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Short Note

First record of serotine bat *Eptesicus serotinus* (Chiroptera: Vespertilionidae) from Early-Middle Holocene in southern Europe (Boeotia - Greece)

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Abstract

This article reports on the first record of *Eptesicus serotinus* (Schreber, 1774) for the Early and Middle Holocene of southern Europe. Fragments of mandibles, maxilla, rostra, humeri, and radii from this species were collected in Mesolithic and Neolithic layers of Sarakenos Cave (Boeotia, Greece). This provides evidence of the presence of the serotine bat in Greece during the Holocene. The new record increases the geographical range known for this species in the postglacial Europe.

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To date, no detailed description of Early-Middle Holocene fossil bat remains found in continental Greece has been provided (Chatzopoulou et al., 2001; Tsoukala et al., 2006; Stiner and Munro, 2011; Mavridis et al., 2013). A few bats from the Holocene were discovered on the islands of the Greek archipelago and some references to other findings are available from the Pleistocene for continental Greece (Horáček and Poulianos, 1988; Kretzoi and Poulianos, 1981; Roger and Darlas, 1999; Chatzopoulou et al., 2001; Chatzopoulou, 2003; Tsoukala et al., 2006; Poulianos, 2013).

In this paper I focus on the fossil remains of bats found in the Sarakenos Cave (located to the east of the Kopais basin in Boeotia, the largest karst area of Greece), representing the first data for the Boreal and Atlantic period in continental Greece (Tab. 1), and featuring the first record of *Eptesicus serotinus* for southern Europe (Fig. 1).

The remains analyzed were found within Mesolithic and Neolithic cultural layers in the Sarakenos Cave. This is one of the 23 caves and rock shelters explored and mapped in this area where traces of human occupation dating back to the Palaeolithic and Neolithic ages have been found. The cave is located at an elevation of 180 m a.s.l., overlooks an ancient (now dry) lake, and has a large entrance hall which allows light into the sole interior chamber (Sampson et al., 2009). It was used as a shelter from the Upper Paleolithic to the Middle Helladic and lately as a shelter for grazing animals. I examined 27 bat bones from Mesolithic and Neolithic layers in trench A. These included six humeri, three radii, 15 mandibles, and three fragments of skulls. In some levels of the cave the predominant bat species was *Eptesicus serotinus*. *Rhinolophus hipposideros*, *R. ferrumequinum*, *Myotis myotis/blythii*, and *Nyctalus noctula*, were represented by a smaller number of remains (Tab. 1). *E. serotinus* was determined from 18 bone fragments: eight mandibles, one maxilla, one rostrum, five humeri (*extremitas distalis*), and three radii (*extremitas proximalis*). I also identified the right jaw of a juvenile (Fig. 2D).

Figure 1 – Middle-Late Pleistocene and Holocene occurrence of Eptesicus serotinus in Europe: □ Middle Pleistocene, △ Late Pleistocene, ○ Holocene, ● Holocene from Sarakenos Cave (Greece), ? Remains of uncertain chronometric age.

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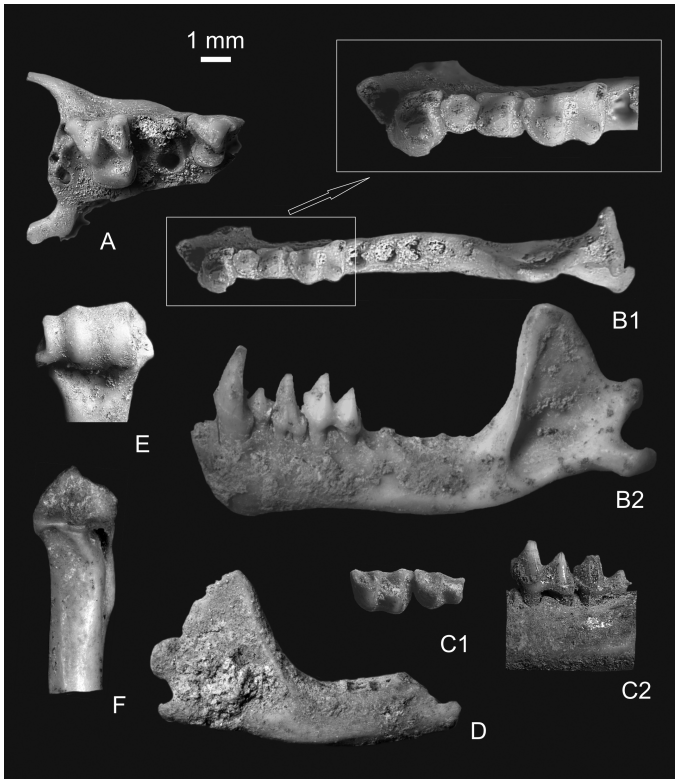

Figure 2 – Fossil bat remains of *Eptesicus serotinus* from the Sarakenos Cave (Greece). A: right maxilla, BI-2: left mandible, CI-2: left lower second and third molar (m2-m3), D: right juvenile mandible, E: right humerus (*extremitas distalis*), F: right radius (*extremitas proximalis*).

The diagnostic criteria adopted to identify *E. serotinus* are the following: the species presents a single premolar (P4) in the maxilla, and the rostrum is larger than that of *E. nilssonii* or *Vespertilio murinus*. The lower teeth row has two premolars, the mandible is large and has a *processus coronoideus* shaped like an acute triangle. The canine (c) is compressed antero-posteriorly. The crown outline of the second premolar (p2) is circular in occlusal view, with a posterior cusp. The crown outline of the fourth premolar (p4) is trapezoidal in occlusal view, the antero-lingual corner is formed by a well pronounced cusp, and the lower margin of the crown, in labial view, is concave between the roots. The molars are myotodont and m3 presents a reduced talonid due to the lingual migration of the hypoconid. The *processus spinosus* of the humerus is not larger than the humerus trochlea, and the lower angle which connects the trochlea with the condylus is particularly concave-convex. In the radius, the fissure epiphysis *proximalis radii* is closed and the tuber *ligamenti laterale* is large. The measurements of the bones (teeth, humeri, and radii) examined fall within the size range-known for *E. serotinus* (Tab. 2).

This species currently occurs in Boeotia (Hanák et al., 2001) and its geographic range includes central and southern Europe to southern England and southern Sweden (Lanza, 2012), extending to the Middle East (Benda and Horáček, 1998; Benda et al., 2008).

E. serotinus can be found in a variety of habitats: semi-desert areas, temperate forests, grasslands, Mediterranean shrubland and urban areas; it usually flies along linear landscape elements such as hedgerows, tree lanes and and wood edges (Verboom and Huitema, 1997). It feeds at woodland edges, tall hedgerows and pastures. It is a quite sedentary species, foraging not more than 4–6 km from its seasonal roosts (Catto et al., 1996).

Fossils of *E. serotinus* are rare: the first certain occurrences for Middle Pleistocene are from Spain (Sevilla, 1988), Austria (Rabeder, 1973), and Italy (Tata and Kotsakis, 2005). The species has been recorded from the Late Pleistocene in France (Jullien, 1972; Sevilla and Chaline, 2011), Hungary (Topál, 1981), Bulgaria (Wołoszyn, 1982; Popov, 2000), and Poland (Ochman, 2003; Nadachowski et al., 2009), while remains from the Holocene have been found in Switzerland (Blant et al., 2004), Hungary (Topál, 1959), Czech Republic (Horáček, 1979), and Poland (Bocheński et al., 1983; Alexandrowicz et al., 1985; Ochman, 2003). The age of other remains found in a bone breccia on Tavolara island, Sardinia (Italy) (Comaschi Caria, 1968) is not precisely known.

The discovery of bone remains of *Eptesicus serotinus* in various layers of Sarakenos Cave provides evidence of the species' wider distribution during the Early-Middle Holocene in southern Europe and confirms its presence in Greece during the Boreal and Atlantic periods.

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Table 1 – Quantitative presence of the bat species in the assemblage analyzed for the Sarakenos Cave, Greece (Wilczyński et al., 2016). NISP: number of identified specimens; MNI: minimum number of individuals.

		Chronology									
		Palaeolithic		**Mesolithic**		**Initial Neolithic**		**Early Neolithic**		**Total**	
Lp	**Taxa**	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	**NISP**	**MNI**
1	*Rhinolophus hipposideros*	-	-	-	-	1	1	-	-	**1**	**1**
2	*Rhinolophus ferrumequinum*	-	-	-	-	-	-	2	1	**2**	**1**
3	*Myotis myotis/blythii*	-	-	1	1	-	-	-	-	**1**	**1**
4	*Myotis blythii*	-	-	1	1	2	1	-	-	**3**	**2**
5	*Eptesicus serotinus*	-	-	4	2	3	1	11	4	**18**	**7**
6	*Nyctalus noctula*	1	1	-	-	-	-	1	1	**2**	**2**
	Total	**1**	**1**	**6**	**4**	**6**	**3**	**14**	**6**	**27**	**14**

Table 2 – Measurements of *Eptesicus serotinus* from the Sarakenos Cave (Greece). Lower case: lower teeth, upper case: upper teeth; in parentheses: measurements taken on the alveoli, Co=height *processus coronoideus*, Ar=width *processus coronideus-processus articularis*. The measurements are expressed in millimeters.

Bones	n	Length min–max	W trigonid min–max	W talonid min–max	Bones	n	Length min–max	Width min–max
p4-m3	1	6.62			**P4**	3	1.51–1.57	1.65–1.71
c-m3	1	8.66			**M2**	3	2.02–2.06	2.34–2.44
c-p4	1	3.25			**M3**	1	0.86	2.42
(m1-m3)	7	5.18–5.46			**M1-M3**	2	4.55–4.58	
(p4-m3)	7	6.41–6.74			**P4-M3**	2	5.94–6.18	
(c-m3)	7	8.38–8.13			**C-M3**	1	7.31	
(c-p4)	7	2.78–3.04			**C-P4**	2	3.12–3.18	
m1	1	2.07	1.26	1.46	**Radius**	3		2.92–3.21
m2	4	1.98–2.26	1.32–1.37	1.42–1.54	**Humerus**	4		3.57–3.83
m3	2	1.81–1.75	1.18–1.26	0.79–0.92	**Co**	5	5.74–6.09	
p4	4	1.27–1.39	1.1–1.17		**Ar**	4	4.88–5.48	

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