

## A new eocene *Chascacocolius*-like mousebird (Aves: Coliiformes) with a remarkable gaping adaptation

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### Abstract

A skull of a new species of mousebird (Aves: Coliiformes) is described from the Middle Eocene of Messel in Germany. *Chascacocolius cacicrostris* n. sp. is the fifth coliiform species described from the Messel deposits, and a further example of the remarkable similarity between the early Eocene avifaunas of North America and Europe. As for its much smaller North American counterpart, *C. oscitans* Houde & Olson, 1992, the new species has greatly elongated retroarticular processes on the mandible, which are an adaptation to gaping, i.e. opening of the bill in a substrate. The cranium and upper beak of *Chascacocolius* are seen for the first time in the new specimen; the latter shows a striking resemblance to the upper beak of some modern New World Blackbirds (Passeriformes: Icteridae). *C. cacicrostris* n. sp. thus provides another example of the diversification of early Tertiary Coliiformes, some taxa of which apparently occupied feeding niches that today are filled by songbirds (Passeriformes).

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### Introduction

In the past decades, the Middle Eocene (about 47 million years ago) fossil site Messel near Darmstadt in Germany has yielded several hundred skeletons of more than 40 bird species, that were buried in a deep crater lake surrounded by tropical or subtropical forests (Schaal and Ziegler 1988; Mayr 2000a; Mertz et al. 2004).

Among the most abundant and diversified small birds in Messel are mousebirds (Coliiformes) (Mayr and Peters 1998; Mayr 2001; Mayr and Mourer-Chauviré 2004). The modern representatives of this taxon are six very similar species that occur in Africa, south of the

Sahara and are classified in the family Coliidae (de Juana 2001). Mousebirds were, however, much more diverse in the early Tertiary; their fossil record has been reviewed by Mayr (2001). Although stem group representatives of the Coliidae were identified in Messel (Mayr and Peters, 1998), most Eocene mousebirds belong to an extinct taxon, the Sandcoleidae, that was originally described by Houde and Olson (1992) from the early Eocene of North America.

Modern mousebirds are herbivorous birds and feed predominantly on fruits. However, comparatively little is known on the feeding habits of their early Tertiary relatives. Judging from the bill shape, most Eocene species appear to have been relatively generalized feeders, although in some Messel sandcoleids seeds are preserved as stomach contents (Houde and Olson 1992; Mayr and Peters 1998).

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The Forschungsinstitut Senckenberg recently acquired a well-preserved skull of a medium-sized bird from the Messel deposits, that exhibits an unusual feeding adaptation. This skull is highly distinctive in its possession of greatly enlarged retroarticular processes on the mandible, and in the shape of its straight, conical beak (Fig. 1). Among the known Eocene birds, such processes occur only in the sandcoleid *Chascacocolius oscitans* Houde & Olson, 1992, of which; however, only the lower jaw and postcranial bones are known (Houde and Olson 1992).

It would have been difficult to assign this isolated skull to a higher avian taxon convincingly, if a complete and well-preserved skeleton of the same species – easily identifiable by its unique skull features – had not been figured by Behnke et al. (1986) (p. 108, 109; reproduced as Fig. 2 here), even though the latter authors erroneously identified it as a songbird (Passeriformes). This specimen exhibits the unmistakable morphology of mousebirds (see Discussion below). Unfortunately, the whereabouts of this complete skeleton are unknown; probably it is in private hands. Therefore, the following description is based on the isolated skull in Forschungsinstitut Senckenberg exclusively.

## Material and methods

The fossil specimen is deposited in the collection of Forschungsinstitut Senckenberg, Frankfurt am Main, Germany (SMF). Osteological terminology follows

Baumel and Witmer (1993); measurement results are given in millimeters.

As noted above, the description and diagnosis of the new species exclusively refer to the SMF specimen. Additional information from the complete skeleton in Behnke et al. (1986) is only used to support assignment of the new species to the Coliiformes. Although the whereabouts of this complete specimen are unknown, I consider it justified to use the information from the published figures for systematic assignment of the new species.

## Taxonomy

Aves Linnaeus, 1758

Coliiformes Murie, 1872

?Sandcoleidae Houde & Olson, 1992

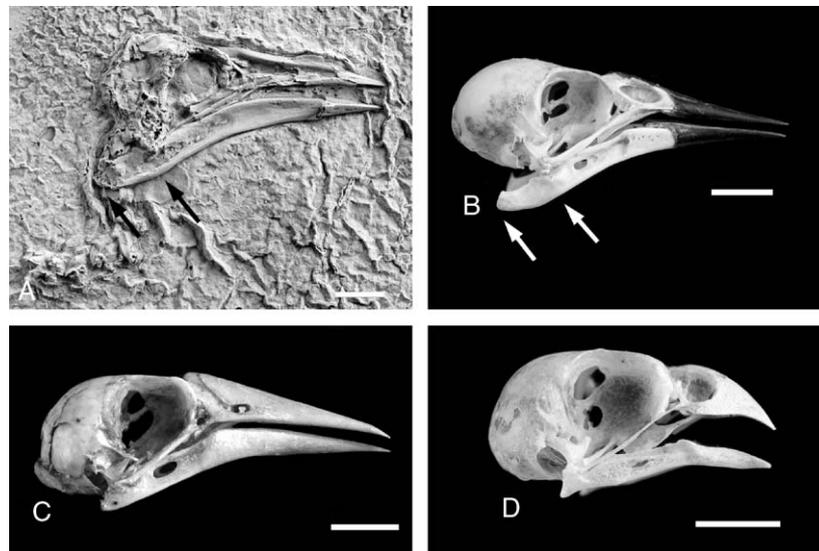
*Chascacocolius* Houde & Olson, 1992

### *Chascacocolius cacicrostris* n. sp. Figs. 1–3

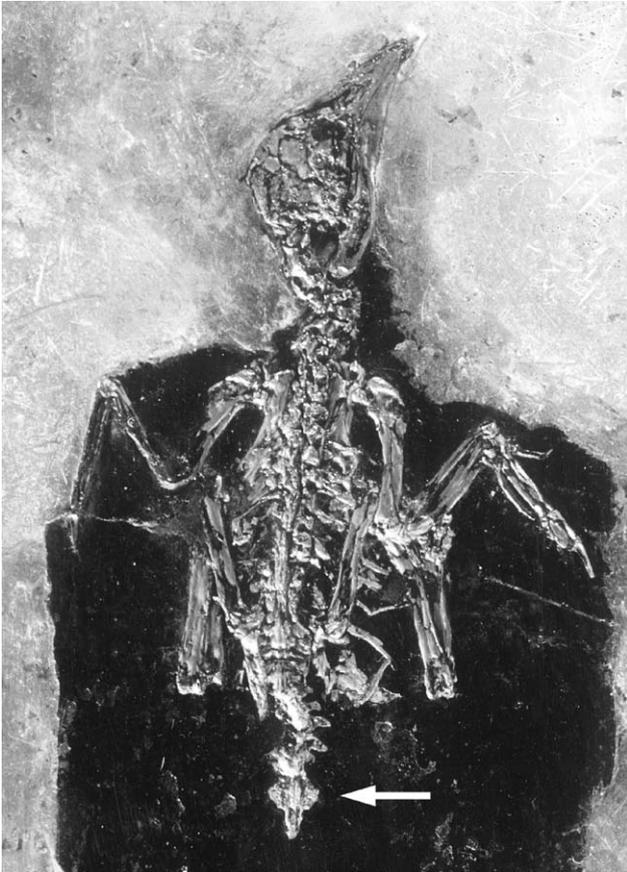
*Holotype*. SMF-ME 3790 (skull and vertebral column on a slab; Fig. 1).

*Type locality and horizon*. Messel near Darmstadt, Germany; lower Middle Eocene (Legendre and Lévêque 1997).

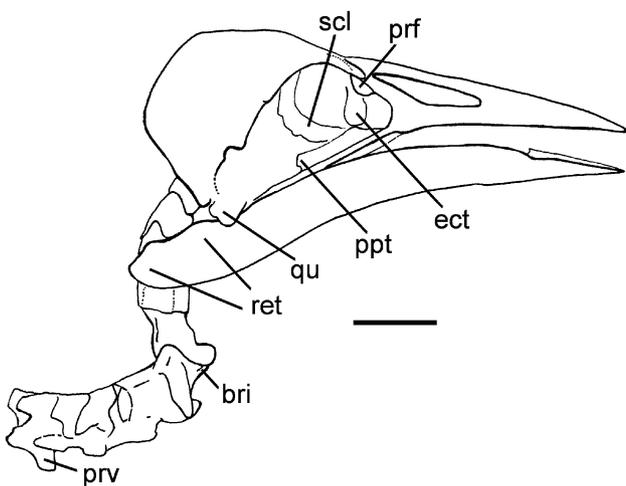
*Etymology*. The species epithet is derived from *Cacicus*, the name of an extant genus of Icteridae with a bill shape similar to that in the fossil species, and the Latin rostrum = beak.



**Fig. 1.** Skull of *Chascacocolius cacicrostris* n. sp. in comparison to several extant birds. (A) *Chascacocolius cacicrostris* n. sp., holotype (SMF-ME 3790); (B) Scarlet-headed Blackbird, *Amblyramphus holosericeus* (Passeriformes, Icteridae); (C) Subtropical Cacique, *Cacicus uropygialis* (Passeriformes, Icteridae); and (D) Blue-naped Mousebird, *Urocolius macrourus* (Coliiformes, Coliidae). Arrows indicate the processus retroarticularis. The fossil specimen is coated with ammonium chloride to enhance contrast. Scale bars equal 10 mm.



**Fig. 2.** *Chascacocolius cacicrostris* n. sp.; complete, articulated skeleton of unknown whereabouts (from Behnke et al., 1986, by permission of C. Behnke). Arrow indicates the greatly enlarged pygostyle.



**Fig. 3.** Interpretive drawing of holotype of *Chascacocolius cacicrostris* n. sp. (SMF-ME 3790). Abbreviations: bri = osseous bridge (see text), ect = os ectethmoidale, ppt = processus pterygoideus of os palatinum, prf = os praefrontale, prv = processus ventralis, qu = quadratum, ret = processus retroarticularis, scl = sclerotic ring. Scale bar equals 10 mm.

**Differential diagnosis.** Coliiform bird that is distinguished from all other early Tertiary avian taxa, except for the early Eocene coliiform *C. oscitans* Houde & Olson, by the greatly elongated processus retroarticularis and the shape of the straight and pointed, conical beak. The new species is distinguished from *C. oscitans* – the holotype of which is an adult individual – by its much larger size (length of mandible 60.0 mm versus 35.6 mm in *C. oscitans*; see Houde and Olson 1992).

**Measurements.** Length of skull, 57.2; length of upper beak (from naso-frontal hinge to tip), 34.4; length of mandible, 60.0; length of processus retroarticularis, 10.4.

**Comparative description.** The conical bill is fairly long and pointed, with a straight culmen and straight tomia, and distinctly differs from the short beak of extant mousebirds (Fig. 3). The nostrils are holorhinal and measure about one-third of the bill length. There appears to have been an ossified nasal septum (Fig. 1), as in modern mousebirds but unlike the early Eocene coliiform *Sandcoleus* (see Houde and Olson 1992).

The small os praefrontale (Fig. 3) is not fused to the os frontale, and the os ectethmoidale is enlarged and plate-like, as in modern Coliiformes (Fig. 3). The processus postorbitalis and processus zygomaticus are very small. The processus pterygoideus of the palatinum is visible above the midsection of the jugal bar. Although the sclerotic ring is preserved (Fig. 3), the number of its plates cannot be counted; likewise, details of the quadrate cannot be discerned.

The mandible resembles that of *C. oscitans*. The rami mandibulae are dorsoventrally deep; a fenestra mandibulae is absent. As in *C. oscitans*, the pars symphysialis measures about one-fifth of the entire length of the mandible. Also as in *C. oscitans*, the greatly elongated, blade-like processus retroarticularis measure about one-sixth of the entire length of the bone (Figs. 1 and 3), protruding even farther caudally than the cranium (the mandible is preserved in its original position and not shifted posteriorly, as shown by the position of its tip, opposite the tip of the praemaxilla).

About 11–12 praesacral vertebrae are preserved in the specimen (the exact number cannot be counted, as part of the vertebral column is hidden by the retroarticular process). At least what are presumed to be the sixth and seventh cervical vertebrae bear an osseous bridge (Fig. 3), from the processus costalis to the midsection of the corpus vertebrae, a feature that is also found in sandcoleids and modern Coliiformes (Houde and Olson 1992). The caudalmost cervical vertebra bears a large processus ventralis (Fig. 3).

**Taxonomic remarks.** The new species is tentatively assigned to *Chascacocolius* Houde & Olson, which is the only other Eocene bird known to have greatly elongated processus retroarticularis. As far as it can be discerned from the published photographs (Behnke et al., 1986;

present Fig. 2), the osteology of the complete skeleton of *C. cacicrostris* n. sp. is in agreement with this classification. However, the assignment is tentative because, as noted above, no detailed comparison of the postcranial skeleton was possible.

## Discussion

Characteristic diagnostic characters that support an assignment of *C. cacicrostris* n. sp. to the Coliiformes, and that are clearly visible in the complete skeleton (Behnke et al. 1986), include a robust humerus with a wide proximal end, a short ulna which is as long as the humerus, a carpometacarpus with a strongly bowed os metacarpale minus, and a greatly enlarged discus pygostyli (Fig. 3).

The new species is the fifth coliform species to be described from the Messel deposits (Mayr and Peters 1998; Mayr 2000b, 2001). As it is considered to be closely related to *C. oscitans* Houde & Olson from the early Eocene of Wyoming (USA), it constitutes a further example of the remarkable similarity between the early Eocene avifaunas of North America and Europe (see also Mayr et al., 2004).

The cranium and upper beak of *C. oscitans* are unknown, whereas in the new species the skull and beak of this highly specialized Eocene mousebird are preserved for the first time, providing further insight into feeding specializations in *Chascacocolius*.

In birds, the mandibular retroarticular process serves as the attachment site of the musculus depressor mandibulae, that depresses the mandible and pronates the upper beak (e.g., Beecher 1951; Zusi 1967). Elongation of the retroarticular process increases the lever arm of this muscle and thus enables a more powerful opening of the beak. All modern landbirds in which the mandible bears markedly elongated processus retroarticulares thus are adapted for gaping, i.e. the opening of the beak within a substrate. Well-known examples include upupiform birds (hoopoes and wood-hoopoes), some starlings (Passeriformes, Sturnidae), and New World Blackbirds (Passeriformes, Icteridae). However, among the representatives of these taxa in the collection of SMF (see Appendix A below), only the Scarlet-headed Blackbird, *Amblyramphus holosericeus* (Icteridae), has processus retroarticulares of a length comparable to that in *C. cacicrostris* n. sp. (Fig. 1), the processus in all other taxa being considerably shorter.

Bill shape in *C. cacicrostris* most closely resembles that of caciques (*Cacicus* spp., Icteridae), which feed on large invertebrates and fruits (Jaramillo and Burke 1999) and “pry in crevices and under bark with the bill partly opened” (Beecher 1951: p. 426), or, when feeding on fruits, behave in a manner similar to that of New

World Orioles (*Icterus* spp., Icteridae), that thrust “the closed bill into the fruit, after which it is opened forcefully against the resistance of the pulp and skin” (Beecher 1951: p. 424; see also p. 425).

*C. cacicrostris* provides further evidence that coliform birds were more diversified both ecologically and morphologically in the early Tertiary than they are today, and that some taxa occupied feeding niches now filled by songbirds (Passeriformes) (see also Houde and Olson 1992; Mayr and Peters 1998; Mayr 2001). Although songbirds constitute more than half of all extant avian species, they are absent from Eocene deposits of the Northern Hemisphere, and the earliest fossil record from this region is from the early Oligocene of Germany (Mayr and Manegold, 2004).

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## Appendix A

Examined species of Upupidae, Phoeniculidae, Icteridae, and Sturnidae (all specimens in the collection of SMF): Upupidae: *Upupa epops*; Phoeniculidae: *Phoeniculus aterrimus*, *P. purpureus*; Icteridae: *Agelaius phoeniceus*, *Amblyramphus holosericeus*, *Cacicus uropygialis*, *Icterus graceanae*, *Molothrus ater*, *Psarocolius decumanus*, *Sturnella bellicosa*, *S. militaris*, *S. neglecta*; Sturnidae: *Ampeliceps coronatus*, *Aplonis metallica*, *A. panayensis*, *Buphagus erythrorhynchus*, *Cosmopsarus regius*, *Gracula religiosa*, *Lamprotornis caudatus*, *L. chalybaeus*, *L. chloropterus*, *L. purpureus*, *L. superbus*, *Leucopsar rothschildi*, *Mino anais*, *M. dumontii*, *Onychognathus albirostris*, *Scissirostrum dubium*, *Spreo superbus*, *Sturnus contra*, *S. malabaricus*, *S. pagodarum*, *S. sinensis*, *S. unicolor*, *S. vulgaris*.

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