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The avifauna of the Grund Beds (Middle Miocene, Early Badenian, northern Austria)

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(With 1 textfigure, 2 tables and 1 plate)

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Abstract

The rare bird bone material from the Middle Miocene Grund Beds represents a boobie (*Microsula pygmaea,* Sulidae, Pelecaniformes), a cormorant (*Phalacrocorax intermedius*, Phalacrocoracidae, Pelecaniformes), a pheasant (cf. *Palaeortyx intermedia*, Phasianidae, Galliformes), and a gull (Laridae indet., Charadriiformes). Thus, the avifauna consists predominantly of aquatic taxa, most of them probably marine, and one terrestrial taxon. *Phalacrocorax intermedius* was previously known only from its Early Miocene type locality and is herewith recorded for the first time in the Middle Miocene (MN5).

Key words: Aves, Sulidae, Phalacrocracidae, Phasianidae, Laridae, Grunder Schichten

Zusammenfassung

Das spärliche Vogelknochen Material aus den mittelmiozänen "Grunder Schichten" repräsentiert einen Tölpel (*Microsula pygmaea,* Sulidae, Pelecaniformes), einen Kormoran (*Phalacrocorax intermedius*, Phalacrocoracidae, Pelecaniformes), einen Fasanartigen (cf. *Palaeortyx intermedia*, Phasianidae, Galliformes) und eine Möwe (Laridae indet., Charadriiformes). Die Avifauna besteht also überwiegend aus aquatischen, wohl meist marinen Taxa und nur einer terrestrischen Art. *Phalacrocorax intermedius* war bisher nur aus seiner mittelmiozänen Typuslokatiltät bekannt und kann hiermit erstmals im Mittelmiozän (MN5) nachgewiesen werden.

Introduction

Quantitatively birds are mostly the worst represented class within fossil vertebrates. The Middle Miocene Grund Beds is comprised of only six bird bones, belonging, however, to at least four taxa of three different bird orders. The studied material is housed in the Museum of Natural History in Vienna, Austria. The osteological terminology used here follows BAUMEL et al. (1993) and occasionally BALLMANN (1969a); measurements were taken according to VON DEN DRIESCH (1976). For localisation see textfigure 1.

Abbreviations:

BSAP: Bayerische Staatssammlung für Anthropologie und Paläoanatomie, München
BSP: Bayerische Staatssammlung für Paläontologie und Geologie, München
CMC: carpometacarpus
FSL: Faculté des Sciences de la Terre, Lyon 1
NHMW: Naturhistorisches Museum Wien
NMB: Naturmuseum Basel

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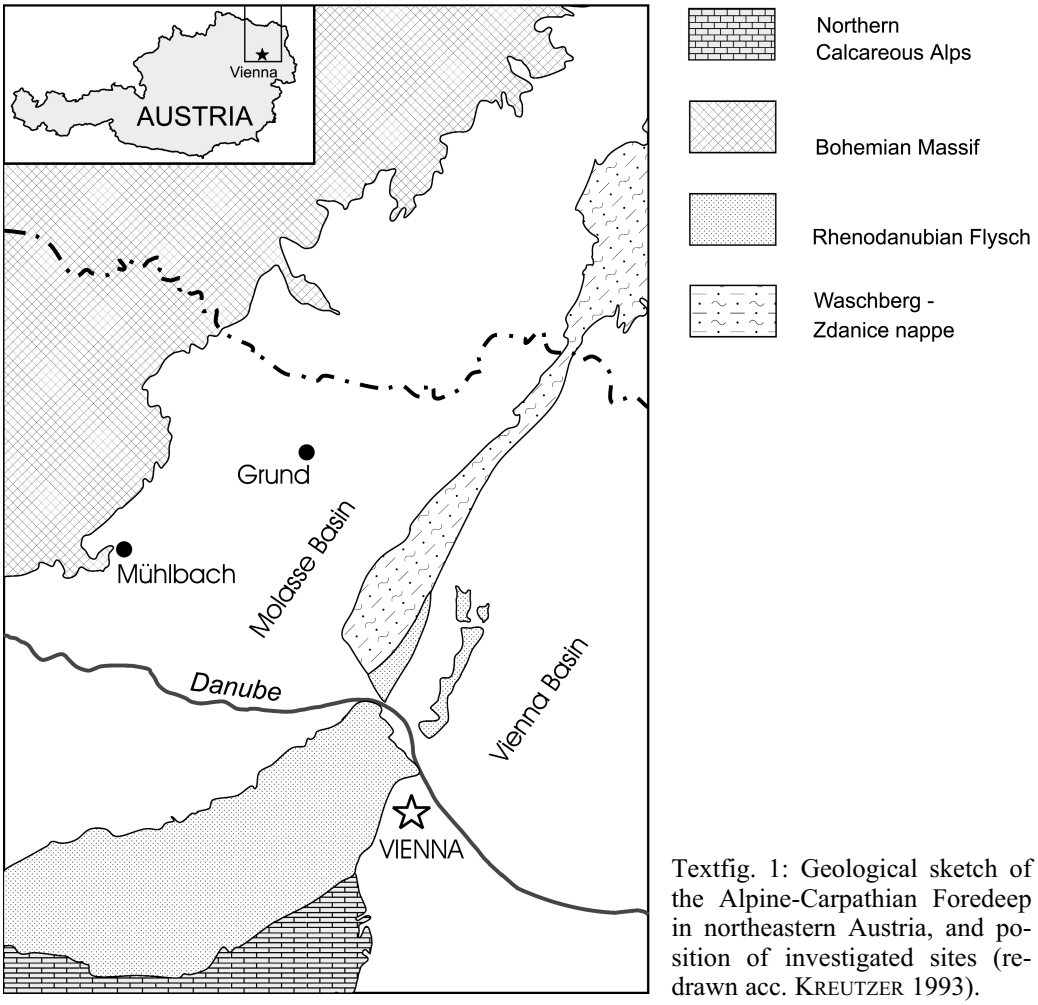

Textfig. 1: Geological sketch of the Alpine-Carpathian Foredeep in northeastern Austria, and position of investigated sites (redrawn acc. KREUTZER 1993).

Systematic Paleontology

Order Pelecaniformes SHARPE, 1891

Family Sulidae REICHENBACH, 1849

***Microsula pygmaea* (MILNE-EDWARDS, 1874)** (Plate 1, fig. 1, 2)

Type locality: Léognan, France, Early Miocene, MN 2-3.

Stratigraphical and geographical distribution: France: Léognan (Early Miocene). – Austria: Grund (Middle Miocene, MN5)

Holotype : Humerus dext. (figured in MILNE-EDWARDS 1874: pl. 2, fig. 2a-e), original in the Muséum d'Histoire Naturelle Bordeaux (No. unknown), casts in FSL No. 0.764 and NMB 0764.

Material: Humerus sin. (GRU-F-11: Inv.-Nr. NHMW 2002z0132/0001), femur dext. (GRU-B1-1: Inv.-Nr. NHMW 2002z0132/0002).

Description: Humerus sin. – Measurements: length: 137,2 mm; proximal width: 18,8 mm; smallest width of corpus: 6,4 mm; distal width: 15,0 mm.

The bone is slender and slightly s-curved in lateral view. The proximal end is strongly bent caudally. The caput humeri is swollen, especially proximocranially; on the caudal side, it is distally bordered by a shallow concavity. The tuberculum ventrale is strongly lengthened in the caudal direction. The fossa pneumotricipitalis extends on the distal side of the tuberculum ventrale and bears some foramina. The tuberculum dorsale is weakly developed. The crista bicipitalis is convex distal to the level of the fossa pneumotricipitalis. The crista deltopectoralis is slightly convex and bears cranially on its distal half a thin impressio m. pectoralis; on the caudal side of the crista deltopectoralis, there is a longish impressio m. latissimus dorsi posterior, which is situated slightly more proximally than the cranial impressio m. pectoralis. There is a strong and long, but thin impressio m. latissimus dorsi anterior dorsocaudally along the proximal third of the shaft.

The sulcus lig. transversus is wide and ends close to the ventral margin of the tuberculum ventrale and forms the distal concave border of the caput humeri. The intumescentia humeri is inflated. The margo caudalis is weakly developed. The shaft is oval to round in cross section. Cranially on the distal end of the humerus, the fossa musculi brachialis is large, wide, and bordered on both sides by sharp crests. The fossa bears distally to the proximal impressio m. brachialis a round deep fossa proximal to the condylus ventralis and a very deep fossa proximal to the condylus dorsalis. The condylus ventralis is round and slightly surpasses the slender condylus dorsalis in the distal direction. The caudal fossa olecrani is very large and deep, whereas the sulcus humerotricipitalis and the sulcus scapulotricipitalis are weakly defined. The processus flexorius is short. The ventral side of the distal end of the humerus is craniocaudally broad and bears the tuberculum supracondylare ventrale close to its cranial margin.

Femur dext.? prox. half. – Measurements: proximal width: 11,5 mm; proximal depth: 9,5 mm; smallest width of corpus: 5,5 mm.

The caput femoris is oriented proximomedially and surpasses the trochanter femoris in the proximal direction. The caput carries a deep fovea ligamenti capitis. The trochanter femoris is not protruding proximally and there is no prominent crista trochanteris. The cranial side of the proximal femur bears a deep pneumatized fossa. Caudally on the proximal end the impressiones obturatoriae are very weak. In lateral view, the femur broadens proximally and wears a hook-like impressio on its proximal end. Along the cranial shaft runs a moderate linea intermuscularis cranialis.

Comparison and discussion: Sulidae are found very rarely in the Tertiary deposits of Europe. Furthermore, the few known fossil taxa are mostly represented by exiguous material, often only in the form of one bone or even one fragment. For most of the European fossil taxa, the humeri are not known; hence, these species are not morphologically comparable. Additionally, a sulid femur has not been previously described from the European Tertiary.

There are only two European species from which the humeri are known. *Microsula pygmaea* (MILNE-EDWARDS, 1874) from the Lower Miocene (MN 2-3) of Léognan, France

and *Sarmatosula dobrogensis* GRIGORESCU & KESSLER, 1977 from the upper Middle Miocene of Credinţa (MN 8), Romania.

The morphology of the Grund humerus corresponds well with the type humerus of *Microsula pygmaea*; the humerus of *Microsula pygmaea* is only slightly shorter whereas the width of the proximal and distal ends are approximately the same (tab. 1). In comparison with the type humerus the dorsal border of the fossa m. brachialis in the Grund specimen is more prominently developed and the fossa above the condylus dorsalis is considerably deeper. Both of these features, however, could possibly be attributed to the fact that the humerus from Grund belonged to a subadult individual. A comparison of humerus lengths for recent *Morus bassanus* (at the BSAP) shows that there is a variation of 4.4% (min. 216.8 mm for females (n= 6) and max. 226.8 mm for males (n= 3)). Taking into consideration that these available specimens of *M. bassanus* are likely insufficient for statistical analysis, the specimens from Léognan and Grund supposedly belong to the same species, although their variation in humerus length is slightly larger (6.7%).

The type humerus and an additional humerus fragment of *Sarmatosula dobrogensis* (figured in GRIGORESCU & KESSLER 1977: pl. I, fig. 1-3 and pl. IV, fig. B) differ by the form of the crista bicipitalis; in *Sarmatosula* it is straight, whereas in *Microsula pygmaea* it is convex. Additionally the margo dorsalis is more obvious (GRIGORESCU & KESSLER 1977: 97 and pl. I, fig. 1-d, fig. 2-d) than in *M. pygmaea* and in *Morus bassanus*. Lastly, the humerus of *S. dobrogensis* is a somewhat larger, while the shaft is somewhat thinner (tab. 1).

An undeterminable fragment of a sulid humerus, described from the Upper Oligocene Thalbergschichten (Subalpine Molasse, southern Germany) by GÖHLICH (1999: fig. 3), is somewhat larger.

Eostega lebedinskyi LAMBRECHT, 1929 (referred to the Sulidae by MLÍKOVSKÝ 2002) from the Middle Eocene (MP 13) of Cluj-Manastur, Romania, is known only by an incomplete lower jaw (figured in LAMBRECHT 1933: fig. 103).

Empheresula arvernensis (MILNE-EDWARDS, 1867) is known by a fragmentary pelvis (lectotype, MNHN 1903-16, figured in MILNE-EDWARDS 1867-71: pl. 43, fig. 12) and a sternum (paralectotype, MNHN 1903-16, figured in MILNE-EDWARDS 1867-71: pl. 42, fig. 13) from the Upper Oligocene (MP 30) of Gannat, France. Later CHENEVAL (1984: 66f) added a coracoid from St.-Gérand-le-Puy (Lower Miocene, MN 2, France). HEIZMANN & HESSE (1995) mentioned *Empheresula* sp. from the Middle Miocene (MN 7) of the Steinheimer Becken (Germany), the material, however, is unpublished.

Additionally, *Mergus ronzoni* GERVAIS, 1848-52 from the Lower Oligocene (MP 21) of Ronzon, France, is represented only by its holotype, a fragmentary pelvis. Beyond that, HARRISON (1975: 52) referred the taxon to the Phalacrocoracidae, whereas MLÍKOVSKÝ (2002) classified it as aves incertae sedis.

Morus olsoni GRIGORESCU & KESSLER, 1988 described from the Middle Miocene of Credinţa and Ciobăniţa (both Romania), is known only by its carpometacarpi, but is described by GRIGORESCU & KESSLER (1988: 95) to be larger than *Sarmatosula dobrogensis*, and is therefore also larger than *Microsula pygmaea*.

The recent Sulidae are devided into gannets (genus *Morus*) and boobies (genus *Sula*).

In comparison with the recent large *Morus bassanus* and the middle sized *Sula leucogaster*, *Microsula pygmaea* differs by its distinctly smaller size. Morphological differences can be found especially on the humerus, but not on the femur. Proximally, the caput humeri is slightly more swollen and more evenly rounded in *M. pygmaea* than in *S. leucogaster* and *M. bassanus*.

In proximal view, the incisura capitis in *M. pygmaea* does not reach to the proximal side of the tuberculum ventrale, whereas in *M. bassanus* and *S. leucogaster* it extends farther ventrally (Plate 1, fig. 1). Also in proximal view, the cranial border of the caput humeri is uniformely convex in *M. pygmaea*, whereas there is a small but deep notch ventrally to the tuberculum dorsale in *M. bassanus*, and a weak one in *S. leucogaster*. In *M. pygmaea* and *S. leucogaster* the crista bicipitalis is convex and protruding and the intumescentia humeri is inflated (in cranial view), whereas these are more straight and flat in *M. bassanus*. Cranially on the distal end, the dorsal border of the fossa m. brachialis is sharp-crested in the Grund specimen, slightly less sharp in *S. leucogaster*, and blunt in *M. bassanus*. The epicondylus ventralis extends more distally (nearly at the same level with the condylus ventralis) in *M. bassanus*, whereas it ends more proximally in *S. leucogaster* and *M. pygmaea*. In ventral view there is a deep and nearly rectangular step between epicondylus ventralis and the processus flexorius in *M. bassanus*, whereas this step is more smooth in *S. leucogaster* and *M. pygmaea.*

In general, the humerus morphology of *M. pygmaea* is closer to *S. leucogaster* than to *M. bassanus*.

Tab. 1: Measurements (mm) of sulid humeri from the European Miocene. Measurements of *S. dobrogensis* from GRIGORESCU & KESSLER (1977: 95)

humerus	greatest length	proximal width	min. width of shaft	distal width
Microsula pygmaea, from Grund	137,2	18,8	6,4	15,0
Microsula pygmaea, type from Léognan	128	19	-	14,8
Sarmatosula dobrogensis, type from Credinţa	(158)	20,7	5,8	-
Sarmatosula dobrogensis, from Credinţa	-	-	-	15,9

Phalacrocoracidae BONAPARTE, 1854

Phalacrocorax intermedius (MILNE-EDWARDS, 1867) (Plate 1, fig. 6)

Type locality: Faluns de l'Orléanais, Early Miocene, MN 4.

Stratigraphical and geographical distribution: France: Faluns de l'Orléanais (Early Miocene, MN4). – Germany: Dechbetten (Bavaria) (Middle Miocene, MN 5, pers. comm. HEISSIG (Munich)). – Czechia: Břešťany (Early Miocene, MN 3). – Austria: Grund (Middle Miocene, MN5).

Holotype: Humerus, proximal end., Musée d'Orléans (following MILNE-EDWARDS 1867-71, vol. 1: 266). Figured in MILNE-EDWARDS 1867-71: pl. 43, fig. 8-11.

Material: CMC sin. (GRU-B1-1: Inv.-Nr. NHMW 2002z0133/0001).

Description: Carpometacarpus sin., fragmentary (GRU-B1-1). – Measurements: proximal width (estimated): (15,5 mm), length of the spatium: 47 mm, estimated length of the bone: approximately 75 mm.

On the proximal end, the trochlea carpalis and the tips of both the processus extensorius and the processus alularis are broken off. The os metacarpale alulare is mediolaterally thin. The processus pisiformis is moderately developed, proximodistally lengthened and situated on a long, vertical, and prominent crest. The depressio muscularis interna (see BALLMANN 1969: 24) is large and deep. The os metacarpale minus is broken off. The distal half of the os metacarpale major is craniocaudally compressed; its entire caudal side is flattened and even slightly concave in its proximal half. The distal articular facies is broken off.

Comparison and discussion: The diagnostic features for cormorants in the present fragmentary CMC from Grund are the deep and large depressio muscularis interna and the well-developed fossa infratrochlearis. In comparison with the recent taxa *Phalacrocorax carbo* and *Ph. aristotelis*, the processus pisiformis in the Grund CMC is somewhat weaker; this could, however, be an effect from the slight general abrasion of the bone or from the immature state of the individual. The shape of the os metacarpale alulare, especially at its proximal margin, is more similar to that of cormorants than to the recent darter, *Anhinga anhinga*. However, the distally compressed shaft of the os metacarpale major is more similar to *Anhinga* than to *Phalacrocorax*. Unfortunately the proximal end of the trochlea carpalis of the Grund CMC is broken off; its cranial margin is dissimilar to *Phalacrocorax* and *Anhinga*. In difference to both *Phalacrocorax* and *Anhinga*, the preserved proximal part of the os metacarpale minus is oriented slightly dorsally. The CMC from Grund is larger than that of *Ph. aristotelis*, but is only slightly smaller than that of *Ph. carbo.*

Phalacrocorax intermedius was created by MILNE-EDWARDS (1867) on a single humerus from the Faluns d'Orleanais, France. Later, different taxa (*Phalacrocorax praecarbo*, *Ardea brunhuberi* and *Botaurites avitus*) were synonymized with *Ph. intermedius*. All these taxa have been described by VON AMMON (1918) from the Middle Miocene of Dechbetten, Germany, (MN 5, pers. comm. HEISSIG, Munich). *Phalacrocorax praecarbo* is known only by a proximal coracoid. The type of *Ardea brunhuberi*, a proximal CMC, was recognized by BRODKORB (1980) to be a cormorant and was named *Phalacrocorax brunhuberi.* He made *Ph. praecarbo* a synonym of *Ph. brunhuberi.* Later, *Botaurites avitus*, represented only by a cervical vertebra, was referred by OLSON (1985: 167) to *Ph. brunhuberi*. Afterwards, the taxon *Phalacrocorax brunhuberi* was synonymized by MLÍKOVSKÝ (1992: 437) with *Ph. intermedius*.

The preserved proximal half of the CMC from Dechbetten, the former type specimen of *Ph. brunhuberi*, morphologically and metrically corresponds well with the specimen from Grund. By means of fig. 4 in VON AMMON (1918), it seems that the processus pisiformis was developed as strongly as in the recent *Phalacrocorax*. Probable explanations for the more weakly developed processus pisiformis in the Grund specimen are described above.

All other species known during the European Miocene and described below, differ from the CMC from Grund by their size.

Nectornis miocaenus (MILNE-EDWARDS, 1867), recorded from the Lower Miocene of France, Germany, and Czech Republic and *Nectornis anatolicus* (MOURER-CHAUVIRÉ, 1978) from the Miocene of Turkey are distinctly smaller (tab. 2).

No carpometacarpus is known of *Phalacrocorax littoralis* (MILNE-EDWARDS, 1963), which was present during the Early Miocene of France (St-Gérand-le-Puy, MN 2). CHENEVAL (1984: 54), however, described this species to be a little smaller than the extant *Ph. aristotelis*, and therefore is distinctly smaller than *Ph. intermedius*.

Phalacrocorax ibericus (VILLALTA, 1963), represented only by a distal humerus from the Upper Miocene (MN 9) of Valles de Fuentiduena, Spain, is described to be smaller than *Ph. littoralis* and *N. miocaenus*.

Furthermore, *Phalacrocorax lautus* KUROCHKIN & GANEA, 1972 from the Upper Miocene (MN ?9) of Golboçica, Moldavia, is supposedly smaller by its types, a proximal femur and distal ulna, and comparable in size to *Ph. littoralis* and *N. miocaenus*.

The specimen of *Phalacrocorax serdicensis* BURCHAK-ABRAMOVICH & NIKOLOV, 1984 from the Late Miocene (MN 11-13) of Hrabarsko, Bulgaria, resembles the recent *Ph. aristotelis* in size.

Phalacrocorax longipes (TUGARINOV, 1940), known from the Late Miocene and the Pliocene of the Ukraine is described in BURCHAK-ABRAMOVICH & NIKOLOV (1984: 24) to be larger than the extant *Ph. carbo*, and is therefore larger than *Ph. intermedius*.

A Late Oligocene cormorant from Enspel, Germany, tentatively assigned to *Oligocorax* by MAYR (2001) is represented by its foot and the distal end of its tibiotarsus, consequently not allowing morphological comparisons. MAYR (2001: 332) described the specimen of similarly sized to *Ph. littoralis*; it is therefore smaller than *Ph. intermedius*.

The only fossil species of Anhinga, *Anhinga pannonica* (LAMBRECHT, 1916) from the Late Miocene of Tataruş-Brusturi, Romania, is known only by its 6th. cervical vertebra and therefore is not comparable.

Tab. 2: Measurements (mm) of the carpometacarpi of Miocene cormorants from Europe and two recent species. Measurements of *N. miocaenus* from CHENEVAL 1984: tab. 5.

CMC	greatest length	proximal width	length of spatium	distal width
Phalacrocorax intermedius from Grund	ca. 75	ca. 15,5	47	-
Phalacrocorax intermedius from Dechbetten, formerly *Ph. brunhuberi*	-	ca. 15	-	-
Nectornis miocaenus from St.-Gérand-le-Puy	41,9-48,4	8,6-10.3	-	5,5-6,4
Nectornis anatolicus from Bes-Konak cast FSL 99.201	ca. 47,5	ca. 11,8		ca. 6,0
Phalacrocorax carbo (n=2)	79,2-82,4	15,0-16,5	48,1-50,2	8,9-10,0
Phalacrocorax aristotelis	55,0	11,3	33,6	6,8

Order Galliformes Temminck, 1820

Family Phasianidae Vigors, 1825

cf. *Palaeortyx intermedia* Ballmann 1969 (Plate 1, fig. 4)

Type locality: Wintershof-West near Eichstätt (Bavaria), Germany, Lower Miocene, MN3.

Stratigraphical and geographical distribution: France: Quercy (late Early Oligocene – Upper Oligocene, Mourer-Chauviré 1992), St.-Gérand-le-Puy (Early Miocene, Mourer-Chauviré 1992), Vieux Collonges (Middle Miocene, Ballmann 1972). – Germany: Wintershof-West (Lower Miocene, MN3; Ballmann 1969b), Sandelzhausen (Middle Miocene, MN5, Göhlich 2002). – Romania: Maluşteni (Pliocene, MN 15, Kessler 1984).

Holotype: Coracoid (BSP 1937II 18103).

Remark: Mlíkovský (2002: 155) synonymized *Palaeortyx intermedia* with *Coturnix longipes*, in which he also includes *Palaeortyx phasianoides*; until definitive results of own current studies on the systematic of European Miocene galliforms the taxon *P. intermedia* is used here further on as valid.

Material and description: Coracoid sin., proximal end (GRU: Inv.-Nr. NHMW2002z0134/0001). – Measurements: smallest width of the shaft: 4 mm (just distally the facies art. humeralis).

The processus acrocoracoideus is broken off. The facies articularis humeralis is lengthened and flatt, the cotyla scapularis is large and also flat. The processus procoracoideus is weak. The shaft is slender, mediolaterally flattened and oval in cross section.

Discussion: Following Ballmann (1969b: 31), the straight caudal end of the tuberculum brachiale of the coracoid (in medial view) is typical for *Palaeortyx*. Unfortunately the tuberculum brachiale is broken off in the present coracoid. But the coracoid corresponds morphologically and metrically very well with the type of *P. intermedia* from Wintershof-West (Ballmann 1969b).

Order Charadriiformes Huxley, 1867

Family Laridae Vigors, 1825

Laridae indet. (Plate 1, fig. 5)

Material and description: Ulna dext., distal half and proximal half of the shaft (GRU-F-11: Inv.-Nr. NHMW 2002z0135/0001).

Ulna, fragmentary. – Measurements: distal diagonal: 8,0 mm; depth of trochlea: 7,0 mm.

The cranial tuberculum carpale is oriented slightly proximally, so that the incisura tuberculi carpalis forms an angle of about 100-110°. The proximal side of the tuberculum carpale is slightly concave. The condylus ventralis ulnae is very strong and is dorsally swollen. In dorsal view, it runs slightly oblique proximocaudally and reaches far proximally; it slightly surpasses the condylus dorsalis in distal direction. The sulcus intercondylaris is deep ventrally and distally. The shaft is craniocaudally compressed. An additional fragment represents a proximal part of a ulna-shaft, with the proximal ulna-end broken off distally to the impressio m. brachialis.

Only a few species of Laridae are known during the Miocene of Europe. All, *Larus elegans* MILNE-EDWARDS, 1867, *Larus totanoides* MILNE-EDWARDS, 1868, *Larus desnoyersii* MILNE-EDWARDS, 1863, have been described from the deposits of St.-Gérand-le-Puy (France, Early Miocene, MN2). In comparison, the ulna of *L. elegans* is distinctly smaller. There is no ulna described of *L. totanoides*; however, this species is larger than *L. elegans*. The systematic affiliation of *L. desnoyersii* to the Laridae is doubted by some authors (OLSON 1985; MLÍKOVSKÝ 2002).

Aves indet.

The poor preservation of an additional, fragmentary carpometacarpus prevents a determination.

Material and description: Carpometacarpus dext., proximal two third, without os metacarpale minus (GRU-F-11: Inv.-Nr. NHMW 2002z0153/0001). – Measurements: proximal width: 12.3 mm.

The proximal half of the cmc is dorsoventrally compressed. The processus pisiformis is broken off. The processus extensorius is dorsoventrally thin and pointed.

Conclusions

The avifauna of Grund contains taxa of different ecological habitats, but is dominated by aquatic, probably mostly marine taxa. Whereas the phasianid is a representative of terrestrial birds, the sulid, the cormorant, and the larid are aquatic birds.

Sulids are sea-birds, which are known nowadays worldwide from pelagic to coastal environments. They nest in colonies in cliffs or in steep coasts either on the ground or in trees. For hunting fishes, cephalopods or crustaceans they swoop down into the sea in nearly vertical nose-dive (PERRINS 1996: 61). The piscivorous cormorants occur today worldwide in marine as well as in freshwater environments. Most of the extant species, which all belong to the genus *Phalacrocorax*, prefer temperate to tropical waters of coasts, lakes, open swamps and slow-flowing rivers. Gulls (Laridae) are in general sea-birds, but also are found in inland waters.

Palaeortyx intermedia was previously known from the late Early Oligocene to the Lower Pliocene in Europe. Also, the presence of *Phalacrocorax intermedius* during the Early to the early Middle Miocene (MN3-MN5) was already substantiated. However, *Microsula pygmaea* from Grund is the first evidence outside the type locality, Léognan (MN2-3), and herewith is confirmed for the first time in the Middle Miocene (MN5).

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References

BALLMANN, P. (1969a): Les oiseaux miocènes de La-Grive-Saint-Alban (Isère). – Geobios, **2**: 157-204. – Lyon.

—— (1969b): Die Vögel aus der altburdigalischen Spaltenfüllung von Wintershof (West) bei Eichstätt in Bayern. – Zitteliana, **1**: 5-60. – Munich.

—— (1972): Les oiseaux Miocènes de Vieux-Collognes (Rhône). – Documents des Laboratoires de Géologie de la Faculté des Sciences de Lyon, **50**: 94-101. – Lyon.

BAUMEL, J.J., A.S. KING, J.E. BREAZILE, H.E. EVANS & J.C. VAN DEN BERGE (1993): Handbook of avian anatomy: Nomina Anatomica Avium. – Publication of the Nuttall Ornithological Club, **23**: 779 pp. – Cambridge, Massachusetts.

BRODKORB, P. (1980): A new fossil heron (Aves: Ardeidae) from the Omo Basin of Ethiopia, with remarks on the position of some other species assigned to the Ardeidae. – Contributions of the National History Museum of Los Angeles County, Contributions scientific, **330**: 87-92. – Los Angeles.

BURCHAK-ABRAMOVICH, N.I. & I. NIKOLOV (1984): Fossil birds *Phalacrocorax serdicensis* sp. n. and *Anser thraceiensis* sp. n. from Bulgaria. – Paleontologiya, Stratigrafiya i Lithologiya, **19**: 23-27. – Sofia [in Russian].

CHENEVAL, J. (1984): Les Oiseaux Aquatiques (Gaviiformes à Ansériformes) du Gisement Aquitanien de Saint-Gérand-le-Puy (Allier, France): Révision Systématique. – Palaeovertebrata, **14**(2): 33-115. – Montpellier.

GÖHLICH, U.B. (1999): Aves. – In: DARGA, R., M. BÖHME, U.B. GÖHLICH & G. RÖSSNER: Reste höherer Wirbeltiere aus dem Alttertiär des Alpenvorlandes bei Siegsdorf/Oberbayern. – Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie, **39**: 91-114. – Munich.

—— (2002): The avifauna of the Miocene Fossil-Lagerstätte Sandelzhausen (Bavaria, Southern Germany). – Zitteliana, **22**: 169-190. – Munich.

GRIGORESCU, D. & E . KESSLER (1977): The Middle Sarmatian Avian Fauna of South Dobrogea. – Revue Roumaine de Géologie, Géophysique et Géographie (Géologie), **21**: 93-108. – Bucuresti.

—— (1988): New Contributions to the knowledge of the Sarmatian birds from South Dobrogea in the frame of the Eastern Paratethyan Avifauna. – Revue Roumaine de Géologie, Géophysique et Géographie (Géologie), **32**: 91-97. – Bucuresti.

HARRISON, C.J.O. (1975): The taxonomic status of MILNE-EDWARDS's Sulids. – Bulletin of the British Ornithological Club, **95** (2): 51-54. – London.

HEIZMANN, E.P.J. & A. HESSE (1995): Die Mittelmiozänen Vogel- und Säugetierfaunen des Nördlinger Ries (MN 6) und des Steinheimer Beckens (MN 7) – ein Vergleich. – In PETERS, D. E. (eds.): Acta palaeornithologica. – Courier Forschungsinstitut Senckenberg, **181**: 171-185. – Frankfurt a. M.

KESSLER, E. (1984): On some bird remains from the Pliocene of Malusteni in the Laboratory of Paleontology, University of Bucharest. – In: 75 years Laboratory of Paleontology, 287-293. – Bucharest.

KREUTZER, N. (1993): Das Neogen des Wiener Beckens. – In: BRIX, F. & SCHULTZ, O. (Eds.): Erdöl und Erdgas in Österreich, 2nd ed. – Veröffentlichungen aus dem Naturhistorischen Museum in Wien, Neue Folge, **19**: 232-248. – Wien.

LAMBRECHT, K. (1933): Handbuch der Palaeornithologie. – 1024 pp. – Berlin (Gbr. Borntraeger).

MAYR, G. (2001): A cormorant from the late Oligocene of Enspel, Germany (Aves, Pelecaniformes, Phalacrocoracidae). – Senckenbergiana lethaea, **81**/2: 329-333. – Frankfurt a. M.

MILNE-EDWARDS, A. (1867-1871): Recherches anatomiques et paléontologiques pour servir à l'histoire des oiseaux fossiles de la France, I+II: 472 pp. + 627 pp. – Paris.

—— (1867-1871): Recherches anatomiques et paléontologiques pour servir à l'histoire des oiseaux fossiles de la France, Atlas I+II: pl. 1-96 + pl. 97-200. – Paris.

—— (1874): Observations sur les oiseaux fossiles des Faluns de Saucats et de la Mollasse de Léognan. – Bibliothéque de l'Ecole des Hautes Études, Section des Sciences Naturelles Paris, **11**(3): 1-12. – Paris.

MLÍKOVSKÝ, J. (1992): The Present State of Knowledge of the Tertiary Birds of Central Europe. – In: CAMPBELL, K. E. [ed.]: Studies in avian paleontology honoring Pierce Brodkorb. – Natural History Museum of Los Angeles County, Sciences Series, **36**: 433-458. – Los Angeles.

—— (2002): Cenozoic birds of the world, part 1: Europe. – 406 pp. – Praha (Ninox Press).

MOURER-CHAUVIRÉ, C. (1992): The Galliformes (Aves) from the Phosphorites du Quercy (France): Systematics and biostratigraphy. – In: CAMPBELL, K. E. (ed.): Papers in Avian Paleontology Honoring Pierce Brodkorb. – Science Series, Natural History Museum of Los Angeles County, **36**: 67-95. – Los Angeles.

OLSON, S. L. (1985): The fossil Record of birds. – In: FARNER, D. S., J. R. KING & K. C. PARKES (eds): Avian Biology, **8**: 79-256. – Orlando.

PERRINS, C. M. (1996): Die große Enzyklopädie der Vögel. – 420 pp. – Munich (Orbis). [Original version (1990): The Illustrated Enzyclopaedia of Birds; London.]

VON AMMON, L. (1918): Tertäre Vogelreste von Regensburg und die jungmiocäne Vogelwelt. – Abhandlungen des naturwissenschaftlichen Vereins zu Regensburg, **12**: 69 pp. – Munich.

VON DEN DRIESCH, A. (1976): Das Vermessen von Tierknochen aus vor- und frühgeschichtlichen Siedlungen. – 114 pp. – Munich (Institut für Paläoanatomie, Domestikationsforschung und Geschichte der Tiermedizin der Universität München).

Plate 1

Figure 1: ***Microsula pygmaea***, humerus sin. a) caudal, b) cranial, c) ventral, d) proximal.

Figure 2: ***Microsula pygmaea***, femur dext. a) cranial, b) lateral, c) caudal.

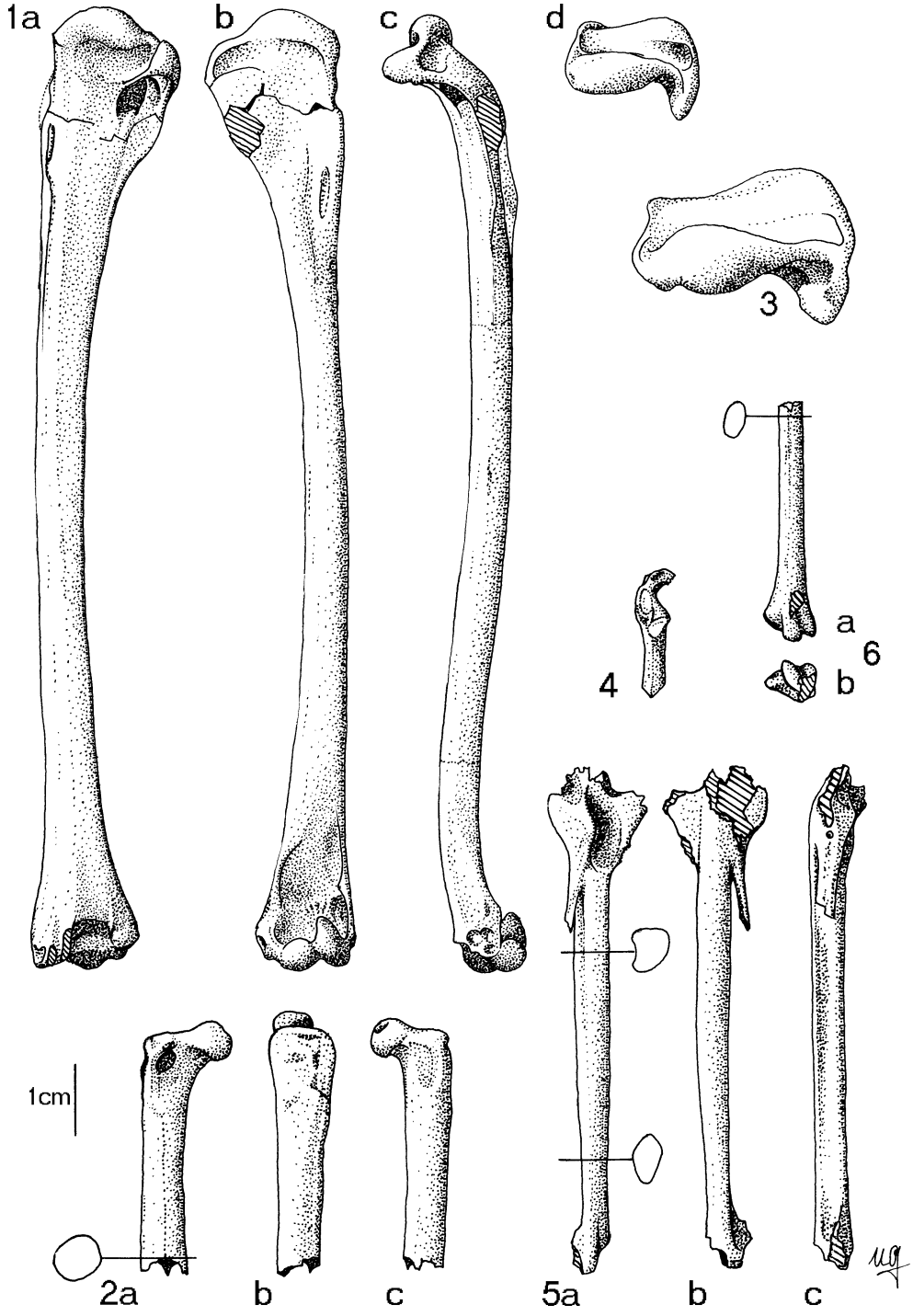
Figure 3: ***Morus bassanus*** (recent) , humerus sin. proximal.

Figure 4: **cf. *Palaeortyx intermedia***, coracoid sin., dorsal.

Figure 5: **Laridae indet.**, ulna dext. a) ventral, b) distal.

Figure 6: ***Phalacrocorax intermedius***, CMC sin., a) ventral, b) dorsal, c) caudal.

all figures in natural size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