

THE CALLOVIAN SHARK *SPHENODUS* FROM THE SOUTHERN CARPATHIANS IN THE GEOLOGICAL NATIONAL MUSEUM COLLECTION

TORCĂRESCU Bogdan-Alexandru, TRIF Nicolae, CODREA A. Vlad

Abstract. The aim of this paper is to provide data about some of the fossil shark teeth hosted in the collection of the Geological National Museum. Two specimens were mentioned in previous papers. They were found in Horoaba Valley and Strunga and were briefly mentioned without any descriptions. Here, we also present an unprecedented tooth found in the Rucăr Valley, more specifically in the Purcărețului Valley. Our descriptions are in accordance with the descriptions reported by other authors for the species *Sphenodus longidens* Agassiz (1843), so we assigned this new tooth to the same species.

Keywords: Middle Jurassic, shark, *Sphenodus*, Getic Nappe, Southern Carpathians.

Rezumat. Rechinul calloviaan *Sphenodus* din Carpații Meridionali aflat în colecția Muzeului Național de Geologie.

Scopul acestei lucrări este de a furniza date pentru câțiva dintre dinții de rechin fosil găzduiți în colecția Muzeului Național de Geologie. Două dintre speciimene au fost menționate în lucrări anterioare. Acestea au fost găsite în Valea Horoaba și Strunga și au fost menționate pe scurt, fără măsurători sau descrieri. De asemenea, prezentăm un dinte nou descoperit provenind din Valea Rucărului, mai exact de pe afluentul său, valea Purcărețului. Descrierile noastre fiind în concordanță cu descrierile raportate de alți autori pentru specia *Sphenodus longidens* Agassiz (1843), am atribuit acest nou dinte aceleiași specii.

Cuvinte cheie: Jurassic Mediu, rechin, *Sphenodus*, Pânza Getică, Carpații Meridionali.

INTRODUCTION

In Romania, currently, our level of understanding when considering paleoichthyology is lower than that of Western Europe or the United States, as a consequence of the mismanagement of the collections that hosted many of the specimens labeled for study (TRIF & CODREA, 2018). Furthermore, when compared to the Upper Cretaceous or more recent relatives, the amount of knowledge is limited, due to a large disparity in the occurrences and geographical distribution (REES, 2010). The aim of this paper is threefold: firstly, to provide descriptions for the fossil shark teeth of the genus *Sphenodus* housed in the National Geological Museum's collection; secondly, to bring to attention a new tooth found in Purcărețului Valley; thirdly, to provide data for a better understanding of the genus *Sphenodus* from the Jurassic of Romania. Two of the specimens were mentioned by PATRULIUS (1969) (P.3590a and P.3590b) while the third one (P.21540) is firstly reported.

GEOLOGICAL SETTING

Two of the fossil teeth described in this paper were found in the Bucegi Mountains, more specifically in Horoaba Valley (a tributary of the Ialomița Valley) and in Strunga (Fig. 1). These two areas belong to the Median Dacides (Getic domain), more specifically they represent a Mesozoic sedimentary area for the Getic Nappe (SĂNDULESCU, 1984). The deposits of the Horoaba Valley refer to the interweaving of carbonatic and detritic beds. The basal section comprises a level of micro-conglomerates and yellowish quartzitic sandstone, followed by a calcareous episode with pseudo-oolitic to oolitic limestones bearing limonite concretions (PATRULIUS, 1969). The upper part of the series consists of variegated, fine grained pink limestone, followed by massive pink and yellow limestone (PATRULIUS, 1969).

Rucăr is the other area where specimens of *Sphenodus longidens* teeth originated from. SIMIONESCU (1899) first found and described four specimens from the Lupului Valley (1899). They were found in a red, hard limestone deposit with *Reineckeia anceps*, i.e. Middle Callovian of *Anceps* Zone of ammonites. From this area originates the new tooth, from nearby Purcărețului Valley. There, one can follow more terrigenous deposits with centimetric marl and siltic beds of reddish colour, which are completed by numerous limestones and hardground levels (LAZĂR & GRĂDINARU, 2013; LAZĂR et al., 2014). The stratigraphic level of origin is the same as in the Lupului Valley, i.e. Middle Callovian – *Anceps* Zone (GRIGORE et al., 2015).

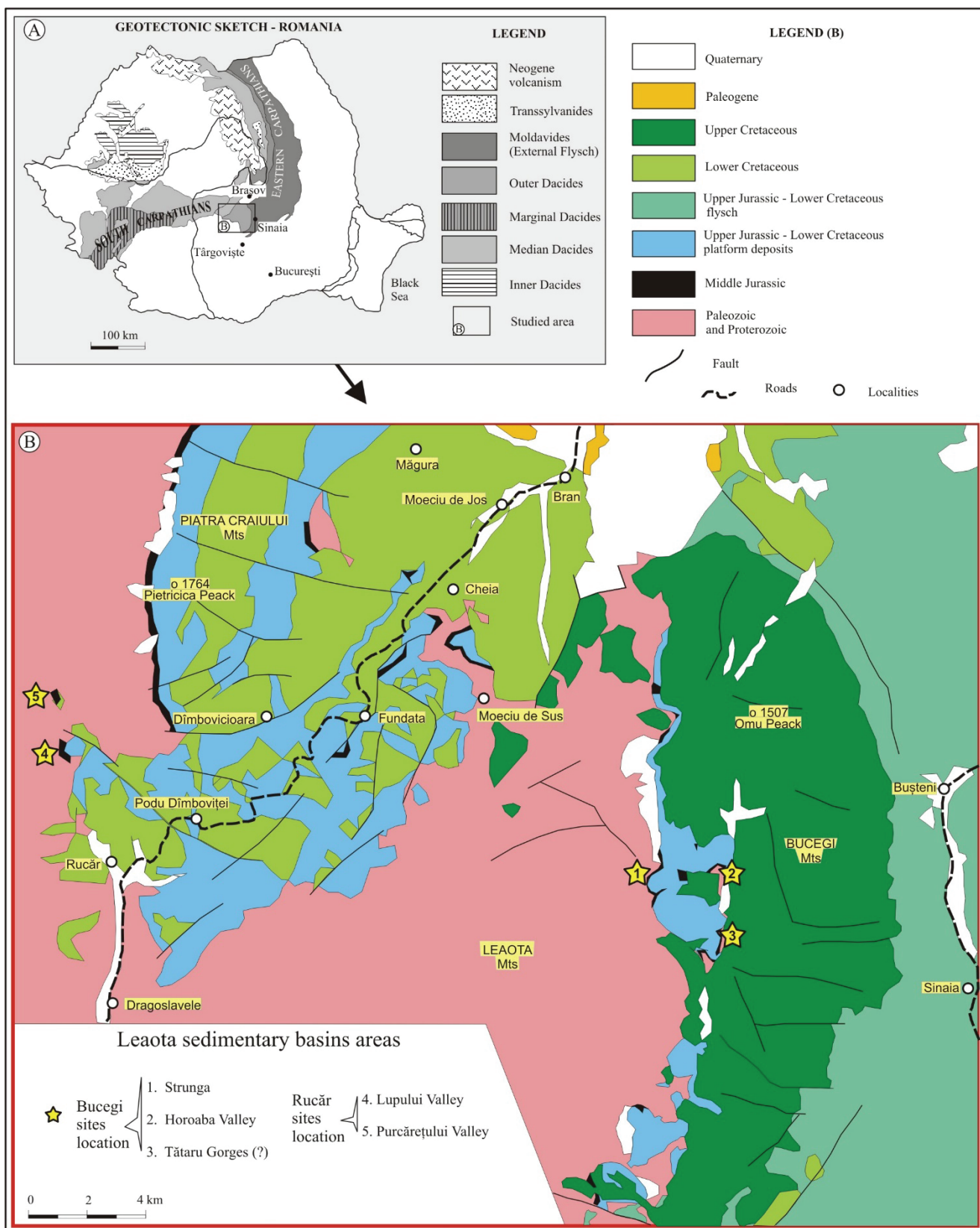


Figure 1. Location of the sites of origin for the shark teeth on a geological map – Leaota Mts. with Proterozoic metamorphic rocks and around the Mesozoic sedimentary basins (after PATRULIUS 1969, modified in GRIGORE et al., 2015).

MATERIAL AND METHODS

The studied material belongs to the National Geological Museum's collections, Bucharest (hereinafter abbreviated NGM). The teeth were taxonomically assigned by comparisons with other specimens reported in references. Also, morphometric measurements for the studied fossil teeth were taken using a digital calliper.

Abbreviations: L= length. W= width.

SYSTEMATIC PALEONTOLOGY

Class Chondrichthyes Huxley, 1880
 Subclass Elasmobranchii Bonaparte, 1838
 Cohort Euselachii Hay, 1902
 Subcohort Neoselachii Compagno, 1977
 Superorder Squalomorphii Compagno, 1973
 Order Hexanchiformes Buen 1926
 Family Orthacodontidae Glikman, 1957
 Genus *Sphenodus* Agassiz 1843
Sphenodus longidens Agassiz 1843

Material. Three NGM teeth, inventory numbers: P.3590 (two specimens, P.3590a and P.3590b) from Bucegi and P.21540 (one specimen) from the Rucăr area.

Description: The first tooth (P.3590) (Figs. 2/1a-1b) exposes a long and slender cusp with its basal portion embedded in the host rock. Additional cusplets are not present. In the lateral view, the tooth has a sigmoidal shape, and a slightly visible torsion in the apical end. A strong lingual inclination can be noticed. The lingual side is much more convex than the labial one. Cutting edges present on the laterals of the tooth are very well developed and visible, running along the whole margin of the tooth's crown. The root is missing. The tooth is devoid of ornamentation, and the labial side is very smooth.

The second tooth (P.3590) (Fig. 2/2) also presents a single, long, slender cusp, without additional cusplets. Its root is also missing. On the lateral sides cutting edges running along the margin of the tooth can be observed. These cutting edges are well developed. The tooth lacks ornamentation, and on the labial side it has a smooth surface. The sigmoidal profile is slightly noticeable, with a slight torsion at the apical end. Its lingual side is embedded in the host rock.

The new tooth found in Purcărețului Valley (P.21540) (Fig. 2/3) also presents a single, long and slender cusp, with a sigmoidal profile, however, hardly noticeable. It is also fragmentary, embedded on its lingual side in the matrix. It also has very well-developed cutting edges, running alongside the tooth margins. On the labial side it presents a smooth surface, without any ornamentation (Table 1).

Table 1. Measurements for the shark teeth.

Specimen	L	W
P.3590 a	36.60 mm	7.67 mm
P.3590 b	28.33 mm	6.85 mm
P.21540	35.55 mm	6.32 mm

DISCUSSIONS

The exact systematic position of the genus *Sphenodus* is very disputed, the genus being included in either Lamniformes (WOODWARD, 1889), Hexanchiformes (CAPETTA, 1987), or Synecodontiformes (DUFFIN & WARD, 1993). However, after THIES (1993) identified a pseudopolyaulacorhize root pattern, there remains little doubt about the fact that the genus *Sphenodus* is related to Synecodontiformes, a relationship further strengthened by the braincase morphology of *Sphenodus* and *Synecodus* (MAISEY et al., 2004). Similarly, KLUG (2009) in a phylogenetic analysis also included *Sphenodus* in Synecodontiformes. However, CAPETTA (1987; 2012) makes a strong pleading for the inclusion to Hexanchiformes, based on extra-dental characters. When talking about the species of the genus *Sphenodus* DUFFIN & WARD (1993) present a number of 29 referred nominal species, of which 23 are Jurassic. Most likely some of these species are invalid or synonymous.

Several species of the genus *Sphenodus* are well-known from Europe: *Sphenodus macer* Quenstedt (1851), with mesio-distally wide teeth, low cusps and well-developed cutting edges, *Sphenodus venulosus* Chabakov & Zonov (1935) whose tooth morphology is similar to that of *S. macer* (probably *S. venulosus* is synonymous with *S. macer*) (REES, 2010) and *Sphenodus nitidus* Wagner (1862) whose mesial cutting edge is more developed than the distal one, and has a strong and sigmoidal curvature of the crown (GUINOT, 2013). While *S. longidens* was reported from the late Cretaceous by authors such as YABUMOTO & UYENO (1994) we believe those mentions to be uncertain at best and the material could probably belong to other species. As such, we consider this species to be a probably exclusive Middle

Jurassic distribution (early Bajocian-Oxfordian). Based on the above description and on the tooth morphology, the new tooth (P.21540) can be assigned to the species *Sphenodus longidens*.

Occurrence: in Europe, this species was reported from Switzerland (AGASSIZ, 1843), Germany (DUFFIN, 1993), from Poland (REES, 2010) and from the Ottange-Roumelange quarry, at the border between France and Luxembourg (DELSATE & FELTEN, 2015); in Romania, it was reported from the Bucegi Mts. (Horoaba Valley, Strunga and Tatarului Gorges) in Middle Callovian and Rucăr Basin (Lupului and Purcărețului valleys) in Middle Callovian (*Anceps* Zone) (SIMIONESCU, 1899). Although there are many more reports in literature, we find that only these ones are reliable.

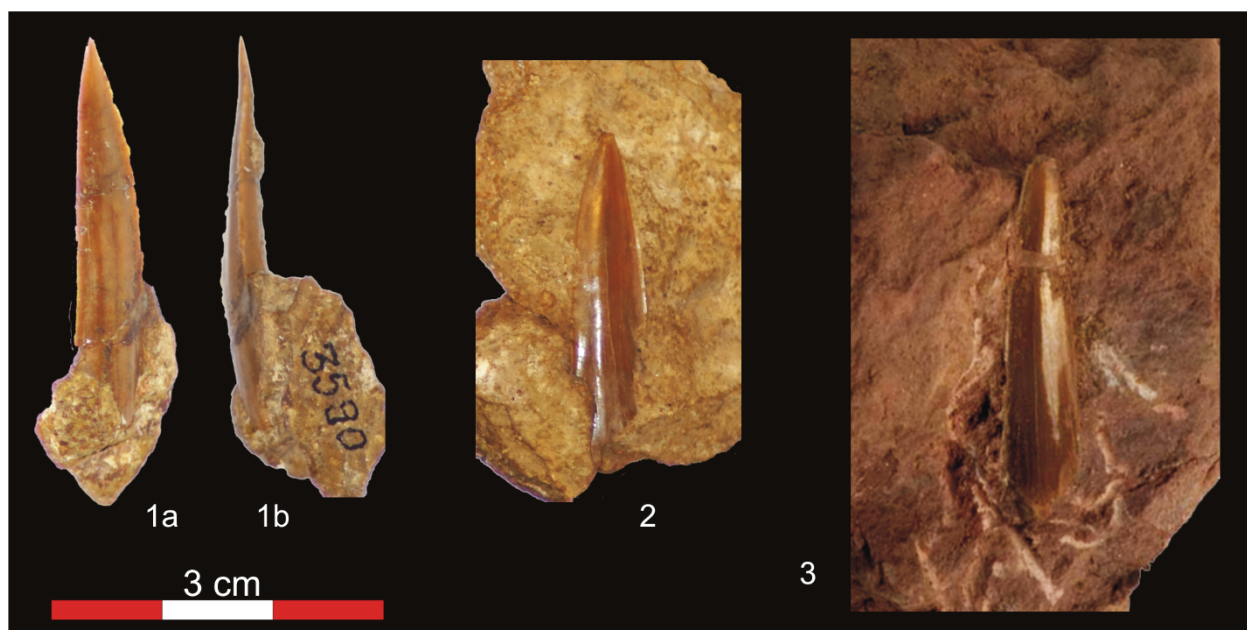


Figure 2. *Sphenodus longidens* Agassiz (1843) from MNG: 1) Patrușiu Collection (inv.no. P.3590a) – Horoaba Valley a) labial and b) lateral view 2) Patrușiu Collection (inv.no. P.3590b) – Cheile Tatarului (?) - labial view; both from Bucegi Mts. 3) Grigore Collection (inv. no. P.21540 provisory) – Purcărețului Valley (Rucăr).

CONCLUSIONS

Although the genus *Sphenodus* is rarely encountered in Romania (TRIF & CODREA, 2018) new material belonging to this species can still be found, such as the one presented here. The systematic position at the order level is still uncertain. Future studies are still necessary for understanding the exact systematic position of the genus. Based on the tooth morphology, and comparisons with the different morphologies of the other species of the genus *Sphenodus*, we assign the teeth herein described to the species *Sphenodus longidens*.

Little is known about *S. longidens* diet. The development of the main cusp and the obvious strong cutting edges suggest a predatory life, with prey likely including fish and reptiles. In fact, *Sphenodus* seems to make a transition from the tearing type dentition to a cutting type one (CAPETTA, 2012), preferring coastal areas where prey was abundant (REES, 2010).

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Torcărescu Bogdan-Alexandru

Geological Institute of Romania
1st Caransebeș Street, 012271 - Bucharest, Romania.
E-mail: torcarescubogdan@yahoo.com

Trif Nicolae

Brukenthal National Museum, Sibiu,
1 Cetății Street, Sibiu, RO-550160, Romania.
E-mail: nicolae.trif@gmail.com

Codrea A. Vlad

Babeș-Bolyai University, Faculty of Biology-Geology
1 Kogălniceanu Street, Cluj-Napoca, RO-40-400084, Romania.
E-mail: vlad.codrea@ubbcluj.ro

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