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## Taxonomic identity of *Eostega lebedinskyi* LAMBRECHT, 1929 (Aves) from the middle Eocene of Romania

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(With 4 text-figures)

### Summary

*Eostega lebedinskyi* LAMBRECHT, 1929 from the middle Eocene of Cluj-Manastur in Romania was identified as a member of the modern family Sulidae. It is the second oldest representative of the Sulidae known so far.

### Zusammenfassung

*Eostega lebedinskyi* LAMBRECHT, 1929 aus dem Mitteleozän von Cluj-Manastur in Rumänien wurde als Mitglied der rezenten Familie Sulidae erkannt. Es ist der zweitälteste Vertreter der Familie, der bis jetzt beschrieben wurde.

### Introduction

*Eostega lebedinskyi* LAMBRECHT, 1929 is one of the very few avian taxa described from the Paleogene of Eastern Europe (MLÍKOVSKÝ 1996, 2002; MAYR 2005). The bird was described by LAMBRECHT (1929) on the basis of an incomplete mandible found in the limestone quarry at Koloszmanostor near Koloszvár in southeastern Austria-Hungary (now Manastur in Cluj in northern Romania) prior to 1891. In 1890, the specimen was presented by János NÁGY to the Society of Transylvanian Museum (Erdélyi Múzeum Egyesület) according to an old label written in Hungarian and attached to the specimen. At a later date, the specimen was forwarded by Anton KOCH to the Naturhistorisches Hofmuseum (now Naturhistorisches Museum) in Wien, Austria (LAMBRECHT 1929: 1269), where it is still deposited, bearing inventory number 1930/0001/0013.

The specimen was originally thought to be the bill of a turtle according to the Hungarian label, but LAMBRECHT (1929) correctly recognized its avian affinities and described on its basis *Eostega lebedinskyi*. He stated that *Eostega* is a "steganopode" (= pelecani-form sensu WETMORE 1930, 1960) bird, but did not include it in a family, concluding only that it is intermediate between *Phalacrocorax* (i.e. Phalacrocoracidae) and *Sula* (i.e. Sulidae). Later, LAMBRECHT (1933) included *Eostega* in his new family Eopterygidae, based on *Elopteryx* ANDREWS, 1913 from the late Cretaceous of Romania. However, the

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latter genus is probably non-avian (OLSON 1985: 93). BRODKORB (1963) continued to list *Eostega* in the Eloptrygidae. OLSON (1985: 193) correctly stated that *Eostega* "is quite probably peleciform, but needs comparison with other Eocene Peleciformes such as *Prophaethon*, *Limnofregata*, and *Protoplotus*, before its familial allocation can be determined."

I reexamined the holotypical mandible of *Eostega lebedinskyi* LAMBRECHT, 1929 with results presented below.

### Systematic paleontology

Order Ardeiformes WAGLER, 1831

Family Sulidae REICHENBACH, 1849

Genus *Eostega* LAMBRECHT, 1929

*Eostega* LAMBRECHT, 1929: 1272 [Type (by monotypy and n.g. n.sp. convention): *Eostega lebedinskyi* LAMBRECHT, 1929.]

*Masillastega* MAYR, 2002: 508 [Type (by original designation): *Masillastega rectirostris* MAYR, 2002.]

**Included species:** *Eostega lebedinskyi* LAMBRECHT, 1929, and *Eostega rectirostris* (MAYR, 2002), new combination.

**Diagnosis** (LAMBRECHT 1929): Extensive description and comparisons, but no diagnosis given.

**Diagnosis** (LAMBRECHT 1933: 289): "Mandible with double proc. coronoideus as in *Phalacrocorax* and *Sula*, but less pneumatized" (my translation).

**Diagnosis** (here emended): Typical sulid with a strong, straight mandible, having a single fenestra, which differs from mandibles of modern sulid genera in having: (1) processus coronoideus located above internal fenestra mandibularis, (2) medial fossa aditus canalis neurovascularis sharply bordered and narrow, (3) cotyla medialis of the fossa articularis quadratica long and slender, (4) cotyla caudalis of the same fossa narrow and clearly bordered posteriorly, and (5) dorsal margin of the intermediate part of ramus mandibulae rather narrow, with medial ridge lower than lateral ridge.

**Distribution:** Middle Eocene (Lutetian) of Cluj-Manastur, Romania, and Messel, Germany.

### *Eostega lebedinskyi* LAMBRECHT, 1929

*Eostega lebedinskyi* LAMBRECHT, 1929: 1272 (Figured by LAMBRECHT 1929, fig. 12-13, and LAMBRECHT 1933, fig. 103).

**Holotype:** Partial mandible in slab, lacking symphyseal part of mandibular ramus; Naturhistorisches Museum Wien, 1930/0001/0013.

**Age and locality:** Cluj-Manastur, Cluj Province, Romania; 46.47 N, 23.36 E. Middle Eocene, Lutetian, MP 13 (see LAMBRECHT 1929, BOMBIȚA 1963, VLAICU-TĂTĂRIM 1963, KESSLER 1996).

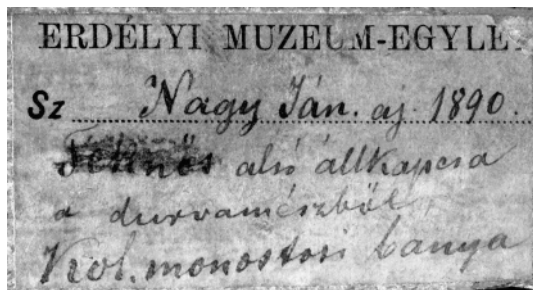


Fig. 1: Original label attached to the specimen.

**F a m i l i a l a f f i l i a t i o n :** Robust mandible with a broad and posteriorly flattened caudal part of rami clearly indicates that *Eostega lebedinskyi* belongs to the Pelecaniformes (sensu WETMORE 1930, 1960). Within this order, the holotypical mandible of *Eostega lebedinskyi* differs from the same element of the Pelecanidae in having: (1) caudal joint laterally not narrowed, (2) posterior facet of the caudal joint not deeply excavated, and (3) fossa aditus canalis mandibulae not restricted, and (4) in being not swollen. It differs from the same element of the Fregatidae in having: (1) Rami not flattened latero-medially, (2) posterior facet of the caudal joint not declined laterally, (3) caudal joint more broad in dorsal view, and (4) processus coronoideus more broad. It differs from the same element of the Phaethontidae in having: (1) processus coronoideus present, (2) caudal joint broad in dorsal view, and (3) caudal joint oval, not rounded. It differs from the same element of the Phalacrocoracidae and Anhingidae in having: (1) rami dorso-ventrally broad, (2) fossa auditus canalis neurovascularis mandibulae more restricted, (3) caudal joint broad, and (4) caudal joint not separated from the intermedial part of rami by a neck. It differs from the same element of the fossil Pelagornithidae (sensu lato) in having no bony teeth (cf. HARRISON & WALKER 1976b). It differs from the same element of the ancestral phaethon *Prophaethon shrubsolei* ANDREWS, 1899 from the early Eocene of England, currently separated at the familial level as Prophaethontidae (HARRISON & WALKER 1976a, 1977), in having: (1) caudal joint dorso-ventrally broad, and (2) rami heavily build. It differs from the same element of the ancestral frigatebird *Limnofregata azygosternon* OLSON, 1977 in having: (1) rami more robust, and (2) caudal joint dorso-ventrally broad. Mandibles of the fossil Plotopteridae are unknown, but this highly specialized family is known only from the Oligocene and early Miocene of the northern part of the Atlantic Ocean, incl. California, Washinton and Japan (HOWARD 1969; OLSON 1979, 1980; OLSON & HASEGAWA 1979, 1985, 1996; GOEDERT 1988; GOEDERT & CORNISH 2002). Its occurrence in the middle Eocene Paratethys Sea is thus less probable.

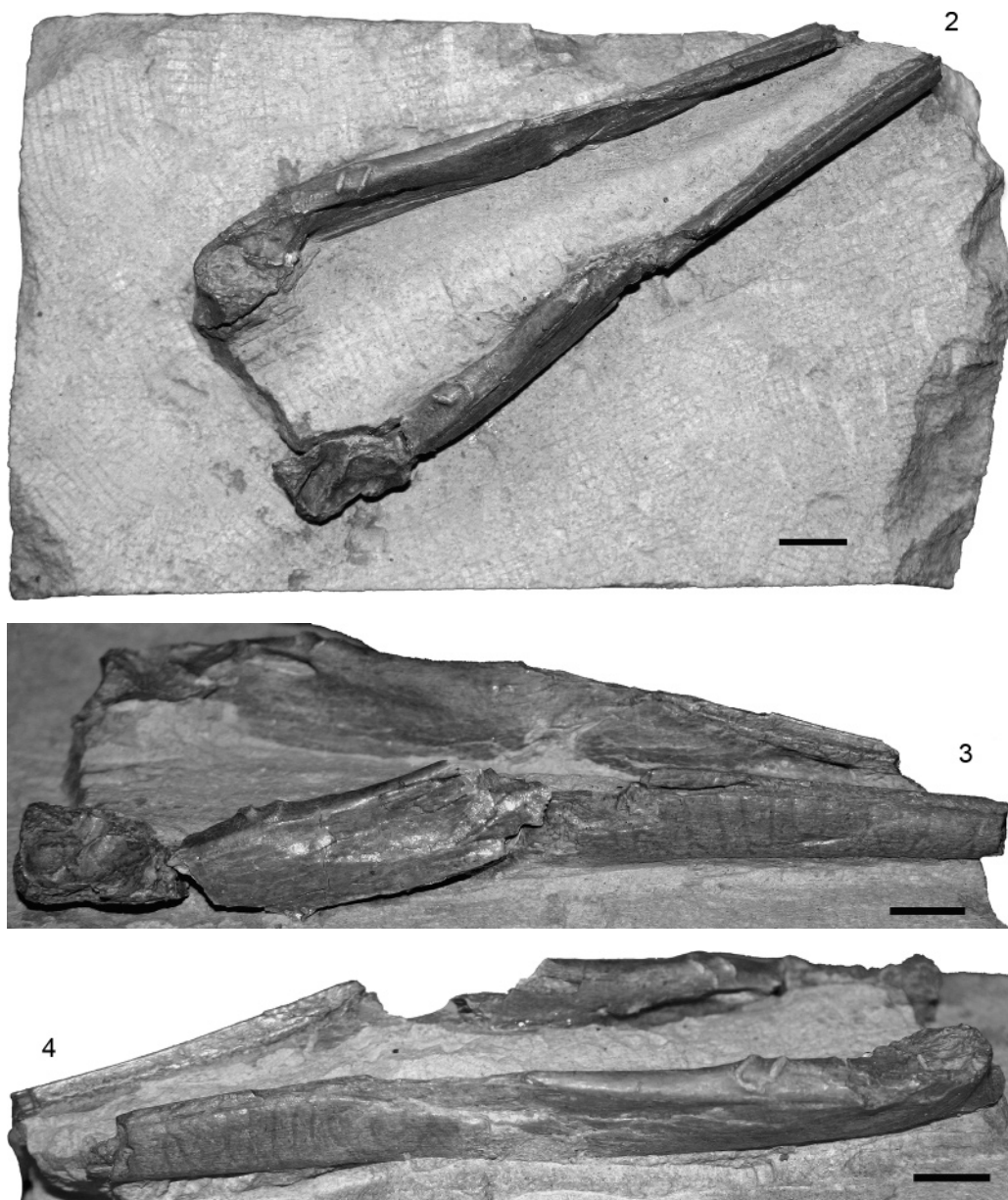
On the other hand, the holotypical mandible of *Eostega lebedinskyi* agrees with the same element of the Sulidae in having: (1) rami robust, but not swollen, (2) posterior facet of the caudal joint almost flat, (3) caudal joint not narrowed laterally, (4) processus coronoideus well developed, and (5) caudal joint broad, but not rounded. Although it is difficult to identify isolated bones of early Tertiary birds (cf. OLSON 1985), it is possible to conclude, that *Eostega lebedinskyi* belongs in the family Sulidae.

**Generic affiliation** (Tab. 1): The family Sulidae consists of three modern and several Neogene genera. The modern genera include *Sula* BRISSON, 1760, *Morus* VIEILLOT, 1816, and *Papasula* OLSON & WARHEIT, 1988 (see OLSON & WARHEIT 1988, VAN TETS et al. 1988). Below, I present a more detailed description of the holotypical mandible of *Eostega lebedinskyi* and add in parentheses, whether the given condition is similar (+) to that found in the modern genera, or differs (x) from it: (1) processus coronoideus is narrow and distinctly bordered (x *Sula*, *Papasula*, + *Morus*, where it is somewhat longer, and posteriorly less well bordered), (2) processus coronoideus is located above the anterior end of medial fossa aditus canalis (x *Sula* and *Morus*, where it is located more posteriorly, x *Papasula*, where it is located more anteriorly), (3) fossa aditus canalis is well defined (x *Sula*, + *Morus* and *Papasula*), (4) fossa aditus canalis narrow (+ *Sula*, x *Morus*, where it is large and broad, x *Papasula*, where it is very narrow and very short), (5) cotyla medialis long and slender (x *Sula*, *Morus* and *Papasula*, where it is short and rounded), (6) cotyla caudalis narrow (x *Sula*, *Morus* and *Papasula*, where it is broader), (7) cotyla caudalis posteriorly clearly bordered (x *Sula*, *Morus* and *Papasula*, where the posterior border is less distinct), (8) posterior facet of the caudal joint positioned in the axis of ramus (+ *Papasula*, x *Sula* and *Morus*, where it is bend medially), (9) intermediate part of ramus not swollen (+ *Sula* and *Morus*, x *Papasula*, where this part of ramus is swollen), (10) dorsal border of rami narrow (x *Sula*, *Morus* and *Papasula*, where it is broader), (11) medial ridge of the dorsal border of rami lower than lateral ridge (x *Sula*, *Morus* and *Papasula*, where this condition applies only to the posterior end of the rami, while medial and lateral ridges are equally high elsewhere). These characters clearly indicate, that *Eostega* is different from all modern genera of sulids.

Tab. 1. Measurements of the bills of *Eostega lebedinskyi* and Recent sulids [in mm]. A – length from the posterior end of the bill to the anterior end of coronoid facet. B – length from the posterior end of the bill to the anterior end of os angulare (measured on the medial side of the bone). C – maximum transversal width of the joint.

	n	A	B	C
<i>Eostega lebedinskyi</i>	1	ca. 33.5	74	15+
<i>Papasula abboti</i>	1	29.5	50	15.0
<i>Sula leucogaster</i>	3	21.5–23.0	29–30	11.2–12.0
<i>Sula nebouxii</i>	3	28.0–30.0	48–50	13.5–13.9
<i>Sula variegata</i>	1	28.0	43	13.8
<i>Sula dactylatra</i>	3	29.5–31.0	53–54	14.6–14.8
<i>Sula sula</i>	3	22.0–23.5	39–40	11.3–11.8
<i>Morus bassanus</i>	3	34.0–35.0	64–65	16.9–17.1
<i>Morus capensis</i>	3	30.5–31.5	55–56	14.8–15.0
<i>Morus serrator</i>	3	30.0–32.0	52–56	14.6–14.8

The Sulidae have a rich Neogene record (BRODKORB 1963, HARRISON 1978, OLSON 1985, MLÍKOVSKÝ 2002), but only few Paleogene fossils have been assigned to the Sulidae so far.



Figs. 2–4: Holotype of *Eostega lebedinskyi* LAMBRECHT. (2) General view, (3) detail of left ramus and (4) detail of right ramus (NHMW 1930/0001/0013).

*Masillastega rectirostris* MAYR, 2002 was described on the basis of a skull from the middle Eocene (MP 11) of Messel, Germany (MAYR 2002). The mandible of this species is very similar to that of *Eostega*. MAYR (2002) claimed that mandibular rami are convex in *Eostega*, while they are straight in *Masillastega*. In fact, mandibular rami are



straight in both these forms. Indeed, the only difference MAYR (2002) did find was in the size of the two mandibles, maximum length being about 152 mm in *Eostega* (estimated, because the tip of the mandible is absent – LAMBRECHT 1929) and 135 mm in *Masillastega*. Such a slight difference in size alone is certainly no reason for separating genera. Hence, I synonymize here *Masillastega* MAYR, 2002 with *Eostega* LAMBRECHT, 1929. Until more data on Paleogene sulids of Europe are available I retain *rectirostris* as a separate species, transferring it to the genus *Eostega* LAMBRECHT, 1929 as *Eostega rectirostris* (MAYR, 2002), new combination.

*Mergus ronzonei* GERVAIS, 1848-1852 from the early Oligocene (MP 21) of Ronzon, France, was transferred to the genus *Sula* BRISSON, 1760 by MILNE-EDWARDS (1867: 271). HARRISON (1975a) suggested that the species belongs in the Phalacrocoracidae. I restudied the holotype of this species – an imperfect pelvis in a slab –, concluding that it is indeterminate at the genus and perhaps even at the family level and relegating it to the Aves incertae sedis (MLÍKOVSKÝ 2002: 260; see also CHENEVAL 1984, OLSON 1985).

*Sula arvernensis* MILNE-EDWARDS, 1867 was described on the basis of an incomplete pelvis in a slab and an incomplete sternum in a slab, both of which originated from the late Oligocene (MP 30) of Gannat, France. HARRISON (1975a,b) separated *arvernensis* at the genus level as *Empheresula* HARRISON, 1975b. The taxonomic position of *Empheresula arvernensis* within the Sulidae is uncertain. A comparison with *Eostega lebedinskyi* is impossible because of the lack of similar elements. However, even if these two forms would be found congeneric in future, the genus name *Eostega* LAMBRECHT, 1929 would have priority of *Empheresula* HARRISON, 1975b.

Neogene genera of sulids include *Microsula* WETMORE, 1938 (Maryland), *Palaeosula* HOWARD, 1958 (California), *Miosula* MILLER, 1925 (California), *Enkurosula* KAŠIN, 1977 (France, incl. *Pseudosula* HARRISON, 1975a, which is preoccupied), and *Sarmatosula* GRIGORESCU & KESSLER, 1977 (Romania). Of them, *Microsula* WETMORE, 1938 was synonymized with the modern *Morus* VIEILLOT, 1816 (OLSON & RASMUSSEN 2001). Mandibles were not described for any of these genera, so that direct comparison with *Eostega* is impossible. Moreover, these genera do not reflect proper phylogeny of the Sulidae and should be restudied (OLSON 1985 and pers. communication in 1997, MLÍKOVSKÝ 2002). Until the Oligo-Miocene history of sulids is clarified, *Eostega* should be regarded as a valid genus.

### Paleogene sulids of Europe

The record of Paleogene sulids of Europe is limited to *Eostega rectirostris* (MAYR) from the middle Eocene (Lutetian, MP 11) of Messel, Germany (MAYR 2002), *Eostega lebedinskyi* LAMBRECHT from the middle Eocene (Lutetian, MP 13) of Cluj, Romania (LAMBRECHT 1929, 1933, MLÍKOVSKÝ 2002, this paper), and to an unidentified sulid from the late Oligocene of Thalberg, Germany (GÖHLICH in DARGA et al. 1999). Although the record is meager, it shows that sulids were members of the Paleogene Paratethys avifauna at least in the middle Eocene and in the late Oligocene.

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