bombycilla hamori* Kessler ande Hír, 2012; *Emberiza bartkoi* Kessler and Hír, 2012; Passeriformes indet. (Kessler & Hír 2009, 2012a,b). Deposited in MMP.

b) Middle Miocene

MN 6-8:

1. Brassó (Brașov), Romania – unindentified feather imprint (Lambrecht 1933, Andrae 1955). Its location is unknown.

2. Dévényújfalú (Devinska Nová Ves, Neudorf), Slovakia – bone fragments of the Phasianidae as *Miogallus altus* (Milne-Edwards 1869) and unidentified passerines (Švec 1986, Kordos 1987, Mlikovskỳ 1996). Deposited in MMB.

3. Egerszólát-Ádám Valley, Hungary – the site was discovered by János Hír in 2005. A few materials (two claw bones) can be attributed to cf. *Palaeortyx* sp. indet. (Kessler & Hír 2012a). Deposited in MMP.

4. Felménes (Minișul de Sus), Romania – the only bone fragment was collected by Vlad Codrea and identified by the author as: *Anser* sp. indet. (Kessler & Codrea 1996). Deposited in MPUBBC.

5. Felsőtárkány, Hungary – the fossil material was collected by János Hír in 2000 and was determined by the author and Erika Gál as: *Miophasianus (Miogallus)* sp.; *Praealauda hevesensis* Kessler and Hír, 2012; *Anthus antecedens* Kessler and Hír, 2012; *Phylloscopus miocaenicus* Kessler and Hír, 2012; *Bombycilla hamori* Kessler and Hír, 2012; Passeriformes indet. (Hír *et al*. 2001, Kessler & Hír 2012b). Deposited in MMP.

6. Felsőtárkány-Felnémet 2/3 and 2/7, Hungary – the fossil material was collected by János Hír in 2002-2003 and was determined by the author as: Ardeidae gen. et sp. indet.; Ciconiidae gen. et sp. indet.; cf. *Miogallus altus; Rallicrex litkaensis* Kessler and Hír, 2012; Strigidae gen. et sp. indet.; *Muscicapa leganyii* Kessler and Hír, 2012*; Lanius schreteri* Kessler and Hír, 2012; Passeriformes indet.; Aves indet. (Kessler & Hír 2012a,b). Deposited in MMP.

7. Kőalja 2. (Subpiatra 2), Romania – the site was discovered by János Hír and Márton Venczel in 2004. The fossiliferous site furnished rich rodent and bird material. The bird bones were determined by the author as: *Proardeola walkeri* Harrison, 1979; *Anas albae* Jánossy, 1979; *Palaeortyx gallica* Milne-Edwards, 1869; Perdicidae gen. et sp. indet., Gruidae gen. et sp. indet., Rallidae gen. et sp. indet., Meropidae gen. et sp. indet., Sittidae gen. et sp. indet., Certhidae

gen. et sp. indet., *Luscinia jurcsaki* Kessler and Venczel, 2011, Sylviidae gen. et sp. indet., Laniidae gen, et sp. indet., Passeriformes indet. (Kessler & Venczel 2009, 2011). Deposited in MȚCO.

8. Mátraszőlős 1, Hungary – situated in Nógrád County the site had been discovered in 1940, but vertebrate remains were collected by János Hír in 1998. The bird material was determined by Kessler and Gál (2001, 2009, 2012) as: aff. *Anhinga* sp.; *Phalacrocorax* sp. indet.; *Bucephala* aff. c*ereti* Boef et Mourer-Chauviré, 1991; *Anas* cf. *velox* Milne-Edwards, 1868; *Clangula matraensis* Kessler and Hír, 2012; *Mergus minor* Kessler, 2009; *Palaeortyx* cf. *gallica* Milne-Edwards, 1869; *Rallicrex litkensis* Kessler and Hír, 2012; *Porzana* aff. *estramosi* Jánossy, 1979; *Porzana matraensis* Kessler, 2009; *Gallinago* cf. *veterior* Jánossy, 1979; Cuculidae g. et sp. indet.; *Galerida cserhatensis* Kessler and Hír, 2012; *Lullula neogradensis* Kessler and Hír, 2012; *Motacilla* sp. indet.; *Erithacus bartkoi* Kessler and Hír, 2012; Passeriformes indet. (Gál *et al.* 1998-1999; Kessler 2009a,b, Kessler & Hír 2012a,b). Deposited in MMP.

9. Mátraszőlős 2, Hungary – discovered by János Hír in 1999, also provided avian fossils, determined by the author and Erika Gál as: *Proardeola walkeri* Harrison, 1979; Ardeidae gen. et sp. indet.; *Megapaleolodus goliath* Miller, 1944; *Mionetta consobrina* Milne-Edwards, 1867; cf. *Miogallus altus* Milne-Edwards, 1869; Columbidae gen. et sp. indet.; *Turdicus minor* Kessler and Hír, 2012; Passeriformes indet.; Aves indet. (Gál *et al.* 2000, Kessler 2009b, Kessler & Hír 2012b). Deposited in MMP.

10. Mátraszőlős 3, Hungary – the new site lays about 20 m south-east to the site Mátraszőlős 2. It was discovered in 2008 by János Hír. The avian material was determined by the author as: *Cygnopterus neogradensis* Kessler and Hír, 2009; *Paleolodus ambiguus/crassipes* Milne-Edwards, 1863; *Tadorna minor* Kessler and Hír, 2012; Anatidae gen. et sp. indet., *Miocorvus larteti* (Milne-Edwards 1871); *Turdicus minor* Kessler and Hír, 2012; Aves indet. (Kessler & Hír 2009, 2012a,b). Deposited in MMP.

11. Oltszakadát (Săcădate), Romania – unidentified feather imprint (Andrae 1855, Lambrecht 1933). Its location is unknown.

12. Radoboj, Croatia – situated near Zagreb, from the site a partial skeleton was identified, formerly thought to be a passerine bird (*Fringilla radobojensis* Meyer, 1865). Subsequently, it was re-defined as *Merops radobojensis* Mlikovskỳ, 1997 (Mlikovskỳ 1997a). Deposited in NHMW.

13. Szentmargitbánya (Sankt Margarethen), Austria – the fossiliferous site in Burgenland provided a partial skeleton of *Gavia schultzi* Mlikovskỳ, 1998 (Mlikovskỳ 2002). Deposited in NHMW.

14. Tasádfő – Drágcséka (Tășad), Romania – the site was discovered by János Hír and Márton Venczel in 1999. The avian material was determined and published by the author and Erika Gál as: *Miocorvus larteti* (Milne-Edwards 1871) (Gál & Kessler 2006, Kessler 2010a). Deposited in MȚCO.

c) Upper Miocene

MN 9:

1. Atzelsdorf, Austria – the *Anas sansanensis* Milne-Edwards, 1868 has been indicated here by Ursula Göhlich (Göhlich 2009). Deposited in NHMW.

2. Heiligenstadt – Wien, Austria – an unidentified eggshell was mentioned by Kálmán Lambrecht (Lambrecht 1933). Deposited in NHMW.

3. Rudabánya, Hungary – rich avian material was determined and published by Dénes Jánossy and Eugen Kessler as: *Anas* aff. *velox* Milne-Edwards, 1868; *Anas* sp.*, Falco* sp.*, Miogallus* cf. *altus* (Milne-Edwards 1869); *Palaeortyx phasianoides* Milne-Edwards, 1869; *P. gallica* Milne-Edwards, 1869; *P. brevipes* Milne-Edwards, 1868; *Miorallus major* Milne-Edwards, 1868; *Strix intermedia* Jánossy, 1972; *Athene* sp.*, Tringa* sp,. *Merops radobojensis* Mlikovsky, 1997; *Miocorvus larteti* Milne-Edwards, 1871; *Certhia janossyi* Kessler and Hír, 2012, *Sturnus kretzoii* Kessler and Hír, 2012 (Jánossy 1993, Kessler 2009a,b, Kessler & Hír 2012b). Deposited in MÁFI.

MN 10:

4. Götzendorf, Austria – the bone of *Anhinga pannonica* Lambrecht, 1916 and *Dendroness* sp. was signaled by Jíri Mlikovskỳ (Mlikovskỳ 1992). Deposited in NHMW.

5. Gyepűfüzes (Kohfidisch), Austria – bird bones identified and published by Jíri Mlikovskỳ as: *Pogonolius* sp., *Crex* sp., *Tyto sanctialbani* Lydekker, 1893 (Mlikovskỳ 2002). Deposited in NHMW.

6. Tataros (Derna-Tătăruș, Brusturi), Romania – bones were collected from bituminous sand and identified by Kálmán Lambrecht as: *Anhinga pannonica* Lambrecht, 1916 (Lambrecht 1916). Deposited in MÁFI and NHMW.

7. Vösendorf, Austria – bones of Phaethontidae and Phasianidae were identified and published by Jíri Mlikovskỳ as: *Heliadornis paratethydicus* Mlikovsky, 1997; *Palaeortyx* sp. (Mlikovskỳ 1997b). Deposited in NHMW and IPUW.

MN 11-13:

8. Csákvár (Esterházy Cave), Hungary – avian material was collected, identified and published by Kálmán Lambrecht and later by Miklós Kretzoi as: *Cygnanser csákvárensis* Lambrecht, 1931; *Grus pentelici* Gaudry, 1872; *Bubo florianae* Kretzoi, 1957 (Lambrecht 1931, Kretzoi 1957). Deposited in MÁFI.

9. Korond (Corund), Romania – unidentified feather imprints (Gheorghiu *et al.* 1965). Their locations are unknown.

10. Rátka, Hungary – the almost complete skeleton in slab was identified by the author as: *Palaeocryptonix hungaricus* Jánossy, 1991 (Kessler 2009b). Deposited in a private museum at Tállya.

11. Sümeg, Hungary – a few bones of the Heliornithidae, Phasianidae and Apodidae were identified and published by Dénes Jánossy and Eugen Kessler as: *Chaetura bacconica* Jánossy, 1977; *Palaeortyx* aff. *grivensis* Lydekker, 1893; (Jánossy 1976b, 1977), *Heliornis sümeghensis* Kessler, 2009 (Kessler 2009b). Deposited in MÁFI.

12. Tardosbánya, Hungary – bones of the Phasianidae, identified by Dénes Jánossy as: *Palaeortyx* aff. *grivensis* (Jánossy 1976b). Deposited in HNHM.

MN 13:

13. Polgárdi, Hungary – in the vicinity of the town Polgárdi the limestone quarry at Somlyó Hill and Kőszár Hill (226 m alt.) contained several karst fissures with vertebrate remains. Among them, the Polgárdi 2, 4 and 5 localities furnished bird bones. Polgárdi 2 had been quarried in two excavation campaigns in 1910 by Tivadar Kormos. The bird remains were identified by Waclav Čapek and were published by Kálmán Lambrecht (Lambrecht 1912b, 1933). Polgardi 4 was discovered in 1984-1985 by László Kordos. This locality yielded a rich mammal and bird assemblage. The bird fauna was identified and published by Dénes Jánossy (Jánossy 1991). Polgárdi 5 was discovered in the NE part of the quarry system in 1988 by László Kordos and the bird

fauna was published by Dénes Jánossy (Jánossy 1991). Based on revision of the whole material and on determination of the unidentified material, the author identified and published the following taxa: *Egretta polgardiensis* Kessler, 2009; *Anas denesi* Kessler, 2013*;* Anatidae indet.; *Anas albae* Jánossy, 1979; *Buteo* sp.; *Falco* cf. *cherrug; Falco tinnunculus atavus* Jánossy, 1972; *Palaeortyx gallica* Milne-Edwards,1869; *P. brevipes* Milne-Edwards,1869; *Palaeocryptonyx hungaricus* Jánossy, 1991; *Pavo archiaci* Gaudry, 1862; Galliformes indet.*; Porzana estramosi* Jánossy, 1979; *Porzana kretzoii* Kessler, 2009; *Rallicrex polgardensis* Jánossy, 1991; *Otis kalmani* Jánossy, 1980; *Otis* aff. *khosiatzkyi* Bochenski & Kurochkin, 1987; *Gallinago* sp.*, Cursorius* sp.*, Calidris janossyi* Kessler, 2009; *Gallinago veterior* Jánossy, 1979; *Charadrius lambrechti* Kessler, 2009; *Limosa* sp. (5), *Tringa* sp. (4), *Tyto campiterrea* Jánossy, 1991; *Athene noctua veta* Jánossy, 1992; *Surnia robusta* Jánossy, 1977; *Cuculus pannonicus* Kessler, 2009; *Apus baranensis* Jánossy, 1977; *Chaetura* aff. *baconica* Jánossy, 1977; *Alauda tivadari* Kessler, 2013; *Calandrella gali* Kessler, 2013; *Lullula minor* Kessler, 2013; *Hirundo gracilis* Kessler, 2013; *Delichon polgardiensis* Kessler, 2013; *Riparia major* Kessler, 2013; *Motacilla intermedia* Kessler, 2013; *Anthus hiri* Kessler, 2013; *Bombycilla brevia* Kessler, 2013; *Cinclus gaspariki* Kessler, 2013; *Troglodytes robustus* Kessler, 2013; *Turdus polgardiensis* Kessler, 2013; *T. miocaenicus* Kessler, 2013; *T. pannonicus* Kessler, 2013; *Prunella freudenthali* Kessler, 2013; *Oenanthe kormosi* Kessler, 2013; *Saxicola lambrechti* Kessler, 2013; *Muscicapa miklosi* Kessler, 2013; *Luscinia denesi* Kessler, 2013; *Tichodroma capeki* Kessler, 2013; *Sylvia intermedia* Kessler, 2013; *Hippolais veterior* Kessler, 2013; *Acrocephalus major* Kessler, 2013; *A. minor* Kessler, 2013; *Cettia janossyi* Kessler, 2013; *Locustella kordosi* Kessler, 2013; *Phylloscopus venczeli* Kessler, 2013; *Aegithalos gaspariki* Kessler, 2013; *Sitta gracilis* Kessler, 2013; *Lanius capeki* Kessler, 2013; *Sturnus brevis* Kessler, 2013; *Passer hiri* Kessler, 2013; *Fringilla kormosi* Kessler, 2013; *Carduelis kretzoii* Kessler, 2013; *C. lambrechti* Kessler, 2013; *Pyrrhula gali* Kessler, 2013; *Emberiza pannonica* Kessler, 2013; *E. polgardiensis* Kessler, 2013; *Plectrophenax veterior* Kessler, 2013; Passeriformes indet.; Aves indet. (Jánossy 1977, 1979a,b,c, 1991, 1995, Kessler 2009 b, 2010a, 2013a,b). Deposited in MÁFI.

Pliocene

The fossil bird material indicates the environmental conditions at the end of the Miocene and after the sedimentation of the Lake Pannon.

a) Lower and Middle Pliocene:

MN 14

1. Osztramos 1, Hungary – the localities lie on the hill Osztramos in NE Hungary. The fossil material was collected by Miklós Kretzoi in 1955 and Dénes Jánossy between 1965 and 1975 (inclusive in Osztramos 9). The bird remains were determined and published by Jánossy as: ?*Palaeortyx intermedia* (redetermined as *Palaeortyx grivensis* Lydekker, 1893 in Kessler 2009b); *Accipiter* sp., *Turdoides borealis* Jánossy, 1979; Passeriformes indet. (Jánossy 1972, 1979a,b,c). Deposited in HNHM.

2. Osztramos 9, Hungary – this site contained the following bird material: Galliformes indet. *Porzana estramosi* Jánossy, 1979 (Jánossy 1979b). Deposited in HNHM.

MN 15:

3. Gérce, Hungary – among the plant remains collected from this site two feather imprints were discovered (Fischer & Hably 1991). Deposited in HNHM.

MN 15-16:

4. Beremend 5, Hungary – Szőlő Hill of Beremend (174 m altitude) is located aproximately 9 km south around Villány village. It made up the flat and has covered Lower Cretaceous limestone (Nagyharsány Limestone Formation). The limestone was mined for over a hundred years and each year there were more and more discovered karst cavities and fissures containing bones. In 1910, 1916 and in the 1930's Tivadar Kormos collected in the sites No. 4-10. In 1953 Miklós Kretzoi and Dénes Jánossy continued to collect in the mine. The bird remains were determined and published by Dénes Jánossy (1976b, 1977, 1979b,c) and by Jenő Kessler (2009b) as: *Falco* sp. *Gallus beremendensis* Jánossy, 1976; *Francolinus capeki* Lambrecht, 1933; Perdicidae indet., *Otis kalmani* Jánossy, 1980; *Upupa phoeniculoides* Jánossy, 1974; *Apus baranensis* Jánossy, 1977; Passeriformes indet. Deposited in MÁFI.

5. Beremend 26, Hungary – Dénes Jánossy and Endre Krolopp ply the research and excavation since 1973 (sites No. 11-17) and with László Kordos (Jánossy 1979a, Kordos 2001). From 1993, László Pongrácz investigated the new sites (No. 18-39) and collected the fossil remains. The bird remains from Beremend 26. were identified and published by the author (Kessler 2009a,b,c; 2013a,b) as: *Podiceps* sp.; *Egretta* sp.; *Accipiter* sp.*; Falco tinnunculus atavus* Jánossy, 1972; *Falco* sp.*, Tetrao praeurogallus* Jánossy,1969; *Tetrao partium* Kretzoi, 1962; *Gallus beremendensis* Jánossy,1976; *Francolinus capeki* Lambrecht, 1933; *Palaeocryptonix hungaricus* Jánossy, 1991; *Perdix perdix jurcsaki* Jánossy,1976; *Rallus polgardensis* Jánossy, 1991; *Miorallus major* (Milne-Edwards 1869); *Porzana* sp., *Otis kalmani* Jánossy*,* 1972; *O. lambrechti* Kretzoi, 1941; *Chlidonias* sp., *Tringa* sp.*, Columba* sp., *Glaucidium baranensis* Kessler, 2010; *Athene noctua veta* Jánossy, 1992; *Strix intermedia* Jánossy, 1972; *Picus pliocaenicus* Kessler, 2012; *Dendrocopos praemedius* Jánossy, 1974; *Melanocorypha minor* Kessler, 2013; *Galerida pannonica* Kessler, 2013; *Lullula parva* Kessler, 2013; *Lullula minuscula* Kessler, 2013; *Delichon major* Kessler, 2013; *Parus robostus* Kessler, 2013; *Parus medius* Kessler, 2013; *Sitta villanyensis* Kessler, 2013; *Muscicapa petényii* Kessler, 2013; *Erithacus minor* Kessler, 2013; *Luscinia pliocaenica* Kessler, 2013; *Saxicola baranensis* Kessler, 2013; *Saxicola magna* Kessler, 2013; *Monticola pongraczi* Kessler, 2013; *Phoenicurus baranensis* Kessler, 2013; *Oenanthe pongraczi* Kessler, 2013; *Turdus major* Kessler, 2013; *Turdus medius* Kessler, 2013; *Turdus minor* Kessler, 2013; *Oriolus beremendensis* Kessler, 2013; *Acrocephalus kretzoii* Kessler, 2013; *Sylvia pusilla* Kessler, 2013; *Locustella magna* Kessler, 2013; *Locustella janossyi* Kessler, 2013; *Regulus pliocaenicus* Kessler, 2013; *Motacilla minor* Kessler, 2013; *Motacilla robusta* Kessler, 2013; *Bombycilla kubinyii* Kessler, 2013; *Prunella kormosi* Kessler, 2013; *Lanius major* Kessler, 2013; *Lanius intermedius* Kessler, 2013; *Sturnus pliocaenicus* Kessler, 2013; *Sturnus baranensis* Kessler, 2013; *Passer pannonicus* Kessler, 2013; *Coccothraustes major* Kessler, 2013; *Loxia csarnotanus* Kessler, 2013; *Emberiza gaspariki* Kessler, 2013. Deposited in a private collection (László Pongrácz).

6. Bodvavendégi (Hostovce 2), Slovakia – only unspecified bird bones have signaled

from this site (Mlikovskỳ 1996). Deposited in a private collection (Jan Horáček).

7. Csarnóta 2, Hungary – Tivadar Kormos began collecting bone material from the columns of red clay deposited in the clefts of the disused stone quarry on the flat top of Cserhegy Hill near the village of Csarnóta in the western part of the Villány Mountains between 1910 and 1930 (marking the site as the 'upper quarries'). Between 1954-1959 Miklós Kretzoi and Dénes Jánossy regularly collected material there. Of the four sites, Sites 2 and 4 yielded bird material. The Csarnóta 2 list of species is as follows: *Podiceps csarnotanus* Kessler, 2009; *Anas albae* Jánossy, 1979; *Falco tinnunculus atavus* Jánossy, 1972; *Palaeortyx brevipes* Milne-Edwards, 1869; *Francolinus capeki* Lambrecht, 1933; *Gallus beremendensis* Jánossy, 1976; *Tetrao praeurogallus* Jánossy, 1969; *Otis kalmani* Jánossy, 1972; *Rallicrex polgardensis* Jánossy, 1991; *Porzana kretzoii* Kessler, 2009; *Gallinago veterior* Jánossy, 1979; *Cuculus csarnotanus* Jánossy, 1979; *Bubo bubo, Aegolius* sp.; *Glaucidium baranensis* Kessler, 2009; *Athene noctua veta* Jánossy, 1992; *Apus baranensis* Jánossy, 1992; *Garrulus glandarius, Pyrrhocorax graculus vetus* Kretzoi, 1962; *Corvus harkanyensis* Kessler, 2009; *Miocorvus larteti* Milne-Edwards, 1871; *Pica pica major* Jánossy, 1979; *Turdoides borealis* Jánossy, 1979 (Kretzoi 1962, Jánossy 1976a,b, 1977, 1979a,b,c, Kessler 2009a,b). Over recent years, the author has identified and defined the species below from the surviving unclassified songbird material as: *Galerida pannonica* Kessler, 2013; *Lullula parva* Kessler, 2013; *Hirundo major* Kessler, 2013; *Delichon pusillus* Kessler, 2013; *Aegithalos congruis* Kessler, 2013; *Parus robustus* Kessler, 2013; *Paru parvulus* Kessler, 2013; *Sitta pusilla* Kessler, 2013; *Certhia immensa* Kessler, 2013; *Saxicola baranensis* Kessler, 2013; *Saxicola parva* Kessler, 2013; *Phoenicurus erikai* Kessler, 2013; *Oenanthe pongraczi* Kessler, 2013; *Turdus major* Kessler, 2013; *Turdus medius* Kessler, 2013; *Turdus minor* Kessler, 2013; *Cettia kalmani* Kessler, 2013; *Acrocephalus kretzoii* Kessler, 2013; *Acrocephalus kordosi* Kessler, 2013; *Sylvia pusilla* Kessler, 2013; *Locustella janossyi* Kessler, 2013; *Phylloscopus pliocaenicus* Kessler, 2013; *Anthus baranensis* Kessler, 2013; *Cinclus minor* Kessler, 2013; *Prunella kormosi* Kessler, 2013; *Lanius hungaricus* Kessler, 2013; *Passer minusculus* Kessler, 2013; *Carduelis parvulus* Kessler, 2013; *Carduelis medius* Kessler, 2013; *Pyrrhula minor* Kessler, 2013; *Fringilla petényii* Kessler, 2013; *Loxia csarnotanus* Kessler, 2013; *Pinicola kubinyii* Kessler, 2013; *Emberiza media* Kessler, 2013; *Emberiza parva* Kessler, 2013 (Kessler 2013a,b). Deposited in MÁFI.

8. Csarnóta 4, Hungary – from Csarnóta 4 in the last years, there were bones of *Tetrao partium* collected by Kretzoi (1962) and determined by Kessler (2009a). Deposited in a private collection (László Pongrácz).

9. Ivánháza (Ivanovce I), Slovakia – situated in West Slovakia, the site furnished a few bones of birds, as: *Alectoris donnezani* (Deperet 1892); *Hirundo rustica, Turdus* sp. (Mlikovskỳ 2002). Deposited in a private collection (Oldřich Fejfar).

b) Upper Pliocene

MN 16:

10. Ajnácskő (Hajnačka), Slovakia – a single bone identified and published by Petr Švec as *Mergus* sp. (Švec in Fejfar & Heinrich 1985), deposited in a private collection. Later, other remains were identified in museum collections and determined by

the author, as *Alectoris donnezani* (Deperet 1892); *Heliadornis minor* Kessler, 2009 (Kessler 2009a,b). Deposited in HNHM.

11. Beremend 11, Hungary – with *Francolinus capeki* Lambrecht, 1933; *Falco* sp.; Passeriformes indet. Collected in 1973 by Dénes Jánossy and Endre Krolopp, and determined by Jánossy (1976b, 1979b,c). Deposited in HNHM.

12. Beremend 15, Hungary – The site was discovered in 1981 and the rich micro- and macrofauna was determined by Dénes Jánossy. From the bird remains, he identified the following taxa: *Ciconia stehlini* Jánossy, 1992; *Anas crecca percrecca* Jánossy, 1992; *Falco tinnunculus atavus* Jánossy, 1972; *Otis khozatzkii beremendensis* Jánossy, 1992; *Numenius* cf. *arquata*, *Anthus* sp., *Serinus* sp., *Corvus pliocaenus* (Portis 1889) (Jánossy 1987, 1991, 1992, 1996b,c) and *Cuculus pannonicus* Kessler, 2010 identified by the author (Kessler 2010a). Deposited in HNHM.

13. Beremend 18, Hungary – collected by László Pongrácz, the bird remains were determined by the author as: *Pelecanus* sp., *Egretta* sp. (*E. alba* size), *Tetrao partium* Kretzoi, 1962; *Palaeocryptonyx hungaricus* Jánossy, 1991; *Francolinus capeki* Lambrecht, 1933; *Perdix perdix jurcsaki* Jánossy, 1976; *Corvus pliocaenus* (Portis 1889) (Kessler 2009a,b, 2010a). Deposited in a private collection (László Pongrácz).

14. Beremend 38, Hungary – collected by László Pongrácz, the bird remains were determined by the author as: *Otis kalmani* Jánossy, 1972; *Upupa phoeniculoides* Jánossy, 1974; Passeriformes indet. (Kessler 2009b). Deposited in a private collection (László Pongrácz).

15. Beremend 39, Hungary – collected by László Pongrácz, the bird remains were determined by the author as: *Miorallus major* (Milne-Edwards 1869-1871); *Gallinula* sp. (Kessler 2009b). Deposited in a private collection (László Pongrácz).

16. Osztramos 7, Hungary – the bird remains were determined and published by Dénes Jánossy as: *Tetrao praeurogallus* Jánossy, 1969; *Francolinus capeki* Lambrecht, 1933; *Bubo* sp., *A. noctua veta* Jánossy, 1992; *Surnia robusta* Jánossy, 1977; Passeriformes indet. (Jánossy 1973, 1976a,b, 1979a,b,c). Deposited in MÁFI.

MN 16-17:

17. Beremend 1-4, Hungary – the bird remains were determined and published by Dénes Jánossy as: *Francolinus capeki* Lambrecht, 1933; (1-3), *Surnia robusta* Jánossy, 1977; (4), (Jánossy 1974, 1976b, 1977). Deposited in HNHM.

18. Betfia 13, Romania – the Betfia localities are among the most important Plio-Pleistocene sites in Europe. They were discovered in 1904 by Mihály Tóth. Since then, numerous investigations have been conducted here. Between 1904 and 1917, Tivadar Kormos, in 1941, Miklós Kretzoi, and from 1951, specialists from the Municipal Museum of Oradea and from the Speological Institute 'Emil Racovitza' of Bucureşti conducted excavations, and discovered new sites. The number of sites raised to 13 in 1971-1972 following work by Elena Terzea and Tibor Jurcsák. The bird remains were determined by the author and Erika Gál as: *Anser* sp., *Anas querquedula, Anas crecca*, Anatidae indet., *Falco vespertinus, Francolinus capeki* Lambrecht, 1933, cf. *Crex crex, Vanellus vanellus, Tringa erythropus, Tringa* cf. *ochropus, Sterna hirundo, Asio* cf. *otus, Columba palumbus, Lanius collurio, Turdus merula* (Kessler 1975, Gál 2002a). Deposited in MŢCO.

19. Kisláng, Hungary – eggshell fragments and bones of the *Struthio pannoni-*

cus (Kretzoi 1954) and remains of *Anas* sp. They were collected, determined and published by Miklós Kretzoi (1954a, 1955). Deposited in MÁFI.

20. Villány 3, Hungary – the quarry from Templomhegy, Villány-Kalkberg was discovered by Károly Hofmann in 1874. Here Tivadar Kormos (between 1910 and 1939), Miklós Kretzoi, and Dénes Jánossy (after 1950) collected fossil materials for decades. The bird remains were determined and published by Dénes Jánossy and by the author, as: *Anas platyrhynchos submajor* (Jánossy 1979); *Anas albae* Jánossy, 1979; Anatidae sp. indet., *Aquila* cf. *chrysaetos, Pandion haliaetus, Falco* sp., *Francolinus capeki* Lambrecht, 1933; *Gallus beremendensis* Jánossy, 1976; *Lyrurus* cf. *partium* Kretzoi, 1962; *Bubo bubo, Strix intermedia* Jánossy, 1972; *Asio otus, Surnia robusta* Jánossy, 1977; *Corvus* sp., *Pyrrhocorax pyrrhocorax* Aves indet. (Jánossy 1976a,b, 1977, 1979a; Kessler 2009a,b, 2010a). Deposited in MÁFI.

Quaternary avian remains and localities of the Carpathian Basin:

The bird fauna of the last 1.8 MY represents the recent avifauna and the majority of recent taxa. There are fossil taxa from the Early and Middle Pleistocene, but in the Late Pleistocene, they almost disappeared. A feature of the period is the alternating cold and mild phases, resulting in bird migration.

During the Holocene, the human impact is becoming stronger in birdlife. This is shown by the large number of zooarcheological sites with fossil and subfossil bird remains. In addition, the role of owls in fossilization of bird bones was of great importance, mostly in cave sediments.

a) Phase I.: Lower Pleistocene (1 800 000 – 800 000 years ago)

MN 17-18: Pliocene-Pleistocene limit: Kolon 2. (Kolinany 2), **Slovakia**.

Q1: Villányian–Lower Biharian: Németóvár 2C, 4B (Deutsch-Altenburg) – **Austria**; Betfia 2, 7/1, 9 – **Romania**; Villány 5; Győrújfalu; Kőröshegy; Nagyharsányhegy 2; Osztramos 2,5,8,20; Somssich-hegy 1; – all **Hungary**.

Q1-2. Betfia 'Aven', 7 – **Romania**.

With species: *Podiceps nigricollis,* cf. *Ixobrychus minutus, Pelargosteon tothi, Ciconia* cf. *stehlini, Anas clypeata, Anas crecca, Anas querquedula, Anas strepera, Aythia nyroca, Anas* sp., Anatidae sp. indet., *Accipiter nisus, Aquila* cf. *clanga, Buteo* cf. *buteo, Buteo lagopus, Circus* sp., *Falco vespertinus, Falco tinnunculus atavus, Falco subbuteo, Falco columbarius, Falco cherrug, Falco* sp., *Tetrao partium, Perdix perdix jurcsaki, Perdix* sp., *Francolinus capeki, Alectoris donnezani, Rallus aquaticus, Crex crex, Porzana porzana, Porzana pusilla/P. parva, Porzana pusilla, Otis lambrechti, Otis kalmani, Limosa limosa, Gallinago* cf. *gallinago, Gallinago media, Recurvirostra* sp. foss. indet., cf. *Tringa erythropus, Tringa* cf. *ochropus, Tringa* cf. *nebularia, Tringa hypoleuca/T. glareola, Tringa* sp., cf. *Philomachus pugnax, Scolopax rusticola, Chlidonias nigra,* Charadriiformes indet., *Tyto* cf. *alba, Bubo bubo, Asio otus, Asio flammeus, Otus scops, Glaucidium passerinum, Aegolius funereus, Athene noctua veta*, *Caprimulgus capeki, Eurystomus* sp. foss., *Merops* sp., *Dendrocopos major, Dendrocopos medius, Dendrocopos minor, Picus viridis, Jynx torquilla, Garrulus glandarius, Corvus pliocaenicus, Corvus hungaricus, Corvus monedula, Pica pica, Pyrrhocorax* cf. *graculus vetus,* Corvidae indet., *Galerida cristata*, cf. *Melanocorypha calandra, Alauda arvensis, Lullula arborea,*

Alaudidae gen. et sp. indet., *Hirundo rustica, Delichon urbica, Riparia riparia, Lanius minor, Lanius excubitor, Anthus trivialis, Anthus* sp., *Motacilla alba, Motacilla* cf. *cinerea, Motacilla flava, Bombycilla garrulus, Oriolus oriolus, Sturnus vulgaris, Acrocephalus palustris, Acrocephalus* sp., *Locustella fluviatilis*, cf. *Sylvia communis,* cf. *Sylvia atricapilla, Sylvia* sp., *Certhia familiaris, Sitta europaea, Turdus viscivorus, Turdus pilaris, Turdus merula, Turdus philomelos, Turdus iliacus*, *Turdus* sp., *Saxicola rubetra, Erithacus rubecula, Luscinia luscinia, Luscinia megarhynchos, Muscicapa* cf. *striata, Aegithalos caudatus, Parus major, Parus lugubris, Parus caeruleus, Lanius excubitor, Lanius minor, Cinclus cinclus, Sturnus vulgaris, Passer montanus, Erithacus rubecula, Fringilla coelebs, Fringilla montifringilla, Carduelis chloris, Carduelis carduelis, Carduelis cannabina, Carduelis spinus, Carduelis* sp., *Loxia curvirostra, Coccothraustes coccothraustes, Pyrrhula pyrrhula, Serinus* cf. *serinus, Pinicola* cf. *enucleator,* Fringillidae indet., cf. *Emberiza calandra, Emberiza* cf. *citrinella,* Emberizidae sp. indet., Passeriformes sp. indet., Aves indet. (Kormos 1913, Lambrecht 1916a, 1933, Čapek 1917, Kretzoi 1941, 1961-1962, 1975, Kessler 1975, 1985b, 2009b, 2010a, 2013a, Jánossy & Kordos 1976, 1977, Jánossy 1976a,b, 1979a,b,c, 1981, Horaček 1985, Döppes & Rabeder 1997, Mlíkovskỳ 1998a, 2002, Gál 2002a).

b) Phase II.: Middle Pleistocene (800 000 – 120 000 years ago)

Q2. Upper Biharian*:* Betfia 5,7/2-3; Kiskóh (Chișcău – Bear Cave) – **Romania**; Méhész (Mihỳska, Včelare 3) – **Slovakia**; Beremend 16, 17, 28; Kövesvárad; Nagyharsányhegy 1-4; Somssichhegy 2; Ürömhegy; Villány 6, 8; – all **Hungary**.

Q3/I. Hundsheim – **Austria**; Aranyosszohodol (Sohodol) – Lucia Cave; Betfia 7/4; Brassó-Fortyogóhegy (Brașov) – Gensperger Cave – **Romania**; Gombaszög (Gombasek) – **Slovakia**; Beremend 23; Tarkő 1, 2-16; Várhegy Cave; Vértesszőlős 2 – **Hungary**.

Q3/II. Pilis stage-Solymár substage: Repolusthöhle – **Austria**; Vindija – **Croatia**; Dorog; Hór-völgy; Nagyharsányhegy 6; Solymár; Süttő; Uppony – **Hungary**.

With species: *Podiceps nigricollis, Ardea cinerea,* cf. *Pelargosteon tothi, Branta ruficollis, Anser anser subanser, Tadorna tadorna, Tadorna* sp.*, Anas penelope, Anas acuta, Anas platyrhynchos submajor, Anas clypeata, Anas* sp.*, Aythya nyroca, Aythya fuligula, Aythya ferina, Aythya* sp.*, Mergus connectens, Mergus merganser, Mergus* sp.*,* Anatidae sp. indet.*, Accipiter gentilis, Accipiter nisus, Aquila heliaca,* cf. *Haliaetus angustipes, Aegypius monachus, Gyps fulvus, Gyps melitensis, Buteo lagopus, Buteo buteo, Buteo* sp.*, Circus aeruginosus, Falco rusticolus, Falco subbuteo, Falco vespertinus, Falco tinnunculus atavus, Falco columbarius, Falco cherrug, Falco* cf. *antiquus, Falco* sp.*,* Accipitriformes sp. indet., *Perdix perdix jurcsaki, Francolinus čapeki, Coturnix coturnix, Alectoris donnezani, Ammoperdix* sp.*, Alectoris graeca,* ?*Phasianus* sp.*,* ?*Gallus* sp.*, Tetrao partium, Tetrao praeurogallus, Bonasia praebonasia, Lagopus lagopus, Lagopus mutus, Grus grus, Rallus* sp.*, Fulica atra, Gallinula chloropus, Rallus aquaticus, Otis lambrechti, Otis kalmani, Otis* sp.*, Tringa ochropus, Scolopax rusticola, Gallinago gallinago, Gallinago media, Vanellus vanellus, Recurvirostra avosetta, Limosa limosa, Larus minutus, Larus ridibundus, Larus* sp.*, Columba palumbus, Columba* sp.*, Cuculus canorus, Tyto alba, Asio otus, Asio flammeus, Bubo bubo, Nyctea scandiaca, Surnia robusta, Athene noctua, Otus scops, Aegolius*

funereus, Glaucidium passerinum, Strix intermedia, Strix aluco, Apus melba submelba, Apus apus palapus, Merops apiaster, Upupa phoeniculoides, Halcyon sp. foss., *Picus viridis, Dendrocopos major submajor, Dendrocopos praemedius, Alauda arvensis, Galerida cristata, Hirundo rustica, Hirundo* sp., *Turdus iliacus, Turdus merula, Turdus viscivorus, Turdus pilaris, Turdus philomelos, Turdus* sp., *Phoenicurus phoenicurus, Oenanthe oenanthe, Muscicapa striata, Luscinia svecica, Parus major, Parus palustris, Parus ater, Parus* sp., *Anthus cervinus, Anthus campestris/spinoletta, Motacilla* sp., *Sylvia borin, Phylloscopus* sp., *Regulus* sp., *Sitta europaea, Sitta* sp., *Lanius excubitor, Bombycilla garrulus, Oriolus oriolus, Sturnus vulgaris, Garrulus glandarius, Pica pica major, Corvus monedula, Corvus corone, Corvus corax, Corvus hungaricus, Corvus pliocaenus, Pyrrhocorax pyrrhocorax, Pyrrhocorax graculus vetus,* Corvidae gen. et sp. indet., *Passer montanus, Pinicola* sp., *Nucifraga caryocatactes, Fringilla coelebs, Coccothraustes coccothraustes, Emberiza citrinella,* Emberizidae gen. et sp. indet., Passeriformes indet., Aves indet. (Toula 1909, Lambrecht 1916a, 1933, Kretzoi 1941, 1961-1962, 1975, Malez, M. 1961, Jánossy 1962b, 1963, 1969, 1971, 1974b, 1976a,b, 1977, 1978, 1979a,b,c, 1980, 1981a, 1982b, 1983, 1986, 1990, Malez, V. 1973, 1988, 1991, Kessler 1975, 1982, 2009a,b, 2010a, 2013a, Malez & Rukavina 1979, Musil 1980, Horaček 1985, Jurcsák & Kessler 1988, Döppes & Rabeder 1997, Gál 2002a, Mlikovskỳ 2002, 2009).

c) Phase III.: Upper Pleistocene (120 000 – 15 000 years ago)

Q4/I. Pilis stage – Szántó substage: Grosse Badlhöhle; Hundsteig bei Krems; Luegloch; Merkenstein; Mixnitz–Drachenhöhle; Schwarzgrabenhöhle – **Austria**; Krapina (Husnjakovo Brdo); Velika Pecina; Velika pec na Lipi; Veternica – **Croatia**; Barcarozsnyó-Gura Cheii Cave (Râşnov); Esküllő (Aştileu) – Igric Cave; Hidegszamos (Someşul Rece) – Csontos Cave; Homoródalmás (Vârghiş) – Orbán Balázs Cave, – Medve Cave; Kőrösmart (Râpa); Magura-Valea Coacăzei Cave; Nándor (Nandru) – Nándori Cave; Ohábaponor – Bordu Mare Cave (Ohaba Ponor); Oláhszászka (Sasca Română) – Néravölgyi Cave; Rév (Vadu Crişului) – Kecske Cave, – Pince Cave, – Vizes Cave; Szamosfalva (Someşeni); Szegyestel (Sighiştel) – Magura Cave, – Tibocoaia Cave; Tordai Gorge (Cheile Turzii) – Binder Cave – **Romania**; Detrekőszentmiklós – Pálffy Cave (Dzeráva Skála – Plavecky Mikulas); Galgóc (Hlohovec); Gánócz (Ganovce); Lándzsásötfalu (Hôrka-Ondrej); Liszkófalva (Lisková) – Baráthegyi Cave; Novi I, III; Óruzsin (Oruzer) – Antal Cave; – Nagy Cave; Porács (Porač) – **Slovakia**; Bajót – Cave no. 3., – Baits Cave, Hóman Cave, Jankovich Cave, – Öregkő Cave; Barcarozsnyó; Budapest – Remete Cave, Remetehegyi Cave; Buják, Csákvár – Eszterházy Cave; Cserépfalu – Subalyuk; Csobánka – Kiskevély; Diósgyőr – Tapolcai Cave; Érd; Felsőtárkány – Peskő Cave, Gencsapáti, Hámor-Herman Ottó Cave; Puskaporos-kőfülke, – Szeleta Cave; Hollókő; Jósvafő – Porlyuk Cave; Kecskésgalya; Kesztölc – Bivak Cave; Kőszeg; Lovas; Mérk, Nagyvisnyó – Háromkúti Cave; Ölyveskőér; Pilisszántói Cave; Répáshuta – Balla Cave; Ballavölgyi-Cave, Poroslyuk; Sály; Szárazgerence; Szilvásvárad – Istállóskő; Tata; Tatabánya – Kálváriahegy Cave No.4., – Szelim Cave; Tokod-Nagyberek; Varbó – Lambrecht Kálmán Cave; Vaskapu – **Hungary**.

With species: *Podiceps auritus, Ardea cinerea, Ciconia ciconia, Plegadis falcinel-*

lus, Anser anser, Anser albifrons, Anser fabalis, Anser sp.*, Branta ruficollis, Tadorna ferruginea, Cygnus olor, Anas crecca, Anas platyrhynchos, Anas penelope, Anas strepera, Anas querquedula, Anas clypeata, Anas acuta, Anas* sp.*, Melanitta nigra, Aythya nyroca, Aythya fuligula, Aythya ferina, Mergus merganser, Mergus albellus, Bucephala clangula, Gypaetus barbatus*, *Aegypius monachus, Gyps fulvus, Aquila chrysaetos, Aquila clanga, Aquila heliaca, Halliaeetus albicilla, Buteo buteo, Buteo lagopus, Buteo rufinus, Pernis apivorus, Circus cyaneus, Circus macrourus, Accipiter nisus, Accipiter gentilis, Falco peregrinus, Falco cherrug, Falco rusticolus, Falco tinnunculus, Falco columbarius, Falco vespertinus, Falco subbuteo, Perdix perdix, Coturnix coturnix, Alectoris graeca, Tetrao urogallus, Tetrao tetrix, Bonasa bonasia, Lagopus lagopus, Lagopus mutus,* Galliformes sp. indet., *Grus grus, Rallus aquaticus, Crex crex, Porzana porzana, Otis tarda, Otis tetrax, Gallinago gallinago, Gallinago media, Tringa erythropus, Tringa totanus, Tringa* sp.*, Scolopax rusticola, Vanellus vanellus, Himantopus himantopus, Calidris alpina, Calidris ferruginea, Charadrius* sp.*, Limosa limosa, Pluvialis squatarola, Numenius arquata, Numenius phaeopus, Numenius phaepus/N. tenuirostris, Numenius* sp.*, Philomachus pugnax, Larus ridibundus, Larus canus, Sterna hirundo, Chlidonias* sp.*, Syrrhaptes paradoxus, Columba palumbus, Columba oenas, Columba livia, Cuculus canorus, Asio otus, Asio flammeus, Nyctea scandiaca, Athene noctua, Aegolius funereus, Surnia ulula, Strix aluco, Strix uralensis, Strix nebulosa, Glaucidium passerinum, Apus apus, Apus melba, Caprimulgus europaeus, Dendrocopos major, Dendrocopos medius, Dendrocopos leucotos, Picus canus, Picus* sp.*, Jynx torquilla, Galerida cristata, Alauda arvensis, Eremophila alpestris, Hirundo rustica, Delichon urbica, Riparia rupestris, Perisoreus infaustus, Pica pica, Pyrrhocorax pyrrhocorax, Pyrrhocorax graculus, Garrulus glandarius, Nucifraga caryocatactes, Corvus monedula, Corvus corone, Corvus frugilegus, Corvus corax, Parus major, Parus palustris, Parus caeruleus, Parus cristatus, Parus montanus, Parus* sp.*, Anthus pratensis, Anthus trivialis, Anthus* sp.*, Motacilla alba, Motacilla flava, Oriolus oriolus, Turdus pilaris, Turdus iliacus, Turdus torquatus, Turdus philomelos, Turdus viscivorus, Turdus* sp.*, Monticola saxatilis, Saxicola torquata, Erithacus rubecula, Cinclus cinclus, Lanius collurio, Lanius senator, Lanius excubitor, Lanius* sp.*, Sylvia curruca, Sylvia borin, Prunella modularis, Sturnus vulgaris, Pastor roseus, Troglodytes troglodytes, Fringilla coelebs, Fringilla montifringilla, Pyrrhula pyrrhula, Coccothraustes coccothraustes, Carduelis cannabina, Carduelis chloris, Carduelis carduelis, Carduelis flammea, Pinicola enucleator, Loxia curvirostra, Passer montanus, Passer domesticus, Emberiza schoeniclus, Emberiza calandra, Emberiza cirlus, Emberiza* sp.*, Plectrophenax nivalis*, Passeriformes indet., Aves indet. (Lóczy 1877, Nehring 1880, Téglás 1880, Róth 1881, Fischer & Maurersberger 1989, Lambrecht 1912a,b, 1913, 1915, 1916a, 1933, Kormos 1914a,b, 1916, Mottl 1938, 1941, 1942, 1951, 1953,Wettstein & Mühlhofer 1938. Jánossy 1952, 1954, 1955, 1960, 1962a, 1964, 1965, 1971, 1976a,b, 1977a,b, 1978; 1979a,b,c, 1980, 1981, 1986, Spahni 1954, Wojčic 1966, Jánossy in Hamar & Csák 1969, Malez, V. 1973, 1984, 1988, 1993, Kessler 1974a, 1977a,b,d, 1982, 1985b, 2013a, Kretzoi 1975, Malez-Bačic, V.1979, Musil 1980a,b, Fischer & Stephan 1977, Jurcsák & Kessler 1988, Fladerer 1993, Gál 1998, 2002a, 2003, 2004, 2005, Mlikovskỳ 2000).

d) Phase IV: Holocene (15.000 – the end of the Middle Ages)

Q4/II.: Grosse Offenbergerhöhle; Hohlensteinhöhle; Knochenhöhle; Marchegg; Teufelslucken; Tropfsteinhöhle; Tunnelhöhle – **Austria**; Aranyosmeggyes (Medieşu Aurit); Berettyószéplak (Suplacu de Barcău); Bégakalodva (Cladova); Diószeg (Diosig); Esküllő (Aştileu)-Kis Cave; Érmihályfalva (Valea lui Mihai); Felsőlubkó (Gornea); Gálospetri (Galoşspetreu); Gyulafehérvár (Alba Iulia); Herkulesfürdő (Herculane) – Rabló Cave, – Zoltán Cave; Kalota (Căalăaătea); Kazánszoros (Cazanele Mari) – Climente I. Cave, – Töröklik Cave – Icoana Cave, – Gaura Chindiei Cave; Kisbács (Baciu) – Bácsi-torok; Kovászna (Covasna); Kisderzsida (Dersida); Kőrösbánlaki (Bălnaca) Cave; Nagyvárad (Oradea) – Szálka Hill; Kőrösgyéres (Girisu de Cris); Mezőfény (Foieni); Mezősámsond (Sincai); Ompolymező (Poiana Ampoiului); Parác (Parţa); Peterd (Petreşti, Cheiile Turzii) – Tordai Gorge – Magyar Cave; Püspökfürdő (Băile 1 Mai, Cordău) Lake; Radnót (Iernuţ); Remetelórév (Lorău) – Bólyikői Cave; Révi (Vadu Crişului) Cave; Révtizfalui (Zece Hotare – Şuncuiuş) Cave; Szegyestel (Sighiştel) – Drăacoia Cave; Szegyestel völgyi (Valea Sighiştel) Cave; Szilágyzovány (Zăuan); Szind (Săndulești-Cheile Turului) – Túri Gorge; Szkerisóra (Scărişoara) – Coiba Mare Cave, – Sasok Cave; Szalacs (Sălacea); Székelykeresztúr (Cristuru Secuiesc); Vargyasi szorosi (Vârgiş) Cave; Vársonkolyos (Şuncuiuş) – Kismagyar Cave, – Izbindis Cave; Vaskóh (Vaşcău); Vizakna (Ocna Sibiului) – **Romania**; Ludas – Budzsák; Nosza – Gyöngypart; Padina; Starcevo; Szabadka – Palics (Palić-Subotica); Vlassać – **Serbia**; Érsekújvár (Nové Zámszky); Jászó (Jasov) – Takács Menyhért Cave; Kisvárad (Nitriansky Hrádok) – **Slovakia**; Ács – Vaspuszta; Aggtelek; Alattyán – Tulát; Bajcsa – Vár; Bakonynána; Balatonboglár – Berekre-dülő; Balatonkeresztúr – Réti-dülő; Balatonlelle – Kenderföldek; Balatonszemes – Bagódomb; Berettyószentmárton; Berettyóújfalu – Herpály; Békés –Városerdő; Bélmegyer; Bodajk – Rigólyuk; Budapest – Aquincum, – Francia-barlang – Gellért-hegy; Csákvár – Esterházy Cave; Csapástető; Csév Cave; Csobánka – Csontos Cave; Debrecen – Nyulas; Dunaújváros – Intrecisa – Koszider; Ecsegfalva; Endrőd 3/6, 39, 119; Esztergom – Alsó sziget; Felnémet – Berva Cave; Felsőnyék – Várhegy; Felsőtárkány – Petényi Cave; Folyás-Szilmeg; Füzesabony; Gyula – Castle; Hillebrand Cave (Bükk); Hosszúhegy (Pilis); Jánoshida; Jósvafő – Musztáng-Cave; Kardoskút – Hatablak; Kevélynyergi Pit; Kisköre – Szingegát; Kötelek – Huszársarok; Legény Cave; Maroslele – Pana; Mélyföld; Mezőkomárom; Mezőlak-Szélmező; Mezőzombor – Cemetery; Mélyvölgy (Mecsek); Miskolc – Felső forrás Cave; – Névtelen Cave; Nagykörü; Nagysomlyói Furow; Neszmély – Tekeres Creek; Ordacsehi – Kistöltés; Ószentiván – Tiszasziget; Paks – Dunakömlőd; Pilismarót – Malom Creek; Polgár-Folyás, – Csőszhalom; Pomáz-Zravlyák; Répáshuta – Rejteki Pit; Rezi; Röszke-Ludvár; Szajol – Felsőföld; Szegvár – Tűzköves; Szendrő; Szentkirály; Szerencs – Taktaföldvár; Székesfehérvár; Szolnok-Szanda; Tatabánya – Denevér Cave; Tatabánya alsó – Törekvés Cave; Tác-Fövénypuszta, – Gorsium; Tápiószele-Tűzköves; Tiszalök-Rázom; Tiszaluc – Danka domb, – Sarkad; Tiszapolgár-Csőszhalom; Tiszaszölős-Gomaháza-Puszta; Tiszavalk-Négyesi Boundary, – Tetes; Tiszavasvári-Deákhalmi Boundary, – Keresztfal; Tokod – Erzsébetakna; Tószeg – Laposhalom; Turkeve – Móricz; Tűzkö-

ves Cave; Visegrád Castle – Alsóvár; Zalaszentistván – **Hungary**.

With species: *Gavia arctica, Gavia stellata, Podiceps griseigena, Podiceps cristatus, Podiceps auritus, Tachybaptus ruficollis, Pelecanus onocrotalus, Pelecanus* sp.*, Phalacrocorax carbo, Platalea leucorodia, Ardea purpurea, Ardea cinerea, Botaurus stellaris, Nycticorax nycticorax, Egretta alba, Egretta garzetta, Ciconia ciconia, Ciconia nigra, Cygnus cygnus, Cygnus olor, Cygnus* sp.*, Anser erythropus, Anser anser, Anser fabalis, Anser* sp.*, Tadorna tadorna, Tadorna ferruginea, Branta* sp.*, Anas platyrhynchos, Anas crecca, Anas penelope, Anas strepera, Anas acuta, Anas querquedula, Anas clypeata, Anas* sp.*, Aythya ferina, Aythya nyroca, Aythya fuligula, Aythya marila, Mergus merganser, Mergus serrator, Accipiter gentilis, Accipiter nisus, Circus aeruginosus, Circus* sp.*, Buteo buteo, Buteo lagopus, Circaetus gallicus*, *Hieraetus pennatus, Milvus migrans, Milvus* sp.*, Gyps fulvus, Aquila chrysaetos, Aquila rapax, Aquila clanga, Aquila pomarina*, *Aquila* sp.*, Haliaeetus albicilla, Falco cherrug, Falco columbarius, Falco tinnunculus, Falco subbuteo, Perdix perdix, Coturnix coturnix, Alectoris graeca, Gallus* sp.*, Phasianus* sp.*, Numida meleagris, Tetrao tetrix, Tetrao urogallus, Bonasa bonasia, Lagopus lagopus, Lagopus mutus, Grus grus, Rallus aquaticus, Crex crex, Porzana porzana, Gallinula chloropus, Fulica atra, Otis tarda, Otis tetrax, Gallinago gallinago, Gallinago media, Lymnocryptes minimus, Vanellus vanellus, Arenaria interpres, Tringa totanus, Tringa hypoleucos,Tringa* sp.*, Scolopax rusticola, Limosa limosa, Numenius arquata, Numenius phaeopus, Charadrius hiaticula, Larus argentatus, Columba palumbus, Columba oenas, Columba livia, Columba* sp.*, Streptopelia turtur, Nyctea scandiaca, Bubo bubo, Strix uralensis, Strix aluco, Asio otus, Asio flammeus, Athene noctua, Aegolius funereus, Coracias garrulus, Upupa epops, Apus apus, Picus viridis, Picus canus, Dendrocopos major, D. leucotos, Galerida cristata, Alauda arvensis, Eremophila alpestris, Hirundo rustica, Delichon urbica, Cinclus cinclus, Garrulus glandarius, Nucifraga caryocatactes, Corvus frugilegus, Corvus corone, Corvus monedula, Corvus corax, Pyrrhocorax graculus, Pyrrhocorax pyrrhocorax, Pica pica, Turdus merula, Turdus philomelos, Turdus viscivorus, Turdus pilaris, Turdus torquatus, Turdus iliacus, Parus major, Luscinia megarhynchos, Anthus trivialis, Motacilla alba, Motacilla cinerea, Muscicapa striata, Phoenicurus ochrurus,* cf. *Oenanthe oenanthe, Erithacus rubecula, Saxicola rubetra, Acrocephalus arundinaceus, Acrocephalus* sp.*, Regulus* sp.*, Oriolus oriolus, Sitta europaea, Prunella collaris, Lanius ecubitor, Lanius minor, Sturnus vulgaris, Passer montanus, Passer domesticus, Fringilla coelebs, Fringilla montifringilla, Montifringilla nivalis, Pinicola enucleator, Pyrrhula pyrrhula, Coccothraustes coccothraustes, Loxia curvirostra, Carduelis chloris, Emberiza citrinella, Emberiza calandra, Emberiza* sp.*,* Passeriformes sp. indet., Aves indet. (Kormos 1915, Lambrecht 1933, Jánossy 1962c, 1976a,b, 1977, 1978, 1979a,b,c, 1985, 1986, Bökönyi 1964, 1974, 1984, Bökönyi & Jánossy 1965, Soergel 1966, Jurcsák & Kessler 1973, 1986, 1988, Kessler 1974b,c, 1977c,d, 1980-81, 1982, 1985a,b, 2009a,b, 2010a, Kretzoi 1975, Jánossy & Kordos 1976b, Fischer & Stephan 1977, Kordos 1981, 1984, Krolopp & Vörös 1982, Bartosiewicz 1991, 1997, Körösi 1991, Rabeder 1992, Fladerer 1993, Bochenski & Tomek 1994, Döppes & Rabeder 1997, Kessler & Gál 1997, 1998, Gál 2002b, 2004, 2005,

2007a,b, 2008, Pike-Tay *et al.* 2004, Tassi 2006, Bindea 2008).

Results and Conclusions

In the area of the Carpathian Basin, fossil and subfossil bird remains are known from 341 paleontological and archaeological sites. The number of taxa reaches 845. In the list, 24 orders, 65 families, 193 genera (five ichnotaxa), 430 species (five ichnotaxa), 10 subspecies and two problematic taxa can be found. Of these, five orders, eight families, 30 genera, 188 species and 10 subspecies have become extinct, while 71 taxa (two orders, 19 families and 50 genera) are thought to be extinct taxa. One hundred and eighty-nine extinct taxa (two orders, four families, nine genera – five ichnotaxa – 154 species – five ichnotaxa – and 10 subspecies) were described primarily from the Carpathian Basin. Besides these, 58 known extinct taxa (three orders, five families, 17 genera and 33 species) have been identified. In addition, more knowledge is gathered from feather imprints (seven cases), eggshells (two cases) and urocoprolits (in one case).

The Mesozoic (Cretaceous) bird fauna is represented from four sites with 20 taxa (five orders, families, genera and species), all extinct taxa, except for one present ordo (Pelicaniformes).

The Paleogene bird fauna is represented from five sites with 46 taxa (nine orders and families, eight genera and ten species – one ichnotaxa – + Aves indet.), with one extinct family, five extinct genera and ten extinct species.

The Neogene bird fauna is represented from 60 sites.

The Miocene sites furnish 193 taxa (12 orders, 34 families, 66 genera and 81 species), of which 76 are extinct (2 families, 15 genera and 59 species).

The Pliocene sites furnish 229 taxa (18 orders, 38 families, 59 genera and 116 species), of which 45 are extinct (6 genera and 39 species).

The Quaternary bird fauna is represented from 272 sites (119 sites from Pleistocene and 153 sites from Finiglaciale-Holocene) and furnish 452 taxa (15 orders, 41 families, 130 genera and 266 species).

The 13 Lower Pleistocene sites furnish 119 species (with 10 extinct species and 3 extinct subspecies);

The 29 Middle Pleistocene sites furnish 120 species (with 10 extinct species and 15 extinct subspecies);

The 77 Upper Pleistocene sites furnish 177 species.

The 153 Finiglaciale and Holocene sites furnish 171 species.

Each of the three ancient Mesozoic bird types (Sauriurae: Archaeornithinae and Enantiornithinae; as well as Ornithurae) is represented in the fossil bird fauna of the Carpathian Basin.

In the Cenozoic, the Sauriurae and Hesperonithidae birds no longer exist. Only Ornithurae (Neornithes) remained alive.

All identified taxa from the Paleogene are typical to water and a humid habitats. Six of them are specifically deep waters feeding species. Four species (*Eostega, Diomedeoides, Rallicrex* and *Charadriipedia*) and two genera representative *(Gavia, Pandion)* are endemic for the area. Three taxa are known from the Western European sites (*Grallavis, Mionetta* and *Balearica*). Only one taxon was described by footprint *(Charadriipedia)*.

The Late Miocene avifauna is represented by coastal wildlife and that of the archipelago by deep sea or waterfront species (*Mic-*

rosula, Phalacrocorax, Cygnopterus, Haliaeetus, Anatidae and Laridae). However, the representative species of forest-grassland areas appear independent from the aquatic environment *(Palaeortyx, Prosybris,* Passeriformes, *Tetraornithopedia)*. The avifauna still has many similarities with the western sites, four such taxa were described from Carpathian Basin *(Microsula, Phalacrocorax, Palaeortyx, Prosybris)*. Eight extinct species *(Cygnopterus neogradensis, Rallicrex litkaensis, Galerida cserhatensis, Cinclus major, Turdicus minor, Luscinia praeluscinia, Bombycilla hamori, Emberiza bartkoi)* and four ichnotaxa *(Avidactyla, Ornithotarnocia, Passeripedia, Tetraornithopedia)* are considered to be endemic.

The Middle Miocene avifauna changed significantly. This is not only a significant increase in the number of taxa, but it also refers to the composition of the species list. The remaining water-covered environment reflects a significant representation of these types of areas (18 taxa), including open water species (*Gavia, Anhinga, Paleolodus, Phalacrocorax, Cygnopterus, Anas, Bucephala, Clangula, Mergus* spp.) and humid environment species (*Anser, Proardeola,* Gruidae, *Rallicrex, Porzana*, Rallidae, *Gallinago* taxa). However, there was a significant increase in the number of representatives of forest grassy open areas' (*Palaeortyx, Miogallus,* Perdicidae, Pteroclidae, Cuculidae, *Merops*), and also in the number of songbirds (17 taxa). Twelve of the 42 taxa are endemic species (*Cygnopterus, Anas albae, Clangula, Mergus, Rallicrex, Porzana estramosi* and *P. matraensis, Merops, Galerida cserhatensis, Lullula neogradensis, Luscinia jurcsaki, Erithacus bartkoi*). The representatives of the Western European type species are present in a large number *(Proardeola, Paleolodus, Anas velox, Mionetta, Bucephala, Miogallus, Miocorvus)*, and are typically mostly aquatic. Of particular interest is the presence of two flamingo species *(Megapaleolodus, Paleolodus)* as indication of the brackish water in the north coast (Mátraszőlős).

The avifauna of the Lake Pannon seems to have been significantly richer than that in the previous periods. The previously dominating marine bird life – was only represented by a tropical bird species (Fam. Phaethontidae: *Heliadornis*). There remains, however, a significantly rich aquatic bird species community (23 taxa), including a special, at present time tropical *Heliornis* species (resembling Grebe and has a similar lifestyle). Another, even more interesting, phenomenon is the presence of *Anhinga pannonica*. Since the aforementioned three genera today are represented only by species living in the tropics, this is also a reference to Lake Pannon's climatic conditions. From the Late Miocene, 65 extinct species and two extinct subspecies were described, which are considered to be endemic (plus also 14 fossil taxa in the family and genus level determined). The Western European Miocene fauna is represented primarily with gallinaceous species (*Palaeortyx, Miophasianus, Pavo* spp.), and perhaps also a duck *(Anas velox)*, crane *(Grus pentelici)*, rail *(Miorallus major)*, owls *(Tyto sanctialbani, Intulula brevis)*, and crows *(Corvus pliocaenus, Miocorvus larteti)*. The ordo Passeriformes are extraordinarily richly represented (44 species).

By analyzing the species list, it becomes clear that almost all ecotypes are represented in the Lake Pannon bird fauna.

The sedimentation of Lake Pannon and the inherent impact of environmental change are both reflected in the Early Pliocene birdlife. Due to disappearing sea types, reduction of

water and humid environment types (only 6 species), the forest-grassland-open habitat-dwelling bird types became significantly dominant. Most of the extinct taxa are endemic (50 species and four subspecies) and we encountered only four extinct species described from other parts of Europe (representative of the genera: *Palaeortyx, Allectoris, Miocorvus*).

The Middle and Late Pliocene avifauna already was much richer and more diverse than the Early Pliocene. Number of taxa increases (42), so does the extent of the aquatic environment. Among them quite interesting is the *Heliadornis minor*, being a pelagic bird, probably represents a vagrant specimen. Also interesting in other respects are the ostrich remains from Kisláng *(Pachystruthio pannonicus)*, which are regarded as the westernmost occurrence of the genus in Europe. A significant number of endemic taxa are described (22 species and 6 subspecies), of which, only six were described from other parts of Europe. In the genus level, the defined taxa represent a large number (39), more than half of which are songbirds (20 taxa).

In the Early Pleistocene bird fauna, the extinct taxa are still represented (with 11 endemic species and subspecies), which is about 10% of the total taxa. By studying the species list, it can be observed that the specifically tropical-subtropical bird fauna is represented by only one taxon (*Eurystomus* sp.). But likewise, the arctic and alpine types are poorly represented (with only *Nyctea, Bombycilla* and *Pyrrhocorax graculus vetus* taxa) and the seabirds are also missing. Thus, we can conclude that bird migration was not common. Other taxa in the species list can be found in the recent bird fauna. In summary, a significant part of recent avifauna of the Carpathian Basin has developed in the Early Pleistocene and only its prevalence changed in the glacials and after.

The Middle Pleistocene bird fauna is more poorly represented than that of the Early and Late Pleistocene. Twenty-two of 142 taxa have been determined to ordo, family and genus level. One of them (*Halcyon* sp.) probably represents a new extinct species. In 120 species level taxa were found fifteen extinct species and 10 extinct subspecies the majority (11 species and 10 subspecies) became first described in the Carpathian Basin area. Six species (*Tetrao* sp., *Bonasa, Otis* sp*., Corvus hungaricus*) and all subspecies are considered predecessors of present taxa. The bird fauna was dominated by the stationary species and the northern guests. The number of warmer-climate species has been considerably reduced (only *Merops, Apus, Cuculus, Upupa, Oriolus, Hirundo, Sylvia, Phylloscopus* sp.), which also indicates the initial stage of migration.

The Late Pleistocene was represented by a rich avifauna in the Carpathian Basin. The direct descendants of extinct species and subspecies from the previous eras can be found. The composition of the species list already reflects the development of seasonal migration patterns. This is confirmed by the number of species which are here only in the summer (their share exceeds 20%, similar rates can be found in today's winter guests). This suggests that summers created suitable conditions for them to feed and breed during the glacial period. It is also possible that today's winter visitors will become summer guest or could overwinter. The northern areas in the Carpathian Basin provided poor survival conditions for them, typically lacking the open sea and coastal bird fauna and the tropical via subtropical species.

The avifauna of the last 15,000 years is showing an image of current bird life. In

the post-glacial warming for over 10,000–12,000 years, the bird fauna was constantly changing, species disappeared and new ones appeared in the Carpathian Basin. The migration routes finally formed. Many already nesting species appeared just as winter guests or migrants. Some summer visitors have become all-year residents. The coastal species reappeared as winter guests. Surprising is the complete lack of some species (e.g. *Phalacrocorax pygmaeus* and *Neophron percnopterus*), which were not uncommon in the past. The capercaillie, the black grouse and the rock partridge moved to the edges of the Carpathian Basin. At the same time, many new species appeared and settled in the area (e.g. Eurasian Collared Dove, Syrian Woodpecker etc.). From the 171 identified taxa, 157 have been determined to species level, representing all recent species.

As it was shown, the evolution of birds in the Carpathian Basin can be tracked from the Jurassic-Cretaceous boundary on the basis of the known remains. Eight fauna exchange stages can be separated based on these data. The first three have been in the Mesozoic. The first one is still hypothetical, because it lacks physical evidence. This is the interval between the Upper-Triassic and Lower Cretaceous. It corresponds to the origin of birds and the different phases of development. The second stage corresponds to the Lower Cretaceous. Despite the poor material, it can be shown, that all ancient bird taxa (types) were already valid (Sauriurae with *Archaeopteryx bavarica*, Ornithurae with *Eurolimnornis corneti, Palaeocursornis biharicus* and one representative of Hesperornithidae). The presence of valid species also makes it apparent that evolution of mentioned taxa has been done, which is important for two reasons. First, it confirms that the Sauriurae were contemporaries of the true birds and therefore could not have been their ancestors. Second, the first true birds lived in aquatic environments. This fact is confirmed by other Lower Cretaceous fossil remains. The third phase is represented by Upper Cretaceous dispersed materials (Enanitornithidae and problematic Ornithurae). They provide less data and inference opportunities.

Since the Paleogene, we know of only true birds. Here, two fauna stages can be distinguished. The first between the Paleocene and the end of Eocene, and the second between the start of the Lower Oligocene and the end of Lower Miocene to the development of the Pannon Lake. All known deposits from the Paleogene indicate that bird types lived in an aquatic environment, with open marine and coastal species. Afterwards, at the beginning of the Miocene, bird species typical to terrestrial environments appeared (including Galliformes, predators and songbirds).

The next phase includes the Lake Pannon avifauna. It reflects a change in the ratio of the water – shore area of the Carpathian Basin, with are typical warm-climate indicator species. Besides typical aqueous environment species, the forest and open land bird fauna were already very rich. The present genera were dominant and many extinct species are to be considered predecessors of the present ones.

Disappearance of the Pannon Lake induced a new phase in the bird fauna. Composition of the Pliocene and Lower Pleistocene avifauna indicates a still hot, but much drier climate. While in the previous phase, the similarity with the Western European bird fauna is high, by the end of the Neogene and beginning of Quaternary, this situation changes and the endemic species

became dominant. A number of present species were already present, while in the Late Pleistocene, the proportion of fossil species barely reached 10-15%.

From the Middle Pleistocene due to the cold and increasingly continental climatic conditions, the last representatives of the old types and of warmth-liking species gradually disappeared from the bird fauna. From the Late Pleistocene to the present, could be found only recent species. From the Holocene a growing human impact is perceptible in birdlife. This represents the last great faunal change in the Carpathian Basin birdlife. The archaeozoological data reflects the impact of human activities.

Acknowledgements

The author wishes to express his deep gratitude to András Galácz and István Szente for their help in the revision of the text and to József Vust and Lórand Abos for the language revision.

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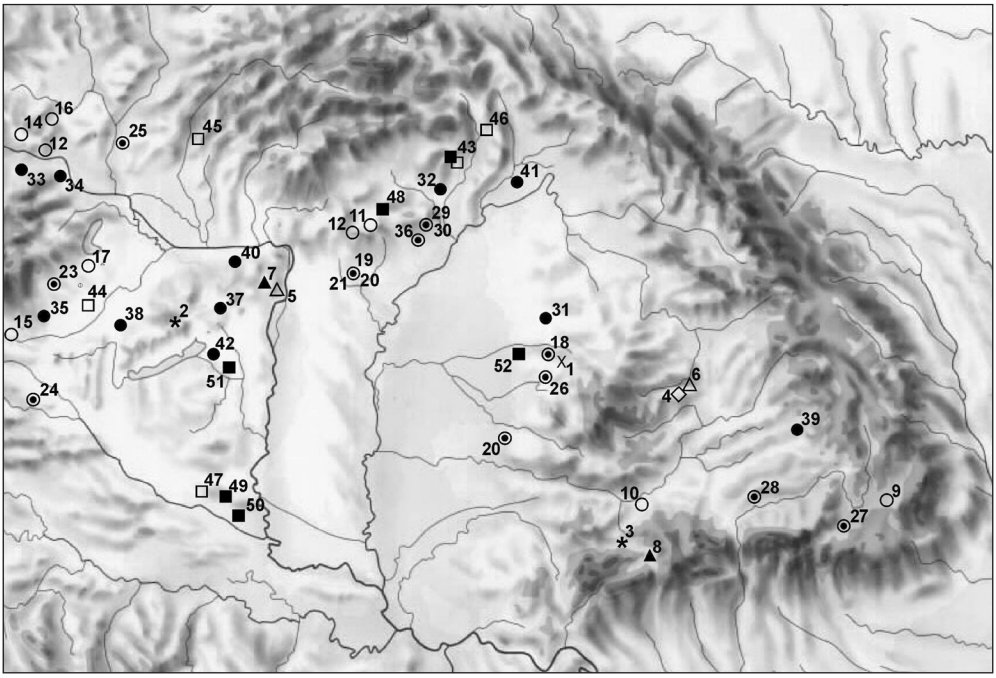
APPENDIX

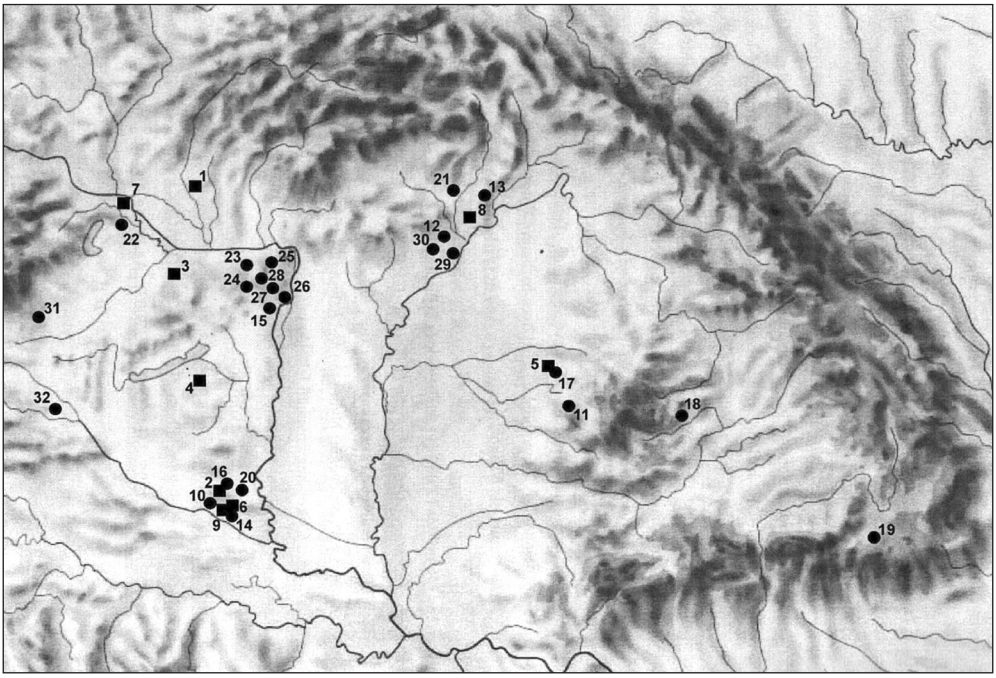


Map 1. Mesozoically and Tertiary sites from Carpathian Basin
1. térkép Mezozoikumi és harmadidőszaki lelőhelyek a Kárpát-medencéből
(After Zentai László 1996. „A Kárpát-medence domborzati alaptérképe". Modified)

Mezozoically sites: 1. Cornet – Lower Creatceous (Berriasian); 2. Iharkút – Upper Cretaceous (Santonian); 3. Hátszeg Basin – Upper Cretaceous (Maastrichtian)

Tertiary – Paleogene sites: 4. Kolozsmonostor – Eocne; 5. Budapest-Szépvölgy; 6. Kolozsvár-Fellegvár – Lower Oligocene; 7. Máriahalom; 8. Petrozsény- Upper Oligocene

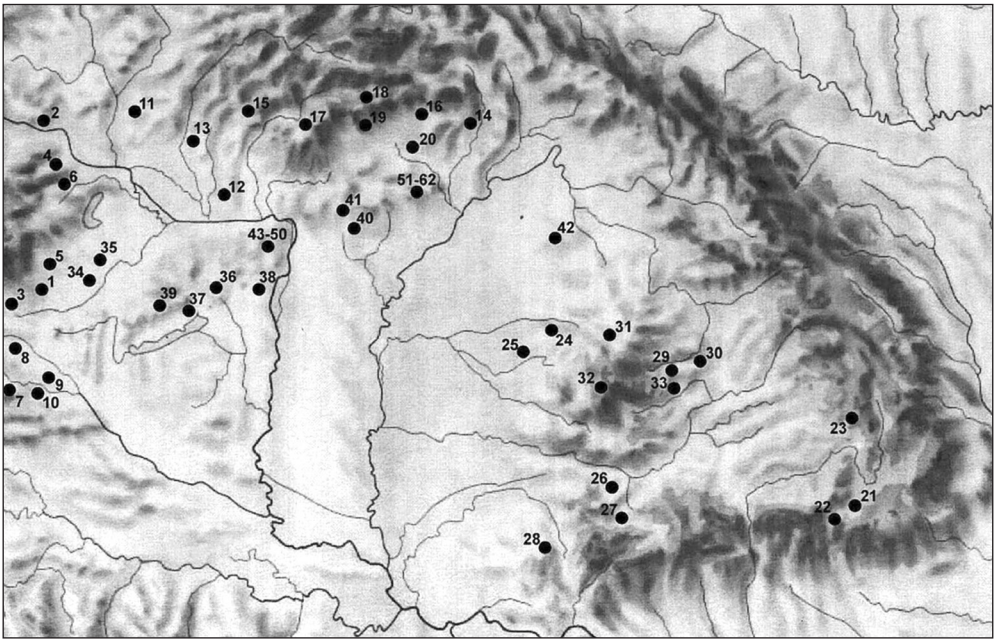
Tertiary – Neogene sites: 9, Erősd; 10. Piski; 11. Ipolytarnóc; 12. Litke 2; 13. Heiligenstadt; 14. Limberg; 15. Oberdorf; 16. Grund; 17. Borosd – Lower Miocene; 18. Kőalja; 19. Mátraszőlős 1; 20. Mátraszőlős 2; 21. Mátraszőlős 3; 22. Dévényújfalu; 23. Felménes; 24. Radoboj; 25. Szentmargitbánya; 26. Tasádfő; 27. Brassó; 28. Oltszakadát; 29. Felsőtárkány; 30. Felsőtárkány-Felnémet; 31. Egerszólát – Middle Miocene; 32. Rudabánya; 33. Vösendorf; 34. Götzendorf; 35. Gyepűfüzes; 36. Tataros; 37. Csákvár; 38. Sümeg; 39. Korond; 40. Tardosbánya; 41. Rátka; 42. Polgárdi – Upper Miocene; 43. Osztramos 1, 7, 9; 44. Gérce; 45. Ivánháza; 46. Bodvavendégi; 47. Csarnóta 1, 2, 4; 48. Ajnácskő; 49. Villány 3; 50. Beremend 1-3, 4-5, 11, 15, 18, 26, 38, 39; 51. Kisláng; 52. Betfia 13 – Pliocene (Lower, Middle and Upper)



Map 2. Lower and Middle Pleistocene sites from Carpathian Basin
2. térkép Alsó- és középső pleisztocén korú lelőhelyek a Kárpát-medencéből
(After Zentai László 1996. „A Kárpát-medence domborzati alaptérképe". Modified)

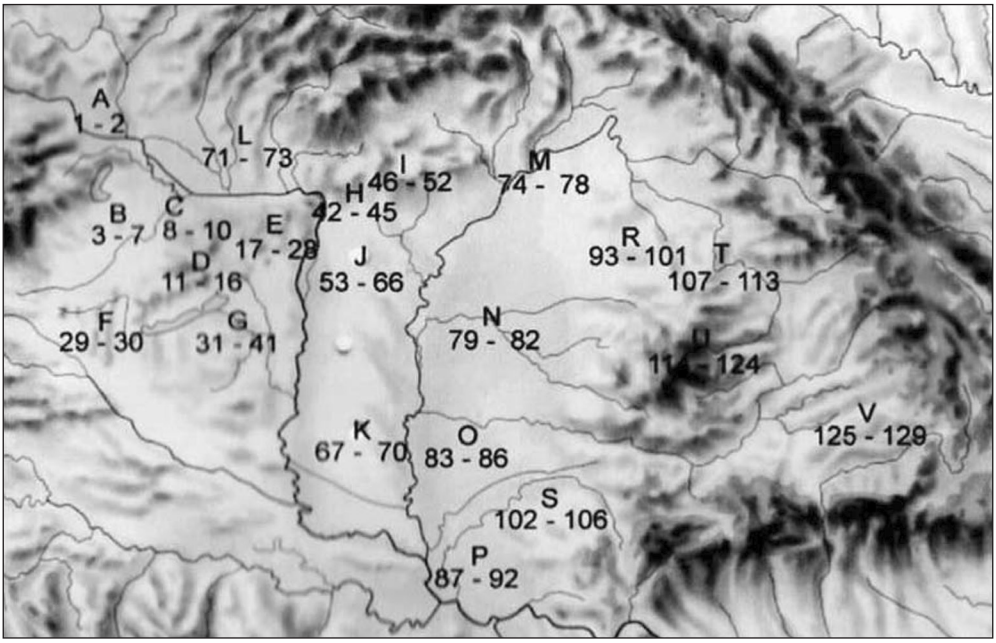
Lower Pleistocene sites: 1. Kolon 2; 2. Villány 5; 3. Győrújfalu; 4. Kőröshegy; 5. Betfia 2, 7/1, 9, 'Aven'; 6. Nagyharsányhegy 2; Beremend 16, 17: 7. Németóvár; 8. Osztramos 2, 5, 8; 9. Somssich-hegy 1

Middle Pleistocene sites: 10. Beremend 28; 11. Kiskóh; 12. Kövesvárad; 13. Méhész 3, 4; 14. Somssich-hegy 2; 15. Ürömhegy16; Villány 6, 8; 17. Betfia 5, 7/2-4; 18. Lucsia-barlang; 19. Brassó-Fortyógóhegy; 20. Nagyharsányhegy 1-4, 6; 21. Gombaszög; 22. Hundsheim; 23. Süttő 1-9; 24. Vértesszőlős 2; 25. Dorog; 26. Budapest-Várhegy; 27. Solymár; 28. Uppony; 29. Hórvölgy; 30.Tarkő 1-16; 31. Repoulust-höhle; 32. Vindija



Map 3. Upper Pleistocene sites from Carpathian Basin
3. *térkép* Felső-pleisztocén korú lelőhelyek a Kárpát-medencéből
(After Zentai László 1996. „A Kárpát-medence domborzati alaptérképe". Modified)

1. Grosse Badhöhle; 2. Hundsteig bei Krems; 3. Luegloch; 4. Merkenstein; 5. Mixnitz –Drachenhöhle; 6. Schwarzgrabenhöhle; 7. Krapina; 8. Velika Pecina; 9. Velika pec na Lipi; 10. Veternica 11; Detrekőszentmiklós; 12. Érsekújvár; 13. Galgóc; 14. Gánócz; 15. Kisvárad; 16. Lándzsásötfalu; 17. Liszkófalva-Baráthegy; 18. Novi I, III.; 19. Óruzsin – Antal- és Nagy-barlang; 20. Porács; 21. Barcarozsnyó; 22. Magura-Valea Coacazai; 23. Homoródalmás-Vargyasi-szoros; 24. Esküllő – Igric-barlang; 25. Kőrösmart; 26. Nándorfalvi barlang; 27. Ohába Ponor; 28. Oláhszászka – Néravölgyi-barlang; 29. Hidegszamos; 30. Szamosfalva; 31. Rév; 32. Szegyestel-völgy; 33. Tordai-hasadék; 34. Gencsapáti; 35. Kőszeg; 36. Csákvár; 37. Lovas; 38. Érd; 39. Szárazgerence; 40. Buják; 41. Hollókő; 42. Mérk; 43-50. Budai-hegység- Gerecse – Pilis (43. Bajót; 44. Budapest; 45.Csobánka; 46. Kesztölc; 47. Pilisszántó; 48. Tata; 49. Tatabánya; 50. Tokod Nagyberek); 51-62. Bükk-hegység (51. Cserépfalu; 52. Diósgyőr; 53. Felsőtárkány; 54. Hámor; 55. Jósvafő; 56. Kecskésgalya; 57. Ölyveskőér; 58. Répáshuta; 59. Sály; 60. Szilvásvárad; 61. Varbó; 62. Vaskapu)



Map 4. Tardiglaciale and Holocene sites from Carpathian Basin
4. térkép Késő-glaciális és holocén korú lelőhelyek a Kárpát-medencéből
(After Zentai László 1996. „A Kárpát-medence domborzati alaptérképe". Modified)

A. Viena Basin: 1. Marchegg, 2.Teufelsluchen; **B. Burgenland:** 3. Grosse Offenber-gerhöhle, 4. Hochlensteinhöhle, 5. Knochenhöhle, 6. Trofsteinhöhle, 7. Tunnelhöhle; **C. Kisalföld:** 8. Ács, 9. Mezőlak; 10. Neszmély; **D. Vértes-Bakony:** 11. Bakonynána, 12. Bodajk, 13. Csákvár, 14. Rezi, 15. Tatabánya, 16. Tűzköves-árok; **E. Buda-Pilis-Gerecse-Visegrád Hills:** 17. Budapest, 18. Csév, 19. Csobánka, 20. Esztergom; 21. Hosszúhegy, 22. Kevélynyereg, 23. Legény-barlang, 24. Nagysomlyó, 25. Pilismarót, 26. Pomáz, 27. Tokod, 28. Visegrád; **F. South Dunántúl**: 29. Bajcsa, 30. Zalaszentistván; **G. Balaton region – Somogy – Tolna – Mecsek:** 31. Balatonboglár, 32. Balatonkeresztúr, 33. Balatonlele, 34. Balatonszemes, 35. Felsőnyék, 36. Mélyvölgy, 37. Mezőkomárom, 38. Orda-csehi, 39. Paks, 40. Székesfehérvár, 41. Tác: **H. Cserhát-Mátra:** 42. Csapástető, 43. Felnémet, 44. Felsőtárkány, 45. Füzesabony; **I. Bükk Hill:** 46. Aggtelek, 47. Cserépfalu, 48. Hilleb-rand-barlang, 49. Jósvafő, 50. Miskolc, 51. Répáshuta, 52. Szendrő; **J. North Alföld:** 53. Alattyán, 54. Folyás, 55. Jánoshida, 56. Kisköre, 57. Kőtelek, 58. Ludas, 59. Nagykörű, 60. Szajol, 61. Szolnok, 62. Tápiószele, 63. Tiszaszőlős, 64. Tiszavalk, 65. Tószeg, 66. Túrkeve; **K. South Alföld:** 67. Maroslele, 68. Röszke, 69. Szegvár, 70. Szentkirály; **L. Slovakia:** 71. Érsekújvár, 72. Jászó, 73. Kisvárad; **M. North Tiszántúl:** 74. Mezőzombor, 75. Polgár, 76. Szerencs; 77. Tiszapolgár, 78.Tiszavasvári; **N. Middle Tiszántúl:** 79. Berettyó-szentmárton, 80. Berettyóújfalú, 81. Bélmegyer, 82. Debrecen; **O. South Tiszántúl:** 83. Békés, 84. Gyula, 85. Kardoskút, 86. Ószentiván; **P. Serbia:** 87.Nosza, 88. Padina, 89. Palics, 90. Szabadka, 91. Starcevo, 92. Vlassac; **R. North Partium (Romania):** 93. Aranyosmeggyes, 94. Berettyószéplak, 95. Diószeg, 96. Érmihályfalva, 97. Gálospetri, 98. Kalota, 99. Nagyvárad, 100. Püspökfürdő, 101. Szalacs; **S. South Partium (Romania):** 102. Bégakalodva, 103. Felsőlubkó, 104. Parác, 105. Herkulesfürdő, 106. Kazánszoros; **T. Middle Transylvania (Romania):** 107. Kisbács, 108. Kisderzsida, 109. Mezőfény, 110. Mezősámsond, 111. Radnót, 112. Szilágyzovány, 113. Vizakna; **U. Apuseni Mountain (Romania):** 114. Körösbánlak, 115. Lórév, 116. Peterd, 117. Révi-szoros, 118. Révtizfalu, 119. Sebeskőrös-völgye, 120. Szind, 121. Szkerisóra, 122. Szegyestel-völgy, 123. Városnokolyos, 124. Vaskóh; **V. South Transylvania (Romania):** 125. Gyulafehérvár, 126. Homoródalmás, 127. Kovászna, 128. Ompolymező, 129. Székelykeresztúr

List of species (Fajlista)

(**Annotation (Magyarázat):** Me – Mesozoic (Mezozoikum); Eo – Eocene (Eocén); Ol – Oligocene (Oligocén); LM – Lower Miocene (alsó-miocén); MM – Middle Miocene (középső-miocén); UM – Upper Miocene (felső-miocén); LP – Lower Pliocene (alsó-pliocén); UP – Upper Pliocene (felső-pliocén); LQ – Lower Pleistocene (alsó-pleisztocén); MQ – Middle Pleistocene (középső-pleisztocén); UQ – Upper Pleistocene (felső-pleisztocén); Ho – Holocene (Holocén); end. – signaled first from the Carpathian Basin area (először a Kárpát-medencéből leírt taxon); – taxon defined until species level (fajszintig nem meghatározott taxon)l; foss – extinct taxon, signaled first from other area (más területről először jelzett taxon); rec. – recent taxon (recens taxon), sp. – species (faj); ssp. – subspecies (alfaj); g/gen. – genus (genus, nemzetség); f/fam. – family (család); sfam. – subfamily (alcsalád); o/ord. – ordo (rend)).

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Ord. **Archaeopterygiformes**	×												foss.ord.
Fam. **Archaeopterygidae**	×												foss.fam.
Gen. ***Archaeopteryx***	×												foss.gen.
Archaeopteryx bavarica	×												foss.
Ord. **Enantiornithiformes**	×												foss.ord.
Fam. **Enantiornithidae**	×												foss.fam.
Gen. ***Bauxitornis***	×												end.gen.
Bauxitornis mindszentyae	×												end.
Enantiornithidae g. sp. indet.	×												foss.?
Ord. **Palaeocursornithiformes**	×												end.ord.
Fam. **Palaeocursornithidae**	×												end.fam
Gen. ***Palaeocursornis***	×												end.gen.
Palaeocursornis biharicus	×												end.
Ord. **Limnornithiformes**	×												end.ord.
Fam. **Limnornithidae**	×												end.fam.
Gen. ***Eurolimnornis***	×												end.gen.
Eurolimnornis corneti	×												end.
Ornithurinae indet.	×												foss.?
Ord. Hesperornithiformes	×												foss.ord.
Hesperonithidae f. g. sp. indet	×												foss.?
Ord. Struthioniformes								×					rec.ord.
Fam. Struthionidae								×					rec.fam.
Gen. *Struthio (Pachystruthio)*								×					rec.gen.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Struthio pannonicus								×					end.
Ord. Gaviiformes			×		×							×	rec.ord.
Fam. Gaviidae			×		×							×	rec.fam.
Gen. *Gavia*			×		×							×	rec.gen.
Gavia ***schultzi***					×								end.
Gavia **sp. foss. indet.**			×										foss.?
Gavia stellata												×	rec.
Ord.Podicipediformes							×		×		×	×	rec.ord.
Fam. Podicipedidae							×		×		×	×	rec.fam.
Gen. *Podiceps*							×		×		×	×	rec.gen.
Podiceps csarnotanus							×						end.
Podiceps nigricollis									×				rec.
Podiceps griseigena												×	rec.
Podiceps auritus											×		rec.
Podiceps cristatus											×		rec.
Ord.Procellariformes			×										rec.ord.
Fam. **Diomedeoididae**			×										foss.fam.
Gen. **Diomedeoides**			×										foss.gen.
Diomedeoides harmathi			×										end.
Ord. Pelecaniformes	×	×		×	×	×						×	rec.ord.
Fam. **Elopterygidae**	×												end.fam.
Gen. ***Elopteryx***	×												end.gen.
Elopteryx nopcsai	×												end.
Fam. Sulidae		×			×								rec.fam.
Gen. ***Eostega***		×											end.gen.
Eostega lebedynskii		×											end.
Gen. ***Microsula***					×								foss.gen.
Microsula pygmaea					×								foss.
Fam. Anhingidae					×	×							rec.fam.
Gen. *Anhinga*					×	×							rec.gen.
Anhinga ***pannonica***						×							end
Anhinga **sp. foss. indet.**					×								foss.?
Fam.Phalacrocoracidae				×	×								rec.fam.
Gen. *Phalacrocorax*				×	×								rec.gen.
Phalacrocorax ***intermedius***				×									foss.
Phalacrocorax **sp. foss. indet.**					×								foss.?
Phalacrocorax carbo												×	rec.
Fam. Pelecanidae								×				×	rec.fam.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. *Pelecanus*								×				×	rec.gen.
Pelecanus onocrotalus												×	rec.
Pelecanus sp. indet.								×				×	rec.?
Fam. Phaethontidae						×		×					rec.fam.
Gen. ***Heliadornis***						×		×				.	foss.gen.
Heliadornis paratethydicus						×							end.
Heliadornis minor							×						end.
Ord. Ardeiformes					×	×		×	×	×	×	×	rec.ord.
Fam. Ardeidae					×	×		×	×	×		×	rec.fam.
Gen. *Ardea*										×		×	rec.gen.
Ardea cinerea										×		×	rec.
Ardea purpurea												×	rec.
Gen. ***Proardeolla***					×								foss.gen.
Proardeolla walkeri					×								foss.
Gen. *Egretta*						×		×				×	rec.gen.
Egretta ***polgardiensis***						×							end.
Egretta **sp. foss. indet.**								×					foss.?
Egretta alba												×	rec.
Egretta garzetta												×	rec.
Gen. *Ixobrychus*												×	rec.gen.
Ixobrychus minutus												×	rec.
Gen. *Botaurus*									×			×	rec.gen.
Botaurus stellaris												×	rec.
Botaurus sp. indet.									×			×	rec.?
Gen. *Nycticorax*									×			×	rec.gen.
Nycticorax nycticorax												×	rec.
Nycticorax sp. indet.									×				rec.?
Fam. Plataleidae											×	×	rec.fam.
Gen. *Plegadis*											×		rec.gen.
Plegadis falcinellus											×		rec.
Gen. *Platalea*												×	rec.gen.
Platalea leucorodia												×	rec.
Fam. Ciconiidae			×		×				×	×		×	rec.fam.
Gen. ***Grallavis***			×										foss.gen.
Grallavis edwardsi			×										foss.
Gen. *Ciconia*								×	×			×	rec.gen.
Ciconia ***stehlini***								×	×				end.
Ciconia ciconia									×			×	rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Ciconia nigra												×	rec.
Gen. ***Pelargosteon***									×	×			end.gen.
Pelargosteon tothi									×	×			end.
Ciconiidae **g. et sp. foss. indet.**					×								foss.?
Fam. **Palaelodidae**					×								foss.fam.
Gen. ***Palaelodus***					×								foss.gen.
Palaelodus goliath					×								foss.
Palaelodus ambiguus/crassipes					×								foss.
Ord. Anseriformes			×	×	×	×	×	×	×	×	×	×	rec.ord.
Fam. Anatidae			×	×	×	×	×	×	×	×	×	×	rec.fam.
Sfam. Cygninae					×	×					×	×	rec.sfam.
Gen. *Cygnus*						×					×	×	rec.gen.
Cygnus ***csakvarensis***						×							end.
Cygnus *olor*											×	×	rec.
Cygnus cygnus												×	rec.
Cygnus sp. indet.												×	rec.?
Gen. ***Cygnopterus***				×	×								foss.gen.
Cygnopterus neogradensis				×	×								end.
Sfam. Anserinae			×		×			×	×	×	×	×	rec.sfam.
Gen. *Anser*			×		×			×		×	×	×	rec.gen.
Anser anser ***subanser***										×			end.ssp.
Anser **sp. foss. indet.**			×		×			×					foss.?
Anser anser											×	×	rec.
Anser fabalis											×	×	rec.
Anser albifrons											×	×	rec.
Anser erythropus												×	rec.
Anser sp. indet.											×	×	rec.?
Gen. *Branta*										×	×	×	rec.gen.
Branta ruficollis										×	×		rec.
Branta leucopsis												×	rec.
Branta sp. indet.												×	rec.?
Gen. *Tadorna*					×			×	×		×	×	rec.gen.
Tadorna ***minor***					×								end.
Tadorna tadorna								×	×			×	rec.
Tadorna ferruginea											×	×	rec.
Tadorna sp. indet.									×				rec.?
Sfam. Anatinae			×		×	×	×	×	×	×	×	×	rec.sfam.
Gen. ***Mionetta***			×		×								foss.gen.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Mionetta consobrina					×								foss.
Mionetta robusta			×										foss.
Gen. *Dendronessa*						×							rec.gen.
Dendronessa **sp. foss. indet.**						×							foss.?
Gen. *Anas*					×	×	×	×	×	×	×	×	rec.gen.
Anas ***velox***					×	×							foss.
Anas ***sansanensis***						×							foss.
Anas ***albae***					×	×	×	×					end.
Anas ***denesi***						×							end.
Anas platyrhynchos ***submajor***								×	×	×			end.ssp.
Anas platyrhynchos											×	×	rec.
Anas penelope									×		×	×	rec.
Anas strepera									×		×	×	rec.
Anas crecca ***percrecca***								×	×				end.ssp.
Anas crecca										×	×	×	rec.
Anas acuta									×	×	×	×	rec.
Anas querquedula								×	×	×	×	×	rec.
Anas clypeata									×	×	×	×	rec.
Anas **sp. foss. indet.**					×	×							foss.?
Anas sp. indet.									×	×	×	×	rec.?
Sfam. Aythyinae					×				×	×	×	×	rec.sfam.
Gen. *Aythya*									×	×	×	×	rec.gen.
Aythya nyroca									×	×	×	×	rec.
Aythya fuligula										×	×	×	rec.
Aythya ferina										×	×	×	rec.
Aythya marila												×	rec.
Aythya sp.										×			rec.
Gen. *Clangula*					×								rec.gen.
Clangula ***matraensis***					×								end.
Sfam. Merginae					×				×	×	×	×	rec.sfam.
Gen. *Bucephala*					×						×		rec.gen.
Bucephala ***cereti***					×								foss.
Bucephala clangula											×		rec.
Gen. *Mergus*					×				×	×	×	×	rec.gen.
Mergus ***minor***					×								end.
Mergus ***connectens***									×				foss.
Mergus serrator												×	rec.
Mergus albellus											×		rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Mergus merganser										×	×	×	rec.
Mergus **sp. foss. indet.**							×						foss.?
Mergus sp.										×			rec.
Gen. *Melanitta*											×		rec.gen.
Melanitta nigra											×		rec.
Anatidae **g. et sp. foss. indet.**					×	×		×					foss.?
Anatidae gen. et sp. indet.									×				rec.?
Ord. Accipitriformes			×	×		×		×	×	×	×	×	rec.ord.
Fam. Accipitridae			×	×		×	×	×	×	×	×	×	rec.fam.
Gen. *Aegypius*										×	×	×	rec.gen.
Aegypius monachus										×	×	×	rec.
Gen. *Gyps*										×	×	×	rec.gen.
Gyps ***melitensis***										×			foss.
Gyps fulvus										×	×	×	rec.
Gen. *Gypaeetus*											×	×	rec.gen.
Gypaeetus barbatus											×	×	rec.
Gen. *Circus*									×	×	×	×	rec.gen.
Circus macrourus											×		rec.
Circus cyaneus											×		rec.
Circus aeruginosus										×		×	rec.
Circus sp.									×			×	rec.
Gen. *Accipiter*									×	×	×	×	rec.gen.
Accipiter nisus									×	×	×	×	rec.
Accipiter gentilis										×	×	×	rec.
Gen. *Aquila*								×	×	×	×	×	rec.gen.
Aquila chrysaetos								×			×	×	rec.
Aquila heliaca									×	×	×	×	rec.
Aquila clanga									×		×		rec.
Aquila pomarina												×	rec.
Aquila rapax												×	rec.
Aquila sp.										×		×	rec.
Gen. *Haliaeetus*				×					×		×	×	rec.gen.
Haliaeetus ***angustipes***									×				foss.
Haliaeetus albicilla											×	×	rec.
Haliaeetus **sp. foss. indet.**				×?									foss.?
Gen. *Milvus*									×			×	rec.gen.
Milvus ***brachypterus***									×				end.
Milvus migrans												×	rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Milvus sp. indet.												×	rec.?
Gen. *Pernis*											×		rec.gen.
Pernis apivorus											×		rec.
Gen. *Buteo*						×			×	×	×	×	rec.gen.
Buteo buteo									×	×	×	×	rec.
Buteo lagopus									×		×	×	rec.
Buteo rufinus											×		rec.
Buteo **sp. foss. indet.**						×							foss.?
Buteo sp.indet.										×			rec.?
Gen. *Hieraetus*												×	rec.gen.
Hieraetus pennatus												×	rec.
Gen. *Circaetus*												×	rec.gen.
Circaetus gallicus												×	rec.
Fam. Pandionidae			×					×					rec.fam.
Gen. *Pandion*			×					×					rec.gen.
Pandion haliaeetus								×					rec.
Pandion **sp. foss. indet.**			×										foss.?
Fam. Falconidae						×	×	×	×	×	×	×	rec.fam.
Gen. *Falco*						×	×	×	×	×	×	×	rec.gen.
Falco aff. ***antiquus***										×			foss.
Falco tinnunculus ***atavus***						×	×	×	×	×			end.ssp.
Falco tinnunculus										×	×	×	rec.
Falco vespertinus								×	×	×	×	×	rec.
Falco subbuteo									×	×	×	×	rec.
Falco cherrug									×	×	×	×	rec.
Falco peregrinus											×		rec.
Falco rusticolus										×	×		rec.
Falco columbarius									×	×	×	×	rec.
Falco **sp. foss. indet.**						×	×						foss.?
Falco sp. indet.									×	×	×	×	rec.
Ord. Galliformes				×	×	×	×	×	×	×	×	×	rec.ord.
Fam. Phasianidae				×	×	×	×	×	×	×	×	×	rec.fam.
Gen. ***Palaeortyx***				×	×	×	×						foss.gen.
Palaeortyx brevipes						×	×						foss.
Palaeortyx gallica				×	×	×							foss.
Palaeortyx phasionides				×		×							foss.
Palaoertyx prisca/phasionides					×								foss.
Gen. ***Palaeocryptonix***						×	×		×				end.gen.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Palaeocryptonix hungaricus						×	×		×				end.
Gen. *Francolinus*							×	×	×				rec.gen.
Francolinus ***capeki***							×	×	×				end.
Gen. *Coturnix*									×	×	×	×	rec.gen.
Coturnix coturnix									×	×	×	×	rec.
Gen. *Alectoris*							×	×	×	×	×	×	rec.gen.
Alectoris ***donnezani***							×	×	×				foss.
Alectoris graeca										×	×	×	rec.
Gen. *Perdix*							×	×	×	×	×	×	rec.gen.
Perdix perdix ***jurcsaki***							×	×	×	×			end.ssp.
Perdix perdix										×	×	×	rec.
Perdix sp. indet.									×				rec.?
Gen. *Ammoperdix*										×			rec.gen.
Ammoperdix sp. indet.										×			rec.?
Gen. ***Miogallus***					×	×							foss.gen.
Miogallus altus					×	×							foss.
Gen. *Gallus*							×	×	×	×	×	×	rec.gen.
Gallus ***beremendensis***							×	×	×				end.
Gallus sp.										×	×	×	rec.
Gen. *Phasianus*										×		×	rec.gen.
Phasianus sp.										×		×	rec.
Gen. *Pavo*						×	×						rec.gen.
Pavo ***bravardi***							×						foss.
Pavo archiaci						×							foss.
Gen. *Numida*												×	rec.gen.
Numida meleagris												×	rec
Perdicidae **g. sp. foss. indet.**					×								foss.?
Perdicidae gen. et sp. indet.											×	×	rec.?
Fam. Tetraonidae						×	×	×	×	×	×	×	rec.fam.
Gen. *Tetrao*						×	×	×	×	×	×	×	rec.gen.
Tetrao ***praeurogallus***							×		×	×			end.
Tetrao urogallus										×	×	×	rec
Tetrao ***partium***						×	×	×	×	×			end.
Tetrao tetrix									×	×	×	×	rec
Tetrao sp. indet.										×	×		rec
Gen. *Bonasa*									×	×	×	×	rec.gen.
Bonasa ***praebonasia***									×	×			end.
Bonasa bonasia											×	×	rec

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. *Lagopus*										×	×	×	rec.gen.
Lagopus lagopus										×	×	×	rec
Lagopus mutus										×	×	×	rec
Galliformes **foss. indet.**						×							foss.?
Ord. Ralliformes			×	×	×	×	×	×	×	×	×	×	rec.ord.
Fam. Heliornithidae						×							rec.fam.
Gen. *Heliornis*						×							rec.gen.
Heliornis ***sumegensis***						×							end.
Fam. Gruidae			×		×	×					×	×	rec.fam.
Gen. *Grus*						×					×	×	rec.gen.
Grus ***pentelici***						×							foss.
Grus grus											×	×	rec.
Gen. *Balearica*			×										rec.gen.
Balearica ***excelsa***			×										foss.
Gruidae **g. et sp. foss. indet.**					×								foss.?
Fam. Otididae						×	×	×	×	×	×	×	rec.fam.
Gen. Otis						×	×	×	×	×	×	×	rec.gen.
Otis ***khozatzki beremendensis***						×		×					end.ssp.
Otis ***kalmani***						×	×	×	×				end.
Otis tetrax										×	×	×	rec.
Otis ***lambrechti***							×	×	×	×			end.
Otis tarda										×	×	×	rec.
Otis sp. indet.									×	×			rec.
Fam. Rallidae			×	×	×	×	×		×		×	×	rec.fam.
Gen. ***Rallicrex***			×	×	×	×	×						end.
Rallicrex kolozsvarensis			×										end.
Rallicrex litkensis				×	×								end.
Rallicrex polgardensis						×	×						end.
Gen. ***Miorallus***						×	×		×				foss.gen.
Miorallus major						×	×		×				foss.
Gen. *Porzana*					×	×	×		×		×	×	rec.gen.
Porzana ***estramosi***					×	×	×						end.
Porzana ***matraensis***					×								end.
Porzana ***kretzoii***						×							end.
Porzana porzana									×		×	×	rec.
Porzana parva									×				rec.
Porzana pusilla									×				rec.
Porzana **sp. foss. indet.**							×						foss.?

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. *Crex*						×			×		×	×	rec.gen.
Crex crex									×		×	×	rec.
Crex **sp. foss. indet.**						×							foss.?
Crex sp. indet.									×				rec.?
Gen. Rallus							×		×	×	×	×	rec.gen.
Rallus aquaticus									×	×	×	×	rec.
Rallus **sp. foss. indet.**							×						foss.?
Rallus sp. indet.									×				rec.?
Gen. *Gallinula*									×	×		×	rec.gen.
Gallinula chloropus									×	×		×	rec.
Gen. *Fulica*									×			×	rec.gen.
Fulica atra									×			×	rec.
Gen. ***Palaeoaramides***									×				foss.gen.
Palaeoaramides beaumonti									×				foss.
Rallidae **gen. et sp. foss. indet.**					×								foss.?
Ord. Charadriiformes					×	×	×	×	×	×	×	×	rec.ord.
Fam. Scolopacidae					×	×	×	×	×	×	×	×	rec.fam.
Gen. *Gallinago*					×	×	×		×	×	×	×	rec.gen.
Gallinago ***veterior***					×	×	×						end.
Gallinago media									×	×	×		rec.
Gallinago gallinago									×	×	×	×	rec.
Gallinago **sp. foss. indet.**						×							foss.?
Gallinago sp. indet.									×				rec.?
Gen. *Lymnocryptes*												×	rec.gen.
Lymnocryptes minimus												×	rec.
Gen. *Limosa*						×			×	×	×	×	rec.gen.
Limosa limosa									×	×	×	×	rec.
Limosa **sp. foss. indet.**						×							foss.?
Gen. *Numenius*								×			×	×	rec.gen.
Numenius arquata											×	×	rec.
Numenius phaeopus											×	×	rec.
Numenius sp. indet.											×		rec.?
Numenius **sp. foss. indet.**								×					foss.?
Gen. *Tringa*						×	×	×	×	×	×	×	rec.gen.
Tringa totanus											×		rec.
Tringa glareola									×				rec.
Tringa erythropus								×	×		×		rec.
Tringa nebularia									×				rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Tringa ochropus								×	×	×			rec.
Tringa hypoleucos									×			×	rec.
Tringa **sp. foss. indet.**						×	×		×				foss.?
Tringa sp. indet.											×	×	rec.?
Gen. *Scolopax*							×		×	×	×	×	rec.gen.
Scolopax ***baranensis***							×		×				end.
Scolopax rusticola										×	×	×	rec.
Scolopax sp. indet.											×		rec.?
Gen. *Cursorius*									×				rec.gen.
Cursorius sp. indet.									×				rec.?
Gen. *Arenaria*											×		rec.gen.
Arenaria interpres											×		rec.
Gen. *Phylomachus*									×		×		rec.gen.
Phylomachus pugnax									×		×		rec.
Fam. Charadriidae						×		×	×	×	×	×	rec.fam.
Gen. *Charadrius*						×					×	×	rec.gen.
Charadrius ***lambrechti***						×							end.
Charadrius hiaticula												×	rec.
Charadrius sp. indet.											×		rec.
Gen. *Calidris*						×					×		rec.gen.
Calidris ***janossyi***						×							end.
Calidris alpina											×		rec.
Calidris ferruginea											×		rec.
Gen. *Vanellus*								×	×	×			rec.gen.
Vanellus vanellus								×	×	×			rec.
Gen. *Pluvialis*											×		rec.gen.
Pluvialis squatarola											×		rec.
Fam. Recurvirostridae									×	×	×		rec.fam.
Gen. *Recurvirostra*									×	×			rec.gen.
Recurvirostra avosetta										×			rec.
Recurvirostra **sp. foss. indet.**									×				foss.?
Gen. *Himantopus*											×		rec.gen.
Himantopus himantopus											×		rec.
Fam. Laridae							×	×	×	×	×		rec.fam.
Gen. *Larus*									×	×			rec.gen.
Larus minutus										×			rec.
Larus ridibundus									×	×			rec.
Larus sp. indet.										×			rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. *Sterna*								×			×		rec.gen.
Sterna hirundo								×			×		rec.
Gen. *Chlidonias*							×		×		×		rec.gen.
Chlidonias niger									×				rec.
Chlidonias **sp. foss. indet.**							×						foss.?
Chlidonias sp. indet.											×		rec.?
Ord. Columbiformes					×		×	×	×	×	×	×	rec.ord.
Fam. Columbidae					×		×	×	×	×	×	×	rec.fam.
Gen. *Columba*							×	×	×	×	×	×	rec.gen.
Columba livia									×		×	×	rec.
Columba palumbus								×	×	×	×	×	rec.
Columba oenas											×	×	rec.
Columba **sp. foss. indet.**							×						foss.?
Columba sp. indet.												×	rec.?
Gen. *Streptopelia*												×	rec.gen.
Streptopelia turtur												×	rec.
Columbidae **gen. et sp. indet.**					×								foss.?
Fam. Pteroclidae					×						×		rec.fam.
Gen. Syrrhaptes											×		rec.gen.
Syrrhaptes paradoxus											×		rec.
Pteroclidae **g. et sp. foss. indet.**					×								foss.?
Ord. Cuculiformes					×	×	×	×		×	×	×	rec.ord.
Fam. Cuculidae					×	×	×	×		×	×	×	rec.fam.
Gen. *Cuculus*						×	×	×		×	×	×	rec.gen.
Cuculus **csarnotanus**							×						end.
Cuculus ***pannonicus***						×		×					end.
Cuculus canorus										×	×	×	rec.
Cuculidae **g. et sp. foss. indet.**					×								foss.?
Ord. Strigiformes				×	×	×	×	×	×	×	×	×	rec.ord.
Fam. Tytonidae				×		×			×	×			rec.fam.
Gen. ***Prosybris***				×									foss.gen.
Prosybris antiqua				×									foss.
Gen. *Tyto*						×			×	×			rec.gen.
Tyto ***sanctialbani***						×							foss.
Tyto ***campiterrae***						×							end.
Tyto alba									×	×			rec.
Tyto sp. indet.									×				rec.?
Fam. Strigidae					×	×	×	×	×	×	×	×	rec.fam.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. ***Intulula***						×							foss.gen.
Intulula brevis						×							foss.
Gen. *Otus*									×	×	×		rec.gen.
Otus scops									×	×	×		rec.
Gen. *Bubo*						×	×	×	×	×	×	×	rec.gen.
Bubo ***florianae***						×							end.
Bubo bubo									×	×	×	×	rec.
Bubo **sp. foss. indet.**							×	×					foss.?
Gen. *Surnia*						×		×	×		×		rec.gen.
Surnia ***robusta***						×		×	×				end.
Surnia ulula											×		rec.
Gen. *Glaucidium*							×		×	×	×		rec.gen.
Glaucidium ***baranensis***							×						end.
Glaucidium passerinum									×	×	×		rec.
Gen. *Athene*						×	×	×	×		×	×	rec.gen.
Athene ***noctua veta***						×	×	×	×				end.ssp.
Athene noctua											×	×	rec.
Athene **sp. foss. indet.**						×							foss.?
Gen. *Strix*							×	×	×	×	×	×	rec.gen.
Strix ***intermedia***							×	×	×	×			end.
Strix aluco											×	×	rec.
Strix nebulosa											×		rec.
Strix uralensis											×	×	rec.
Gen. *Aegolius*							×	×	×		×	×	rec.gen.
Aegolius funereus									×		×	×	rec.
Aegolius **sp. foss. indet.**							×	×					foss.?
Gen. *Asio*								×	×	×	×	×	rec.gen.
Aso flammeus									×	×	×	×	rec.
Asio otus								×	×	×	×	×	rec.
Asio sp. indet.									×				rec.?
Gen. *Nyctea*										×	×	×	rec.gen.
Nyctea scandiaca										×	×	×	rec.
Strigidae **g. et sp. foss. indet.**					×								foss.?
Strigidae gen. et sp. indet.											×		rec.
Ord. Caprimulgiformes									×		×		rec.ord.
Fam. Caprimulgidae									×		×		rec.fam.
Gen. *Caprimulgus*									×		×		rec.gen.
Caprimulgus europaeus									×		×		rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Ord. Apodiformes						×	×	×	×	×	×	×	rec.ord.
Fam. Apodidae						×	×	×	×	×	×	×	rec.fam.
Gen. *Apus*						×	×	×	×	×	×	×	rec.gen.
Apus ***baranensis***						×	×	×					end.
Apus apus									×	×	×	×	rec.
Apus melba										×	×		rec.
Gen. *Chaetura*						×	×						rec.gen.
Chaetura ***baconica***						×	×						end.
Ord. Coraciiformes					×	×	×	×	×	×		×	rec.ord.
Fam. Meropidae					×	×			×	×			rec.fam.
Gen. *Merops*					×	×			×	×			rec.gen.
Merops ***radobojensis***					×	×							end.
Merops apiaster										×			rec.
Merops **sp. foss. indet.**									×				foss.?
Meropidae **g. et sp. foss. indet.**					×								foss.?
Fam. Coraciidae							×		×				rec.fam.
Gen. *Eurystomus*							×		×				rec.gen.
Eurystomus ***beremendensis***							×						end.
Eurystomus **sp. foss. indet.**									×				foss.?
Fam. Upupidae								×		×		×	rec.fam.
Gen. *Upupa*								×		×		×	rec.gen.
Upupa ***phoeniculides***								×		×			end.
Upupa epops												×	rec.
Fam. Alcedinidae										×			rec.fam.
Gen. *Halcyon*										×			rec.gen.
Halcyon **sp. foss. indet.**										×			foss.?
Ord. Piciformes						×	×	×	×	×	×	×	rec.ord.
Fam. Picidae						×	×	×	×	×	×	×	rec.fam.
Gen. *Jynx*									×		×		rec.gen.
Jynx torquilla									×		×		rec.
Gen. *Picus*								×	×	×	×	×	rec.gen.
Picus ***pliocaenicus***								×					end.
Picus viridis									×	×	×	×	rec.
Picus canus											×	×	rec.
Picus sp. indet.											×		rec.?
Gen. *Dendrocopos*							×	×	×	×	×	×	rec.gen.
Dendrocopos major ***submajor***							×		×	×			end.ssp.
Dendrocopos major										×	×	×	rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Dendrocopos ***praemedius***							×	×					end.
Dendrocopos medius									×	×	×		rec.
Dendrocopos minor									×				rec.
Dendrocopos leucotos												×	rec.
Gen. *Pogoniulus*						×							rec.gen.
Pogoniulus **sp. foss. indet.**						×							foss.?
Ord. Passeriformes				×	×	×	×	×	×	×	×	×	rec.ord.
Fam. Alaudidae				×	×	×	×		×	×	×	×	rec.fam.
Gen. *Melanocorypha*							×		×				rec.gen.
Melanocorypha ***minor***							×						end.
Melanocorypha calandra									×				rec.
Melanocorypha sp. indet.									×				rec.?
Gen. *Galerida*				×			×		×		×	×	rec.gen.
Galerida ***cserhatensis***				×									end.
Galerida ***pannonica***							×						end.
Galerida cristata									×		×	×	rec.
Galerida sp. indet.									×				rec.?
Gen. ***Praealauda***					×								end.gen.
Praealauda hevesensis					×								end.
Gen. *Alauda*						×			×	×	×	×	rec.gen.
Alauda ***tivadari***						×							end.
Alauda arvensis									×	×	×	×	rec.
Gen. *Lullula*					×	×	×		×				rec.gen.
Lulula ***neogradensis***					×								end.
Lullula ***minor***						×							end.
Lullula ***parva***							×						end.
Lullula ***minuscula***							×						end.
Lullula arborea									×				rec.
Gen. *Calandrella*						×							rec.gen.
Calandrella ***gali***						×							end.
Gen. *Eremophila*											×	×	rec.gen.
Eremophila alpestris											×	×	rec.
Fam. Hirundinidae						×	×		×	×	×	×	rec.fam.
Gen. *Hirundo*						×	×		×	×	×	×	rec.gen.
Hirundo ***gracilis***						×							end.
Hirundo ***major***							×						end.
Hirundo rustica									×	×	×	×	rec.
Hirundo **sp. foss. indet.**							×		×				foss.?

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Hirundo sp. indet.									×	×			rec.?
Gen. *Delichon*						×	×		×		×	×	rec.gen.
Delichon ***polgardiensis***						×							end.
Delichon ***pusillus***							×						end.
Delichon ***major***							×						end.
Delichon urbica									×		×	×	rec.
Gen. *Riparia*						×			×		×		rec.gen.
Riparia ***major***						×							end.
Riparia rupestris											×		rec.
Riparia riparia									×				rec.
Fam. Corvidae						×	×	×	×	×	×	×	rec.fam.
Gen. *Corvus*						×	×	×	×	×	×	×	rec.gen.
Corvus ***pliocaenus***						×	×	×	×	×			foss.
Corvus ***hungaricus***									×				end.
Corvus ***harkanyensis***							×						end.
Corvus monedula									×	×	×	×	rec.
Corvus corax										×	×	×	rec.
Corvus corone cornix										×	×	×	rec.
Corvus frugilegus											×	×	rec.
Corvus **sp. foss. indet.**				×		×	×	×					foss.?
Corvus sp. indet.									×		×	×	rec.?
Gen. ***Miocorvus***					×	×	×						foss.gen.
Miocorvus larteti					×	×	×						foss.
Gen. *Garrulus*									×	×	×	×	rec.gen.
Garrulus glandarius									×	×	×	×	rec.
Gen. *Nucifraga*									×	×	×	×	rec.gen.
Nucifraga caryocatactes									×	×	×	×	rec.
Gen. *Pica*							×		×	×	×	×	rec.gen.
Pica pica ***major***							×		×	×			end.ssp.
Pica pica										×	×	×	rec.
Gen. *Pyrrhocorax*							×	×	×	×	×	×	rec.gen.
Pyrrhocorax graculus ***vetus***							×	×	×	×			end.ssp.
Pyrrhocorax graculus										×	×	×	rec.
Pyrrhocorax pyrrhocorax									×	×	×	×	rec.
Gen. *Perisoreus*											×		rec.gen.
Perisoreus infaustus											×		rec.
Corvidae **g. et sp. foss. indet**							×						foss.?
Corvidae gen. et sp. indet.									×		×		rec.?

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Fam. Paridae						×	×		×	×	×	×	rec.fam.
Gen. *Aegithalos*						×	×		×				rec.gen.
Aegithalos ***gaspariki***						×							end.
Aegithalos ***congruis***							×						end.
Aegithalos caudatus									×				rec.
Gen. *Parus*							×		×	×	×	×	rec.gen.
Parus ***medius***							×						end.
Parus ***robostus***							×						end.
Parus ***parvulus***							×						end.
Parus caeruleus									×		×		rec.
Parus major									×	×	×	×	rec.
Parus lugubris									×				rec.
Parus ater										×			rec.
Parus palustris										×			rec.
Parus montanus											×		rec.
Parus sp. indet.										×	×		rec.
Fam. Sittidae					×	×	×		×		×	×	rec.fam.
Gen. *Sitta*						×	×		×		×	×	rec.gen.
Sitta ***gracilis***						×							end.
Sitta ***pusilla***							×						end.
Sitta ***villanyensis***							×						end.
Sitta europaea									×		×	×	rec.
Sittidae **g. et sp. foss. indet.**					×								foss.?
Fam. Certhiidae					×	×	×		×				rec.fam.
Gen. *Certhia*						×	×		×				rec.gen.
Certhia ***janossyi***						×							end.
Certhia ***imensa***							×						end.
Certhia familiaris									×				rec.
Certhidae **g. et sp. fos. indet.**					×		×						foss.?
Fam. Tichodromidae						×							rec.fam.
Gen. *Tichodroma*						×							rec.gen.
Tichodroma ***capeki***						×							end.
Fam. Muscicapidae					×	×	×		×	×	×	×	rec.fam.
Gen. *Muscicapa*					×	×	×		×	×		×	rec.gen.
Muscicapa ***leganyii***					×								end.
Muscicapa ***miklosi***						×							end.
Muscicapa ***petényii***							×						end.
Muscicapa striata									×	×		×	rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. *Erithacus*					×		×		×	×	×	×	rec.gen.
Erithacus ***horusitskyi***					×								end.
Erithacus ***minor***							×						end.
Erithacus rubecula									×	×	×	×	rec.
Erithacus sp. indet.									×				rec.?
Gen. *Luscinia*				×	×	×	×		×	×	×		rec.gen.
Luscinia ***praeluscinia***				×									end.
Luscinia ***jurcsaki***					×								end.
Luscinia ***denesi***						×							end.
Luscinia ***pliocaenica***							×						end.
Luscinia luscinia									×				rec.
Luscinia megarhynchos									×		×		rec.
Luscinia svecica										×			rec.
Luscinia sp. indet.									×				rec.?
Gen. *Saxicola*						×	×		×		×	×	rec.gen.
Saxicola ***lambrechti***						×							end.
Saxicola ***baranensis***							×						end.
Saxicola ***parva***							×						end.
Saxicola ***magna***							×						end.
Saxicola rubetra									×			×	rec.
Saxicola torquata									×		×		rec.
Gen. *Monticola*							×				×		rec.gen.
Monticola ***pongraczi***							×						end.
Monticola saxatilis											×		rec.
Gen. *Phoenicurus*							×			×		×	rec.gen.
Phoenicurus ***erikai***							×						end.
Phoenicurus ***baranensis***							×						end.
Phoenicurus phoenicurus										×			rec.
Phoenicurus ochruros												×	rec.
Gen. *Oenanthe*						×	×			×		×	rec.gen.
Oenanthe ***kormosi***						×							end.
Oenanthe ***pongraczi***							×						end.
Oenanthe oenanthe										×		×	rec.
Muscicapidae **g. et sp. foss. indet.**						×	×						foss.?
Fam. Turdidae				×	×	×	×	×	×	×	×	×	rec.fam.
Gen. ***Turdicus***				×	×	×	×		×				end.gen.
Turdicus matraensis				×	×								end.
Turdicus pannonicus						×							end.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Turdicus tenuis									×				end.
Gen. *Turdoides*							×						rec.gen.
Turdoides ***borealis***							×						end.
Gen. *Turdus*					×	×	×	×	×	×	×	×	rec.gen.
Turdus ***miocaenicus***						×							end.
Turdus ***polgardiensis***						×							end.
Turdus ***major***							×						end.
Turdus ***medius***							×						end.
Turdus ***minor***							×						end.
Turdus torquatus									×		×	×	rec.
Turdus merula									×	×	×	×	rec.
Turdus philomelos									×	×	×	×	rec.
Turdus iliacus									×	×	×	×	rec.
Turdus viscivorus									×	×	×	×	rec.
Turdus pilaris									×	×	×	×	rec.
Turdus **sp. foss. indet.**					×	×	×	×					foss.?
Turdus sp. indet.									×	×	×		rec.
Turdidae **g. et sp. foss. indet.**					×								foss.?
Fam. Oriolidae							×		×	×	×	×	rec.fam.
Gen. Oriolus							×		×	×	×	×	rec.gen.
Oriolus ***beremendensis***							×						end.
Oriolus oriolus									×	×	×	×	rec.
Fam. Sylviidae					×	×	×		×	×	×	×	rec.fam.
Gen. *Acrocephalus*						×	×		×			×	rec.gen.
Acrocephalus ***major***						×							end.
Acrocephalus ***minor***						×							end.
Acrocephalus ***kretzoii***							×						end.
Acrocephalus ***kormosi***							×						end.
Acrocephalus palustris									×				rec.
Acrocephalus **sp. foss. indet.**					×		×		×				foss.?
Acrocephalus sp. indet.												×	rec.?
Gen. *Cettia*						×	×						rec.gen.
Cettia ***janossyi***						×							end.
Cettia ***kalmani***							×						end.
Gen. *Hippolais*						×	×		×				rec.gen.
Hippolais ***veterior***						×							end.
Hippolais **sp. foss. indet.**							×		×				foss.?
Gen. *Sylvia*						×	×		×	×	×		rec.gen.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Sylvia ***intermedia***						×							end.
Sylvia ***pusilla***							×						end.
Sylvia *atricapilla*									×				rec.
Sylvia communis									×				rec.
Sylvia borin										×	×		rec.
Sylvia curruca											×		rec.
Sylvia **sp. foss. indet.**						×	×		×				foss.?
Gen. *Locustella*					×	×	×		×				rec.gen.
Locustella ***kordosi***						×							end.
Locustella ***janossyi***							×						end.
Locustella ***magna***							×						end.
Locustella fluviatilis									×				rec.
Locustella **sp. foss. indet.**					×								foss.?
Gen. *Phylloscopus*					×	×	×			×			rec.gen.
Phylloscopus ***miocaenicus***					×								end.
Phylloscopus ***venczeli***						×							end.
Phylloscopus ***pliocaenicus***							×						end.
Phylloscopus sp. indet.										×			rec.?
Gen. *Regulus*							×						rec.gen.
Regulus ***pliocaenicus***							×						end.
Regulus sp. indet.										×		×	rec.?
Sylviidae **g. et sp. foss. indet.**					×								foss.?
Fam. Motacillidae					×	×	×	×	×	×	×	×	rec.fam.
Gen. *Anthus*					×	×	×	×	×	×	×	×	rec.gen.
Anthus ***antecedens***					×								end.
Anthus ***hiri***						×							end.
Anthus ***baranensis***							×						end.
Anthus pratensis											×		rec.
Anthus cervinus										×			rec.
Anthus trivialis									×		×	×	rec.
Anthus spinoletta											×		rec.
Anthus campestris/spinoletta									×				rec.
Anthus **sp. foss. indet.**								×	×				foss.?
Anthus sp. indet.											×		rec.
Gen. *Motacilla*					×	×	×		×	×	×	×	rec.gen.
Motacilla ***intermedia***						×							end.
Motacilla ***minor***							×						end.
Motacilla ***robusta***							×						end.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Motacilla flava									×		×		rec.
Motacilla alba									×		×	×	rec.
Motacilla cinerea									×		×		rec.
Motacilla **sp. foss. indet.**					×	×	×						foss.?
Motacilla sp. indet.										×			rec.?
Fam. Bombycillidae				×	×	×	×		×	×	×		rec.fam.
Gen. *Bombycilla*				×	×	×	×		×	×	×		rec.gen.
Bombycilla ***hamori***				×	×								end.
Bombycilla ***brevia***						×							end.
Bombycilla ***kubinyii***							×						end.
Bombycilla garrulus										×	×		rec.
Bombycilla **sp. foss. indet.**							×		×				foss.?
Fam. Troglodytidae						×					×		rec.fam.
Gen. *Troglodytes*						×					×		rec.gen.
Troglodytes ***robustus***						×							end.
Troglodytes troglodytes											×		rec.
Fam. Cinclidae				×		×	×		×		×	×	rec.fam.
Gen. *Cinclus*				×		×	×		×		×	×	rec.gen.
Cinclus ***major***				×									end.
Cinclus ***medius***						×							end.
Cinclus ***minor***							×						end.
Cinclus cinclus									×		×	×	rec.
Fam. Prunellidae						×	×				×	×	rec.fam.
Gen. *Prunella*						×	×				×	×	rec.gen.
Prunella ***freudenthali***						×							end.
Prunella ***kormosi***							×						end.
Prunella modularis											×		rec.
Prunella collaris												×	rec.
Fam. Laniidae					×	×	×	×	×	×	×	×	rec.fam.
Gen. *Lanius*					×	×	×	×	×	×	×	×	rec.gen.
Lanius ***schreteri***					×								end.
Lanius ***capeki***						×							end.
Lanius ***hungaricus***							×						end.
Lanius ***major***							×						end.
Lanius ***intermedius***							×						end.
Lanius senator											×		rec.
Lanius excubitor									×	×	×	×	rec.
Lanius collurio									×		×		rec.

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Lanius minor									×		×	×	rec.
Lanius **sp. foss. indet.**							×	×					foss.?
Laniidae **g. et sp. foss. indet.**					×								foss.?
Fam. Sturnidae						×	×		×	×	×	×	rec.fam.
Gen. *Sturnus*						×	×		×	×	×	×	rec.gen.
Sturnus ***kretzoii***						×							end.
Sturnus ***brevis***						×							end.
Sturnus ***pliocaenicus***							×						end.
Sturnus ***baranensis***							×						end.
Sturnus vulgaris									×	×	×	×	rec.
Sturnus roseus											×		rec.
Sturnus sp. indet.									×		×		rec.?
Fam. Passeridae						×	×		×	×	×	×	rec.fam.
Gen. *Passer*						×	×		×	×	×	×	rec.gen.
Passer ***hiri***						×							end.
Passer ***minusculus***							×						end.
Passer ***pannonicus***							×						end.
Passer montanus									×	×	×	×	rec.
Passer domesticus											×	×	rec.
Fam. Fringillidae				×	×	×	×	×	×	×	×	×	rec.fam.
Gen. *Serinus*								×			×		rec.gen.
Serinus serinus											×		rec.
Serinus **sp. foss. indet.**								×					foss.?
Gen. Carduelis						×	×		×		×	×	rec.gen.
Carduelis ***kretzoii***						×							end.
Carduelis ***lambrechti***						×							end.
Carduelis ***parvulus***							×						end.
Carduelis ***medius***							×						end.
Carduelis chloris									×		×	×	rec.
Carduelis carduelis									×		×		rec.
Carduelis spinus									×				rec.
Carduelis cannabina									×		×		rec.
Carduelis flammea											×		rec.
Carduelis sp. indet.									×		×		rec.?
Gen. *Pinicola*							×		×	×	×	×	rec.gen.
Pinicola ***kubinyii***							×						end.
Pinicola enucleator									×		×	×	rec.
Pinicola sp. indet.										×			rec.?

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Gen. *Coccothraustes*							×		×	×	×	×	rec.gen.
Coccothraustes ***major***							×						end.
Coccothraustes coccothraustes									×	×	×	×	rec.
Gen. *Pyrrhula*						×	×		×	×	×	×	rec.gen.
Pyrrhula ***gali***						×							end.
Pyrrhula ***minor***							×						end.
Pyrrhula pyrrhula									×	×	×	×	rec.
Pyrrhula **sp. foss. indet.**							×						foss.?
Gen. *Fringilla*				×	×	×	×		×		×	×	rec.gen.
Fringilla ***kormosi***						×							end.
Fringilla ***petenyii***							×						end.
Fringilla montifringilla									×		×	×	rec.
Fringilla coelebs									×		×	×	rec.
Fringilla **sp. foss. indet.**				×	×								foss.?
Gen. *Montifringilla*												×	rec.gen.
Montifringilla nivalis												×	rec.
Gen. *Loxia*							×		×	×	×	×	rec.gen.
Loxia ***csarnotanus***							×						end.
Loxia curvirostra									×	×	×	×	rec.
Loxia sp. indet.											×		rec.?
Fringillidae **g. et sp. foss. indet.**						×	×						foss.?
Fringillidae gen. et sp. indet.											×		rec.?
Fam. Emberizidae				×		×	×		×	×	×	×	rec.fam.
Gen. *Emberiza*				×		×	×		×	×	×	×	rec.gen.
Emberiza ***bartkoi***				×									end.
Emberiza ***pannonica***						×							end.
Emberiza ***media***							×						end.
Emberiza ***parva***							×						end.
Emberiza ***gaspariki***							×						end.
Emberiza cirlus									×				rec.
Emberiza calandra									×		×	×	rec.
Emberiza citrinella									×	×	×	×	rec.
Emberiza schoeniclus											×		rec.
Emberiza sp. indet.									×		×	×	rec.?
Gen. *Plectrophenax*						×							rec.gen.
Plectrophenax ***veterior***						×							end.
Plectrophenax nivalis											×		rec.
Emberizidae gen. et sp. indet										×	×		rec.?

Taxa	Me	Eo	Ol	AM	KM	FM	AP	FP	QA	QK	QF	Ho	character
Passeriformes **foss. indet.**				×	×	×	×	×					foss.?
Passeriformes indet.									×	×	×	×	rec.?
Aves **foss. indet**.			×	×	×	×	×	×					foss.?
Aves indet.									×	×	×	×	rec.?
Ichnotaxa: Gen. ***Charadripedia***			×										end.gen.
Charadriipedia limosa			×										end.
Gen. **Avidactyla**				×									end.gen.
Avidactyla media				×									end.
Gen. ***Ornithotornocia***				×									end.gen.
Ornithotarnocia lambrechti				×									end.
Gen. ***Passeripedia***				×									end.gen.
Passeripedia ipolyensis				×									end.
Gen. **Tetraornithopedia**				×									end.
Tetraornithopedia tasnadii				×									end.
Feather imprints				×	×	×	×			×			foss.
Eggshells				×				×					foss.
Urokoprolits								×					foss.