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# *Euleptes gallica* Müller (Squamata: Gekkota: Sphaerodactylidae) from the Lower Miocene of North-West Bohemia, Czech Republic

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**Abstract.** Gekkotan lizards are widely distributed in tropical regions and extend into more northern regions in Asia and Europe. Unfortunately, gekkotans lack significant fossil record and many aspects of their evolutionary biology are still poorly understood. Our study provides the first information about occurrence of this group in the Czech Republic. The fossil material comes from the Lower Miocene sediments (MN 3) of the locality Merkur-North. All the gekkonid bones can be assigned to the family Sphaerodactylidae and represent a single taxon, *Euleptes gallica*. This taxon was previously known only from the French locality Montaigu (zone MN 2), and thus our study extends its stratigraphic and geographic range.

**Key words:** morphology, lizards, Eggenburgian, the Merkur-North locality

## Introduction

The fossil record of gekkotan lizards is, in general, poor (Estes 1983, Augé 2005). Other than a few remains from Paleogene and Neogene deposits, most Cenozoic finds are no older than Pleistocene (Müller & Mödden 2001). Moreover, most of the fossil material found is very fragmentary, often rendering determination below the familial level impossible (Augé & Rage 2000, Augé 2005). A notable exception is the gecko found in Eocene Baltic amber (Bauer et al. 2005). The record of gekkotans from the Lower and Middle Miocene of Europe comprises just several remains of dentaries and maxillae and other isolated, often fragmentary, elements from Slovakia (Estes 1969), France (Hoffstetter 1946, Müller 2001, Augé et al. 2002), Germany (Schleich 1985, 1987, Müller & Mödden 2001), and Spain (Alferez Delgado & Brea Lopez 1981). Because of this limited material, the diversity and evolution of gekkotans in Europe remain largely unknown (Augé 2005). We here describe new material, referable to the sphaerodactylid gecko

*Euleptes gallica* from the lower Miocene locality of Merkur-North (zone MN 3) in the Czech Republic. This taxon was previously known only from the French locality Montaigu (zone MN 2).

## Study Area

The locality is represented as an opencast mine near Chomutov. The specimens are preserved in grey calcareous marls at the base of the so-called, “Main Brown Coal Seam,” which are interpreted as reworked volcanic ash. This second Lower Miocene (MN 3) locality lies in the North West Bohemian rift and besides of gekkotan lizards yielded a rich material of various groups of amphibians and reptiles, e.g. frogs (Vejvalka 1997, Kvaček et al. 2004), chamaeleonids (Fejfar & Schleich 1994, Čerňanský 2010), lacertids (Čerňanský & Joniak 2009), an amphisbaenid lizard (Čerňanský & Venczel 2010), choristoderans (Evans & Klembara 2005), an anguimorph lizard (Klembara 2008) and snakes (Ivanov 2002). The sediments are also richly fossiliferous in remains of limnic and terrestrial

mollusks, plants, and mammals (Fejfar & Kvaček 1993, Fejfar et al. 1997a, b, 1998, Kvaček et al. 2004).

## Material and Methods

This study is based on fossils housed in the Geological collection of the Bílina opencast mine, and consists of isolated elements collected by screen-washing or surface prospecting from the Lower Miocene (Eggenburgian), zone MN 3, of the Merkur-North locality, Czech Republic. The material was compared to the type material of *Euleptes gallica* and to other European fossil finds of the genus *Euleptes*. The material described by Schleich (1985, 1987) and Hofstetter (1946) can be excluded from a detailed comparison as they are not referable to the genus *Euleptes*. The first taxon, *Palaeogekko risgoviensis* Schleich, 1987 differs from the Czech gekkonid in lacking the triangular process at the anterior part of the maxilla. The jaw material of *Gerandogekko* described by Hofstetter (1946) is very poorly preserved. The majority of this material consists of vertebrae and one frontal. Unfortunately, these elements are unknown from the Czech locality. Likewise, material from the Middle Miocene of the French locality of Sansan (Augé & Rage 2000) is too fragmentary for an exact determination. Comparisons were also made with the sole extant member of the genus, *E. europaea*, based on a cleared and stained specimen (Texas Cooperative Wildlife Collection TCWC 78071), several radiographs (Museo Zoologico de la Specola, Università di Firenze, MZUF 19119–19139) and published descriptions and illustrations (Wiedersheim 1875, Estes 1969, Rieppel & Schneider 1981). Osteological terminology follows that of Daza et al. (2009). The term supradental shelf for the maxilla (or subdental shelf for dentary) is widely used in the literature. Unfortunately, this name is ambiguously defined (see Estes et al. 1988, Conrad 2008, Rage & Augé 2010). Here, the term supradental shelf of maxilla is applied to a medial extension of the shelf that projects medially to the teeth and does not support them. All the gekkonid bones can be assigned to the single taxon, *E. gallica*, on the basis of a combination of features characteristic of this taxon and exhibited by the type material described from France by Müller (2001). Abbreviations of repositories: Ah-number SGDB, geological collection of the Bílina opencast mine, Czech Republic.

## Results

*Euleptes gallica* Müller, 2001

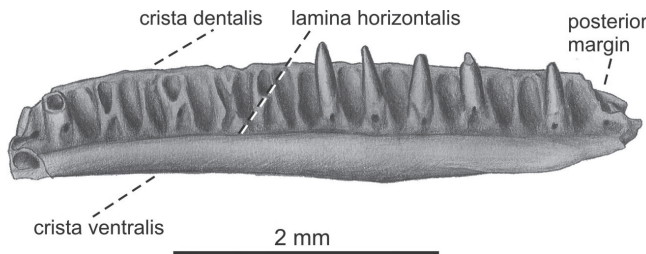
*Locality and horizon:* Merkur-North locality in Czech

Republic, Lower Miocene (Eggenburgian), zone MN 3. *Material:* Ah-875 SGDB, right dentary; Ah-931 SGDB, 932 SGDB, 933 SGDB, left maxillae.

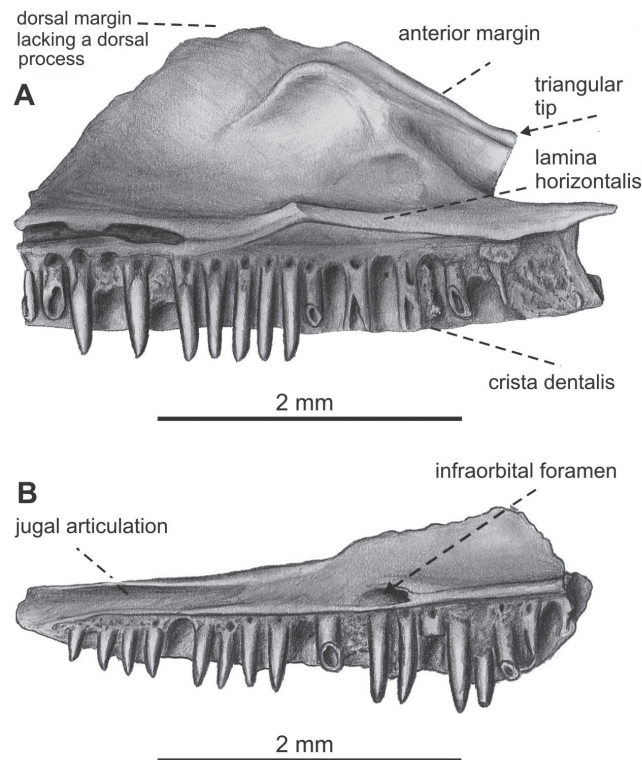
*Description:* The dentary is a long, slender, elongate bone (Fig. 1), with a slight medial curvature at its anterior end. It is mediolaterally compressed and in lateral view heightens gradually posteriorly. The posteriormost portion of the element and the symphyseal facet for the complementary dentary are missing. A high straight alveolar ridge supports a single row of at least 21 (probably more given the incomplete posterior margin of the element), typically uncuspid, pleurodont teeth (five teeth and 16 unoccupied tooth loci are present in Ah-875 SGDB). The alveolar shelf is proximately 50% higher than ventral portion of the dentary. The height of the shelf is identical along its whole length. A *sulcus dentalis* is present along the tooth row. In medial view, the closed Meckelian canal is exposed on the ventral side in the posterior third of the bone. The otherwise smooth labial surface of the dentary is pierced along its central portion by a longitudinal series of four mental foramina.

The maxilla is subtriangular in shape (Fig. 2A). It is a rather elongate, relatively lightly-built bone. The highest portion is approximately 25% of the length of the entire maxilla. The nasal process (*pars nasalis*) is well-preserved in Ah-931 SGDB and is high and trapezoidal in shape. The anterior margin of the nasal process is thickened and slopes gently anteroventrally in a nearly straight line. Its terminus is free and well bounded from the dental portion (*pars dentalis*) of the maxilla and forms a triangular tip, typical for *Euleptes* spp. The ventral margin of the tip is oriented at 90° to the anterior margin of the maxilla. The posterior margin of the nasal process is higher and slopes more steeply than the anterior. The medial surface of the *pars nasalis* bears a posterodorsally directed curved ridge, the *carina maxillaris* (sensu Müller 1996), which contributes to the anterolateral wall of the nasal capsule. This feature terminates in a narrowing, posteroventrally-arching branch near the center of the *pars nasalis*, dorsal and parallel to a less prominent branch of the *carina maxillaris*. Twenty-one tooth loci are present in Ah-931 SGDB and 20 in Ah-932 SGDB. The alveolar ridge is straight and high. The supradental shelf (*lamina horizontalis*) is very well developed and widened, particularly in its anterior portion. In the middle portion of the shelf there is a prominent horizontal expansion (the palatine process of maxilla), the medial edge of which is slightly recurved dorsally. Its edge is thickened,

narrowing as the shelf decreases in width posteriorly. In Ah-932 SGDB a well preserved infraorbital foramen lies above the medial shelf, approximately at its midpoint (Fig. 2B). The posterior portion of the maxillary is slender and straight, and tapers slightly distally. It bears an elongated jugal facet.



**Fig. 1.** *Euleptes gallica*: the right dentary Ah-875 SGDB, in medial view.



**Fig. 2.** *Euleptes gallica*: A) the left maxilla Ah-931 SGDB, in internal view, B) posterior ending of the left maxilla Ah-932 SGDB, in internal view.

The otherwise smooth labial surface of the maxilla is pierced along its lower margin by a series of ten supralabial foramina, whereas a shorter series of three foramina lie dorsal to these.

**Dentition:** A high number of pleurodont teeth is the

classic feature of the gekkotan lizards. The sizes of inter-dental gaps are very small. The teeth are slender, smooth, conical and straight, with those in the central portion of the dentary highest. Small circular resorption pits are present on the lingual sides of the tooth bases. In general, tooth shape of maxilla is similar to that of the dentary.

**Comparisons:** The Czech material described here is referable to the genus *Euleptes* on the basis of the triangular tip of the anterior margin of the pars nasalis of the maxillary and the smooth dorsal margin of the *pars nasalis*, lacking a pronounced dorsal process (Bauer et al. 1997, Müller & Mödden 2001). This configuration of the nasal process contrasts sharply with the prominent, often pointed process typical of many gekkotans (Daza 2008), including the Middle Miocene *Palaeogekko risgoviensis* (Schleich 1987). The specifically diagnostic features of the maxilla are those recorded for *E. gallica* by Müller (2001) and the fragmentary dentary is, likewise, fully compatible with that of this species. We, therefore, refer the new material to *E. gallica*.

*Euleptes gallica* differs from the extant *Euleptes europaea* in having a straight (versus weakly concave [in our comparative material, although illustrated by Estes (1969) as weakly convex]) anterior margin of the *pars nasalis* of the maxilla, terminating in a more prominent and more anteriorly-projecting triangular tip. Further, although our material is indicative of smaller specimens (estimated SVL 60–70 mm) than those (estimated SVL 85 mm) reported by Müller (2001), this is still much larger than the living species, which reaches a maximum of only 45 mm SVL (Delaugerre 1985; although Estes (1969) gives a SVL of „approximately 50 mm“).

Our material of *E. gallica* differs from *Phyllodactylus* (= *Euleptes*) sp. from the middle Miocene of Slovakia described by Estes (1969) by a distinctly lower dorsal process of the maxilla and a greater number of supralabial foramina (13 in two rows versus seven).

Our material may be distinguished from *Euleptes* sp. described from Germany (Müller & Mödden 2001) by its more gently sloping and straighter (versus steeply angled and weakly concave) anterior margin of the *pars nasalis* of the maxilla, and the presence of a large and prominent *carina maxillaris* on the medial surface of the nasal process of the maxilla (described as small in *Euleptes* sp. by Müller & Mödden (2001)). Unfortunately, the fragmentary dentary does not provide diagnostic information relevant at the species level. Likewise tooth size, shape, and number appear to be consistent across *Euleptes* spp. We estimate



the total number of maxillary tooth loci at 28 in the Czech material of *E. gallica*. Estes reported 29 loci for *Euleptes* sp. from Slovakia, and Müller & Möden (2001) reported 26–28 in *Euleptes* sp. from Germany. Bauer et al. (1997) reported approximately 25 maxillary teeth in extant *E. europaea*, but we have confirmed that this may reach 30 loci in some specimens (e.g., TCWC 78071). Müller (2001) noted at least 31 loci in the larger type material of *E. gallica*. Given typical intraspecific variation in tooth counts among gekkotans and the increase in number of loci with body size within a single species (Bauer & Russell 1990) we consider this character as uninformative.

## Discussion

The European gecko genus *Euleptes*, represented by a single extant species as well as fossil material, has been long synonymized within a nearly cosmopolitan *Phyllodactylus*. Bauer et al. (1997) dismantled *Phyllodactylus*, leaving it restricted to the New World and resurrected *Euleptes*. The first approaches to partition *Phyllodactylus* were considerably earlier (Dixon & Kroll 1974). Recent higher order reclassification of gekkotan lizards based on molecular phylogenetics has unambiguously placed *Euleptes* within the family Sphaerodactylidae (Gamble et al. 2008), within which it is the only leaf-toed genus. The Merkur-North material represents the first proof of the former existence of the family Sphaerodactylidae and, indeed, of the Gekkota in the

Czech Republic. The finding seems noteworthy from three points. First, the new find thus demonstrates the occurrence of the species *E. gallica* not only in western Europe, but in central Europe as well, and expands its stratigraphic range to somewhat younger deposits. Second, since the distribution of gekkotan lizards is confined to subtropical and tropical regions (Estes 1983), this finding, together with fossil remains of chameleons from the same locality (Fejfar & Schleich 1994, Čerňanský 2010), further corroborates evidence for tropical or subtropical climatic conditions in central Europe during the early Miocene (Böhme 2003). Finally, it contributes to our understanding of the paleodiversity and evolution of the family Sphaerodactylidae.

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